On International Monetary Environment and Stock Returns

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Abstract

Monetary decisions affect firms' cash flows and the level of interest rate which in turn will affect the stock price. There are many articles which analyze the relationship between local monetary policy and stock returns and find that an expansive monetary policy increases stock returns. Some of these articles extend the analysis to the relationship between the international monetary environment and stock returns. However, all of these articles assume the error variance to be constant, i.e., the articles use homoscedastic models instead of more general heteroscedastic models.

This thesis extends the existing literature in several ways. Firstly, the generalized autoregressive conditional heteroscadestic models (GARCH) instead of homoscedastic models are used in the analysis of the relationship between the stock returns and monetary variables. Secondly, the analysis is further extended by using more sophiscated models like GARCH-M and GARCH-M with spillover effect. In this study, four countries (France, the U. K., Germany, and Japan) are analyzed. The impact of the US monetary policy is included in the analysis that represents the impact of international monetary environment. Finally, a vector autoregressive (VAR) model is used in order to account for the dynamic relationship among the monetary variables. It is found that, in the case of every country, the excess stock returns are significantly affected by both the local and the U.S. monetary environment, although significance varies according to time period and the specification of variance. The results from the VAR model indicate that stock returns in different countries react differently to the changes in the US monetary.

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1.INTRODUCTION

Monetary policy decisions matter to an investor since they set the level of interest rates, which is crucial for the valuation of equity. The price of a stock is defined as the sum of its expected cash flows discounted at a factor that represents the return claimed by the investors. This remuneration is composed of a risk premium added to the risk-free rate. The expected cash flows will depend on the profit of the company, this latter will be affected by the cost of the debt of the company and so by the risk free rate. Hence the risk free interest rate will change the price of a stock through its expected cash flows and its discount factor. During an expansive monetary policy period, the interest rate decreases, decreasing thereby both the discount factor and the cost of the company's debt - and increasing thereby cash flows, resulting in a higher stock return. When the interest rate increases during a period of recession, this mechanism is reversed.

Thus investors have to pay close attention to the different monetary stances. A monetary event, such as a change in the federal funds rate, can modify the value of their investments in stocks and therefore ought to influence their investment strategy.

This paper will examine the relationship between the international monetary environment and stock returns. We will pay special attention to the impact of U.S. monetary policy on the non-U.S. market. The proposition that the U.S. monetary environment could influence stock prices in a non-U.S. market seems obviously true when we consider the increasing integration of markets.

Our main concern will be to further our understanding of this relationship in the light of models that consider some realistic specifics: non-constancy of variance, risk aversion of investors, spillover effects and dynamic relationships among monetary variables. We will extend the model of Conover, Jensen and Johnson (1999), which is a simple linear regression. The GARCH model will be ventured in order to take into account a variance that is not constant. The methodology of Bollerslev, Engle and Wooldridge (1988) will be observed through a GARCH-M model. This will allow us to see whether the significance of the monetary variables changes when the risk aversion of investors is taken account of. Then a spillover specification of the GARCH-M model will be examined, and this will permit us to consider the volatility transmission from one market to another. Many of the existing papers on the subject deal with the stock returns rather than excess returns. Our main focus in this thesis is to analyze the sensitivity of excess stock returns to a number of factors, including the domestic and U.S. monetary policy. However, in order to compare our empirical results with existing ones, we estimate models both with stock returns and excess stock returns.

Several articles examine the relationship between domestic monetary policy and stock returns, using the vector autoregressive method (Thorbecke, 1997 and Patelis,1997). This dynamic model considers the relationships among the monetary variables. We will also consider the dynamic relationships among variables through our own implementation of the vector autoregressive method.

The layout of this thesis is as follows. The second chapter will discuss the pertinent studies on the relationships between domestic monetary policy and domestic stock returns, and between the international monetary environment and domestic stock returns. The third chapter will articulate our hypothesis. In the fourth chapter, the variables and the models used in this research will be presented. Chapter five will detail our findings that follow from our estimations. The final chapter will be comprised of a summary of the findings and our conclusions.

2. REVIEW OF THE LITERATURE

Many studies have focused on the relationship between monetary policy and stock returns. Numerous articles have described the impact of the domestic economic environment on the domestic stock returns. But few have explored the relationship between domestic stock returns and foreign monetary environments. In the first part of my review of the existing literature, I will consider the works that look at the relationship between domestic monetary policy and stock returns in order to show the general interaction between monetary policy and stock returns, without taking into consideration the international impact. In the second part of my review of the literature, the studies which take into consideration the international monetary environment and stock returns will be presented. This will give us an understanding of the work, which has already been done on this topic.

2.1 On Domestic Monetary Policy and Stock Returns: Evidence from the United States.

The common findings of the studies of monetary environment in its relation to stock returns is that they are higher during expansive monetary and lower during restrictive monetary. The following mechanism can explain this. The price of a security is the sum of discounted cash flows. The discount factor is a function of the risk free rate. So, when monetary authorities lower interest rates (in a period of monetary expansion), the discount factor decreases and the stock prices go up. This decrease in the interest rate reduces the cost of the debt of the company. Hence, it increases the profitability of the company and its cash flows. By virtue of this effect on the discount factor and cash flows, an expansive monetary period drives the stock prices up. This result has been corroborated by different research presented in the literature review. Most of the time the authors utilize the instruments of the monetary authorities to measure the monetary environment. Reserve requirements and interest rates (such as the federal funds rate and the discount rate) were the more useful instruments in approximating monetary decisions.

Modifications to the Federal Reserve's operating procedures in 1979 and 1982 required Thorbecke (1997), Patelis (1997) and Fortune (1989) to consider the impact of another instrument, namely the nonborrowed reserves. Patelis (1997) used some variables that can enable investors to evaluate the impact of the monetary policy on the economy. First to be presented will be the studies that address interest rates; these will be followed by those concerned with the nonborrowed reserves; and lastly, we will attempt to disclose the alternative way of approximating the intervention of monetary authorities developed by Patelis (1997).

2.1.1 On Interest Rate and Stock Returns

Waud (1970), who analyzed the effect of the daily announcements of the Federal Reserve on the Standard and Poor's 500 stock returns between June 1952 and June 1967, found that the random component of an adaptive expectations stock pricing model was affected by the announcements of the change in the discount rate. May (1992) provided similar evidence of the impact of the discount rate announcements in analyzing hourly data of the Dow Jones composite index between 1973 and 1988 by a simple ordinary least squares method. He showed that the market responded quickly (within a period six hours before to six hours after an announcement) to a change in the monetary policy, and that an increase in the discount rate resulted in a decrease in the Dow Jones 65 composite index.

The federal funds rate can also be considered a good indicator of future monetary policy actions and economic health. Bernanke and Blinder (1992) studied the informative power of the federal funds rate over monetary policy by using a vector autoregressive model of seven monthly economic variables between 1961 and 1989. They showed by variance decomposition that the federal funds rate has a greater informative power for the prediction of several macroeconomic variables (such as industrial production, employment, personal income) than either the consumer price index, the money aggregates (M1 and M2), or the T-bill and the ten-year Treasury bond rate. The federal funds rate, by its informative power over the real macroeconomic indicators, can be a useful variable for investors who are forecasting future cash flows. This is consistent with the results of Thorbecke (1997). He finds a negative and significant relationship between the change in the federal funds rate and the change in the Dow Jones composite average, by way of a simple linear regression.

Jensen, Mercer and Johnson (1996) extend the work of Fama and French (1989), who find that dividend yield, default spread and term spread can approximate business conditions, and explain part of the excess returns (computed from the value and equally weighted portfolios of the New York Stock Exchange (NYSE) and the T-bill returns). Jensen et. al. (1996) conclude that, for the period extending from February 1954 to

December 1992, when the monetary environment is taken into consideration, the explanatory power of the three business condition variables decreases. The dividend yield and default spread properly explain the expected stock returns only in expansive periods. During the restrictive periods, the three variables do not have any explanatory power. To approximate the monetary policy, Jensen et al. used dummy variables approach. The dummy variable reflects the change in the direction of the discount rate. They consider a change in the direction of the discount rate to be more telling than the level of the discount rate.

Booth and Booth (1997) modify the procedure of Jensen et. al. (1996) by substituting the federal funds rate for the change in the direction of the discount rate. They examine the portfolio returns from the NYSE, and conclude that the federal funds rate as well as the changes of the direction of the discount rate have a predictive power over stock and bond returns. This is consistent with the results of Bernancke and Blinder (1989).

The conclusions of another article by Fama and French (1992) - on the positive premium of the small capitalization and low price-to-book firms over the large capitalization and high price-to-book -also change when the monetary environment is taken into account. Jensen, Mercer and Johnson (1997) point out that the small firm low price-to-book premium is significant during periods of expansion, while it is small, even negative, during periods of recession. They used monthly U.S. data from 1967 to 1994 to create 100 portfolios. The monetary variable took a value 1 when the discount rate was up and 0 when it was down.

In this subsection, evidence has been produced of the predictive power of monetary interest rates used by the Federal Reserve. In 1979 the Federal Reserve established some new monetary procedure controls. Specifically, it began targeting the growth of monetary aggregates and nonborrowed reserves. The nonborrowed reserves are the quantity of reserves that can be borrowed by the bank but at a rate not fixed by the Federal Reserves. It targeted particularly the borrowed reserves in 1982, although it still used the nonborrowed reserves as a monetary tool. The following article discusses the relationship between stock returns and nonborrowed reserves.

2.1.2 Nonborrowed Reserves and Stock Returns

Thorbecke (1997) demonstrates the impact of the nonborrowed reserves on the U.S. stock returns through a vector autoregressive model. His model takes into account seven variables that approximate monetary position. Three of these represent the ultimate target of monetary policy: the industrial production growth rate, the inflation rate and the log of an index commodity price. Three variables concern the tools of the monetary authorities: the log of nonborrowed reserves, the federal funds rates and the log of total reserves. Lastly, he included the stock returns composed of different U.S. portfolio. He studied impulse functions for two periods, one of the federal funds rate (December 1967 to December 1990) and one of the nonborrowed reserves (October 1979 to August 1982). This move was justified by the fact that between October 1979 and August 1982 the Federal Reserve targeted the nonborrowed reserves. A positive shock of nonborrowed reserves increased stock returns (an average of +1.79 per month) during the period October '79 to August '82, and a positive shock on the federal funds rate decreased stock returns (an average of -.80 percent per month) during the period December '67 to December '90. On average 3.94 % of the forecast error variance of the portfolio returns is explained by the federal funds rate innovations, and 15.85 % of the forecast error variance of stock returns is explained by nonborrowed reserves innovations. He therefore was able to show that the nonborrowed reserves as well as the federal funds rates have an impact on the stock returns.

Fortune (1989) concludes that the volatility of the debt market, is significantly affected by surprises in the monetary variables, such as nonborrowed reserves and monetary aggregate, in the period 1970-87, and that this is not the case for the stock markets. Using a dummy variable signifying 1 during the period 1979 to 1982 and zero otherwise in a simple linear regression model, he concludes that targeting the nonborrowed reserves instead of the interest rate or borrowed reserves increases volatility.

From this subsection, we can conclude that a monetary policy that targets nonborrowed reserves has a predictive power over stock returns. All the articles presented in this review of the literature found that investors react to the intervention of the monetary authorities with interest rates and nonborrowed reserves.

2.1.3 Other Proxies of Monetary Policy

Patelis (1997) has used, in addition to the federal funds rate and the first log difference of the nonborrowed reserves, the spread between the federal funds rate and the yield on the ten-year treasury note, the spread between the yield on six-month commercial paper and six-month T-bill, as well as the portion of the nonborrowed reserves not included in the reserves. The spread between the federal funds rate and the ten-year Treasury note enables him to take into account the difference in the level of inflation. If there is inflation, monetary authorities will raise the federal funds rate to reduce the money supply, thereby decreasing the spread.

The spread between the yield on six-month commercial paper and six-month T-bill is used to forecast the position of monetary policy. When the monetary policy of the central bank is for tightening, the Federal Reserve forces banks to reduce the bank loan supply and therefore it increases the rate of commercial paper. This causes an increase in the spread. Patelis (1997) refers to the work of Strongin (1995)[1], which argues that the Federal Reserve can have a large influence over the market by altering a mix between the borrowed and nonborrowed reserves. That is why that part of the nonborrowed reserves not included in the total reserves is important in the prediction of stock returns. With the use of long horizon regression, he obtains the results, which support the importance of both the federal funds rate, and the spread between the federal funds rate and the yield with the ten years treasury note. Therefore, the forecast of inflation seem to have a significant impact, and this means that investors anticipate the monetary interventions.

By a variance decomposition of the excess returns (where the data used are the monthly NYSE stock returns and the one-month T-bill over the period 1962 to 1994), Patelis found that a monetary shock primarily affects the expected excess returns and expected dividend growth but has little impact on expected real returns.

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[1] The identification of monetary policy disturbances: explaining the liquidity puzzle, Journal of monetary economics 35, 463-497.

2.2 On The International Monetary Environment and Stock Returns

In this section, some papers on the impact of international monetary environment on stock returns are discussed. Some of these papers use the growth of the monetary aggregates and short-term interest rate (Foerster and Schmitz, 1997), and the change in the discount rate dummy (Conover, Jensen and Johnson,1999) as the proxies for monetary environment. Cheung (1997), on the other hand, uses vector autoregressive (VAR) model to test the impact of shock in the US returns on four Asian countries. These papers are discussed in detail below.

2.2.1 U.S. Monetary Growth Short-term Interest Rate and Stock Returns

Foerster and Schmitz (1997) find that the lag of the monthly growth in the real U.S. monetary aggregate and the lag of the U.S. short-term interest rate explain the foreign stock market returns from February 1956 to June 1986. They use stock index return data from International Monetary Fund. They find that stock returns in Belgium, Denmark, Japan, the U.K. and Sweden are the most sensitive to growth in the U.S. monetary aggregate, whereas Australia, Belgium, Canada and Denmark are the most sensitive to U.S. short-term interest rate. The positive sign of the coefficient associated with the growth of the U.S. money aggregates (for all the countries) and the negative sign of the coefficient associated with the U.S. short-term interest rate (for Australia, Canada and Japan) confirm the previous results; that an expansive monetary policy is associated with higher excess returns. Whereas the positive relationship between U.S. short-term interest rate and excess stock returns (for Austria and Denmark.) leads to the opposite conclusion.

2.2.2 U.S. discount Rate and Stock Returns

Conover, Jensen and Johnson (September 1999) measure the monetary environment by change in the direction of the discount rate. They used a dummy variable signifying 1 when the monetary environment is restrictive and 0 when it is expansive. Their sample consists of 15 countries from the O.E.C.D for the period 1956 to 1995. The main assumption is that monetary policy is stated ex ante. This means that investors anticipate the change in the discount rate, as the monetary policy is transparent. They find a significant negative relationship between U.S. monetary variables and stock returns except in the cases of Austria, France and Italy where the relationship is not significant. When the stock returns are regressed on the local dummy variables and on the U.S. change in the discount rate, the coefficient associated with the U.S. monetary environment is no longer significant for Canada (which is surprising), France, Germany, Italy and New Zealand. They generate consistent results when the stock returns are adjusted for inflation.

Conover, Jensen and Johnson (August 1999) expand the scope of their work, on the same time frame and sample, to consider trading strategies. They constructed five different portfolio investment strategies based upon the monetary policy periods of expansion or restrictiveness in the countries of their samples. They provide us with the conclusion that both local and U.S monetary environments must be taken into account for a more beneficial international diversification. The best market performance occurred when both local and U.S. policies simultaneously tended towards expansion, whereas the worst performance corresponded to those periods when both U.S. and local monetary policy were restrictive.

2.2.3 An alternative way

Cheung (1997) states that a monetary change occurred in the U.S. in 1994 when the Federal Reserve began to more frequently vary the federal funds rates. He found that this change had a significant impact on the Asian Pacific stock market returns and integration. But his methodology is open to criticism. He made a VAR model for 1993 and for 1994, composing his vector only of the daily stock returns of five countries: the U.S., Japan, Hong-Kong, Singapore and Australia. He then proceeded to compare the relative impacts of a shock in the U.S. stock returns on the four others countries. He found that in 1994 this shock was more considerable. However, he did not test whether the evolution of the U.S. impact on the other stock markets was due to the change in the federal funds rate.

All of these articles have provided evidence of the international relationship between stock returns and thef U.S. monetary environment. The impact of the U.S.

monetary variables is different for different countries. Generally, an expansive U.S. monetary policy period occurred at the same time as a higher local stock return. This means that any change in U.S. economic policy has the greatest potential for influence over the global monetary environment. All the articles have used a similar modeling methodology (ordinary least squares), except Cheung (1997), to evidence the international monetary relationship. This model has certain drawbacks and limits, and these will be our concern in the next section. In the course of that discussion we will seize the opportunity to discuss the objectives of the present study. A brief review of the methodology used in the articles of this review of the literature is provided in Appendix 1.

3. OUR HYPOTHESIS

From the discussion in the preceding chapter, we discern three noteworthy aspects of the methodology of the studies of stock returns and the international monetary environment. These have to do with the way the U.S. monetary environment is estimated, the specification of the model (especially the assumptions about variance) and, finally, the impact of the volatility transmission.

3.1 The Methodology for Approximating the U.S. Monetary Environment

The articles on the international monetary environment did not consider the variables that define the relationships between domestic monetary policy and stock returns. Monetary instruments, such as the federal funds rate or the nonborrowed reserves, could have been used to proxy the U.S. monetary environment. Even if the nonborrowed reserves have not been targeted by the Federal Reserves since 1982, it nonetheless remains a variable that can explain actions of the monetary authorities (see Patelis, 1997).

3.2 Specification of the Models

Most of the models used are static. They do not take into account the dynamic relationships among the different monetary variables. Thorbecke (1997) and Patelis (1997) are exceptions since they used a vector autoregressive model.

The articles that examined the international monetary environment and stock returns also ignored some financial and statistical properties of the stock returns. Most of the models, in trying to account for the variation of stock returns, consider the variance of the returns to be constant over time. This assumption may not hold. There might be some ARCH and GARCH effects.

Furthermore, the financial theory states that the risk premium of a stock depends on its risk. Foerster and Shimtz (1997) is the only study that considered the risk premium by regressing risk adjusted excess stock returns on the lagged U.S. short-term interest rate, the U.S. monetary aggregate, the January dummy, U.S. term structure interest rate, the lagged U.S. dividends, lagged U.S. government expenditures, the year 2 election dummy variables, the domestic short-term interest rate and the domestic term structure in a simple linear regression. Yet, Foerster and Schimtz did not explicitly study the relationships between the risk and return in a ARCH or GARCH-in-the-mean model. We will say more about these models in the methodology section of the thesis. Conover, Jensen and Johnson (1999) also neglected risk premium.

3.3 The Integration of the Markets

The increasing integration of the markets is also a factor to consider, a fortiori in that there may be stock return volatility transmission from one country to another (the so-called spillover effect). The evidence for the spillover effect among three stock index returns (Nikkei 225, FTSE100 and Standard and Poor's 500) from 1985 to 1988 was shown by Hamao, Masulis and Ng (1990). A significant spillover effect was discovered through a MA(1)-GARCH(1,1) modeling. This kind of effect must also be considered in order to assess the effect of the monetary variables on the stock returns.

The purpose of our research is to study the relationships between the monetary policy and stock returns. To this end we will use different models which are able to comprehend the three factors discussed in the preceding paragraphs. The following hypothesis will be tested:

HYPOTHESIS: There is a significant impact of the domestic and U.S. monetary environment on the stock returns in France, Germany, the United Kingdom and Japan. Holding other factors constant, we will examine first whether an expansive (restrictive) monetary period in the domestic market will be associated with increasing (decreasing) stock returns. We will then examine, holding other factors constant, whether an expansive (restrictive) monetary period in the U.S. market will be associated with increasing (decreasing) stock returns. We will just consider the effect of the U.S.

monetary environment on other sample countries. The effect of these countries' monetary policy environments on each other's stock returns is not considered in this study.

4. METHODOLOGY and DATA

First the data will be examined, and then the models to be employed in the research will be presented.

4.1 Data

Since we are using some macroeconomic data, which cannot be given at a daily frequency, monthly observations are used in this study.

*** The Market Data**

We use the Standard and Poor 500 index for the United States, the Nikkei 225 index for Japan, the CAC 40 index for France, the FTSE 100 index for the United Kingdom, and the DAX 40 index for Germany. CAC 40, FTSE 100, Standard and Poor500 and Dax 40 are equity weighted indices, whereas Nikkei 225 is a share price weighted index. All of these stock price indices have come from a Goldman Sachs database or the Yahoo.com website.

***Data on the Discount Rate**

The Federal Reserve Bulletin and the O.E.C.D database provide the end of the month discount rates for the five countries. For the United States, the discount rate of the Federal Reserve Bank of New York is used, as is the norm in the studies of international monetary policy. For the United Kingdom, we use the minimum lending rate. The data series started in 1986 and reported in the Bundesbank Review. For Germany, Japan and France, the discount rate data from the U.S. Federal Reserve are used.

***Data on the short-term interest rate**

The three-month maturity interest rates from Treasury bill are used, except for the U.S, where we use the federal funds rate. The O.E.D.C database provides these interest rates.

*** Data on inflation, money growth and nonborrowed reserves**

The IMF database gives us the inflation rate and the monetary aggregates. The larger[2] definition of monetary aggregates was used for all the countries except for Japan, where only the narrow[3] definition was available from the IMF. The money aggregates are seasonally adjusted. Inflation is the percentage change in the consumer price index of a given country. For the United States, the nonborrowed reserves were downloaded from the website of the Federal Reserves Bank of Saint Louis[4].

The following table summarizes the sources of our data, which, in turn, will explain the sample period chosen to test our hypothesis.

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[2] This is the notes and coins in circulation and demand deposit accounts plus the sight investments deposits, certificates of credit and time and savings.
[3] This comprises notes and coin in circulation and demand deposit accounts.
[4] http://www.stls.frb.org

Table 1 : The Data

Variable	Type	The United States	The United Kingdom	Germany	France	Japan
Stock index	End of the month	56:1-98:12	79:1-98:12	75:1-98:12	87:12-98:12	82:10-98:12
Discount rate	End of the month	55:1-98 :12	86:4 – 98:12	55 :12-98:12	55:12-98 :12	55:10-98:12
Short-term interest rate	Average daily rates	60:1-98:12	80:1-98:12	60:1-98:12	70:1-98:12	80:1-98:10
Money aggregate	Average value over the month	60:1-98:12	69:1-98:12	69:1-98:12	61:1-98:12	60:1-98:10
Inflation	Average over the month	57:1-98:12	57:1-98:12	57:1-98:12	57:1-98:12	57:1-98:12
Sample period for the subject countries			**86:4-98:12**	**75:1-98:12**	**87:12-98:12**	**82:10-98:12**

The correlation matrix has been examined in order to detect any possible collinearity problems (Appendix 4). We are detecting mild levels of collinearity only between U.S. and U.K and Germany and Japan on the direction of the monetary policy variable, $DIR_{k,t}$. However, it appears that a mild amount of multicollinearity is also present in the excess returns for the sample countries.

4.2 Variable Definitions.

There are different ways to calculate stock returns. We use the following method:

Nominal stock return at time t: $\left(\frac{\text{Stock Index}_t}{\text{Stock Index}_{t-1}} - 1 \right) * 12$

Real stock return: $\frac{(1 + \text{Nominal return})}{(1 + \text{inflation rate})} - 1$

Excess stock return = Nominal stock return – Short term interest rate

We could have computed nominal stock returns under continuous compounding as follows:

$$Log\left(\frac{SP_t}{SP_{t-1}}\right)*12$$

and the excess returns with the following formula:

Excess stock return = Nominal stock return – Short-term interest rate.

We compared our results from these two methods, and found no significant differences.

The growth of monetary aggregates is computed as:

$$\left(\frac{\text{Money aggregate}_t}{\text{Money aggregate}_{t-1}}-1\right)*12$$

The symbols used for the variables are as follows.

$SP_{k,t}$: Stock price index for country k at time t.

$SR_{k,t}$: Stock index return for country k at time t.

$RESR_{k,t}$: Real stock index return for country k at time t.

$INFL_{k,t}$: Inflation rate for country k at time t.

$DISC_{k,t}$: Discount rate for country k at time t.

$DIR_{k,t}$: Direction of the monetary policy for country k at time t. This variable is equal to 1 during a period when the discount rate follows a trend of increase (restrictive monetary policy), and is equal to 0 when the discount rate follows a decreasing trend (expansive monetary period).

FFR_t: Federal funds rate at time t. This will be the short-term interest rate for the U.S. at time t.

$SHINT_{k,t}$: The short term interest rate for country k at time, with the exception of the U.S.

$EXSR_{k,t}$: Excess stock return for country k at time t.

NBRE: The nonborrowed reserves for the United States.

LNBRE: the log of nonborrowed reserves.

$MA_{k,t}$: Monetary aggregates for country k at time t.

$GMA_{k,t}$: The growth in the monetary aggregates.

We note that k = France (FR), Germany (GE), Japan (JA) or the United Kingdom (U.K.). A brief summary of the descriptive statistics for the variables above is provided in Appendix 2.

4.3 A Summary of the Methodology

Two kinds of models will be used in this paper: static and dynamic. For the static models, our first step will be to follow the methodology of Conover, Jensen and Johnson (1999) who employ a simple linear regression to test the impact of the monetary environment on stock returns. In this kind of model (presented in sub-section 1), it is assumed that variance of the stock returns is constant over time, though we note that this is usually not the case for the stock returns.

Consequently, our second step will be to consider that the variance is not constant over time, and to employ a GARCH model to do so. This model will be discussed in sub-section 2.

The excess stock returns can be explained by risk, as Bollersev, Engle and Wooldridge (1987) show. This methodology will be used by us as well in order to take into account the risk aversion of the investors. This will be our third step and will constitute sub-section 3.

In our final step we will consider the transmission of volatility from one country to another, following Hamao, Masulis and Ng (1990). The model used to test this will be presented in the last sub-section.

The dynamic model, that is, the vector autoregressive (VAR) model, will enable us to talk about the dynamic relationship between the monetary variables. It will allow us to understand the impact of an unpredicted change in the monetary instrument on risk premium. Its presentation will conclude this part.

4.3.1 The Static Models

Conovor, Jensen and Johnson (1999) used the following OLS model, but only for the domestic monetary variable ($DIR_{k,t}$) and the U.S. monetary variable ($DIR_{us,t}$):

$$SR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \varepsilon_t$$

We will also implement this model as a first test for our hypothesis. As the $DIR_{k,t}$ dummy variable is equal to 1 for a restrictive monetary period and as the stock returns are conjectured to decrease during a restrictive period, we are expecting that the coefficient estimates associated with both the U.S. and domestic monetary environment variables should be negative.

The GARCH model was introduced by Bollersev (1986). It assumes that the variance of the errors of the stock returns is not constant over time and is dependent on its lagged values and the lagged values of square of the error terms. This model captures the volatility clustering in time series data:

$$\begin{aligned} &SR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \varepsilon_t \\ &\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + u_t \\ &\varepsilon_t / \Omega_{t-1} \sim N\ (0, \sigma_t^2) \\ &u_t \sim N(0, \text{constant}) \end{aligned}$$

Bollersev, Engle and Wooldridge (1988) proposed the first GARCH-M model where M stands for in the mean.

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma_t^2 + \varepsilon_t$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + u_t$$
$$\varepsilon_t / \Omega_{t-1} \sim N\ (0, \sigma_t^2)$$
$$u_t \sim N(0, \text{constant})$$

In this model, the risk σ_t^2 is an explanatory variable . From the CAPM model, the risk for a stock is the beta, which is the covariance of the asset returns with the market portfolio returns. Since market indices are used in this study, the risk in this case is the variance of the error of excess returns, as those indices represent the market.

Hamao, Masulis and Ng (1990) modified the variance equation of the GARCH-M model to study the transmission of volatility from one market to another. Following their works, our GARCH-M model is reexpressed as:

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma_{k,t}^2 + \varepsilon_{k,t}$$
$$\sigma_{k,t}^2 = \alpha_0 + \alpha_1 \varepsilon_{k,t-1}^2 + \alpha_2 \sigma_{k,t-1}^2 + \phi \varepsilon_{us,t}^2 + u_{k,t}$$
$$\varepsilon_{k,t} / \Omega_{t-1} \sim N\ (0, \sigma_t^2)$$
$$u_{k,t} \sim N(0, \text{constant})$$

where $\varepsilon_{us,t}^2$ term is now capturing the volatility transmission from U.S. to country k. $\varepsilon_{us,t}^2$ are estimated from running a first step GARCH-M model for the U.S. as follows.

$$EXSR_{us,t} = \beta_0 + \beta_3 \sigma_{ud,t}^2 + \varepsilon_{us,t}$$
$$\sigma_{us,t}^2 = \alpha_0 + \alpha_1 \varepsilon_{us,t-1}^2 + \alpha_2 \sigma_{us,t-1}^2 + u_{us,t}$$
$$\varepsilon_{us,t} / \Omega_{t-1} \sim N\ (0, \sigma_t^2)$$
$$u_{k,t} \sim N(0, \text{constant})$$

The GARCH and GARCH-M models will be estimated by using the BHHH (Berndt-Hall-Hall-Hausman) method of iteration (used by Bollersev (1987)), with a tolerance convergence criteria of 0.001 and 0.005. The softwares used in this research are TSP and SAS.

4.3.2 The Dynamic Model.

The VAR model is often used in economics, as it permits one to see the impact of an unpredictable change of a variable on the other variables. Sims (1980) introduced the structural vector autoregressive model. A detailed explanation from de Souza (1998) will allow us to better understand the vector autoregressive model. In this model each variable of the vector depends on its own lagged values and the lagged values of the other variables.

$$\overrightarrow{X_t} = a_0 + A_1 \overrightarrow{X}_{t-1} + \ldots + A_p \overrightarrow{X}_{t-b} + \vec{u}_t$$

where

$$\overrightarrow{X}_t = \begin{pmatrix} X_1 \\ X_2 \\ \ldots \\ X_n \end{pmatrix}$$ represents a vector of n variables.

b is the number of lag values,

$\vec{u}$ is the vector of errors for each of the variables, also called innovations process.

For example, a VAR model with n=3 and b=1 is represented by:

$$\vec{X}_t = A_0 + A_1 \vec{X}_{t-1} + \vec{u}_t$$

$$\begin{bmatrix} X_{1t} \\ X_{2t} \\ X_{3t} \end{bmatrix} = \begin{bmatrix} a_{0,1} \\ a_{0,2} \\ a_{0,3} \end{bmatrix} + \begin{bmatrix} a_{1,11} & a_{1,12} & a_{1,13} \\ a_{1,21} & a_{1,22} & a_{1,23} \\ a_{1,31} & a_{1,32} & a_{1,33} \end{bmatrix} * \begin{bmatrix} X_{1,t-1} \\ X_{2,t-1} \\ X_{3,t-1} \end{bmatrix} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \end{bmatrix}$$

$$X_{1t} = a_{0,1} + a_{1,11} X_{1,t-1} + a_{1,12} X_{2,t-1} + a_{1,13} X_{3,t-1} + u_{1,t}$$
$$X_{2t} = a_{0,2} + a_{1,21} X_{1,t-1} + a_{1,22} X_{2,t-1} + a_{1,23} X_{3,t-1} + u_{2,t}$$
$$X_{3t} = a_{0,3} + a_{1,31} X_{1,t-1} + a_{1,32} X_{2,t-1} + a_{1,33} X_{3,t-1} + u_{3,t}$$

The goal of the VAR model is to ascertain the impact of a shock. We must obtain a pure random shock u_t. In other words, the error terms $u_{i,t}$ must be independent. In order to obtain a vector of pure random shocks, both sides of the equation are multiplied by the lower triangular matrix furnished by the Cholesky decomposition. Consider a matrix K such that $K\Sigma K'=I$ where $\sum$ and I are a variance covariance and identity matrix, respectively. Matrix K is unique for each vector. That means that matrix K is different for a vector with the same variable placed in a different order.

$$K\vec{X}_t = K\left[a_0 + A_1\vec{X}_{t-1} + \cdots + A_p\vec{X}_{t-b} + \vec{u}_t\right]$$
$$K\vec{X}_t = a'_0 + A'_1\vec{X}_{t-1} + \cdots + A'_p\vec{X}_{t-b} + \vec{e}_t$$

Where $a'_0 = Ka_0$, $A'_1 = KA_i$ and $\vec{e}_t = K\vec{u}_t$. Therefore, the covariance matrix of $\vec{e}_t$ is equal to $K\Sigma K'=I$.

$$\begin{pmatrix} k_{1.1} & 0 & 0 \\ k_{2.1} & k_{2.2} & 0 \\ k_{3.1} & k_{3.2} & k_{3.3} \end{pmatrix} * \begin{pmatrix} X_{1.t} \\ X_{2.t} \\ X_{3.t} \end{pmatrix} = \begin{pmatrix} a'_{0.1} \\ a'_{0.2} \\ a'_{0.3} \end{pmatrix} + \begin{pmatrix} a'_{1.11} & a'_{1.12} & a'_{1.13} \\ a'_{1.21} & a'_{1.22} & a'_{23} \\ a'_{1.31} & a'_{1.32} & a'_{1.33} \end{pmatrix} * \begin{pmatrix} X_{1.t-1} \\ X_{2.t-1} \\ X_{3.t-1} \end{pmatrix} + \begin{pmatrix} e_{1.t} \\ e_{2.t} \\ e_{3.t} \end{pmatrix}$$

Let us develop this expression into three linear equations:

$$k_{1.1}X_{1.t} = a'_{0.1} + a'_{1.11}X_{1.t-1} + a'_{1.12}X_{2.t-1} + a_{1.13}X_{3.t-1} + e_{1.t}$$
$$k_{2.1}X_{1.t} + k_{2.2}X_{2.t} = a'_{0.2} + a'_{1.21}X_{1.t-1} + a'_{1.22}X_{2.t-1} + a_{1.23}X_{3.t-1} + e_{2.t}$$
$$k_{3.1}X_{1.t} + k_{3.2}X_{2.t} + k_{3.3}X_{3.t} = a'_{0.3} + a'_{1.31}X_{1.t-1} + a'_{1.32}X_{2.t-1} + a_{1.33}X_{3.t-1} + e_{3.t}$$

We observe that the variable X_1 is not dependent on the current value of the other variables X_2 and X_3. But the variable X_2 is dependent on the current value of the variables X_1 while X_3 is dependent on the current values of the variables X_2 and X_1.

So we see that ordering the variables in the vector X brings out the assumptions underlying the contemporaneous correlation of the economic variables. Therefore, if one places the stock returns at the end of the vector one implicitly assumes that the stock returns are contemporaneously dependent on all the monetary variables. But, as we place the U.S. monetary variables before the domestic monetary variables, we impose that the domestic monetary variables are contemporaneously dependent on the U.S. monetary variables. We will order the variables as follows:

The U.S. monetary goal

U.S. growth in monetary aggregate

U.S. inflation

The U.S. monetary instruments

Log of the nonborrowed reserves

Federal funds rate

The domestic monetary objectives for a given subject country

Growth in the domestic monetary aggregates

Domestic inflation

The local monetary instrument for a given subject country

Domestic short-term interest rate

Excess stock returns for a given subject country

In this ordering, we assume that monetary instruments are contemporaneously dependent upon the monetary objectives, as they are placed at the end of the vector. In order words, it is assumed that the monetary authorities react at time t to a change in their monetary objectives. It is also assumed that domestic monetary objectives and tools are contemporaneously dependent on the U.S. monetary objectives and tools. We estimate this VAR model four times for the following country parings: U.S.-FR, U.S.-GR, U.S.-U.K. and U.S.-JA.

The usefulness of this model remains in the impulse response function and the repartition of the forecast error variance as explained de Souza (1998). The impulse response function enables us to learn how a variable of interest reacts to a shock on any of the other variables in the vector. We must rewrite the VAR equation in order to have the vector of economic variables dependent only on the shocks. This is the vector moving average (VMA) representation. It is obtained by successive substitutions.

$$\overrightarrow{X}_t = f(\overrightarrow{X}_{t-1})$$
$$\overrightarrow{X}_{t-1} = f(\overrightarrow{X}_{t-2})$$

Therefore, we can write:

$$\overrightarrow{X}_t = f(f\overrightarrow{X}_{t-2}) = f^2(\overrightarrow{X}_{t-2})$$
$$\overrightarrow{X}_{t-2} = f^{2^{-1}}(\overrightarrow{X}_t)$$

where f^{-1} denotes an inverse function.

Each lagged value of the vector $\overrightarrow{X}_t$ can be written as a function of the vector $\overrightarrow{X}_t$ at time T. Therefore, the following VMA representation is obtained:

$$\vec{X}_t = A_1 L(\vec{X}_t) + A_2 L^2(\vec{X}_t) + A_3 L^3(\vec{X}_t) + \cdots + A_b L^b(\vec{X}_t)$$
$$KA(L)\overrightarrow{X}_t = \vec{e}_t$$
$$A(L) = I - A_1 L + A_2 L^2 + \cdots A_p L^p$$
$$\overrightarrow{X}_t = K^{-1} A(L)^{-1} \vec{e}_t$$

where A(L) is the lag operator.

The coefficient of the impulse response to an orthogonalised shock, e_t ,is:

$$(A(L)^{-1}K^{-1}).$$

The forecast error of variance permits us to learn to what extent a shock on a variable contributes to the forecast error of the variance. Let us use the VMA representation:

$$\vec{X}_t = \sum_{i=0}^{\infty} \Phi_i \vec{e}_{t-i}$$

If we want to make a forecast for s periods ahead, we obtain:

$$\vec{X}_{t+s} = \sum_{i=0}^{\infty} \Phi_i \vec{e}_{t+s-i}$$

As we know, the past values of $\vec{e}_t$, the forecast error will be only the sum of the error concerning the time interval between t and t+s:

$$\sum_{i=0}^{s-1} \Phi_i \vec{e}_{t+s-i}$$

The forecast error covariance matrix will be:

$$\sum_{i=0}^{s-1} \Phi_i \left[\text{Covariance matrix}(\vec{e}_{t+s-i}) \right] \Phi'_i$$

As we know, by pre-multiplication with the matrix K, the covariance matrix of $\vec{e}_t$ is an identity matrix (one on the diagonal and zero elsewhere). Therefore, the covariance matrix of the forecast error is equal to:

$$\sum_{i=0}^{s-1} \Phi_i \Phi'_i$$

The forecast error variance of the second component of $\vec{X}_t$ is given by the second element on the diagonal of $\sum_{i=0}^{s-1} \Phi_i \Phi'_i$. We can write this forecast error variance another way:

$$\sum_{i=0}^{s-1} \sum_{l=1}^{N} \varphi_{i,kl}^2$$

$\varphi_{i,kl}$ is the element at the intersection of the k-th row and l-th column of Φ_i.

The impact of a change in the g-th component of the vector will be in the g-th column of the matrix Φ_i. Therefore, the impact of a change in the g-th on the k-th component of the vector will be the k-th row of the g-th column. The contribution of the innovation of g to the forecast error variance of the variable k is equal to $\sum_{i=0}^{s-1} \varphi_{i,kg}^2$. Now, we are able calculate the percentage of contribution of the innovation in variable g in the forecast error variance of variable k.

$$FEVD_{kg,s} = \frac{\sum_{i=0}^{s-1} \varphi_{i,kg}^2}{\sum_{i=0}^{s-1} \sum_{l=1}^{n} \varphi_{i,kL}^2}$$

Several tests are available to determine the optimal number of lagged values b. For example, Akaike's Information Criterion (AIC) Schwarz-Bayesian Information Criterion (SBIC), the Dickey Fuller test or Q-Lung Box test. There is no precise methodology, as Canova (1995), has explained. The comparison of the number of the parameters estimated to the number of observations must also be considered. In fact, if the number of parameters is too large in relation to the number of observations, then the reliability of the estimation will be questionable. This is especially the case for the vector used in this study, which is composed of eight variables; therefore, for each additional lag, the number of parameters estimated will increase by eight.

We decided to choose two lags for the VAR model. The reasons for this choice and a discussion of the details of AIC, SBIC, and Q-Lung Box test are described in Appendix 3. The next section will explain the results obtained from our models.

5.THE RESULTS

The results will be presented in the same order as the empirical models in the previous chapter.

5.1 The Ordinary Least Squares (OLS) Results

In Appendix 5 the results obtained from the OLS models are presented and compared with the results of Conover, Jensen and Johnson (1999). It is important to note that our sample period as well as the data used in our study differs from theirs. This could account for some of the divergence in results.

As it was explained in the methodology section, an expansive monetary period (monetary environment variable equal to 0) should increase the stock returns: hence, the coefficient estimates associated with the monetary environments (domestic and U.S.) are expected to be negative.

For France, we find that none of the variables are significantly different from zero whereas Conover et. al. found a significant and negative coefficient estimate for the French monetary environment. Concerning the Japanese market, we find insignificance for the monetary variables (both U.S. and domestic), which is not consistent with the results in Conover et. al.. Their findings show significant and negative coefficients estimates for the U.S. and domestic monetary variables. For Germany, and the U.K., we find that the U.S. monetary environment is significant and that an expansive monetary period in the U.S. occurs at same time with higher domestic stock returns. The results in

Conover et. al. show that in Germany only the domestic monetary environment was a significant impact on the stock returns. Their findings support both U.S. and domestic monetary environments significantly affect the British stock returns.

We could explain the differences between our results and those of Conover, Jensen and Johnson's by the fact that our sample contains 1997 and 1998, when the stock markets were unusually bullish. The size of our sample can be at the origin of divergences in empirical findings between our study and Conover et. al.'s. As it can be observed in Appendix 5 the number of ours observation is very low compared to theirs.

5.2 The GARCH Models:

In the ordinary least squares estimations, it is assumed that the variance of the residuals is constant. As this is usually not the case, the constancy of the variance must be tested. Appendix 6 presents the results of the LM test in order to detects possible ARCH effects for the four stock returns index of our study. There we undertake a simple linear regression analysis of the stock returns on the domestic and U.S. monetary variables. The evidence of the ARCH effect is supported for most countries. For France, a null hypothesis of the non-correlation of error terms cannot be rejected, but only up to six lags. For the U.K. the same null hypothesis can be rejected up to eight lags but cannot be rejected beyond that. For Germany and Japan, the same null hypothesis is rejected at the 10 % level of significance for any number of lags. These conclusions verify the fact that the squared error terms are serially dependent, and therefore we have to consider a model with a non-constant variance over time, as it is with the GARCH model. Nonetheless behaviors of the probability value (p value) for Germany and the U.K. are puzzling and have to be further examined.

The results from GARCH estimations are presented in Appendix 5. The GARCH (1,1) model does not improve the OLS results for France and Japan. The significance of $DIR_{us,t}$ disappears for the U.K. results. Only for Germany does the domestic monetary variable become significant at 1%. Taking into consideration a non-constant variance for stock returns does not change the significance of the monetary variables.

The results pertaining to the GARCH-M estimations, which include time varying volatility of residuals in the regressions equations, are in Appendix 7. For all the countries, the coefficient associated with the variance is insignificant. For France and Japan, no significant relationship is found between excess stock returns and monetary variables. In Germany, the two monetary variables are found to be different from zero. For the U. K., both the U.S. and domestic monetary environments are significant, respectively, at 6.6% and 2.7% significance levels. But the sign of the coefficient estimate associated with the domestic monetary environment implies that an expansive (restrictive) monetary period leads to a decrease (increase) in stock returns. This is not consistent with the previous empirical results. This is not consistent with our expectations either.

When GARCH-M (2,2) and GARCH-M (2,1) models are used for Japan and Germany (see Appendix 8), the results change only for Germany. The coefficient associated with the variance is negative and still insignificant. The domestic variable is not significantly different from zero. In this case our hypothesis holds for Germany, but only in the case of the U.S. monetary variables.

Some differences remain between Germany and the U.K.. The U.S. monetary environment has a greater impact on the U.K. than on Germany. British investors are more sensitive to the U.S. monetary change than German ones. It also appears from these results that the GARCH(1,1)-M model better reflects the sensitivity of the investors to the monetary variables for Germany and for the U.K. than the GARCH or OLS models do; especially for the domestic monetary variables which become significant only in the GARCH-M model.

We have used different time frames for each country. This could possibly explain why the results vary from one country to another. The same models were reapplied for a common time period from 1988:1 to 1998:12 results. The results are tabulated in Appendix 9. For this time period, no estimation convergence has been reached for Germany in the GARCH(1,1) specification. Therefore, instead an ARCH-M(1) has been estimated for Germany. Here, some of our results differ from earlier GARCH results. For Japan, in the GARCH-M the domestic and U.S monetary variables become significant, respectively, at the 10% and 5% significance levels. Those variables were not significant in the previous GARCH and in the OLS models. The sign of the coefficient estimate associated with the U.S. monetary variable is not consistent with the earlier empirical results. A monetary period of expansion in the United States decreases the excess returns. This puzzling result could be due to Japan's deep and rather long recession. For the ten previous years, the Japanese economy has faced a major recession, which was not the case in the European countries. Our results are also different for Germany and the United

Kingdom, where both domestic and U.S. monetary environments are not significantly different from zero for any of the three different models. We remind that we obtained some significant results in our previous estimations for both countries. No change in the French market is observed, where the monetary variables remain insignificant for each of the three models.

Changing time period even in our own data, while holding methodology constant alters results. Conover et. al. did not consider different time periods in their paper. From the GARCH-M models, we find that the domestic and U.S. monetary environments for Japan, Germany and the U.K. significantly affect a sample country's excess stock returns, but for different time frames. The findings also support the thesis that adding volatility into the return equation via GARCH-M models makes results more significant and interesting.

5.3 Spillover Effects

We will first consider the transmission of U.S. volatility to Japan, Germany, France and the U.K. Then, the transmission of volatility from one of these countries to the remaining four will be considered. Appendix 10A highlights the results obtained with the spillover specification. The coefficients associated with the squared error terms extracted from the regression of the U.S. excess stock returns on its own volatility are significant at 10% for Japan and Germany, and at 5% for France and the U. K. Therefore, we find a significant spillover effect from the U.S., which is consistent with Hamao, Masulis and Ng (1990). In light of this effect, none of our previous conclusions about the United Kingdom holds, as the domestic and U.S. monetary variables are no longer significant. For Germany, only the U.S. monetary environment is no longer significant. Our conclusions do not, however, change for France and Japan, as the monetary variables there remain insignificant. Those results provide evidence that investors react more to an error of prediction in the U.S. markets than to the U.S. monetary variables. Spillover effect from the U.S. to the others stock markets is a control variable for the significance of the monetary variables. We might also consider some courses of transmission of volatility from countries other than the U.S.

We employed several models with spillover effect where a transmission of the Japanese, French, or German volatilities was considered. Estimations did not converge for the U.K. model. Only those models for which convergence is attained are described in Appendix 10B. The spillover effect is significant in the transmission of German, Japanese and French volatility to all of the countries at 5%. The only exception is the case of the transmission of French volatility to the Japanese market, with a significance of 10%. All the monetary variables are insignificant, except for Germany (with Japanese volatility) and France (with German volatility). The transmission of German volatility to the French market presents an interesting case. Here, the significance of the U.S. monetary variable increases (from 45.5% to 16.6%) and the domestic monetary variable becomes significant at the 10% level. The variance is also significant at 5%. This finding shows that the markets' domestic integration affects the excess stock returns for investors and the sensitivity to the domestic monetary environment. The signs of the coefficients are consistent with the theory for sensitivity of the French market to the U.S. monetary variables, but not for the sensitivity of the French market to the domestic monetary variable. An expansive domestic monetary period decreases the excess premium.

Another interesting result is found in the case of the transmission of Japanese volatility to the German and U.S. market. In the case of the German market, the coefficient estimate for the volatility of the DAX is negative and significant at the 1% level, while the U.S. monetary variable remains significant at the 10% level. For the U.S. market, we find that the coefficient estimate for the variance of the S&P 500 index returns is significant at the 10% level. As explained in the methodology a negative coefficient estimate for the variance of the domestic index returns means that investors claim less returns when the volatility increases. These results are against the fundamental financial relationship between the risk and returns. A possible explanation to this puzzling finding may be that signals from the troubled Japanese markets may be interpreted as bad or mixed news, leading to this relationship.

From the different static models, we find evidence that the monetary policy matters for the excess stock returns. Both U.S. and domestic environments are found to be statistically significantly different from zero for all the countries, but at different time periods and with different specifications of variance. In the next section, the results obtained from the vector autoregressive model will be discussed.

5.4 Results from the Dynamic Model

The goal of this model is to determine whether an unpredicted change in the monetary instruments affects the stock market. That is why the following comments on the impulse function and 24 month forecast error variance are based on the monetary instruments (interest rate and nonborrowed reserves). The results obtained from the impulse response function will be first commented following by the discussion on the findings on the 24-month forecast error variance.

The results of the impulse function are shown in Appendix 11. The comments to follow consider the impact of the nonborrowed reserves and the short-term interest rate, as these are the monetary instruments on the excess index returns.

A positive shock in the nonborrowed reserves increases excess returns for every country except the U.K., where there is a decrease in the risk premium. An increase in the nonborrowed reserves is a sign to the market of an expansive monetary policy since the banks then have less restriction on their reserves. Therefore, the increase in the excess returns for France, Japan and Germany is consistent with the hypothesis and findings of Thorbecke (1997) for the U.S. stock returns. For the U.K., this increase occurred two months after the shock, as can be seen in the plot of the impulse function (Appendix 11A). It appears from this plot that the British stock market has an inverse response as compared to the responses of the other stock markets.

The reaction of the stock market to an unpredictable change in the domestic interest rate is consistent with what we have seen in our review of the literature. One month after the shock in the domestic interest rate, there is a lowering of the excess returns. As regards the plot of the impulse function, the impact of a change in the domestic short-term interest rate seems to be as large as the effect of a change in the federal funds rate. It also appears that the stock markets react similarly to an unpredicted shock in the local short-term interest rate.

An unpredictable increase in the federal funds rate must reduce the excess stock returns, as it is a sign of a tightened monetary policy. One month after the shock, only the U.K. market reacts consistently with the theory, whereas the Japanese, French and German excess stock returns increase. Two months after the shock, the excess returns of the three markets decrease as predicted by our hypothesis. In the plot of the impulse function, we observe an inverse response between the U.K. stock markets and the other stock markets similar to what we have previously observed in the impulse function of the nonborrowed reserves. The reason of this difference between the British market and the other stock markets of our sample may be in the conduct of the monetary policy in the U.K.. The U.K. was the last country in our sample to target clearly inflation. Furthermore, their non-cooperation in the implementation of the Euro could also explain the difference with France and Germany. However this results has to be further examined.

We may so far conclude that the U.S. and domestic monetary tools affect the risk premium of different countries. Some differences remain among the four markets. Our hypothesis holds for each country. But, for the different instruments, although the Japanese, French and German markets react consistently to the theory of a change in the nonborrowed reserves, the U.K. alone reacts consistently to a change in the federal funds rate one month after the shocks.

Appendix 12 provides the repartition of the percentage of forecast error variance. It allows us to discriminate the weight of each variable in the error of forecasting the excess stock returns. The most significant results are obtained for the U.K. and Japan, where the F test is significant at almost 10% and the adjusted R-squared is the highest.

A shock on the FFR has less impact on the 24-month forecast error variance than a shock on domestic short-term interest rate has for any of the countries. The logarithm of the nonborrowed reserves has a larger effect than the FFR for all the countries with the exception of Japan. We note also that the logarithm of the nonborrowed reserves has less effect on the forecast error variance than the local short-term interest for each of the countries with the exception of the U.K..

The U.K. and France are the most sensitive to a change in the monetary variables; with 19% and 17%, respectively; of their 24 month forecast error variance. In the case of Japan and Germany, however, those variables cause only 7% and 12% of the 24 month forecast error variance. The United Kingdom is clearly influenced by U.S. monetary policy, especially policies which pertain to the nonborrowed reserves. For France, the repartition of the forecast error variance is more balanced, with 6% for local as against 10% for U.S. monetary variables. The forecast error variance is mainly influenced by the money aggregate (2.7%) and U.S. inflation (5.1%).

From the forecast error variance we can see that, and in which way, some differences remain among the countries. It is clear that U.S. monetary policies have more effect on the excess premium forecast in U.K. and France.

6.CONCLUSIONS

This paper has explored the relationship between the international monetary environment and stock returns. Different models, which extended the OLS of Conover, Jensen and Johnson (1999), have been examined, specifically the GARCH, GARCH-M and GARCH-M models with spillover effects. These have enabled us to take into consideration some factors, which are more realistic: the non-constancy of the variance, the aversion of investors to risk, and the transmission of volatility. The dynamic relationships among the different monetary variables have also been considered through a vector autoregressive model.

It has been shown that the relationship between the international monetary environment and excess stock returns exists, and is significant for Japan, Germany, the U.K. and France. However, the tenability of this relationship depends not only on the time frame but also on the variance specification (e.g. volatility transmission from Germany to France). Furthermore, this paper has demonstrated that more conclusive results are obtained from the GARCH-M model when considering the excess returns for Germany (75:2 to 98:12) for Japan (88:1 to 98:12) the U.K. (86:5 to 98:12) and France (88:1 to 98:12 with a spillover effect).

This corroborates our initial thesis that risk aversion as well as volatility transmission must be taken into consideration when studying the sensitivity of investors to the monetary environment.

It has been emphasized that there are some differences among the markets to the sensitivity of an unpredictable shock in one of the U.S. monetary tools. British and French risk premiums proved to be the most sensitive to a change in U.S. monetary tools through the vector autoregressive model.

Moreover, it has obtained that the nonborrowed reserves have more impact on the forecast error variance than the federal funds rate. This shows that the U.S. monetary policy should be defined by a large array of monetary instruments, and not only the federal funds rate.

The impulse response function of the British markets shows that British investors react to a change in the U.S. monetary tools in opposite ways from the Japanese, French and German investors. This result should be developed with daily data, in order to consider some further implications in portfolio management.

Our study highlights also some other results, which have noteworthy implications.

We have seen some significant relationships between monetary environment and excess stock returns emerge which are not consistent with previous findings in the existing literature. A period of monetary expansion in the United States decreases the excess stock returns in Japan, and a period of monetary expansion in the United Kingdom and France decreases the risk premium in the British and French stock markets. This could be attributed to a fear on the part of the investor of possible inflation, and also to the finding of some articles[5] that inflation depreciates stock price. This track deserves further exploration.

Another interesting result has to do with the sign of the coefficient associated with the risk parameter. For Germany (in the GARCH-M (2,1)) and the U.K., the coefficient associated with the risk is negative. This means that when the risk increases the risk premium decreases! In other words, this should imply that investors from Germany and the United Kingdom are risk lovers. Even if those coefficients are insignificant, it is worth noticing this difference among the aversion to risk of different nationalities of investors. The differencc in the aversion to risk of investors in Europe is therefore also worth further investigation.

[5] See David P. Ely, Kenneth J. Robinson, March 1989, The stock market and inflation: A synthesis of Theory and evidence, Economic review, Federal Reserve Bank of Dallas for a presentation of the studies pertaining to this topic.

7.BIBLIOGRAPHY

Bernancke Ben S. and Blinder Alan S., (1992) "The Federal Funds Rate and the Channels of Monetary Transmission", *The American Economic Review*, Sep 1992, 82:4, pp. 901-921.

Bollerslev, Tim, (1986), " Generalized Autoregressive Conditional Heteroscedasticity", *Journal of Econometrics*, 31, pp.307-327.

Bollersev,Tim, Engle Robert F. and Wooldridge Jeffrey M.. "A capital Asset Pricing Model with Time-varying Covariances", *Journal of Political Economy*, 96:1,pp.116-131.

Booth James R. and Booth Lena Chua (1997), " Economic Factors, Monetary Policy and Expected Returns on Stock and Bonds", *Federal Reserve Bank of San Francisco Economic Review*, 1997, Iss.2, pp. 32-41.

Canova, Fabio (1995), "Vector Autoregressive Models", from Handbook of Applied Econometrics chap 2, pp 73-131, Persaran, Hashem.,Wickens, Mike, Blackwell handbooks in Economics,1st edition 1995.

Cheung Daniel W.W.,(1997) "Pacific Stock Market Integration under Different Federal Funds Rate Regimes", *Journal of Business, Finance, and Accounting*, Oct/Dec 1997, 24: 9/10, pp. 1343-1352.

Conover C. Mitchell, Jensen Gerald R. and Johnson Robert R.(1999), "Monetary Environments and International Stock Returns", *Journal of Banking and Finance*, Sep 1999, 23: 9, pp. 1357-1381.

Conover C. Mitchell, Jensen Gerald R. and Johnson Robert R.(1999), "Monetary Conditions and International Investing", *Financial Analysts Journal*, Jul/Aug 1999, 55: 4, pp. 38-48.

Fama Eugene F. and French Kenneth R.(1989), "Business Conditions and Expected Returns on Stocks and Bonds", *Journal of Financial Economics*, 1989, 25:1, pp. 23-49.

Fama Eugene F and French Kenneth. R (1992), "The Cross-Section of Expected Returns", *Journal of Finance*, June 1992, 47: 2, pp. 427-465.

Foerster Stephen R. and Schmitz John J. (1997), "The Transmission of U.S. Election Cycles to International Stock Returns", *Journal of International Business Studies*, First quarter 1997, 28: 1, pp.1-28.

Fortune Peter (1989), "An Assessment of Financial Market Volatility: Bills, Bonds, and Stocks", *New England Economic Review*, November 1989, pp. 13-28.

Greene William H. (1997), "Econometric Analysis", Prentice Hall the Third Edition, New Jersey.

Hamao, Yasushi, Masulis, Ronald W and Ng, Victor (1990), "Correlations in Price Changes and Volatility Across International Stock Markets", *The Review of Financial Studies*, 1990, 3: 2, pp 281-307.

Jensen Gerald R., Mercer Jeffrey M. and Johnson Robert R.(1996), " Business Conditions, Monetary Policy and Expected Security Returns", *Journal of Financial Economics*,1996, 40, pp. 213-237.

Jensen Gerald R., Mercer Jeffrey M. and Johnson Robert R.(1996), " New Evidence on Size and Price-to-Book Effects in Stock Returns", *Financial Analyst Journal* , Nov/Dec 97, pp. 34-42.

May Don O. (1992) "A Reexamination of Market Returns Discount Rate Changes, and Market Efficiency", *Journal of Macroeconomics*, Summer 1992, 14: 3, pp.545-553

Patelis Alexis (1997), "Stock Return Predictability and the Role of Monetary Policy", *Journal of Finance*, December 1997, 50: 2,1951-1972.

Waud. Roger N. (1970), " Public Interpretation of Federal Reserve Discount Rate Changes: Evidence on the Announcement Effect", *Econometrica* , 1970, 38 pp.231-250.

de Souza ,*Structural Vector Autoregressive Models* , Econometrics course, European University Bruges.

Sims C.A.(1980) , "Macroeconomics and Reality", *Econometrica*, 1980,Vol.48:1, pp. 1-48.

Thorbecke Willem (1997), "On Stock Market Returns and Monetary Policy", *Journal of Finance*, Jun 1997, Vol. 52: 2

APPENDIX 1: Methodology Review

	Authors' articles	Model used	Variable
Local monetary Policy and stock returns	Waud (1970)	Examination of the error distribution, exctracted from a Moving Average on the stock returns around an annoucement date	Stock return
	May (1992)	Ordinary least squares	Stock Price
	Jensen Mercer and Johnson (1996), (1997)	Ordinary least squares	Stock return, excess stock return
	Booth and Booth (1997)	Ordinary least squares	Stock return
	Thorbecke (1997)	Ordinary least squares	Stock return
		Vector autoregressive	
	Patelis (1997)	Nested regression	Excess stock return
		Vector autoregressive	
International monetary policy and stock returns	Foerster and Schmitz (1997)	Ordinary least squares	Excess stock return
	Conover, Jensen and Johnson (1999)	Ordinary least squares	Stock return
	Cheung (1997)	Vector autoregressive	Stock return

APPENDIX 2: Descriptive Statistics

Germany

Time period 1975:2 to 1998:12
Number of observations: 287

	Mean	Std Dev	Minimum	Maximum
SP	1438.81031	1111.07913	468.39999	5897.43994
SR	0.11810	0.62927	-2.58206	2.03435
RESR	0.086171	0.61567	-2.56768	1.97835
EXSR	0.057150	0.63149	-2.62946	2.00295
SHINT	0.060953	0.024711	0.031200	0.13600
INFL	0.030061	0.018358	-0.011542	0.073486
DISC	0.046594	0.017932	0.025000	0.087500
DIR	0.36237	0.48152	0.00000	1.00000
MA	1171.20540	551.49941	438.67001	2317.50000
GMA	0.070408	0.11187	-0.26169	1.68053

The United States

Time period 1960:2 to 1998:12
Number of observations: 456

	Mean	Std Dev	Minimum	Maximum
SP	230.90514	232.81599	53.39000	1229.22998
SR	0.090539	0.50603	-2.61156	1.95656
RESR	0.044816	0.48361	-2.54249	1.63965
EXSR	0.024080	0.51014	-2.68446	1.85596
FFR	0.066458	0.032879	0.011600	0.19100
INFL	0.045637	0.030899	0.0057748	0.14682
DISC	0.059899	0.024996	0.030000	0.14000
DIR	0.47323	0.49982	0.00000	1.00000
MA	2229.94561	1665.18476	300.39999	5995.79980
GMA	0.077275	0.042930	-0.054536	0.18454
NBRE	26.14195	15.47603	10.07000	60.80000
LNBRE	3.09955	0.56448	2.30956	4.10759

France

Time period 1988:1 1988:12
Number of observations: 132

	Mean	Std Dev	Minimum	Maximum
SP	2099.72576	648.84519	893.82001	4203.45020
SR	0.14755	0.73559	-1.80795	2.93697
RESR	0.12280	0.72091	-1.80440	2.84633
EXSR	0.075188	0.73798	-1.84335	2.86017
SHINT	0.072358	0.026865	0.033200	0.12100
INFL	0.022358	0.0090639	0.0016738	0.038056
DISC	0.065504	0.025055	0.030000	0.10250
DIR	0.33333	0.47320	0.00000	1.00000
MA	4967.82880	473.25046	3804.69995	5589.89990
GMA	0.034048	0.095086	-0.28842	0.44906

The United Kingdom

Time period 86:5 98:12
Number of observations: 152

	Mean	Std Dev	Minimum	Maximum
SP	2989.89210	1170.42215	1234.90002	5932.20020
SR	0.13751	0.64290	-3.12527	3.36146
RESR	0.091478	0.61501	-3.03434	3.19573
EXSR	0.046747	0.64372	-3.22507	3.25096
SHINT	0.090763	0.030813	0.051300	0.15290
INFL	0.042909	0.023178	0.012200	0.10890
DISC	0.089092	0.030931	0.051250	0.14875
DIR	0.44737	0.49887	0.00000	1.00000
MA	3853.44737	2176.70277	-1733.00000	10297.00000
GMA	-0.41101	53.11028	-419.87692	213.28177

Japan

Time period 1982:11 to 1998:12
Number of observations: 194

	Mean	Std Dev	Minimum	Maximum
SP	19649.51785	6882.16498	7895.62012	38915.87109
SR	0.062851	0.74472	-2.30724	2.40795
RESR	0.049093	0.73397	-2.27219	2.30752
EXSR	0.020671	0.74427	-2.39074	2.32485
SHINT	0.042180	0.024823	0.0051000	0.083500
INFL	0.014023	0.011403	-0.010604	0.039674
DISC	0.030587	0.018518	0.0050000	0.060000
DIR	0.13402	0.34156	0.00000	1.00000
MA	122.25815	36.59003	75.24350	207.76300
GMA	0.063089	0.30147	-0.73378	0.87873

APPENDIX 3: The Choice of the Optimum Lag for the Vector Autoregressive (VAR) Model.

France

Number of Lags	Akaike's Information Criteria (AIC)	Schwarz-Bayesian Information Criteria (SBIC)
1	-47.2146	**-68.3373**
2	-47.2185	-66.9216
3	-47.2506	-65.5198
4	-47.0144	-63.8351
5	-46.7678	-62.1252
6	-46.6141	-60.4931
7	-46.6875	-59.0728
8	-46.6623	-57.5383
9	-46.6376	-55.9885
10	-47.0932	-54.9027
11	-48.4348	-54.6865
12	**-51.0396**	-55.7168

Germany

Number of Lags	Akaike's Information Criteria (AIC)	Schwarz-Bayesian Information Criteria (SBIC)
1	-41.8877	**-63.6703**
2	**-42.3100**	-63.2701
3	-42.2217	-62.3550
4	-42.0442	-61.3465
5	-42.0473	-60.5143
6	-41.9322	-59.5596
7	-41.8088	-58.5923
8	-41.6588	-57.5939
9	-41.5792	-56.6616
10	-41.4515	-55.6766
11	-41.5253	-54.8887
12	-41.7968	-54.2939

Japan

Number of lags	Akaike's Information Criteria (AIC)	Schwarz-Bayesian Information Criteria (SBIC)
1	-42.9719	**-64.4578**
2	**-43.5910**	-63.9866
3	-43.4880	-62.7855
4	-43.1797	-61.3711
5	-43.0367	-60.1138
6	-42.8149	-58.7696
7	-42.6622	-57.4861
8	-42.5710	-56.2558
9	-42.5360	-55.0732
10	-42.5461	-53.9269
11	-42.8490	-53.0649
12	-42.8427	-51.8847

The United Kingdom

Number of lags	Akaike's Information Criteria (AIC)	Schwarz-Bayesian Information Criteria (SBIC)
1	-33.4278	**-54.6921**
2	-33.8463	-53.8197
3	-33.5711	-52.2419
4	-33.3391	-50.6957
5	-33.2124	-49.2429
6	-33.1240	-47.8162
7	-32.9960	-46.3377
8	-33.3630	-45.3416
9	-33.6164	-44.2194
10	-33.9596	-43.1741
11	-34.8166	-42.6294
12	**-35.5800**	-41.9779

The Q Lung test

France

The value of the Q lung and Box statistic with $b = 30$.

Dependant variables	1	2	4	6	8	10	12
$GMA_{us,t}$	36.4512 **[.194]**	35.7461 **[.217]**	21.3898 **[.875]**	22.4220 **[.838]**	29.0277 **[.516]**	37.4769 **[.164]**	48.1065 [.019]
$INFL_{us,t}$	126.925 [.000]	72.9061 [.000]	77.5951 [.000]	49.9820 [.012]	31.9388 **[.370]**	38.8070 **[.130]**	38.1372 **[.146]**
LNBRE	38.5158 **[.137]**	33.6829 **[.294]**	28.7271 **[.532]**	27.0119 **[.623]**	32.5723 **[.341]**	26.8628 **[.630]**	20.6078 **[.900]**
FFR	95.8323 [.000]	43.9053 [.049]	35.1722 **[.236]**	22.8419 **[.822]**	27.2660 **[.609]**	23.2745 **[.804]**	51.3306 [.009]
$GMA_{fr,t}$	45.4186 [.035]	44.7293 [.041]	28.4274 **[.548]**	21.0018 **[.888]**	33.1642 **[.315]**	19.0441 **[.939]**	33.4589 **[.303]**
$INFL_{fr,t}$	102.664 [.000]	92.4501 [.000]	66.3543 [.000]	50.9657 [.010]	44.5766 [.042]	41.6320 [.077]	33.3748 **[.307]**
$SHINT_{fr,t}$	44.5659 [.042]	36.3125 **[.198]**	35.4675 **[.226]**	30.4066 **[.445]**	27.0049 **[.623]**	40.0024 **[.105]**	31.8999 **[.372]**
$EXSR_{fr,t}$	26.4828 **[.650]**	29.4223 **[.496]**	37.3738 **[.166]**	24.3631 **[.755]**	26.0784 **[.671]**	30.5462 **[.438]**	37.9598 **[.151]**

Germany

Dependant variables	1	2	4	6	8	10	12
$GMA_{us,t}$	43.3353 [.055]	37.7781 **[.156]**	30.7742 **[.427]**	21.5904 **[.869]**	21.6426 **[.867]**	26.1418 **[.668]**	26.2736 **[.661]**
$INFL_{us,t}$	151.810 [.000]	116.017 [.000]	95.9874 [.000]	91.3378 [.000]	85.8480 [.000]	68.0154 [.000]	67.7695 [.000]
LNBRE	66.0806 [.000]	30.3032 **[.450]**	28.6814 **[.534]**	28.1450 **[.563]**	21.1406 **[.883]**	18.6159 **[.948]**	16.4540 **[.979]**
FFR	181.253 [.000]	78.7620 [.000]	60.7419 [.001]	46.3641 [.029]	44.5392 [.043]	35.8507 **[.213]**	30.5818 **[.436]**
$GMA_{ge,t}$	10.7614 **[1.00]**	10.5752 **[1.00]**	12.7256 **[.998]**	16.9140 **[.974]**	19.4494 **[.930]**	21.5545 **[.870]**	21.4817 **[.872]**
$INFL_{ge,t}$	83.3481 [.000]	71.1390 [.000]	69.6903 [.000]	63.7287 [.000]	42.1264 [.070]	39.6305 **[.112]**	26.0418 **[.673]**
$SHINT_{ge,t}$	62.2143 [.000]	38.9515 **[.127]**	30.9590 **[.417]**	32.9509 **[.325]**	28.4400 **[.547]**	36.5573 **[.190]**	39.0305 **[.125]**
$EXSR_{ge,t}$	29.5312 **[.490]**	29.6588 **[.483]**	31.9746 **[.369]**	33.6444 **[.295]**	32.3197 **[.353]**	26.1530 **[.667]**	22.6193 **[.831]**

The United Kingdom

Dependant variables	1	2	4	6	8	10	12
$GMA_{us,t}$	42.5644 [.064]	37.0919 **[.174]**	26.2753 **[.661]**	34.6615 **[.255]**	38.7864 **[.131]**	41.3490 [.081]	43.3619 [.054]
$INFL_{us,t}$	92.3140 [.000]	61.4841 [.001]	65.0651 [.000]	42.0108 [.071]	45.3784 [.036]	38.9344 **[.127]**	44.2641 [.045]
LNBRE	33.5521 **[.299]**	24.9704 **[.726]**	37.7019 **[.158]**	36.5745 **[.190]**	29.4903 **[.492]**	24.7331 **[.738]**	28.7510 **[.531]**
FFR	40.9267 [.088]	46.4061 [.028]	35.9278 **[.210]**	28.8447 **[.526]**	29.6726 **[.483]**	36.1732 **[.202]**	20.3965 **[.906]**
$GMA_{uk,t}$	43.0705 [.058]	34.9628 **[.244]**	38.2354 **[.144]**	32.3031 **[.354]**	39.1828 **[.122]**	32.5615 **[.342]**	40.2259 **[.101]**
$INFL_{uk,t}$	146.665 [.000]	58.7486 [.001]	47.8495 [.021]	33.9419 **[.283]**	22.0423 **[.853]**	24.9796 **[.726]**	32.0587 **[.365]**
$SHINT_{uk,t}$	60.7268 [.001]	87.0634 [.000]	44.0602 [.047]	35.3876 **[.229]**	41.2056 [.084]	38.2145 **[.144]**	36.8269 **[.182]**
$EXSR_{uk,t}$	25.9639 **[.677]**	17.4874 **[.966]**	16.4444 **[.979]**	22.3047 **[.843]**	16.3819 **[.979]**	29.9844 **[.466]**	29.4333 **[.495]**

Japan

Dependant variables	1	2	4	6	8	10	12
$GMA_{us,t}$	36.9002 **[.180]**	29.9516 **[.468]**	32.6170 **[.339]**	28.4847 **[.545]**	19.9577 **[.918]**	22.3935 **[.839]**	20.2627 **[.910]**
$INFL_{us,t}$	113.547 [.000]	47.9794 [.020]	45.5439 [.034]	34.8315 **[.249]**	23.8099 **[.781]**	24.3126 **[.758]**	32.6095 **[.340]**
LNBRE	77.4544 [.000]	28.5721 **[.540]**	22.4279 **[.838]**	26.7360 **[.637]**	20.6887 **[.897]**	18.6943 **[.946]**	27.3368 **[.606]**
FFR	55.2220 [.003]	20.2074 **[.911]**	25.6310 **[.694]**	30.3889 **[.446]**	36.8477 **[.182]**	27.6521 **[.589]**	41.7578 [.075]
$GMA_{ja,t}$	357.103 [.000]	82.5761 [.000]	69.2837 [.000]	77.3365 [.000]	59.7350 [.001]	45.6816 [.033]	31.7568 **[.379]**
$INFL_{ja,t}$	46.5977 [.027]	41.5235 [.079]	34.2625 **[.270]**	32.6394 **[.338]**	29.0117 **[.517]**	25.5593 **[.697]**	22.5476 **[.833]**
$SHINT_{ja,t}$	44.0556 [.047]	21.4545 **[.873]**	19.6595 **[.925]**	27.0491 **[.621]**	20.9390 **[.890]**	18.5504 **[.949]**	18.9987 **[.940]**
$EXSR_{ja,t}$	32.9680 **[.324]**	28.3193 **[.554]**	28.1112 **[.565]**	25.9106 **[.680]**	28.6171 **[.538]**	22.0135 **[.854]**	26.8205 **[.633]**

The AIC and SBIC are information criteria to choose the optimum number of lags. We will test several VAR models with different number of lags, for each of those the AIC and SBIC will be calculated. The following equations show the definition of AIC and SBIC:

$$AIC = -2\ln(L) + 2c$$

$$SBIC = -2\ln(L) + \ln(N)c$$

where:

L is the value of the likelihood function evaluated at the parameter estimates,

N is the number of observations,

c = is the number of estimated parameters,

A model is considered to be most informative when its likelihood function (L) assumes the highest value. It becomes clear that the optimum number of lags will be the one for which we will find the lowest AIC and SBIC, since we take negative of the maximum likelihood in findings AIC and SBIC.

The results from the AIC and SBIC for Germany and Japan are consistent and show that two or one are the optimum number of lags. But for France and the U.K., AIC and SBIC provide different optimum number of lags, respectively 12 and 2. This difference can be explained by the low number of observations for France and the United Kingdom. From these two equations, it appears that the number of observations could be a source of divergence among the AIC and SBIC.

The null hypothesis of the Q-portmanteau test is the absence of autocorrelation among the residuals for a given number of lags. We regressed each of the variables of the vector on their own lagged values and the lagged values of the other variables. The number of lags goes from 1 to 12. For each regression, we took the value of the Q test and its p value. The optimum number of lags for the VAR model will be the one for which we will not be able to reject the non-autocorrelation of residuals for a maximum number of variables of our vector. Hence, we have to choose the number of lags for which the highest p value is observed for a maximum number of variables. This test is followed in order to obtain a pure error random shock vector. Each error terms are independent from its own lagged values. The results of the Q test show that the optimum number of lags seems to be equal to 10 for Germany, the United Kingdom and Japan, and 8 for France. As we have 8 variables, thus either 80 or 64 coefficients have to be estimated. This is too large compared to the number of observations available (for France especially: 132). Therefore, it appears to us unavoidable to do a trade-off between the SBIC and the Q-tests. We have to find a number of lags not too large for the number of coefficients that has to be estimated, and large enough to have variables that have their error terms, which are not correlated and have lower information criteria.

Two lags seem to be a reasonable value as with two lags less variables have their error terms correlated compared with one lags. Regards to the SBIC, with two lags the second lowest value for the criterion is obtained, and finally only 16 parameters will have to be estimated. The VAR model will be specified with two lags for each variable.

APPENDIX 4: The Correlation Matrix

For the periods specific at each country

	DIR uk,t	DIR ja,t	DIR fr,t	DIR ge,t
Sample period	86:5 to 98:12	82:11 to 98:12	88:1 to 98:12	75:2 to 98:12
DIR us,t	**0.50515**	0.32430	-0.08177	0.29750

For the period 1988:1 to the Period 1998:12

	DIR uk,t	DIR ja,t	DIR fr,t	DIR ge,t	DIR us,t
DIR uk,t	1				
DIR ja,t	0.19311	1			
DIR fr,t	0.25077	-0.064533	1		
DIR ge,t	0.11031	**0.60611**	0.29118	1	
DIR us,t	**0.55977**	0.30922	-0.08177	0.23262	1

For the period 1988:1 to the Period 1998:12

	$EXSR_{UK,t}$	$EXSR_{ja,t}$	$EXSR_{fra,t}$	$EXSR_{ge,t}$	$EXSR_{US,t}$
$EXSR_{uk,t}$	1				
$EXSR_{ja,t,}$	0.36069	1			
$EXSR_{fra,t}$	**0.58627**	0.35678	1		
$EXSR_{ge,t}$	**0.56643**	0.35129	**0.75528**	1	
$EXSR_{U.S,t}$	**0.68307**	0.3783	**0.51644**	**0.52123**	1

APPENDIX 5: RESULTS OF THE OLS AND GARCH(1,1) MODELS FOR THE STOCK RETURNS

	Dependant Variable	Sample size	R^2	Adjust R^2	β_0	β_1	β_2
	OLS MODEL						
CJ&J	SRFR	424	2.00E-02		0.0114** 2.72	-0.0022 -0.4	-0.0143** -2.44
Ours	SRFR	132	4.23E-03	-0.011208	0.167452 1.71	-0.083528 -0.64	0.04469 0.33
	GARCH MODEL						
Ours	SRFR	132	3.91E-03	-1.15E-02	0.178237* 2.45	-0.067491 -0.62	0.068508 0.61
	OLS MODEL						
CJ&J	SRJA	408	0.04		0.0174** 5.6	-0.0114** -2.64	-0.0109* -2.22
Ours	SRJA	194	0.010269	-9.48E-05	0.102431 1.541	-0.038444 -0.322	-0.197745 -1.192
	GARCH MODEL						
Ours	SRJA	194	9.56E-03	-8.16E-04	0.120216* 2.005	3.71E-03 0.038	-0.137891 -0.754
	OLS MODEL						
CJ&J	SRGE	440	0.02		0.0121** 3.67	-0.0069 -1.54	-0.0075* -1.65
Ours	SRGE	287	0.021744	0.014855	0.199773** 3.891	-0.177686* -2.248	-0.032316 -0.402
	GARCH MODEL						
Ours	SRGE	287	0.021079	0.014186	0.182621** 3.354	-0.160764** -2.607	-0.06719 -1.128
	OLS MODEL						
CJ&J	SRUK	410	0.05		0.0209* 5.62	-0.0144** -2.69	-0.0113* -2.07
Ours	SRUK	152	0.022691	9.57E-03	0.159137** 2.187	-0.225587* -1.828	0.147388 1.219
	GARCH MODEL						
Ours	SRUK	152	0.022496	9.37E-03	0.146201** 2.412	-1.33E-01 -0.813	0.076497 0.428

t statistics are under the coefficients

* denotes significantly different from zero by one tailed test at 5%

** denotes significantly different fron zero by one tailed test at 1%

SRFR, SRJA, SRGE and SRUK mean the stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 6 : Test Results for the ARCH effect, the Lagrange Multiplier test.

The null hypothesis of the Lagrange Multiplier (LM) test is the constancy of the variance of the error terms. Hence the prob value must be the lowest in order to reject that the variance is constant.

Order	France		Germany		Japan		United Kingdom	
	LM	Prob>LM	LM	Prob>LM	LM	Prob>LM	LM	Prob>LM
1	9.9672	0.0016	13.8562	0.00020	8.2052	0.00420	0.6523	0.41930
2	9.995	0.0068	15.5906	0.00040	16.8154	0.00020	0.7709	0.68010
3	10.8208	0.0127	19.9133	0.00020	17.884	0.00050	0.9012	0.82510
4	11.0211	0.0263	20.3204	0.00040	19.1093	0.00070	0.9174	0.92210
5	11.2809	0.0461	20.7657	0.00090	22.0744	0.00050	0.9399	0.96730
6	11.4138	0.0764	21.1158	0.00170	23.6717	0.00060	1.2929	0.97200
7	11.4757	0.1192	21.6388	0.00290	23.7151	0.00130	1.3296	0.98760
8	12.6322	0.1251	22.3153	0.00440	24.3515	0.00200	1.3844	0.99450
9	13.1291	0.1569	24.2034	0.00400	24.5591	0.00350	27.6509	0.00110
10	13.2811	0.2084	25.8389	0.00400	24.5618	0.00620	27.6675	0.00200
11	13.4044	0.2677	26.5583	0.00540	24.8399	0.00960	27.7941	0.00350
12	13.5832	0.3281	26.5757	0.00890	24.843	0.01560	27.9582	0.00560

APPENDIX 7:Results from the OLS, GARCH(1,1) and GARCH-M(1,1) for Excess Stock Returns.

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma^2_{k,t} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1 \varepsilon^2_{k,t-1} + \alpha_2 \sigma^2_{k,t-1} + u_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2
EXSRFR *(GARCH-M)*	Jan:88 Dec:98	132	7.09E-03	-8.30E-03	0.024859 [.888]	-0.077298 [.475]	0.039602 [.766]	0.191986 [.576]	0.280765** [.000]	0.359243+ [.067]	0.129898 [.397]
EXSRFR *(GARCH)*			5.04E-03	-0.010383	0.112123 [.130]	-0.078129 [.479]	0.055647 [.628]		0.28757** [.000]	0.360624** [.030]	0.100847 [.398]
EXSRFR *(OLS)*			5.29E-03	-0.01013	0.103195 [.295]	-0.098843 [.453]	0.039531 [.774]				
EXSRJA *(GARCH-M)*	Nov:82 Dec:98	194	0.01754	7.26E-03	-0.010695 [.959]	0.016403 [.872]	-0.184212 [.359]	0.178399 [.642]	0.090604 [.217]	0.161544+ [.055]	0.671838** [.000]
EXSRJA *(GARCH)*			0.01265	2.31E-03	0.076706 [.187]	9.00E-03 [.926]	-0.162175 [.379]		7.89E-02 [.243]	0.158976+ [.069]	0.702626** [.000]
EXSRJA *(OLS)*			0.01352	3.19E-03	0.06381 [.337]	-0.034808 [.770]	-0.233526 [.160]				

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 7(cont'd):Results from the OLS, GARCH(1,1) and GARCH-M(1,1) for Excess Stock Returns.

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma^2_{k,t} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1 \varepsilon^2_{k,t-1} + \alpha_2 \sigma^2_{k,t-1} + u_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2
EXSRGE *(GARCH-M)*	Feb:75 Dec:98	287	0.02422	0.017352	0.128793 [.160]	-0.15245* [.022]	-0.109928+ [.068]	6.13E-03 [.977]	0.011401 [.284]	0.091325* [.040]	0.883929** [.000]
EXSRGE *(GARCH)*			0.0243	0.01743	0.131232* [.016]	-0.153377* [.012]	-0.110781+ [.064]		9.86E-03 [.413]	0.090396* [.024]	0.890921** [.000]
EXSRGE *(OLS)*			0.02506	0.018196	0.15078* [.004]	-0.17193* [.031]	-0.071575 [.375]				
EXSRUK *(GARCH-M)*	May:86 Dec:98	152	0.01817	4.99E-03	0.141376+ [.086]	-0.310856* [.027]	0.274756* [.066]	-0.10695 [.481]	0.122435 [.270]	0.596388+ [.064]	0.283099 [.338]
EXSRUK *(GARCH)*			0.02523	0.012147	0.07323 [.193]	-0.147225 [.372]	0.071536 [.702]		7.83E-03 [.309]	0.05167 [.792]	0.923011** [.000]
EXSRUK *(OLS)*			0.02544	0.012356	0.079866 [.274]	-0.242537+ [.051]	0.136408 [.261]				

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 7A:Results from the OLS, GARCH(1,1) and GARCH-M(1,1) when Returns are Compounded Continuously.

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2
EXSRFR *GARCH-M)*	Jan:88 Dec:98	132	7.36E-03	-8.03E-03	0.023947 [.902]	-0.083866 [.435]	0.056991 [.666]	0.146028 [.707]	0.289654** [.000]	0.339139⁺ [.056]	0.117452 [.424]
EXSRFR *(GARCH)*			5.47E-03	-9.95E-03	0.089764 [.224]	-0.083791 [.444]	0.068146 [.558]		0.294052** [.000]	0.33632* [.023]	0.096011 [.442]
EXSRFR *(OLS)*			5.90E-03	-9.51E-03	0.081408 [.404]	-0.103259 [.429]	0.041919 [.759]				
EXSRGE *GARCH-M)*	Feb:75 Dec:98	287	0.023889	1.70E-02	0.123008 [.138]	-0.15397* [.020]	-0.105531⁺ [.088]	-2.92E-02 [.876]	0.010827 [.245]	0.090203* [.029]	0.887038** [.000]
EXSRGE *(GARCH)*			0.023463	1.66E-02	0.112939** [.041]	-0.152395* [.014]	-0.106878⁺ [.076]		8.81E-03 [.423]	0.091901* [.018]	0.894193** [.000]
EXSRGE *(OLS)*			0.013523	3.19E-03	0.132418** [.011]	-0.174852** [.029]	-0.064876 [.425]				

P values in brackets ** Significant at 1% * Significant at 5% ⁺ Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan,

APPENDIX 8:Results from the OLS, GARCH(2,2) and GARCH-M(2,1) for Excess Stock Returns

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma^2_{k,t} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1 \varepsilon^2_{k,t-1} + \alpha_2 \varepsilon^2_{k,t-2} + \alpha_3 \sigma^2_{k,t-1} + \alpha_4 \sigma^2_{k,t-2} + \upsilon_{k,t}$$

Dependant Variable	Time period	ample siz	R^2	Adj R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2	α_3	α_4
EXSRGE	Feb:75 Dec:98	287	0.027721	0.020874	0.179218* [.040]	-0.165406* [.045]	-0.1121 [.189]	-0.1036 [.634]	0.02056 [.149]	.140079* [.014]		0.137179 [.530]	0.675384** [.002]
EXSRJA	Jan:82 Dec:98	194	0.021484	0.011238	-0.01263 [.948]	0.012244 [.905]	-0.254 [.269]	0.20541 [.553]	0.14419 [.217]	0.08801 [.412]	0.15172 [.174]	0.495636+ [.054]	
			0.017644	7.36E-03	0.062705 [.821]	5.39E-04 [.996]	-0.2702 [.339]	0.07564 [.875]	0.15865 [.253]	0.06449 [.657]	0.22734 [.241]	0.162167 [.771]	0.256641 [.516]

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 9: Results from the OLS, GARCH(1,1) and GARCH-M (1,1) for Excess Stock Returns for 1988:1-1998:12

Dependant Variable	Time period	Sample siz	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2	α_3
EXSRFR *(GARCH-M)*	Jan:88 Dec:98	132	7.09E-03	-8.30E-03	0.024859 [.888]	-0.077298 [.475]	0.039602 [.766]	0.191986 [.576]	0.280765** [.000]	0.359243+ [.067]		0.129898 [.397]
EXSRFR *(GARCH)*			5.04E-03	-0.010383	0.112123 [.130]	-0.078129 [.479]	0.055647 [.628]		0.28757** [.000]	0.360624* [.030]		0.100847 [.398]
EXSRFR *(OLS)*			5.29E-03	-0.01013	0.103195 [.295]	-0.098843 [.453]	0.039531 [.774]					
EXSRJA *(GARCH-M)*	Jan:88 Dec:98	132	0.063501	0.048982	-0.743053 [.172]	0.262492* [.030]	-0.449165+ [.100]	1.20028 [.213]	0.326033 [.203]	0.167029+ [.085]	0.199965+ [.091]	0.12028 [.823]
EXSRJA *(GARCH)*			-3.69E-03	2.08583	-0.081946 [.408]	0.232273+ [.067]	-2.08E-01 [.296]		0.165555 [.452]	0.152279 [.262]	9.43E-02 [.627]	0.503599 [.268]
EXSRJA *(OLS)*			0.014344	-9.37E-04	-0.056979 [.547]	0.136237 [.371]	-0.237732 [.208]					

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 9 (cont'd): Results from the OLS, GARCH(1,1) and GARCH-M (1,1) for excess stock returns for 1988:1-1998:12

Dependant Variable	Time period	Sample siz	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2	α_3
EXSRGE (GARCH-M)	Jan:88 Dec:98	132	0.069019	0.054585	0.816423 [.240]	-0.091914 [.409]	-0.116135 [.319]	-1.46E+00 [.392]	0.374852** [.000]	0.126212 [.276]		
EXSRGE (GARCH)			0.017292	2.06E-03	0.218432** [.007]	-0.092793 [.408]	-0.142486 [.184]		0.363809** [.000]	0.180586 [.110]		
EXSRGE (OLS)			0.017502	2.27E-03	0.193474* [.024]	-0.072497 [.558]	-0.153142 [.227]					2.66E-06 [1.00]
EXSRUK (GARCH-M)	Jan:88 Dec:98	132	0.011355	-3.97E-03	-0.01518 [.960]	2.88E-03 [.981]	-0.067025 [.663]	0.416232 [.733]	0.177802 [.555]	0.12617 [.600]	0.160349 [.651]	0.047548 [.974]
EXSRUK (GARCH)		132	2.48E-03	-0.012988	0.059647 [.279]	0.085471 [.654]	-0.109141 [.555]		1.59E-02 [.490]	0.023388 [.865]	0.196797 [.406]	0.747707** [.000]
EXSRUK (OLS)		132	9.40E-03	-5.96E-03	0.082593 [.195]	-0.022008 [.843]	-0.08526 [.438]					

p values in brackets ** Significant at 1% * Significant at 5% ' Significant at 10%

EXSRFR, EXSRJA, EXSRGE and EXSRUK mean the excess stock returns for France, Japan, Germany and the United Kingdom.

APPENDIX 10A: Volatility Spillover from U.S.

$$EXSR_{k,t} = \beta_0 + \beta_{k,1} DIR_{us,t} + \beta_{k,2} DIR_{k,t} + \beta_{k,3}\sigma^2_{k,t} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1\varepsilon^2_{k,t-1} + \alpha_2\sigma^2_{k,t-1} + \phi\varepsilon^2_{us,t} + u_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_0	α_1	ϕ
EXSRUS	Jan:88 Dec:98	132	0.020849	0.020849	-8.16E-04 [.994]			0.461839 [.486]	9.05E-03 [.181]	0.085963* [.004]	0.874481** [.000]	
EXSRFR	Jan:88 Dec:98	132	0.007	-0.009	1.31E-01 [.184]	-0.094129 [.336]	1.05E-01 [.284]	-0.011265 [.952]	0.157834** [.001]	0.314134 [.156]	0.087014 [.534]	0.861615** [.002]
EXSRFR	Jan:88 Dec:98	132	5.29E-03	-0.01013	0.103195 [.295]	-0.098843 [.453]	0.039531 [.774]					
EXSRUS	Feb:75 Dec-98	287	2.47E-03	2.47E-03	-2.90E-02 [.922]			0.288056 [.807]	1.38E-02 [.559]	0.042787 [.430]	0.907768** [.000]	
EXSRGE	Feb:75 Dec-98	287	0.177137	0.171342	0.33361* [.011]	-0.1202+ [.060]	-7.40E-02 [.233]	-0.55469 [.210]	0.174007* [.000]	0.129708 [.180]	0.014231 [.917]	0.495505+ [.054]
EXSRGE	Feb:75 Dec-98	287	0.025062	0.018196	0.15078** [.004]	-0.17193* [.031]	-0.071575 [.375]					

$\varepsilon^2_{us,t}$ is calculated from the following GARCH-M model:

$$EXSR_{us,t} = \beta_{us,0} + \beta_3\sigma^2_{k,t} + \varepsilon_{us,t}$$

$$\sigma^2_{us,t} = \alpha_{us,0} + \alpha_{us,1}\varepsilon^2_{us,t-1} + \alpha_{us,2}\sigma^2_{k,t-1} + u_{k,t}$$

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

APPENDIX 10A (cont'd): Volatility Spillover from U.S.

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_0	α_1	ϕ
EXSRUS	Nov:82 Dec:98	194	1.60E-03	1.60E-03	0.052725 [.507]			0.06316 [.870]	8.92E-03 [.194]	0.069915* [.004]	0.897989** [.000]	
EXSRJA	Nov:82 Dec:98	194	0.026785	0.016595	0.184917* [.028]	0.015093 [.864]	-1.14E-01 [.481]	-0.170983 [.386]	0.085349 [.254]	0.281223* [.021]	0.422324* [.011]	0.37259⁺ [.087]
EXSRJA	Nov:82 Dec:98	194	0.013523	3.19E-03	0.06381 [.337]	-0.034808 [.770]	-0.233526 [.160]					
EXSRUS	May:86 Dec:98	152	2.62E-04	2.62E-04	7.34E-02 [.260]			-0.036682 [.875]	3.16E-03 [.308]	0.084827* [.000]	0.911696** [.000]	
EXSRUK	May:86 Dec:98	152	0.123047	0.111276	1.31E-01 [.104]	-0.096766 [.324]	9.47E-03 [.925]	-0.132857 [.650]	0.129893** [.000]	0.024581 [.436]		0.732986** [.000]
EXSRUK	May:86 Dec:98	152	0.025438	0.012356	0.079866 [.274]	-0.242537⁺ [.051]	0.136408 [.261]					

p values in brackets ** Significant at 1% * Significant at 5% ⁺ Significant at 10%

$$EXSR_{k,t} = \beta_0 + \beta_{k,1} DIR_{us,t} + \beta_{k,2} DIR_{k,t} + \beta_{k,3}\sigma^2_{k,t} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1\varepsilon^2_{k,t-1} + \alpha_2\sigma^2_{k,t-1} + \phi\varepsilon^2_{fr,t} + \upsilon_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_0	α_1	ϕ
EXSRFR,t	Jan-88 : Dec-98	132	4.21E-03	4.21E-03	-9.08E-03 [.960]			0.213489 [.530]	0.279714** [.000]	0.352536* [.059]	0.138643 [.387]	
EXSRGE,t	Jan-88 : Dec-98	132	0.053	0.039	0.272228** [.001]	-0.028668 [.777]	-0.115893 [.172]	-0.260272 [.185]	0.089364** [.004]	0.10454 [.341]		0.574831** [.000]
EXSRFR,t	Jan-88 : Dec-98	132	4.21E-03	4.21E-03	-9.08E-03 [.960]			0.213489 [.530]	0.279714** [.000]	0.352536* [.059]	0.138643 [.387]	
EXSRJA,t	Jan-88 : Dec-98	132	1.46E-02	-7.28E-04	4.15E-02 [.847]	0.17781 [.148]	-0.090087 [.559]	-0.180286 [.646]	0.239612 [.268]	0.1877 [.291]	0.194887 [.525]	0.315201+ [.085]
EXSRFR,t	Jan-88 : Dec-98	132	4.21E-03	4.21E-03	-9.08E-03 [.960]			0.213489 [.530]	0.279714** [.000]	0.352536* [.059]	0.138643 [.387]	
EXSRUS,t	Jan-88 : Dec-98	132	0.014017	-1.27E-03	0.208663* [.038]	-0.011899 [.874]	6.14E-03 [.937]	-0.514378 [.347]	0.093128** [.003]	0.066105 [.687]		0.18069** [.002]

p values in brackets ** Significant at 1% * Significant at 5% + Significant at 10%

$\varepsilon^2_{fr,t}$ is obtained from the GARCH-M model similar to the one described for the U.S. data in the footnote of Appendix 10A.

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma^2_{k,t-1} + \varepsilon_{k,t}$$

$$\sigma^2_{k,t} = \alpha_0 + \alpha_1 \varepsilon^2_{k,t-} + \alpha_2 \varepsilon^2_{k,t-2} + \alpha_3 \sigma^2_{k,t-1} + \phi \varepsilon^2_{ja,t} + \upsilon_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	α_2	α_3	α_4	ϕ
EXSRJA,t	Jan-88 : Dec-98	132	1.64E-02	1.64E-02	-0.324193 [.541]			0.522998 [.534]	0.252611 [.159]	0.138357 [.128]	0.134175 [.255]	0.290866 [.456]	0.054579 [.894]	
EXSRFR,t	Jan-88 : Dec-98	132	0.009	-0.006	0.160025 [.318]	-0.134407 [.219]	0.093367 [.367]	-0.04462 [.890]	0.179635* [.027]	0.356718 [.107]	8.43E-03 [.954]	0.095316 [.704]		0.179229* [.030]
EXSRJA,t	Nov-82 : Dec-98	194	2.03E-03	2.03E-03	7.58E-03 [.960]			0.11908 [.669]	0.141553 [.380]	0.125831 [.196]	0.117224 [.408]	0.501527 [.209]		
EXSRGE,t	Nov-82 : Dec-98	194	1.34E-01	1.25E-01	0.694455** [.000]	-0.155034 [.090]	-0.035286 [.672]	-1.25492** [.007]	0.198639** [.000]	0.0806* [.045]	1.28E-02 [.751]	0.155132 [.179]		0.21168* [.016]
EXSRGE,t	Nov-82 : Dec-98	194	0.021608	0.011363	0.186695** [.006]	-0.205655' [.063]	-0.035833 [.748]							
EXSRJA,t	May-86 : Dec-98	152	9.46E-03	9.46E-03	-2.37E-01 [.583]			0.438553 [.529]	0.226491 [.111]	0.112648 [.155]	0.123958 [.291]	0.346036 [.477]	5.21E-02 [.898]	
EXSRUK,t	May-86 : Dec-98	152	0.048791	0.036023	0.154588' [.055]	-0.184768 [.165]	0.082217 [.555]	-0.113645 [.636]	0.113132** [.009]	0.083094 [.371]		4.14E-02 [.486]		0.444509* [.025]
EXSRJA,t	Nov-82 : Dec-98	194	2.03E-03	2.03E-03	7.58E-03 [.960]			0.11908 [.669]	0.141553 [.380]	0.125831 [.196]	0.117224 [.408]	0.501527 [.209]		
EXSRUS,t	Nov-82 : Dec-98	194	0.066291	5.65E-02	0.269402** [.000]	-0.09927 [.137]	-0.017146 [.847]	-0.607296' [.059]	0.128906** [.000]	0.047511 [.169]				0.185722* [.021]

p values in brackets ** Significant at 1 * Significant at 5% ' Significant at 10%

α_3 Coefficient associated with the second lag value of the error term in the conditional heteroskedastic Japanese variance

α_4 Coefficient associated with the second lag value of the variance in the conditional heteroskedastic Japanese variance.

APPENDIX 10B (cont'd): Volatility transmission from Germany

$$EXSR_{k,t} = \beta_0 + \beta_1 DIR_{us,t} + \beta_2 DIR_{k,t} + \beta_3 \sigma^2_{k,t-1} + \varepsilon_{k,t}$$
$$\sigma^2_{k,t} = \alpha_0 + \alpha_1 \varepsilon^2_{k,t-} + \alpha_2 \varepsilon^2_{k,t-2} + \alpha_3 \sigma^2_{k,t-1} + \phi \varepsilon^2_{ge,t} + \upsilon_{k,t}$$

Dependant Variable	Time period	Sample size	R^2	Adjust R^2	β_0	β_1	β_2	β_3	α_0	α_1	ϕ
EXSRGE,t	Jan:88 Dec:98	132	6.49E-02	6.49E-02	1.38164 [.482]			-2.96465 [.510]	0.399566** [.000]	0.072279 [.438]	
EXSRFR	Jan:88 Dec:98	132	0.003	-0.013	0.019882 [.802]	-0.119457 [.166]	0.150403* [.099]	0.195417* [.029]	0.114783** [.000]	0.161767* [.013]	0.854739** [.000]
EXSRFR	Jan:88 Dec:98	132	5.29E-03	-0.01013	0.103195 [.295]	-0.098843 [.453]	0.039531 [.774]				
EXSRGE,t	Nov:82 Dec:98	194	6.97E-02	6.97E-02	8.93843 [.929]			-19.2505 [.930]	0.453655** [.000]	0.011419 [.928]	
EXSRJA,t	Nov:82 Dec:98	194	1.48E-02	4.44E-03	0.197388** [.010]	9.30E-03 [.910]	-0.24776 [.161]	-0.14171 [.335]	0.082514 [.186]	0.074478 [.565]	0.289658* [.027]

p values in brackets ** Significant at 1* Significant at 5% + Significant at 10%

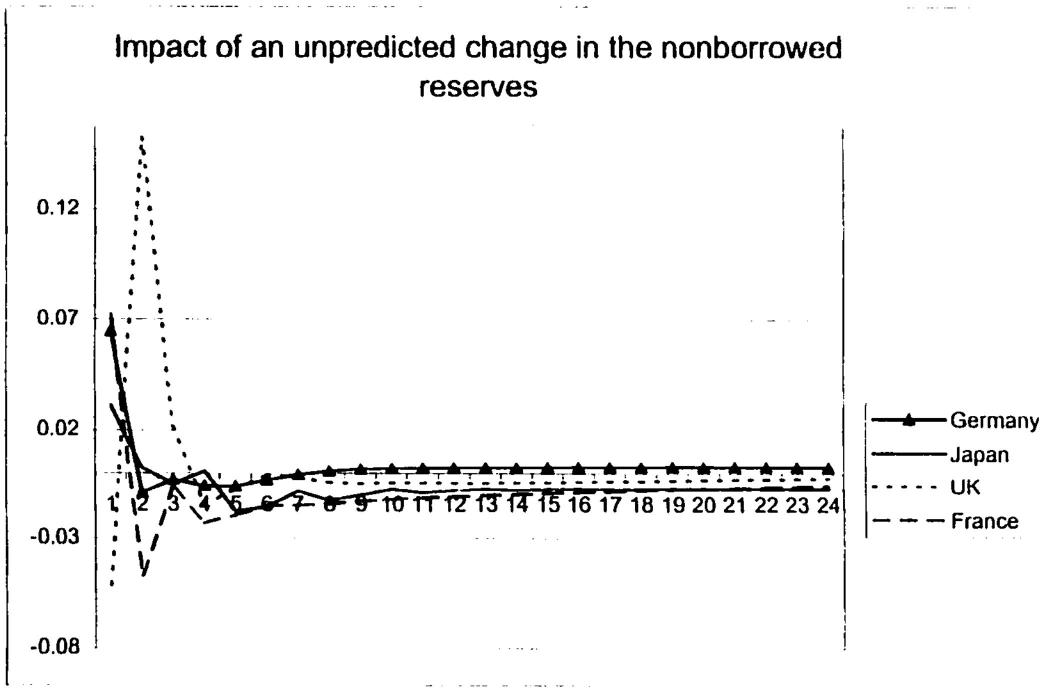
$\varepsilon^2_{ge,t}$ is obtained from the GARCH-M model similar to the one described for the U.S. data in the footnote of Appendix 10A.

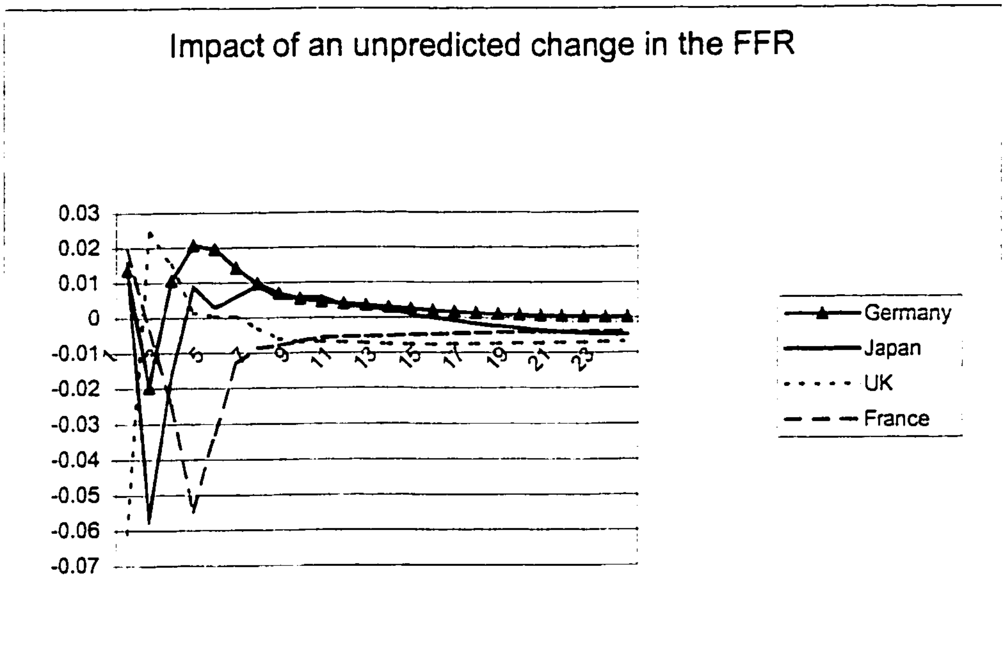
APPENDIX 11

Coefficients of the Impulse Function One Month after a Shock in the Nonborrowed Reserves and in the Interest Rate

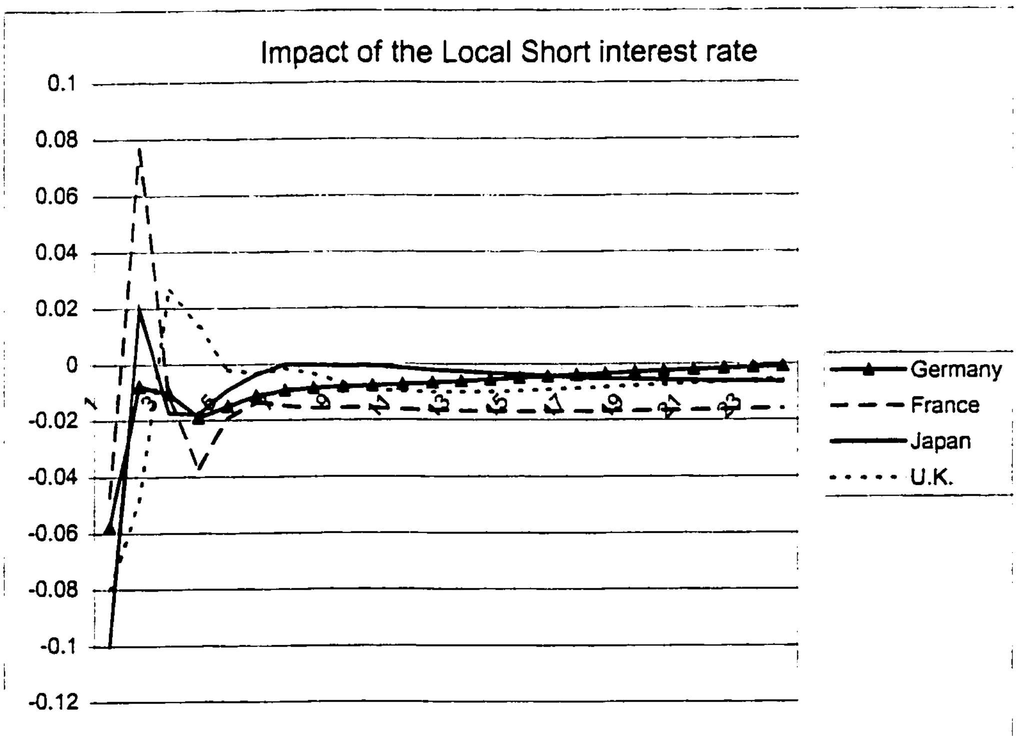
	Interest rate		Nonborrowed reserves
	U.S.	Domestic	U.S.
France	0.019575	-0.04717	0.072343
Germany	0.013604	-0.05791	0.064886
Japan	0.015813	-0.09999	0.031208
U.K	-0.06076	-0.07996	-0.051036

APPENDIX 11A: PLOTS OF THE IMPULSE RESPONSE FUNCTION





Impact of an unpredicted change in the FFR
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
Germany
Japan
UK
France



Impact of the Local Short interest rate
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
Germany
France
Japan
U.K.

APPENDIX 12: Repartition of the 24 Month Forecast Error Variance.

	F block test	Adj R^2	Stdev	GMA_{us}	$INFL_{us}$	LNBRE	FFR	GMA_k	$INFL_k$	$SHINT_k$	$EXSR_k$	Total
France	1.07463 [.388]	-2.13E-03	0.7363	2.767	5.113	1.923	1.058	0.861	2.690	2.770	82.816	100
Germany	1.06306 [.392]	-2.09E-03	0.6469	0.443	1.605	1.081	0.463	1.265	0.841	1.149	93.152	100
Japan	1.51411 [.110]	0.029361	0.7738	0.347	4.668	0.466	0.709	1.004	2.738	1.910	88.157	100
U.K.	1.62333 [.081]	0.061416	0.6791	5.690	2.886	5.926	1.169	0.834	0.410	2.336	80.749	100

	Monetary U.S.	Monetary Local	Monetary total	Total
France	10.862	6.322	17.184	100
Germany	3.593	3.255	6.848	100
Japan	6.192	5.652	11.843	100
U.K.	15.671	3.580	19.251	100