<u>ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ</u>

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Θέμα : Financial variables and real economic activity- Empirical evidence from G7 and EU-15 countries

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Contents

<u>Introduction</u>

The purpose of this thesis is to examine the ability and the degree up to which a number of financial variables can predict the level of future economic activity. The variables that are going to be examined concerning their predictive power are stock market returns, their volatility, term structure of interest rates as well as inflation. As measures of the real economic activity we are going to use the Real Gdp per capita and in some cases the percentage change in industrial production index.

Our main target is to define the existence and then the direction of the dependence between finance and economics. In the first part of this thesis we will try to give a theoretical explanation concerning how financial variables can predict economic activity. At that point, there will be an extended presentation of relative to our subject researches (published in various journals) which will help us in our theoretical approach. The rest of the thesis is organized as follows:

The second part describes the data and the econometric methods. For the conduction of our research, we will use the Vector Autoregressive model and then we will move on to the variance decomposition and impulse response analysis in order to identify relationships between the variables under investigation. VAR model is used very often for the prediction of systems with interrelated time series and for the analysis of the shocks' behavior over the system of variables.

This empirical research is going to be conducted for the EU-15 as well as the G-7 countries. The third part summarizes our main conclusions and provides the statistical tables of our econometric tests.

The relationship between stock market returns and real economic activity

A theoretical approach

It is a common fact that any changes in the macroeconomic variables of an economy have a direct and quick impact on the Stock Market returns. Let's take for example the decision of a central Bank to raise the domestic Interest rates as a policy against the existing inflation. This action will have a direct and quick impact on the Stock Market's returns as the Investors will prefer now to invest in T-bonds and certificates of deposits which offer higher yields than before rather than to invest in the Stock Market. The explanation is very simple: When the risk free Interest rate rise, an investor demands a higher return from the Stock Market than before so as to invest in it. Taking into account the fact that the return and the risk are positively correlated, it means that the higher the return that an Investor demands, the higher the risk that he is going to undertake. The increase of the possibility for an investor to lose his money by taking higher risk, forces him to prefer safer investments such as Government Bonds and certificates of deposit. This action leads to the decline of the stock returns. The opposite occurs when the risk free interest rate falls.

Although the Stock Market reacts quickly in any announcement as far as the potential changes in the macroeconomic variables is concerned, (such as a change in the interest rates, a scenario that has been analyzed above, or a change in CPI or in real GNP e.t.c) by pushing the stock prices up or down, it is not very clear if the stock market returns have an impact on the real economic activity giving us the opportunity to predict the future economic activity by analyzing the current information included in the stock returns.

The basic conception that prevails and proves to be true from the empirical research is that stock returns can explain an important part of the real economic activity. The theory which supports this perception is based on the DCF model. According to this model, stock prices should reflect the investors' expectations as far as the future dividends and corporate earnings are concerned. Taking into account the fact that the growth rate of dividends and corporate earnings is positively influenced by the growth rate of GNP, current stock prices should include useful information for the future economic activity measured by GDP or Industrial production.

In this chapter we are going to define the main transmission channels established by economic theory through which stock price movements may influence economic developments. Having defined in a theoretical level the existence of the relationship between stock market returns and real economic activity, in the second part of the dissertation we are going to examine if theory can be verified by the empirical results for a variety countries identifing how intense this relationship is, taking into account the specific characteristics of each economy's Stock Market. (Market Capitalization e.t.c)

The first channel through which stock price movements may have a direct impact on real economic activity is the private Investment and Consumption channel. It is well known that the total output of a country produced in a year, equals to the total consumption, plus the total investments (domestic and foreign), the government expenditures and the net Exports that are produced through the same year. $Y = C + I + G + NX$. According to this equation, an increase either in Consumption, Investment, Capital Expenditures or net Exports will lead to the rise of the total Product. It means that, if Stock Market movements have a direct impact on private Consumption and Investment they will also have an indirect impact on real economic activity.

In Theory, stock price movements may have direct effects on private Investment and Consumption (as mentioned before) through three main channels: The q channel on Private Investment, the balance Sheet Channel and Consumption wealth channel. The first channel was developed by Tobin[1]. The q-ratio is the ratio of the stock price to the replacement cost of capital. When Stock prices are higher than the replacement cost of capital it is profitable for the company to expand its capital stock by issuing new shares rather than by purchasing other companies' shares which are already negotiated in the Stock Exchange. In other words, when an additional unit of capital is worth more than the replacement cost of Capital, the company can increase its profitability by investing. An increase in investing spending leads to the increase in aggregate demand and aggregate output.

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[1] Tobin (1961), Brainard and Tobin (1968)

The second channel, through which stock returns have a direct impact on Private Investment and consumption and thus an indirect impact on real economic activity, is the balance-sheet channel. This channel influences not only the investment decisions of the listed companies but also the decisions of all the companies holding Stocks in their portfolio. One of the factors that affect the companies' ability to borrow money is the value of the collateral they can provide. As stock prices increase, the value of collateral of companies holding stocks increases, enhancing their access to external funding for their investments. On the other hand, when stock prices decline, the value of their collateral decreases forcing them to cut off their Investment projects, due to the limited access to external financing. The Balance Sheet channel, affects not only the borrowers but also the lenders. More specifically, the change of stock returns may have a great impact on both the lending behavior of banks and the consumption of households.

When Stock prices decline, the value of the portfolio (consisting of stocks) that a company holds, declines too. Taking into account, the fact that the companies' holdings on other listed companies appear on the left side of their Balance Sheets, a decline in the stock market will lead to the decrease of their assets' value with a great impact on their creditworthiness. For a Financial institution, this practically means that, when stock prices fall it should be forced to reduce lending because of the increase in regulatory capital that it needs so as to be protected by the augmentative credit risk due to the decline of the companies' net worth (Total Assets – Total Liabilities) in which a Financial Institution has borrowed funds. With profits and cash flows falling as a result thereof, a company's ability to finance investment spending by internal funds may worsen as well, starting a self enhancing process.

Stock Market returns may also influence the Households' consumption in a similar way as in the case of companies. The balance sheet effects might result in reduced consumption, if falling stock prices reduce the value of the collateral deteriorating households' ability to raise new loans. Moreover, the weakening of households to raise money is positively correlated with a decline in liquidity, leading consumers (in the fear of a depression) to postpone purchases of durable goods.

The third channel is the consumption wealth channel. If a consumer possesses a portfolio of stocks, a rise in stock prices (and thus in stock returns) implies an increase in his financial wealth. This will lead him to higher levels of consumption, stimulating aggregate demand and total output.

Another explanation that could be given for the relationship between current Stock Market returns and future real economic activity has to do with the investors' expectations for the future real activity, which are derived from the analysis of the information that are depicted on the current level of Stock Prices. In general, the most well Known theories which are based on expectations are the following:[2]

- From the moment that Stock prices reflect the present value of all future dividends and growth is related to GDP growth, a correlation between this year's stock returns and next year's economic growth arises naturally.
- Stock Market prices provide managers with information of the future economic developments. Managers base their investment decisions upon that information, thereby justifying the market's expectations. In this case, stock price changes turn out to be perfectly correlated with fundamentals.
- Managers' decisions about investment are influenced by stock price movements but managers cannot distinguish between movements reflecting fundamentals and those reflecting market 'sentiment'. Stock market movements that are not motivated by fundamentals can therefore mislead managers into over investing or underinvesting compared with what later turns out to be warranted by fundamentals.

[2] All the following theories have been reviewed by Morck et. Al. (1990)

Review of Bibliography

Eugene F. Fama with his article 'Stock Returns, Expected returns and Real activity' that was published in the Journal of Finance (September 1990) made the following argument: Due to the fact that stock prices reflect expected future cash flows, stock price changes predict future macro conditions. In his article he says that measuring the total variation explained by shocks to expected cash flows, time varying expected returns and shocks to expected returns is one way to judge the rationality of stock returns. This study was made for the New York Stock Exchange for the period starting from 1953 until 1987 and according to the econometric tests that are used to control for variations in stock returns as reflected in dividend yields on stocks, default spreads on corporate bonds and term spread son bonds, a large proportion of the variation of stock returns can be explained primarily by time varying expected returns and forecasts of real activity. Fama used monthly, quarterly and annual data for the stock returns and found that the degree of correlation increases with the length of the holding period.

The same year William Schwert published an article with the title 'Stock Returns and Real activity: A century of Evidence'. In this paper he analyzes the relationship between Stock returns and real activity as far as the United States is concerned for a period of time much larger than that which was analyzed by Fama, starting form 1889 until 1988. In his analysis he uses two measures of industrial production in the tests. The first measure is the series produced by Babson from 1889-1918, spliced with the Federal Reserve Board Index of industrial production from 1919-1988 and the second measure is the new Miron and Romer (1989) index spliced with the Federal Reserve Board index in 1941. According to Schwert the Fama's findings are more evident for this longer period. That leads to the conclusion that future production growth rates explain a large proportion of the variation of stock returns. Robert J. Barro(1990) investigates the relationship between Stock returns and real economic activity through the q-ratio channel. His findings differ, comparing to the previous empirical results mostly in the case of the United States. Concerning the United States, the lagged stock returns had a significant forecasting power over the future Investment growth, taking into account the fact that they managed to predict eight out of nine periods which were characterized as recession periods. It is worth to mention that stock markets failed when predicted three recessions that never happened.

Later on, in 1997 Yin-Wong Cheung and Lilian K. Ng in their article titled 'International Evidence on Stock Market and aggregate economic activity' which was accepted for publishing by the Journal of Empirical Finance found empirical evidence of long run comovements between five stock indices and the level of real economic activity measured by the real oil price, real consumption, real money and real output. In their study they obtained quarterly stock index and macroeconomic data for Canada, Germany, Italy Japan and United States made available by the International Finacial Statistics data tape and Citibase.

Using the cointegration technique so as to examine the above empirical relationship, they came to the following conclusion: 'Real Stock Market indices are typically cointegrated with measures of the countries' aggregate real activity such as the real oil price, real consumption, real money stock and real output.'

Paolo Mauro moved a step further when he studied the correlation between output growth and lagged stock returns in a panel of emerging and advanced economies.(Stock Returns and output growth in emerging and advanced economies, Journal of Development economics 2001). In his study, he found that the degree of significance as far as the correlation between the lagged stock returns and real economic activity is concerned, is the same on both the emerging and the advanced economies using annual date and a bit lower using quarterly data. Besides that, he found that the strength of this correlation depends on a number of stock market characteristics such as the ratio of Market capitalization to GDP, the number of listed companies and initial public offerings (IPO's) and the origin of Stock Market's framework. Mauro used annual data of real stock returns and real GDP growth for at least 22 years for 17 advanced countries (including the G-7 countries, Spain, Singapore, Belgium, Spain, Sweeden and many more) and 8 emerging countries.(Argentina, Chile, Greece, India ,Korea, Mexico, Thailand, Zimbabwe) and quarterly data for at least 10 years for 6 emerging and 18 advanced countries. In order to test whether the association between output growth and lagged stock returns is the same for both, advanced and emerging countries he used individual country regressions and panel regressions.

Jongmoo Jay Choi, Shmuel Hauser and Keneth Kopecky (1999) examine the relationship between Industrial production (IP) growth rates and lagged real stock returns for the G-7 countries using both in sample cointegration and error correction models and the out of sample forecast procedure proposed by Ashley . Running the cointegration tests they find a long-run relationship between the log levels of Industrial production and real stock returns while the error-correction models indicate a correlation between IP growth and lagged real stock returns for all countries except Italy. The out of sample analysis reveals that in several sub-periods the US, UK, Japanese and Canadian stock markets enhance predictions of future IP.

Mathias Binswanger in his article 'Stock returns and real activity in the G-7 countries: did the relationship change during the 1980's?' examines the repetitiveness of the relationship between lagged stock returns and real economic activity. In one of his previous articles (International Review of Economics and Finance, 2000) indicated that this traditionally strong relation has disappeared in the United States in the early 1980's. In this paper, he comes to the same conclusion for the Stock Markets of Canada, Japan and in an aggregate economy consisting of the four European G-7 countries.(UK, France, Germany, Italy) According to Binswanger his results provide evidence in favor of the hypothesis that speculative bubbles during the 1980s and 1990s were an international phenomenon which was occurred not only in the United States. With the term 'Speculative Bubbles' we mean that stock returns during 1980s did not reflect the companies' fundamentals (dividend yields, growth rates e.t.c) and their abnormal returns occurred due to Investors' speculative actions. Binswanger found that since 1980 stock markets do not lead real economic activity as regressions fail to establish any significant relationship between stock returns and real economic activity.

Stock and Watson[3] focus exclusively on forecasts of output and Inflation using quarterly data on as many as 43 financial variables (such as interest rates, exchange rates, the term structure of Interest rates, stock prices e.t.c) from each of the G-7 countries over 1959-99. In order to identify the variables that can be used as predictors of output and Inflation they use an in sample autoregressive distributed lag (ADL) model and out of sample forecast procedure. Specifically, as far as the out of sample analysis is concerned, Stock and Watson quantify the out of sample forecast performance by computing the mean squared forecast error of a candidate forecast relative to a benchmark. As a candidate forecast they use the following univariate regression: $Y_t = \alpha_0 + \sum_{i=1}^{m} a_i Y_{t-i} + e_{1t}$ while as benchmark forecast they use the following bivariate model: $Y_t = b_0 + \sum_{i=1}^{m} b_i Y_{t-i} + \sum_{j=1}^{n} C_j S_{t-j} + e_{2t}$. Then, an h-step ahead mean squared forecast error of

[3] Forecasting Output and Inflation: The role of asset prices- Journal of Economic literature

forecast i relative to that of the benchmark is: $\dfrac{\dfrac{1}{T_2 - T_1 - h + 1}\sum_{t=T_1}^{T_2-h}(Y_{t+h}^h - \hat{Y}_{i,t+h/t})^2}{\dfrac{1}{T_2 - T_1 - h + 1}\sum_{t=T_1}^{T_2-h}(Y_{t+h}^h - \hat{Y}_{0,t+h/t})^2}$ If this fraction is less than one then the candidate forecast is estimated to have performed better than the benchmark.

Through the in sample and out of sample analysis of the data they were lead to four main conclusions:

1) Some asset prices have been useful predictors of Inflation and/or output growth in some countries in some time periods. They found that the term structure of Interest rates was a good predictor of output growth for the United States and Germany prior to the mid-1980s. Although term structure was a good predictor for those two countries, its good performance was offset by poor performance in other periods and countries.
2) There is a considerable instability in bivariate and trivariate predictive relations involving asset prices and other predictors.
3) In sample Granger causality tests provide a poor guide to forecast performance. Stock and Watson come to the conclusion that testing for Granger noncausality is uninformative for assessing predictive content .
4) Simple combination forecasts reliably improve upon the AR benchmark and forecasts based on individual predictors.

Christis Hassapis(2003) uses data from the Canadian and U.S market so as to investigate the relationship between Financial Market Variables and Canadian output growth. As Financial variables he uses real stock price changes, interest rates, interest rate spreads and monetary aggregates for Canada and United States. The data are monthly and cover the period from January 1966 to September 2000. As a measure of growth rate he uses the Industrial production Index seasonally adjusted. The writer adopts a non parametric technique proposed by Andrews (1991)[4] confirming the theoretical explanations and empirical evidence provided by former parametric studies, on the relationships between the financial variables and output.

[4] For more details about non parametric techniques we send the readers to the book of Ruey S. Tsay ‘Analysis of Financial Time series chapter 4’

The relationship between Stock Market Volatility and real economic activity

The basic concept of this section is the predictive power of stock Market fluctuations. We will try to prove in a theoretical way, why Stock Market Volatility can help in the prediction of future economic activity. The basic transmission channels which have the power to explain the above relationship are the following:

1) The DCF Model

We have analyzed in the previous section that according to the DCF model, the current Stock Price equals to the discounted Value of the expected Capital and dividend gains. $E_t P_t = E_t \Sigma_{K=1}^{\infty} \frac{D_{t+k}}{[1+R_{t+k}]^k}$ (1). If discount rates are constant in equation (1), the conditional variance of stock prices is proportional to the conditional variance of the expected future cash flows. Thus, it is plausible that a change in the level of uncertainty about future macroeconomic conditions would cause a proportional change in stock return volatility at time t. This is a rational channel through which current levels of stock volatility may include useful information about future economic activity.

2) Another channel through which stock market volatility is expected to be related with future economic developments has to do with what we mean with the term '**Financial Distress** of a firm'. When a firm faces economical problems, this situation can be depicted on its stock price. In other words, when a firm faces financial distresses, the investors' worries about the firm's health tend to rise. This uncertainty makes its Stock prices to fluctuate leading to the rise of Stock's volatility.

The uncertainty that prevails among investors as far as the future health of a problematic company is concerned, influences the Financial institutions. It means that in bad times, the firm's access to external funds is deteriorated. The limited external funding has negative effects on both the firm's effort to recover and the realization of its investment projects. Having limited capitals, the firm's financial distress may

worsen and this may have a negative impact on its future production and on the number of the working places offered. In this way, an increase of Stock Market Volatility may be taken by the market as a signal that the existing listed firms face (if not all the most of them) financial problems. This belief makes the market participants to close their positions on the stocks that they held, leading to the decease of stock market returns which has a negative impact on the future economic activity through the balance sheet or the confidence level channel that mentioned in the previous channel.

3) Behavioral Biases

With this term we describe the human tendency to consider some events as being representative of a certain structured class of broader phenomena. For example, financial intermediaries may consider a momentum in economic data as reinforcing the view that the economy will continue to expand. Behavioural Biases may also be responsible of the predicting power of financial volatility. Market participants may put together the following two concepts in the same box: high volatility in financial markets, and adverse evolution of the economic activity in general**. A period of high volatility on a Stock Market can be understood as being representative of a general box containing bad news in general. For example, a series of positive and persistent volatility shocks may make market participants reinforce the view that the wealth of the economy is deteriorating. If this view comes to be diffusely held, we should effectively observe that a persistent period of high financial volatility anticipates a decline in the future real economic activity**. Anchoring might be a related explanation. According to this explanation, investors (financial intermediaries) might come to have negative thoughts about the future of the economy simply because they are currently influenced by the readily available anchor of high and persistent financial volatility. In other terms, we can define "volatility anchoring" as an inadequate allowance for the effects financial volatility might really exert on real economic activity in the counterfactual situation of absence of anchoring biases. The difference between representativeness heuristic and anchoring is of course very fragile here, as both rely on investors making similarities between present circumstances (high volatility) and future economic activity.

Literature review

William Schwert (1989) tried to determine the factors that make Stock Market Volatility change over time. In his article, he related stock market volatility to the time-varying volatility of a variety of economic factors such as nominal macroeconomic volatility, economic activity, financial leverage, and stock trading activity. In order to estimate volatility from monthly data, he used the following procedure:

i) Firstly he estimated a 12th order autoregression for the returns (monthly returns using daily data from Standard and Poor's composite portfolio.) including dummy variables D_{jt} to allow for different monthly mean returns, using all data available for the series, $R_t = \Sigma_{j=1}^{12} a_j D_{jt} + \Sigma_{j=1}^{12} \beta_i R_{t-1} + \varepsilon_t$ (1)

ii) Then he estimated a 12th order autoregression for the absolute values of the errors from equation (1) including dummy variables to allow for different monthly standard deviations,

iii) The regressand ε_τ is an estimate of the standard deviation of the stock market return for month t similar to σ_t. The fitted values from equation (2) estimate the conditional standard deviation of R_t given information available before month t.

Through his analysis Schwert came to the following conclusions:

- Most of the economic series that were examined for the period 1857-1987 (nominal macroeconomic volatility, economic activity, financial leverage, and stock trading activity) appeared to be more volatile during the period which was characterised as the period of great Depression. (1929-1939). Stock market volatility increased by a factor of two or three during the same period compared with the other economic series.
- Most of the examined economic series were more volatile during recessions. This phenomenon can be explained by the fact that during recessions firms' operating leverage increases causing problems to the realization of their projects.
- As far as the predictive power of the above economic series is concerned, it is proved that there is weak evidence that macroeconomic volatility helps to predict stock volatility. On the other hand, Stock volatility seems to have some explanatory power concerning the future economic volatility.

- The ratio of borrowed to self owned capitals (financial Leverage) affect stock volatility. However, this effect explains only a small proportion of the changes in stock volatility over time.
- Trading activity and share trading volume growth are positively correlated with stock volatility.

Hamilton and Susmel (1994) and Sinha (1996) having estimated GARCH models of monthly U.S equity returns, concluded that macro conditions significantly affect equity returns in the sense that equity volatility is more likely to become high during recessions confirming in that way Schwert's findings. In 1998 Errunza and Hogan estimated VAR models and found that money Supply volatility Granger causes equity volatility in Germany and France. Moreover, they concluded that Industrial production granger causes equity volatility in Italy and the Netherlands. In the same article they didn't find any evidence that past macro variables affect equity returns in a variety of countries including the United Kingdom, Switzerland, Belgium or the United States.

Beltrati and C. Morana try in their article 'Breaks and persistency: macroeconomic causes of Stock Market Volatility' to give an explanation concerning the economic causes of Stock Market volatility as Schwert did some years before. According to the authors, scwhert's analysis does not accurately model the persistence properties of volatility and it ignores the potential downward bias affecting the estimates, due to the use of noisy volatility proxies. In their study concerning the relationship between S&P 500 returns volatility and the volatility of some macroeconomic factors from 1970 until 2001, they take into account recent evidence about the stochastic process followed by volatility, and allow for both long memory and structural breaks. This allows the study of the relations among breaks in the series and among break free series. Besides that, in order to account for the presence of observational noise, they extent the non linear log periodogram estimator of Sun and Philips to the multivariate case and develop semiparametric noise filtering approach for disturbed long memory processes. Moreover, they exploit the long run properties of the volatility properties investigated and identify the cointegration space and the sources of persistent volatility dynamics.

Through their econometric methology the found that fractional cointegration analysis leads to three long run relationships linking stock market, money growth, inflation, the Federal funds rate, and output growth volatility , with money growth and stock market volatility being related to the federal funds rate and inflation volatility and the federal funds rate volatility being related with output growth.

Fabio Fornari and Antonio Mele[5] test the predictive power of Financial Volatility over real economic activity measured by the Industrial production Index for the case of the United States. According to their research, Indicators of financial volatility predict roughly 30% of post-war economic activity in the US. This figure increases to roughly 50% in the last twenty-five years. They also suggest that the financial volatility indicators that are used, are not proxing any traditional leading variables. Moreover, the predictive power of financial volatility survives a number of out-of-sample tests. They investigate the predictive power of financial and macroeconomic volatility for the economic activity in the United States. The data that are used include the seasonally adjusted industrial production index, the consumer price index, the unemployment rate, an index of leading indicator (macro-variables); a stock price (total return) index, the price-dividend ratio, the government bond yield (10 year rate), and the 3-month rate (financial variables). An important variable which is also used, is the slope of the yield curve and the corporate spread. Fornari and Mele define the slope of the yield curve as the difference between the 10 year government bond yield and the yield on 3-month Treasury Bills; the measure of the corporate spread is the difference between the baa yield and the 10 year Government bond yield. Finally, their dataset includes the oil price index and a price index of metals. The observations are available on a monthly basis from January 1957 to August 2005. All data are collected from the Global Financial Data (available through the ECB electronic library service), with the exception of the industrial production index, which is taken from the IMF Financial Statistics database.

In order to quantify the stock market volatility, Fornari and Mele use continuously compounded returns. The return of an asset index (bond Index or Stock Index) is defined as $R_t^{Tot} = \log \frac{P_t + D_t}{P_{t-1}}$ where D_t is the dividend paid off by the asset Index. The writers want to calculate the stock market volatility which is induced only by fluctuations in Prices (and not fluctuations in dividends) because these fluctuations convey better information concerning the real activity. On the other hand they want to extract the long

[5] Financial Volatility and real economic activity –Working paper

run component of this fluctuation. For this reason they decompose R_t^{Tot} as $R_t^p + R_t^d$ where $R_t^p = \log\frac{P/D_t + 1}{P/D_{t-1}}$ and $R_t^d = \log\frac{D}{D_{t-1}}$

In this way they disentangle the returns component due to variation in the payoff (dividends) from the returns component due to the (possibly rational) reaction of prices to changes in the economic environment. To extract the long run component of the returns fluctuations they define volatility as a moving average of past absolute returns $\sigma_t^j(l) = \sqrt{6\pi} \cdot \frac{1}{l}\sum_{i=1}^{l}\left|R_{t+1-i}^j\right|$, (1) $J \in \{p, tot\}$ where L is the lag that is used to estimate volatility of past returns. The idea of Fornari and Mele to use absolute returns to track volatility is not new and goes back at least to Taylor (1986), Schwert (1989) and Ding, Granger and Engle (1993). It is well-known that absolute financial returns have rich information content about future stock-market fluctuations. For that reason they were primarily interested in understanding whether absolute returns also bring valuable information about future economic activity. The idea of using moving averages of past absolute returns is related to an old paper by Officer (1973).

Apart from the above model, concerning the calculation of stock market volatility ARCH model might also be a good measure of Financial Volatility. The advantage of the volatility model (equation 1) which is proposed by the writers is that it is essentially nonparametric and very simple to implement.

For a forecasting Horizon of one up to 24 months ahead they use the following regression where they regress the Industrial Production growth on a number of regressors. The first set of regressors is on stock market volatility and the volatility of the yield curve slope. The other sets of regressors are summarised in the table below. The regression has the following form: $G_{t\to t+k} = a^k + \sum_{j=1}^{M}\sum_{lag\in\{0,i_1^k,\ldots,i_4^k\}}\beta_j^k(lag)\cdot \mathrm{Re}\,gressor_j(t-lag) + Error(t+k)$ (2)

Apart from the above in sample analysis they proceed further using out of sample analysis to identify statistically significant relationship between financial volatility and real economic activity.[6] The first finding of the above research (which is not finished yet) is that financial volatility is countercyclical. The writers were based on this property so as to forecast real economic activity. They have found significant evidence suggesting

[6] For more details see their working paper

that large portions of economic activity can indeed be explained and forecast through the measures of financial volatility which they propose.

Table 1

Predictors of economic activity

Block 1: Financial Volatility (1 through 4)
P1 = stock market volatility
P2 = volatility of the yield curve slope
P3 = volatility of the corporate spread
P4 = volatility of oil price
Block 2: Macroeconomic Volatility (5 through 8)
P5 = volatility of industrial production index
P6 = volatility of inflation
P7 = volatility of unemployment rate
P8 = volatility of metals prices
Block 3: Traditional Predictors (9 through 17)
P9 = yield curve slope
P10 = corporate spread
P11 = stock returns
P12 = oil price
P13 = index of leading indicators
P14 = 3-month rate
P15 = inflation
P16 = dividend yield
P17 = lagged industrial production

Term structure of Interest rates and real economic activity

The theory of the term structure of interest rates is very often used by financial institutions in order to explain the process of estimating the impact of an unexpected shock in Short term interest rates on the entire term structure. The term structure of interest rates is defined as the difference between the yield of long term securities and the yield of short term securities assuming that all the other characteristics (default risk, coupon rates e.t.c) are the same. The shape of the yield curve (the diagrammatic representation of the term structure) can be explained by various theories which can be categorized into three main theories: The unbiased expectations theory, the liquidity premium theory and the market segmentation theory.

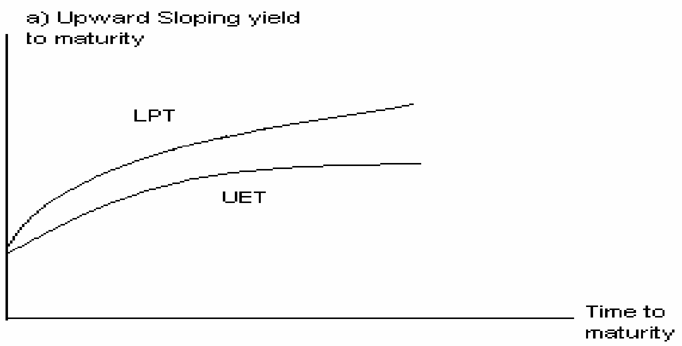
According to the unbiased expectations theory, the term structure of interest rates reflects the market's expectations as far as the future short term interest is concerned. So, an upward- sloping yield curve reflects the fact that the market expects the short term interest rates to rise. On the other hand, a downward moving or a flat yield curve reflects the market's expectations that the short term interest rates will decline in one case or stay unchanged in the other.

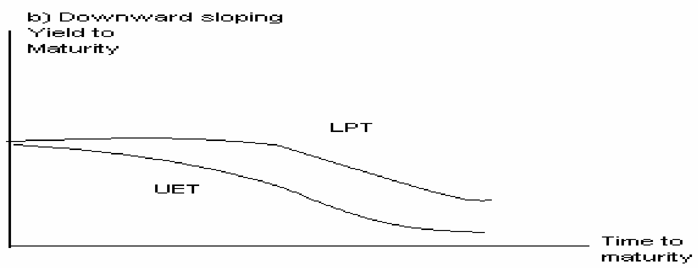
Concerning the first theory, the intuition behind it is very simple: If the investment horizon of an investor is twenty years then the investor has two investment options: The first is to buy a 20 year bond and earn the current yield on a 20 year bond each year. The other option is to invest his money in 20 consecutive 1-year bonds .In this case the investor knows a priori the current one short term 1-year rate and forms expectations about the future short term interest rates. In equilibrium, the 20-year bond rate must be equal to the 20 successive 1-year bond rates so as the investor to be indifferent concerning the two different investment options. Due to the fact that the investor makes assumptions about the future rates when he chooses the second option, it goes without saying that if the future 1-year rates are expected to rise each successive year the yield curve will go upwards. If the investor expects the interest rates to fall the following years the yield curve will go downwards. Finally if the investor expects the interest rates to remain constant the yield curve will be flat.

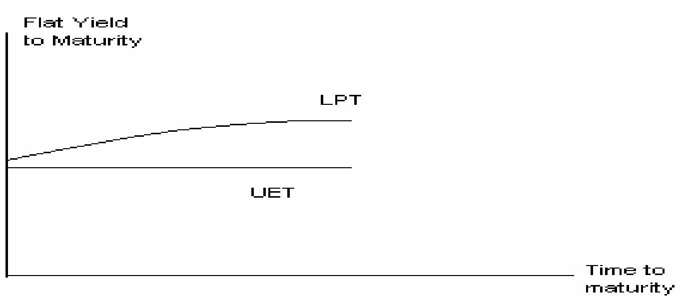
The mathematical equation which is hidden behind the above intuition is:

$$(1+R_n)^N = (1+R_{1N})(1+E_2(r_1))...(1+E_N(r_1)) \Leftrightarrow R_N = \sqrt[N]{(1+R_{1N})(1+E_2(r_1))...(1+E_N(r_1))} - 1$$

Graphic description of the Yield Curve under the Unbiased Expectations Theory (UET) versus the liquidity premium theory (LPT)







According to the second theory about the shape of the yield curve, the liquidity premium theory, in the above equation we must add one more term which has to do with the uncertainty about the future levels of interest rates. Its concept is the following: The above mathematical equation gives us the opportunity to calculate the current yield of a long term bond using the current yield of the one year bond and the expected yields of the following one year bonds. Due to the fact that we make assumptions about the future short term rates there is a risk in holding long term securities and that risk increases as the security's maturity increases. For example, if an investor expects the interest rates to fall he may invest in long term securities to take advantage of the higher interest rates that prevail now. But if his expectations prove to be false and the interest rates fall, the bond's value will decline and he will suffer a loss. This type of risk is called interest rate risk. It is obvious that the longer the investment horizon the greater the exposure to interest rate risk. For this reason, the main idea of the liquidity premium theory is that an investor demands a premium as a compensation for the risk that he is going to undertake by investing in long term securities. This premium increases as the security's maturity increases. In other words

this theory states that the long term rates are equal to the geometric average of short term interest rates plus a liquidity premium which increases with the time. According the liquidity premium theory, although the yield curve reflects the market's expectations for the future short term interest rate, because the liquidity premium increases as the security's maturity increases, the yield curve will nevertheless increase along with the time to maturity. The mathematical expression of the above expression is the following:

$$(1+R_n)^N = (1+R_{1N})(1+E_2(r_1)+LP_2)\ldots(1+E_N(r_1)+LP_N) \Leftrightarrow R_N = \sqrt[N]{(1+R_{1N})(1+E_2(r_1)+LP_2)\ldots(1+E_N(r_1)+LP_N)} - 1$$

The third theory concerning the shape of the yield curve is the market segmentation theory which states that the maturity preferences of the investors are very specific. For example let's examine the nature of a financial institution's assets and liabilities. A financial institution has long-term assets in most cases (long term loans) and short term liabilities (Customers' deposits). In order to manage its duration gap that exists because of the maturity discrepancy between assets and liabilities a financial institution may prefer to hold short term T-bills because of the short term of its liabilities. On the other hand an insurance company which faces the reverse problem (it has long term liabilities and short term assets) may prefer long term bonds. That leads to the conclusion that interest rates are determined by distinct supply and demand conditions within a particular maturity bucket.

Having defined the sense of the term structure of interest rates and the theories that determine the shape of the yield curve, we are going to analyze the theoretical channels through which we can predict the future economic activity by interpreting the information that is hidden in the current term structure. The predictive power of the term structure of interest rates has been a matter of investigation by many researchers. Later on, we will present the most important researches but at this point we will analyze the two basic explanations that have been proposed for the above relationship.

The first theory states that the shape of the yield curve can reflect the direction of the monetary policy. When the government tightens its monetary policy, the short term interests rise. With this action the cost of financing increases and the money supply decreases. In most cases, the rise of the short-term interest rates has an impact on the long term interest rates. The rise of long term interest rates is not so high as the rise in short term interest rate. (This can be more easily understood by taking a glance in the theories that explain the shape of the yield curve) The result of this action is to cause the difference between long term and short term interest rates to decrease. The rise of interest rate rates leads to the expenditures' decrease, especially in the sectors of the economy which are more sensitive in those changes, and results to the deceleration of economic activity. From the above theory we can reach to the following conclusion: The shape of the yield curve (moving upwards, downwards or be flat) is related with the growth rate of real economic activity (measured by the growth rate of real GDP or the growth rate of industrial production.)

An alternative explanation for this relationship can be provided by the market's expectations which are reflected on the yield curve. For example, let's assume that the market expects that the future level of the real economic activity will increase. This increase presupposes the current augmentation of the profitable investment opportunities. The companies, in order to take advantage of these opportunities, tend to borrow money by issuing long term securities. The rise of the offering long term securities leads to the decrease of their price and the increase of their yield. That leads to the conclusion that the long term interest rates tend to rise at a higher rate than the short term interest rates leading to the increase of the yield curve's slope. If this kind of expectation is fulfilled (even partially) the rise of the yield curve can be definitely connected with the rise of the future level of real economic activity.

Review of Bibliography

Arturo Estrella and Gikas Hardouvelis (1991) studied the term structure as a predictor of real economic activity for the case of the United States. As a proxy for the real economic activity they used data of real GDP in a quarterly basis starting from 1955 through the end of 1988. They estimated the term structure of Interest rate spreads as the difference between the 10 year government bond rate and the 3-month Treasury bill rate .Both rates are annualised bon equivalent yields.

Through their study they found out that a positive slope of the yield curve is associated with a future increase in real economic activity. Specifically, they presented evidence that the slope of the yield curve can predict cumulative changes in real output for up to four years into the future and successive marginal changes in real output to a year and a half into the future. The slope outperforms survey forecasts both in sample and out of sample and it predicts all the private sector components of real GNP such as consumption, consumer durables and investment.

Arturo Estrella and Frederic Mishkin examine in their paper -'Predicting US. Recessions: Financial Variables as leading indicators 1998'- the out of sample performance of various financial variables such as the interest rates and spreads ,stock returns and monetary aggregates which are examined for their power to predict forthcoming recessions in the economy of the United States from one to eight quarter ahead. Contrary to the previous papers Estrella and Mishkin focus on predicting recessions rather than on quantitative measures of future economic activity such as the real GNP or the Industrial production Index. In order to quantify the relationship between the potential recessions and the financial variables they used a probit model which is defined in inference to a theoretical linear relationship of the following form:

$Y^{*}_{t+k} = \beta \chi_t + \varepsilon_t$ where Y^{*}_{t} is an unobservable variable that determines the existence of a recession at time t, k is the length of the forecast horizon (one to eight quarters ahead) β is a vector of coefficients and Xt is a vector of the values of the independent variables (stock returns, interest rates and spreads as well as monetary aggregates) including a constant. Through their model they found out that stock prices have strong predictive power for one to three quarter horizons. However, beyond one quarter the slope of the yield curve performs better in comparison with other financial variables.

David Peel and Mark Taylor 'Journal of Economics Letters 1998' studied the relationship between the slope of the yield curve and real economic activity for two countries: United States and United Kingdom. They used quarterly data for the period 1957(first quarter) until 1994(fourth quarter.) for both countries concerning the real and nominal GNP that was used as leading indicator for the real economic activity and the term structure of interest rates that was defined as the difference between the 10-year government bonds and the three month treasury bill rate. The basic regression which is used has the following form: $Y_{t+k} = a + \beta(r_t - i_t) + n_{t+k}$ where K denotes the forecasting horizon in quarters, Y_t is the logarithm of the level of real GDP at time t, $(r_t - i_t)$ denotes the slope of the yield curve and n_{t+k} is the standard error of the regression. Their results accord closely with the results of previous researchers in that regressions of cumulative movements in output are strongly correlated with the slope of the yield curve for a number of forecasting horizons for the countries under examination.

Caroline Jardet in her article 'Why did the term structure of interest rates lose its predictive power-journal of economic modeling, July 2203'concluded in the existence of a break in the correlation between the spread of interest rates and real economic activity using monthly data for the United States. In order to identify this break she applied a test which was proposed by Bai and Perron (1998). After applying the test she showed that this break is associated with the loss of the predictive power of the term structure. The reason why the yield curve lost its predictive power is due to a substantial drop in the contribution of monetary policy shocks and in the contribution of supply shocks. She estimated a structural VAR-VECM and used a standard mixture of Short term and long term restrictions to identify four structural disturbances: a supply, a demand, a monetary policy and a long term interest rate shocks.

Ioannis Venetis, Ivan Paya and David Peel (2002) adopt a smooth transition non linear approach which allows regime-switching nonlinearity in conjunction with parameter time variation in order to test the strength of the link between the interest rate spread and the Real GDP on one hand and the stability of this link on the other for three counties: United States, Canada and United Kingdom. Concerning the first matter they choose time varying smooth transaction non liner model (TV-STR) presented by Lundbergh, Terasvirta, and Van Dijk (2000) which is not so restrictive as the rest threshold models. The data that are used are available on a quarterly basis concerning the real GDP, the 10-

year government bond and the three-month Treasury bill. Through their analysis they confirm the breaks in the link between spreads and future real economic activity.

This break seems to coincide with a lagged recognition of a change in monetary policy attitude towards inflation. Venetis, Paya and Peel mention that the use of linear models in order to describe the relationship between financial variables(stock returns, interest rate spreads etc) and real activity prove to be inadequate and prompt researches to be cautious while using linear techniques.

David A. Peel and Christos Ioannides (2002)[7] test for the structural stability of an output growth forecasting equation that includes the term structure of Interest rates as a regressor for the United States and Canada. Their data are quarterly and cover the period from Q2-1972 to Q1 1999 for Canada and from Q3 1959 until Q1 1999 for the United States. As a long term interest rate they use the 10-Year government Bond yields while as a short term interest rate they use the 3-month T-bill. Ioannides and Peel adopt a model specified by Fuhrer and Moore (1995) and also analyzed by Svensson (1997) in his discussion of policy by independent Central Banks. The model consists of the following five structural equations:

$\pi_{\tau+1} = \pi_t + ay_t + \varepsilon_{t+1}$ (1)…………………Philips curve

$Y_{t+1} = b_1 y_t - b_2 \rho_t + n_{t+1}$ (2)………………….The IS curve

$r_{t+1} = g_1 r_t + g_2 \pi_{t+1} + g_3 y_{t+1} + (1 - g_1 - g_2) z_{t+1}$ (3)...Monetary Policy R. Function

$R_t = \rho_t + 0.5(E_t \pi_{t+1} + E_t \pi_{t+2})$ (4)…………...…Fischer equation

$R_t = 0.5(r_t + E_{t+1} r_{t+1})$ (5)……...Expectation Hypothesis

Through their empirical results they confirm that there is parameter instability as the coefficient associated with the term structure is reduced in size as the policy maker becomes more averse to inflation.

Christel Rendu de Lint and David Stolin[8] investigate whether dynamic equilibrium asset pricing models are able to provide a theoretical foundation for the term structure of interest rates as a leading indicator. For this reason, two types of economies are examined: An endowment economy and a stochastic production economy. The main findings of this research can be summarized as follows: Despite the general belief, the first type of economy does not seem to support the role of interest spreads as leading

[7] Empirical Evidence on the relationship between the term structure of interest rates and future real output changes when there are changes in policy regimes.

[8] The predictive power of the yield curve: a theoretical assessment – Journal of Monetary Economics August 2003

indicators. In reality, at time t, a rise of the yield curve is negatively related with the growth rate of consumption of the same period. The existence of the above phenomenon can be attributed to the specific type of economy where the impact of a shock in the consumption sector is greater during the period that is happening and tend to zero as time goes by. The result of this action is the short term interest rates to react more intensively than the long term interest rates. So, when a positive shock of government expenditures takes place, what we expect to happen is the term structure to increase (because the short term interest rates will decrease more than the long term) and the future consumption to increase.

In the case of the stochastic production economy, the term structure seems to predict well the future production in all forecasting horizons. In this type of economy, the consumption is affected some periods after the shock because the people try to smooth out the impact of the shock by altering their consumption preferences through the time.

The relationship between inflation and Stock Returns: A theoretical approach

With the term Inflation we mean the rate of change in prices, and the price level is the cumulation of past inflations. If for example P_{t-1} represents the price level last year and P_t represents today's price level, then the inflation rate over the past year can be written as $\pi = \frac{P_t - P_{t-1}}{P_{t-1}}$ where π stands for the inflation rate[9].

In this chapter we will try to define a theoretical relationship between the current rate of inflation and future economic activtiy. The forecasting horizon varies from one to eight quarters ahead. We will try to analyze the theoretical channels through which inflation can give statistically significant forecasts for the future level of economic activity. The empirical analysis will be made for the European countries which are members of the European Union and the G-7 countries. In our empirical analysis we will measure inflation using the consumer price index (CPI). CPI measures the cost of buying a fixed basket of goods and services representative of the purchases of urban consumers. An alternative measure of inflation might be the GDP deflator which is the ratio of nominal GDP in a given year to real GDP of that year[10] but for the needs of our analysis we will focus on the consumer price index.

According to the Fischer's theory (1930) which is focused on the relationship between future interest rates and expected inflation, a potential rise of the current level of inflation will lead to the rise of interest rates. Hence, if we count that the real interest rate remains stable through the time, then the expected inflation is the determinant of the level of future interest rates. Fisher expressed the opinion that the real and the monetary sector of the economy are largely unrelated and thus only real factors such as the productivity of capital or the time preferences of savers can influence the real interest rate. For this reason, what has to be taken into account concerning the decisions about consumption

[9] This is a definition for the term inflation as it was given by Dornbusch, Fisher and Startz 'Macroeconomics ninth edition page 38'

[10] For GDP deflator and CPI we used the definitions which were given Dornbusch, Fisher and Startz 'Macroeconomics ninth edition page 39-40'

and investment is only the real interest rate and not the nominal. The mathematical expression of Fischer's theory is the following:

Nominal Interest rate = Real interest rate + Expected Inflation.

According to the above mathematical expression, the interest rates are expected to rise when the level of inflation is expected to rise. Taking for granted the positive relationship between the expected level of inflation and future level of interest rates, we can extend the fisher's theory in order to extract a theory concerning the relationship between the current rate of inflation and the future real economic activity.

If we assume that Fischer's theory is correct, then a potential rise of inflation is expected to lead to the rise of the companies' cost of fund, because higher level of inflation signals the rise of interest rates and that leads to the decline of the present value of future dividend yields. Taking into account the fact that the current stock prices can be defined as the sum of future dividend discounted with the opportunity cost of capital it seems that a negative relationship must exist between inflation and stock returns and thus between inflation and real economic activity taking into account all these we have already said about stock returns and real economic activity.

Fisher Hypothesis, states that real rates of return on common stocks and expected inflation rates are independent and that nominal stock returns vary in one-to-one correspondence with expected inflation. Of course there are many objections for the stability of the above hypothesis and many researchers have conducted researches in order to test the fisher's theory. Bulent N. Gultekin (Stock Market returns and inflation: Evidence from other countries, 1983) uses the following regression in order to test the relationship between nominal stock returns and inflation: $R_t = a + \beta E(\pi_t / \phi_{t-1}) + \varepsilon_t$

where *Rt* is the nominal return on common stocks and $\boldsymbol{\pi_t}$ is the inflation rate. The time subscript t denotes returns between the end of time period t-1 and the end of time period t. ϕ_{t-1} is the information set that investors use in forming their expectations. E is the mathematical expectations operator.

The above regression model estimates the conditional expected value of the stock market return as a function of the expected inflation rate. Therefore, an estimate of β which is statistically indistinguishable from unity is consistent with the hypothesis that the expected nominal return on common stocks varies in one to-one correspondence with the expected inflation rate, and this implies that common stocks are a complete hedge against expected inflation. Furthermore, since the expected real return on an asset is equal to its expected nominal return less the expected inflation rate, an estimate of **β** that is indistinguishable from unity is also consistent with the hypothesis that the expected real return on stocks and the expected inflation rate are independent.[11]

Conducting the research for 26 countries and using for data the percentage change of the consumer price Index (CPI) made available by the IMF for the period January 1947-December 1979, Gultekin is leaded to the following conclusions:

The expected stock returns are negatively correlated with the expected level of inflation for the United States, but as far as the United Kingdom and the Israel is concerned the things are different. In the case of the United Kingdom and Israel the estimation of β coefficient is positive. In general, although the case of the United Kingdom seems to be consistent with the Fischer's hypothesis the empirical results do not support the above hypothesis. Another point that is worth to be mentioned according to the Gultekin's findings is the fact that the relationship between stock returns and inflation is not stable over the time and differs among the countries under investigation. Specifically, Gultekin reveals that countries with high growth rate of inflation tend to appear higher nominal stock returns.

Except for the fischer's hypothesis, there are many other theories that examine the connection between inflation and stock returns. Martin Feldstein (1980) proposes an explanation which takes into account the tax regulation, the historical cost of depreciation and the taxation of the nominal taxable earnings. He states that, as the inflation rate is expected to rise there will be additional taxation over the nominal capital gains and this action is going to squeeze the earnings per share (EPS). The squeezed earnings per share curtail the company's investment projects resulting to the decrease of the expected dividend to EPS ratio. If we assume that stock prices reflect the present of value of future dividends then we conclude that stock prices are going to fall.

Jeffrey F.Jaffe and Gershon Mandelker (1976) using monthly data examine the relationship between inflation and stock returns and find a negative relationship between the two variables. This negative relationship is also supported by the article of Charles Nelson. Nelson runs a regression between a portfolio of stocks and the CPI (for the period 01-1973 until 06-1974 and finds a statistically significant negative relationship confirming also a systematic violation of Fischer's Hypothesis.

[11] Stock returns and inflation: Evidence from other countries. Bulent Gultekin, Journal of finance 1983, page 50-51

Lintner(1975) is one more researcher who sides with those who support the negative relationship between inflation and stock returns. Specifically, he asserts that the rise of inflation, (expected or not) leads companies to extend their external funding in order to maintain steady the margin of profit on the one hand and the dividend yield on the other because during periods if high inflation they need higher levels of external funding so as to satisfy their capital needs. What this theory presupposes, is the fact that the companies' investments on the left side of their balance sheet are not enough in order to cover the cost of capital and that's the reason why stock returns are squeezed.

Fama (1981) and Fama and Gibbons (1982) have emphasized the negative relation between inflation and real activity as the key determinant of the negative relations between stock returns (or interest rates) and inflation in the post-war sample period. By using mainly the growth rate in industrial production, Fama (1981) found a negative relation between inflation and real activity, whereas, by using mainly the employment to population ratio as a measure of real economic activity, Ram and Spencer failed to find the negative relation. Geske and Roll (1983) argue that stock returns cause (or signal) changes in inflationary expectations because of a chain of macroeconomic events. When stock prices decline in response to anticipated changes in economic conditions, the government, given largely fixed expenditures, will tend to run a deficit. To the extent that the deficit is monetized, expected inflation will rise. Ram and Spencer (1983), however, find evidence of unidirectional causality from inflation to stock returns. Using a vector autoregressive-moving average **(VARMA)** model, James, Koreisha, and Partch (1985) examine simultaneously the causal links between stock returns, real activity, money supply, and inflation. They find evidence that stock returns signal both changes in real activity and changes in the monetary base, which suggests a link between money supply and real activity that is consistent with the money supply explanation offered by Geske and Roll.

Bong Soo lee (1992) 'Causal relation among stock returns, Interest rates, Real activity and inflation' use a multivariate VAR approach in order to investigate causal relation among asset returns, real activity and inflation in the post-war United States. His major findings are the following:

1) Stock returns appear Granger-causally prior and help explain a substantial fraction of the variance in real activity, which responds positively to shocks in stock returns.

2) With interest rates in the VAR system, stock returns explain little variation in inflation. However, interest rates explain a substantial fraction of the variation in inflation, with inflation responding negatively to shocks in real interest rates.
3) Inflation explains little variation in real activity, which responds negatively to shocks in inflation for the post-war period.

Jeong-Ryeol Kim (2003) using the granger causality approach for the re-examination of the relationship between inflation and stock returns confirms the proxy hypothesis of Fama as well as the predictive power of stock returns concerning the real activity. This empirical research is based on quarterly observations of stock returns, inflation and GDP growth for the case of Germany. The data cover the period from 1970 until 1999 made available from the databank of the Deutsche Bundesbank.

Although most of the empirical researches converge to the negative relationship between inflation and stock returns, there are many references which state that this kind of relationship exist only for short term periods while for long term periods is converted to positive. A possible explanation for this phenomenon is proposed by Jakob Boudoukh and Mathew Richardson (2003). According to their theory, the problem is hidden in the organization of large samples of data while an additional difficulty lies in the exact estimation of the ex ante inflation. The two researchers, having taken into account the disadvantages concerning the way the data are organized, they find out that the ex post returns seem to compensate the investors for the losses they suffer due to inflation (for long term horizons).

Data and definitions

Our data are made available from DataStream on a quarterly basis for the EU-15 and G-7 countries (Canada, United States, United Kingdom, France, Italy, Germany, Japan, Austria, Finland, Belgium, Greece, Denmark, Spain, Ireland, Portugal, Sweden, Netherlands).

As a measure of the total output, we use the real GDP per capita, or the balance of trade for each country or the Industrial production Index. The term GDP is defined as the ‘value of final goods and services that are produced in a country during a predetermined time interval. Real GDP measures changes in physical output in the economy, between different time periods, by valuing all goods produced in the two periods at the same prices or in *constant dollars* .It means that, in calculating real GDP, today’s physical output is multiplied by the prices that prevail in a predetermined year. ’[12] In our analysis we use Real GDPs that are measured with the prices that prevailed in 2000. Specifically, our quarterly data sample for the G-7 countries covers the period from Q1-1950 until Q4 -2006 for the United States, from Q1-1960 until Q4 -2006 for Canada, from Q1-1978 until Q4-2006 for France, from Q1-1955 until Q4-2006 for United Kingdom, from Q1 1991 until Q4 2006 for Germany, from Q1 1994 until Q4 2006 for Japan and from Q1-1961 until Q4 2006 for Italy. As far the rest of the EU-15 countries is concerned, the data sample for GDP covers a period from Q1-1980 until Q4- 2006 expect for Portugal which cover the period from Q1 1995 until Q4 2006 , Ireland (Q1-1997 until Q4 2006) and Sweden (Q1-1995 until Q4 2006). Concerning the second measure of real economic activity (trade of balance), that was obtained again from the DataStream and is denominated in million or billion of each country’s domestic currency. In the case of the G-7 countries, the data sample covers on average the period from Q1 1975 until Q1 2007 while for the rest of the countries the data sample is very small covering the period from Q1 1990 until Q2 2007. The industrial production Index (measured in units) covers the period from Q1 1957 until Q2 2006 for the countries except for Portugal. (Q1 1961-Q2 2006) The industrial production Index which was used in our analysis is a seasonally adjusted Index with base year the year 2000. Due to the lack of data concerning the balance of trade, we will examine the predictive power of the financial variables over the

[12] Te definitions of GDP and real GDP have been given by Dornbusch, Fisher and Startz. Macroeconomics ninth edition page 35,37

real economic activity, using as a measure of economic activity in the case of EU-15 countries the real GDP per capita and the Industrial production Index, while in the case of G-7 countries the GDP per capita, the Industrial Production Index and the balance of trade.

For the calculation of stock returns of each country we used the following stock indices: In the case of the United States we used the **Dow-Jones Industrial Price Index** from Q2 1951-Q4 2006. DJ was created on the 26th of May 1896 by Charles H. Dow and is the most widely Known Stock Index. It consists of 30 stocks that belong to the most important companies of the industrial sector. (Blue chips)

In the case of France we used the **CAC-40** price Index (Compagnie des Agents de Change 40 Index) from Q4 1987 until Q1 2007. **CAC 40** is composed of 40 French companies (blue chips) which are negotiated in the Euronext Stock market of Paris. As far the United Kingdom is concerned we used the **FTSE 100** price index from Q2 1978 until Q1 2007. **FTSE 100** consists of the 100 higher stocks (according to their market value) that are negotiated in the London Stock exchange. Concerning the case of Italy we used as a representative Stock Index, the **MIB 30 Index** from Q1 1973 until Q1 2007. **MIB 30** is a weighted stock index using as weights, the market values of the 30 blue chips of Italy's stock exchange that are used for the construction of this index. The **Ibex 30** Stock index was used for Spain covering the period from Q1 1987 until 2006 while for Portugal we used the **PSI 20** price Index (Q1 1990- Q1 2007). For both indices the base price is 3000 units.

Nikkei Stock average 225 is one of the most known indices and that's the reason why we used it in our analysis. In the case of Germany and Greece we used the **DAX 30** price index (Q1 1965-Q1 2007) and the **Athex composite index** (Q4 1988-Q1 2007) while for the rest of the countries that were not mentioned above we used the DataStream Price Index for a twenty three year period starting from Q1 1973 until Q1 2007 except for of the case of Finland where the 'Finland DS price Index' covers the period from Q1 1988 until Q1 2007.

The **DAX 30** Price Index that was used as a representative Index of the German Stock Market consists of 30 Blue Chip companies which are negotiated in Frankfurt Stock Exchange. This Index was constructed on the first July of 1988 having as a base date the 1st December of 1987 and a base of 1000 units. Dax 30 is a composite weighted Index using as weights the market values of its stocks. The Athex Composite Price Index is also one composite weighted Index which was created on the fourth of January 1988 and uses as a base date the 31^{st} of December 1980 and a base of 100 units. For the rest of the Countries we thought that use of DS Price Index is the best solution four the needs of our analysis. 'DS price Index was created for the majority of the countries in 1973 and has as a base the level of 100 units.

Because in our analysis we use as a proxy of the real economic activity the real prices of GDP per capita and Industrial Production Index, calculated with the prices that prevailed in 2000, we have to convert the nominal stock returns of the above Indices in real Stock returns so as to make these time series easily comparable. The process that we followed is very simple: first we obtained from the cd-rom of the International Monetary Fund the percentage changes of the Consumer Price Index on a quarterly basis for all counties and then we divided each period's nominal stock price Index by the corresponding consumer Price Index.

In a previous chapter we defined the term structure of Interest rates as the difference between the long term Interest rates and short term interest rates. As a long term interest rate we used for all the countries the 10- Year Government Bond yield and as a short term interest rates we used the Treasury bill yield. For the countries where data on T-bills were not available, we used the 3-month interbank interest rate.

Finally we used both, daily data of the Stock Indices already mentioned and the generalized autoregressive conditional Heteroskesdasticity Model (GARCH) that was proposed by Bollerslev (1986) for the calculation of Stock Market Volatility (conditional standard deviation of the underlying asset return).

The volatility σ of a stock is a measure of our uncertainty about the returns provided by the stock. The volatility of a stock can be defined as the standard deviation of the return provided by the stock in 1 year with continuous compounding. When the time interval is small (T), $\sigma\sqrt{T}$ is approximately equal to the standard deviation of the percentage change in the stock price in time T. In order to identify the 3 month volatility of stock returns we are going to calculate the daily volatility estimated by 60 daily observations of stock returns and then we will multiple this by the squared root of 60.

The GARCH model is an extension of the ARCH model that was proposed by Engle (1982). For a log return series r_t we let $u_t = r_t - \mu_t$ be the innovation at time t. Then we say that that u_t follows a GARCH (m,s) model if

$$U_t = \sigma_t \in_t, \qquad \sigma_t^2 = a_0 + \sum_{i=1}^{m} a_i a_{t-i}^2 + \sum_{j=1}^{s} \beta_j \sigma_{t-j}^2 \quad \text{……………………(1)}$$

where $\{\varepsilon_t\}$ is a sequence of independent and identically distributed variables with mean 0 and variance 1.0, $a_0 \succ 0$, $a_i \geq 0$, $\beta_j \geq 0$, and $\Sigma_{i=1}^{\max(m,s)} (a_i + \beta_i) \prec 1$.

Aς before, ε_t is often assumed to be a standard normal or standardized Student-t distribution or generalized error distribution. Equation (1) reduces to a pure ARCH(m) model if S=0. The a_i and β_j are referred to as ARCH and GARCH parameters respectively.

Model Description

What we want to test empirically, using the data that were presented in the previous chapter, is the ability of a number of financial variables (stock returns, stock market volatility, term structure of interest rates) to predict the level of future economic activity on the one hand, and the ability of a number of macroeconomic variables (CPI, M1) to predict stock returns on the other. Our main target is to give a clear answer concerning the direction of dependence: 'Is it Finance that can be used by analysts to forecast the level of economic activity (expansion or deceleration) or is it the level of economic activity (which is depicted in the macroeconomic indices) that can be used to predict Finance?

In order to give an answer in the above question we will use the Vector Autoregressive model (VAR) the dynamic properties of which will be summarized using three main types of structural analysis: a) the granger causality test b) the impulse response function and c) the forecast error variance decompositions. Before proceeding to the presentation of the model that we are going to use, we will define the concept of stationarity which is the foundation of time series analysis.

A time series $\{r_t\}$ is said to be strictly stationary if the joint distribution of $(r_{t1 \ldots\ldots\ldots} r_{tk})$ is identical to that of $(r_{1+t, \ldots\ldots\ldots\ldots} r_{tk+}t)$ for all t whereas k is an arbitrary positive integer and $(t_1, \ldots.., t_k)$ is a collection of k positive integers. In other words, strict stationarity requires that the joint distribution $(r_{t1 \ldots\ldots\ldots} r_{tk})$ is time invariant under time shift.[13] Nevertheless, a weaker form of stationarity is often assumed. A time series $\{r_t\}$ is considered to be weakly stationary if it fulfills the following two conditions:

a) $E(r_t) = \mu \;\; \forall\, t\, \varepsilon\, T$
b) $Cov(r_t, r_s) = \gamma_\delta$ which only depends on δ. The weak stationarity implies that the time plot of the data would show that the T values fluctuate with constant variation around a fixed level. It is a fact that the theory of time series analysis has been built over the assumption of Stationarity. Thus, it is vital before proceeding to the modeling of the relationship between time variables, to ensure that they are stationary. In case of non stationarity, we should build the model in such a way so that it gives us consistent results.

[13] Ruey Tsay ' Analysis of Financial Time series' Chapter 2, page 25

Unit Root Non Stationarity

In the field of economics, most of the series such as stock prices, interest rates, exchange rates e.t.c. tend to be non stationary. In time series literature, the time series which not fulfill the conditions of stationarity are called unit root non stationary series. One of the most representative unit root series is the random walk process. A process is called random walk if it is characterized by the following generalized equation: $X_t = \alpha + X_{t-1} + U_t$ (1) where U_t is a white noise time series while the constant 'a' is the drift rate of the series. Looking at the equation (1) we can consider a random walk process as an AR(1) model where the coefficient of X_{t-1} is the unity. Let's consider also the following autoregressive model: $Y_t = \beta_0 + \beta_1 Y_{t-1} + U_t$ (2) where {Yt} is a stationary time series and U_t is a white noise process. By definition, $E(Y_t) = \mu \ \forall \ t \ \varepsilon \ T$ (we have assumed that {Yt} is stationary). If we substitute this property in the equation (1) we have: $E(Yt) = E(\beta_0 + \beta_1 Y_{t-1} + U_t) = E(\beta_0) + \beta_1 E(Y_{\tau-1}) + E(Ut) \Leftrightarrow \mu = \beta_0 + \beta_1\mu \Leftrightarrow \mu = \frac{\beta_0}{1-\beta_1}$. In the case of a random walk time series β_1 equals to 1 and thus the one of the two conditions of weak stationarity is violated. The unit root test is based exactly on the proof concerning the non stationarity of random walk time series. To test whether a time series is stationary or not, we only have to prove that the series under examination doesn't follow a random walk stochastic process (in order to prove that it is stationary), or that the series follows a random walk stochastic process (with or without a drift) so as to prove that the time series is not stationary. For this reason, we employ the models $X_t = \beta_1 X_{\tau-1} + U_t$ (2) and $X_t = \beta_0 + \beta_1 X_{\tau-1} + U_t$ (3) and consider the null hypothesis H_o: $\beta_1 = 1$ versus the alternative hypothesis H_1: $\beta_1 < 1$. A convenient test statistic is the t-ratio of the least squares estimation of β_1. The t-ratio is the $DF \equiv t-ratio = \frac{\hat{\beta}_1 - 1}{std(\hat{\beta}_1)}$ and it is commonly referred to as the Dickey Fuller Test. We reject the null hypothesis versus the alternative if t-statistic is lower that the critical value.

It is a fact that most of the economic series such as interest rates, stock prices, exchange rates e.t.c are non stationary series but the log return series $Y_t = \log(Y_t) - \log(Y_{t-1})$ tends to be stationary. Thus, one way to transform them in stationary time series is to take the first differences. This technique is called differencing in time series literature. Having ensured that the series which are used in our analysis are stationary, we can proceed to the presentation of the Vector Autoregressive model.

VAR description[14]

A simple vector model useful in modeling the dynamic relationships between financial variables, is the vector autoregressive model (VAR). The simplest Var process is the process of order 1 which follows the model $Y_t = \alpha + \beta Y_{t-1} + U_t$ (1) where: a= is a k dimensional vector, β = a K×K matrix and U_t is a sequence of serially uncorrelated random vectors with Zero mean and covariance matrix Σ. The number of order denotes the lags which the endogenous variables are dependent on. There are many criteria that are used in order to estimate the best number of lags on condition that the hypothesis of stationarity remains unbiased. The types of these criteria (Akaike Information criterion e.t.c.) are going to be mentioned later in this chapter. In finance literature it is often assumed that U_t is multivariate normal. In order to understand better the equation (1) let's consider the case of a VAR model of order 1 consisting of two variables Y_{1t} and Y_{2t}. In this case α and u_t = 2×1 vector and β = 2×2 vector. The Var(1) model has the following form:

$$\begin{pmatrix} Y_{1t} \\ Y_{2t} \end{pmatrix} = \begin{pmatrix} \alpha_{10} \\ \alpha_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta 22 \end{pmatrix} \times \begin{pmatrix} Y_{1t-1} \\ Y_{2t-1} \end{pmatrix} + \begin{pmatrix} U_{1t} \\ U_{2t} \end{pmatrix} \qquad (2)$$

If we make the operations in the above matrices we take the following equations:

$$Y_{1t} = \alpha_{10} + \beta_{11} Y_{1\tau-1} + \beta_{12} Y_{2\tau-1} + U_{1t} \quad (3)$$

$$Y_{2t} = \alpha_{20} + \beta_{21} Y_{1\tau-1} + \beta_{22} Y_{2\tau-1} + U_{2t} \quad (4)$$

According to the equation (3) the coefficient β_{12} denotes the linear dependence of Y_{1t} on $Y2t_{-1}$. If $\beta_{12} \neq 0$ and statistically significant, it means that Y_{1t} depends not only on its own past, but also on the past of the variable Y_{2t}. The same analysis applies for the equation (4). If we consider the two equations jointly, then in case where $\beta_{12}=0$ and $\beta_{21} \neq 0$, there is an unidirectional relationship from Y_{1t} to $Y_{2t.}$ If $\beta 12=0$ and $\beta_{21}=0$, the time series Y_{1t} and Y_{2t} are unrelated and if $\beta_{12} \neq 0$ and $\beta_{21} \neq 0$ there is a feedback relationship between the two series.

[14] Model specification as it is analyzed by Ruey Tsay in his book 'Analysis of Financial Time series' second edition

One of the model's advantages is the fact that it does not assume a priori any direction of dependence between the variables. In other words all variables are treated as endogenous variables.

Structural Analysis of the VAR Model

A VAR model may have many parameters and the may be difficult to interpret due to complex interactions and feedback between the variables in the model. As a result the dynamic properties of a VAR can be summarized using various types of structural analysis. For the needs of our empirical study we will use the following types of structural analysis (as we have already mentioned in the beginning of this chapter): The Granger causality test, the forecast error variance decompositions and the impulse response functions.

Granger Causality test

Correlation does not necessarily imply causation in any meaningful sense of that word. The econometric graveyard is full of magnificent correlations, which are simply spurious or meaningless. Interesting examples include a positive correlation between teachers' salaries and the consumption of alcohol and a superb positive correlation between the death rate in the UK and the proportion of marriages solemnized in the Church of England. Economists debate correlations which are less obviously meaningless.

The Granger (1969) approach to the question of whether X causes Y is to see how much of the current Y can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation. Y variable is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged X's are statistically significant. Note that two-way causation is frequently the case; X Granger causes Y and Y Granger causes X.

It is important to note that the statement "X Granger causes Y" does not imply that Y is the effect or the result of X. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term.

The Granger Causality test is based on the following equations:

$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_i Y_{t-i} + \gamma_1 X_{t-1} + \gamma_2 Xt_{-2} + \gamma_i Xt_{-i} + U_t$ (5)

$X_t = \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_i Y_{t-i} + \gamma_1 Y_{t-1} + \gamma_2 Yt_{-2} + \gamma_i Yt_{-i} + U_t$ (6)

If $\gamma 1$, $\gamma 2$, $\gamma i \neq 0$ and statistically significant then we say that X granger causes Y in regression (5) and Y granger causes X in regression (6).

Impulse response function

Impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR. A shock to the i-th variable not only directly affects the i-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. If the innovations U_t are contemporaneously uncorrelated, interpretation of the impulse response is straightforward: The i-th innovation Ui,t is simply a shock to the i-th endogenous variable. Innovations, however, are usually correlated, and may be viewed as having a common component which cannot be associated with a specific variable. In order to interpret the impulses, it is common to apply a transformation to the innovations P so that $U_t = P\varepsilon_t$ (0,D). This can be done using Cholesky decomposition. In order to understand the impulse response function we can consider a Var Model of P order as linear function of its past innovations:

$Y_t = \mu + u_t + \Gamma_1 ut_{-1} + \Gamma_2 u_{t-2} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Gamma_T u_{t-T} \rightarrow Y_t = C(L)u_t$ (7)

This is a moving average representation with the coefficient Γ_i being the impact of past innovation U_{t-I} on Y_t. The coefficient Γ_i is often referred to as the **impulse response function** of Yt. Because innovations are in most cases correlated, we use the Cholesky decomposition analysis which helps us to transform the innovations U_t in such way so that the resulting components are uncorrelated. The main idea of the Cholesky analysis is the following[15]:

- Let Z be a symmetrical (N×N) real matrix. If Z is a positive definite matrix (A square matrix is a positive definite matrix if: (a) the matrix is symmetric and (b)

[15] The Cholesky decomposition analysis as presented above comes from the notes that I was given by Mr Skiadopoulos for the course 'Financial Derivatives and Hedging Strategies' University of Piraeus Msc in Banking and Financial Management.

all the eigenvalues of the matrix are positive.)[16] then it can be decomposed into its Cholesky factors K so that Z = KK' where K is (N×N) lower triangular matrix with zeroes in the upper right corners.

- The purpose of Cholesky factorization is to construct a (N×1) vector ε which we would like to display the correlation structure Z. → Cov(ε) = E(εε')= R
- We start from a (N×1) vector ξ which is composed of independent standardizes normal variables Cov(ξ)= I
- Finally we construct ε as ε = T × ξ → Cov (ε) = Z

Coming back to our analysis concerning the Impulse response function and according the Cholesky decomposition, there is a lower triangular matrix L such as the variance covariance matrix of white noise innovation Ut Σ equals to LGL' where G is a diagonal matrix and the lower diagonal elements of L are unity. Let $b_t = L^{-1}a_t$. Then $Cov(b_t) = G$ so that the elements of b_t are uncorrelated.

If we rewrite the equation (5) we have:

$$
\begin{aligned}
Y_t &= \mu + u_t + \Gamma_1 u_{t-1} + \Gamma_2 u_{t-2} + \ldots\ldots \\
&= \mu + LL^{-1}a_t + \Psi_1 LL^{-1}a_{t-1} + \ldots\ldots \\
&= \mu + \Psi_0^{*}b_t + \Psi_1^{*}b_{t-1} + \ldots\ldots \quad (8)
\end{aligned}
$$

The coefficients Ψ_ι of equation (8) are called **impulse response function** of Y_τ. After transforming the innovations so that the elements are uncorrelated, we can observe the impact of a shock in one endogenous variable on the other variables. Equation (8) can be also written as $Y_t = C(L)u_t$ where Y_t is a $n_y \times 1$ vector of the endogenous variables Y_t and U_t is a $n_u \times 1$ vector of shocks. As C we define a $n_y \times n_u$ matrix with typical element [Ci,j,k] which equals to:

$$
C_{i,j,k} = \frac{\theta Y_{i,t}}{\theta u_{j,t-k}} = \frac{\theta Y_{i,t+k}}{\theta \varepsilon_{j,t}} \quad \ldots\ldots(9)
$$

$C_{i,j,k}$ is called again the impulse response function of $U_{j,t}$ for $Y_{i,t}$ and shows how $Y_{i,t+k}$ changes in response to a one unit 'impulse' in $\varepsilon_{j,t}$. In the classic econometric literature on distributed lag models, the impulse responses are called dynamic multipliers.

[16] Ruey Tsay 'Analysis of Financial Time series' second edition chapter 8 appendix A

At this is point we should mention one important weakness of the impulse response function. The weakness is that the result depends on the ordering of the components of Y_t. Different orderings may give different results.

For this reason, we should predetermine the order of the components that are going to be used (IP growth or real GDP growth, real stock returns, stock volatility, term structure of interest rates and inflation). The causal model that is specified with the aid of economic theory is the following:

Inflation → Term structure of Interest rates → Stock Volatility → Stock returns → IP growth or real GDP growth.

The intuition behind this ordering is very simple: The rise of inflation is a monetary shock. When inflation rises, governments usually start thinking the possibility of an interest rate rise so as to avoid the phenomenon of hyper inflation. The most common way that is often followed by governments in order to sustain inflation in acceptable levels is the rise of short term interest rates. With this way inflation is restricted from the demand side. In most cases, the rise of the short-term interest rates has an impact on the long term interest rates. The rise of long term interest rates is not so high as this of short term interest rates. (This can be more easily understood by taking a glance in the theories that explain the shape of the yield curve) The result of this action is the difference between long term and short term interest rates to decrease. Because of the increase in short term interest rates, the companies' cost of financing increases while private consumption starts decreasing because now people prefer saving their money due to the higher yields which is offered for their deposits than spending it in consumable goods. These two actions start affecting the volatility of stock returns because a shock in inflation combined with the rise of interest rise send vague signals concerning the direction of stock market. . A period of high volatility on a Stock Market can be understood as being representative of a general box containing bad news in general. For example, a series of positive and persistent volatility shocks may make market participants reinforce the view that the wealth of the economy is deteriorating. If this view comes to be diffusely held, we should effectively observe that a persistent period of high financial volatility anticipates a decline in stock returns and furthermore a decline in economic activity.(measured by IP growth or real GDP growth) The reverse things happen (following the same thinking) when inflation starts declining.

What is also worth to be mentioned is the Generalized Impulses as described by Pesaran and Shin in 1998. Generalised Impulse response constructs an orthogonal set of innovations that does not depend on the VAR ordering. The generalized impulse responses from an innovation to the j-th variable are derived by applying a variable specific Cholesky factor computed with the j-th variable at the top of the Cholesky ordering. For this reason we are also going to adopt this application.

The forecast error variance decomposition structural analysis

Variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. The forecast error variance decomposition (FEVD) answers the question: what portion of the variance of the forecast error in predicting $yi,_{t+h}$ is due to the structural shock Uj? Using the orthogonal shocks Ut the h-step ahead forecast error vector, with known VAR coefficients, may be expressed as

$$Y_{T+h} - Y_{T+h/T} = \sum_{s=0}^{h-1} \Theta_s U_{T+h-s}$$

For a particular variable $yi,_{T+h}$, this forecast error has the form

$$Yi,_{T+h} - y,i_{T+h/T} = \sum_{s=0}^{h-1} \Theta_{i1}^{s} U_{1,T+h-s} + \ldots\ldots\ldots\ldots\ldots + \sum_{s=0}^{h-1} \Theta_{in}^{s} U_{n,T+h-s}$$

Since the structural errors are orthogonal, the variance of the h-step forecast error has the following form:

$$\mathrm{Var}(yi,_{T+h} - yi,_{T+h/T}) = \sigma_{u1}^{2} \sum_{s=0}^{h-1} (\theta_{i1}^{2})^{2} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \sigma_{un}^{2} \sum_{s=0}^{h-1} (\theta_{in}^{2})^{2}$$

Where σ_{uj}^{2} = var(Ujt). The portion of $\mathrm{Var}(yi,_{T+h} - yi,_{T+h/T})$ due to shock in the white noise innovation Uj is then

$$FEVD_{i,j}(h) = \frac{\sigma_{\eta_j}^{2} \sum_{s=0}^{h-1} \left(\theta_{ij}^{s}\right)^{2}}{\sigma_{\eta_1}^{2} \sum_{s=0}^{h-1} \left(\theta_{i1}^{s}\right)^{2} + \cdots + \sigma_{\eta_n}^{2} \sum_{s=0}^{h-1} \left(\theta_{in}^{s}\right)^{2}},\ i,j = 1,\ldots,n$$

In a VAR with n variables there will be n^2 FEV Di,j(h) values. It must be kept in mind that the FEVD depends on the recursive causal ordering used to identify the structural shocks ηt and is not unique. As in the case of Impulse response function, different causal orderings will produce different FEVD values

In most applications the probability structure is specified by assuming that the shocks are i.i.d, so that any serial correlation in the exogenous variables is captured in the lag polynomial C(L) in equation (5). The assumption of Zero mean is inconsequential, since deterministic components such as constants and trends always be added. Viewed in this way U_t represents innovations or unanticipated shifts in exogenous variables. The question concerning the relative importance of the shocks can be made more precise by casting it in terms of the h- step ahead forecast errors of Y_t.

Let $Y_{t/t-h} = E(Y_t / \{u_s\}_{s=-\infty}^{t-h})$ denote the h-step ahead forecast of Y_t made at time t-h and let $a_{t/t-h} = Y_t - Y_{t/t-h} = \Sigma_{\kappa=0}^{h-1} C_k u_{t-k}$ denote the resulting forecast error. The importance of a specific shock can then represented as a fraction of the variance in $a_{t/t-h}$ that is explained by that shock; when the shocks are mutually correlated there is no unique way to do this, since their covariance must somehow be distributed. However when the shocks are uncorrelated, the calculation is straightforward. If we assume that Σ_u is diagonal with diagonal elements σ_j^2, then the variance of the ith element of $a_{t/t-h}$ is $\sum_{j=1}^{n_u} \left[\sigma_j^2 \sum_{k=0}^{h-1} c_{i,j,k}^2 \right]$ so that $R_{i,j,h}^2 = \frac{\left[\sigma_j^2 \sum_{k=0}^{h-1} c_{i,j,k}^2 \right]}{\sum_{m=1}^{n_u} \left[\sigma_m^2 \sum_{k=0}^{h-1} c_{im,k}^2 \right]}$ shows the fraction of the h-step ahead forecast error variance in $Y_{i,t}$ attributed to $U_{j,t}$. The set of n_u values of $R_{i,j,h}^2$ are called the variance decomposition of $Y_{i,t}$ at horizon h[17]. The above methods are going to be used in our empirical analysis. First we will do the unit root tests in order to ensure that the first differences of the time series under examination are stationary and then we will apply the granger causality test, the impulse response function and variance decomposition analysis for the identification of any kind of dependence between our variables.

[17] Engle, McFadden ' Handbook of Econometrics, volume iv' chapter 47 pg 2898-2910

Lag length criteria

The use of the impulse response function and the variance decomposition analysis presupposes the construction of a VAR(p) model like this of equation (2). The optimal number of orders can be determined using selection criteria. The general approach is to fit VAR(p) models with orders p = 0, ..., pmax and choose the value of p which minimizes some model selection criteria. Model selection criteria for VAR(p) models have the following form:

$$IC(p) = \ln|\bar{\Sigma}(p)| + c_T \cdot \varphi(n,p)$$

Where $\sum(p) = T^{-1}\Sigma_{\tau=1}^{T} \hat{\varepsilon}_\tau \hat{\varepsilon}_\tau'$ is the covariance matrix of residuals without a degrees of freedom correction from a VAR(p) model, C_T is a sequence indexed by sample size T and φ(n,p) is a penalty function which penalizes large VAR(p) models. The three most popular criteria which help us to identify the optimal number of lags in a VAR(p) model are the Akaike Information, the Schwarz-Bayensian criterion and the Hannan-Quinn criterion the mathematical equations of which are the following:

$$\begin{aligned} AIC(p) &= \ln|\bar{\Sigma}(p)| + \frac{2}{T}pn^2 \\ BIC(p) &= \ln|\bar{\Sigma}(p)| + \frac{\ln T}{T}pn^2 \\ HQ(p) &= \ln|\bar{\Sigma}(p)| + \frac{2\ln\ln T}{T}pn^2 \end{aligned}$$

The AIC criterion asymptotically overestimates the order with positive probability, whereas the BIC and HQ criteria estimate the order consistently under fairly general conditions if the true order p is less than or equal to Pmax.

In sample versus out of sample analysis

Econometric methods for measuring predictive content can be divided into two groups: in-sample and out-of sample methods. The above analysis is an in-sample analysis. Except for the in sample analysis we will also use an out of sample analysis for measuring the predictive power of the financial variables. The basic difference between the two methods is that the in-sample correlations between the variables is an ex post property of the data while the out of sample analysis of time series provides an ex ante view of the causal relation between the variables under examination.

The methology that is going to be used for the out of sample analysis of the predictive power of stock returns, stock market volatility and the term structure of interest rates, is the one as described by Jongmoo Jay Choi, Shmuel Hauser and Kenneth J. Kopecky in their article with title: 'Does the stock market predict real activity? Time series evidence from the G-7 countries.'

The out of sample methology that was used by the writers in order to prove the ability of stock returns to forecast the growth rate of the Industrial production can be summarized in the following 4 steps:

1. They estimated an in sample univariate ARIMA model for each time series of the growth rate of Industrial production using Box and Jenkins procedure (1970).

   $$Y_t = \alpha_0 + \sum_{i=1}^{m} a_i Y_{t-i} + e_{1t} \quad (9)$$

2. They also estimated an in-sample bivariate model of the growth rate of the Industrial production that includes both, lagged Industrial Production growth and lagged real stock returns. The lags length could be selected using an information criterion such as the Akaike or Bayes Information criteria. (AIC or BIC)

   $$Y_t = b_0 + \sum_{i=1}^{m} b_i Y_{t-i} + \sum_{j=1}^{n} C_j S_{t-j} + e_{2t} \quad (10)$$

3. The above models were used to generate one step-ahead forecast for a preassigned out-of sample period.
4. They compared the relative significance of the forecasting errors of the two models.

In an out of sample analysis, a common way to quantify the forecast performance is to compute the mean squared forecast error of a candidate forecast relative to a benchmark forecast. Choi, Hauser and Kopecky used as a candidate forecast the bivariate regression (10) and as a benchmark forecast the regression (9). If we let $\hat{y}^{h}_{0,t+h/t}$ and $\hat{y}^{h}_{i,t+h/t}$ be the benchmark and i_{th} candidate forecast of Y^{h}_{t+h} , then the h-step ahead mean squared forecast error (MSFE) of forecast i relative to that of benchmark forecast is: $\dfrac{\frac{1}{T_2-T_1-h+1}\sum_{t=T_1}^{T_2-h}(Y^{h}_{t+h}-\hat{Y}^{2}_{i,t+h/t})^2}{\frac{1}{T_2-T_1-h+1}\sum_{t=T_1}^{T_2-h}(Y^{h}_{t+h}-\hat{Y}^{2}_{0,t+h/t})^2}$[18] where T_1 and T_2-h are the first and last dates over which the pseudo out of sample forecast is computed. If its relative MSFE is less than one, the candidate forecast is estimated to have performed better than the benchmark.

In order to test for significant differences between the Mean squared error of the benchmark forecast (regression 9) and the mean squared error of the benchmark forecast, Choi, Hauser and Kopecky adopted a modification of the Ashley (AGS test 1970) procedure: They denoted e_1 and e_2 as the forecasting errors of the univariate regression (9) and the bivariate regression (10) respectively and defined $d_t = e_{1t}-e_{2t}$ and $\Sigma_t = e_{1t}+e_{2t}$. Letting cov and μ represent the out of sample covariance and mean, AGS shows that the mean squares errors of the univariate model are significantly greater than the mean squared errors of the bivariate model, if the null hypothesis of COV(d,Σ) =0 and μ(d) is rejected in favor of the alternative hypothesis that both of these quantities are non negative and at least one is positive. AGS test shows that this is equivalent to testing the null hypothesis that a_0 and a_1 are equal to zero against the alternative that both are non negative and at lest one is positive in the following regression:

$$d_t = a_0 + a_1[\Sigma_t - \mu(\Sigma_t)] + w_t \quad (11)$$

where w_t represents a random error term.

[18] James Stock and Mark Watson 'Forecasting output and Inflation: The role of asset prices'

Empirical Analysis

The basic steps of our empirical analysis (that are going to be followed for all the countries under examination) are the following:

- First, we run the Augmented Dickey Fuller (ADF) and the Phillip Perron unit root tests in order to ensure that the time series that are going to be used are stationary.

- For each one of the financial variables (real stock returns, stock return volatility, term structure of Interest rates, inflation) we test for Granger Causality between the specific variable and real economic activity measured either by the Industrial Production growth or by the real GDP growth.

- We construct bivariate VAR models consisting of the growth of Industrial Production and one financial variable each time and we examine their dynamic properties by estimating the impulse response function and the forecast error variance decomposition.

- Then, we construct a VAR model consisting of all the financial variables under examination and a measure of real economic activity, (GDP growth or Industrial Production growth) and through its structural analysis we test for the predictive power of all financial variables concerning real economic activity.

- Finally, we extent our analysis so as to examine the out of sample performance of the variables under examination.

United States

Table 1

Pairwise Granger Causality Tests
Date: 05/12/07 Time: 19:02
Sample: 1957Q1 2006Q3
Lags: 5

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause REAL STOCK RETURNS	192	1.96153	0.08643
REAL STOCK RETURNS does not Granger Cause IP GROWTH		8.18523	**5.5E-07**

According to the above statistical table, for the period Q1 1957 until Q3 2006, real stock returns of Dow Jones Industrial Index seems to granger cause Industrial Production. The null hypothesis of the above test is that IP growth does not Granger Cause Real Stock returns on the one hand, and that real stock returns do not granger cause IP growth on the other. In the first case the Probability equals to 0.08643 and supports the null hypothesis. In the second case the P-value does not support the null hypothesis and thus we conclude that there is a causal relation among real Stock returns and Industrial Production. We should mention that both, IP growth and real stock returns are stationary time series.

In table 2 we present the 1-quarter up to 8-quarter Forecast error Variance in IP growth which is explained by Innovations in each variable based on two-variable innovation accounting. The two variables are real stock returns and growth in Industrial Production. The forecast error is computed by using a bivariate VAR system with one constant and five lags. The lags' length was defined with the use of the Akaike Information criterion (AIC). The first component of the VAR system is the real stock returns.

Table 2

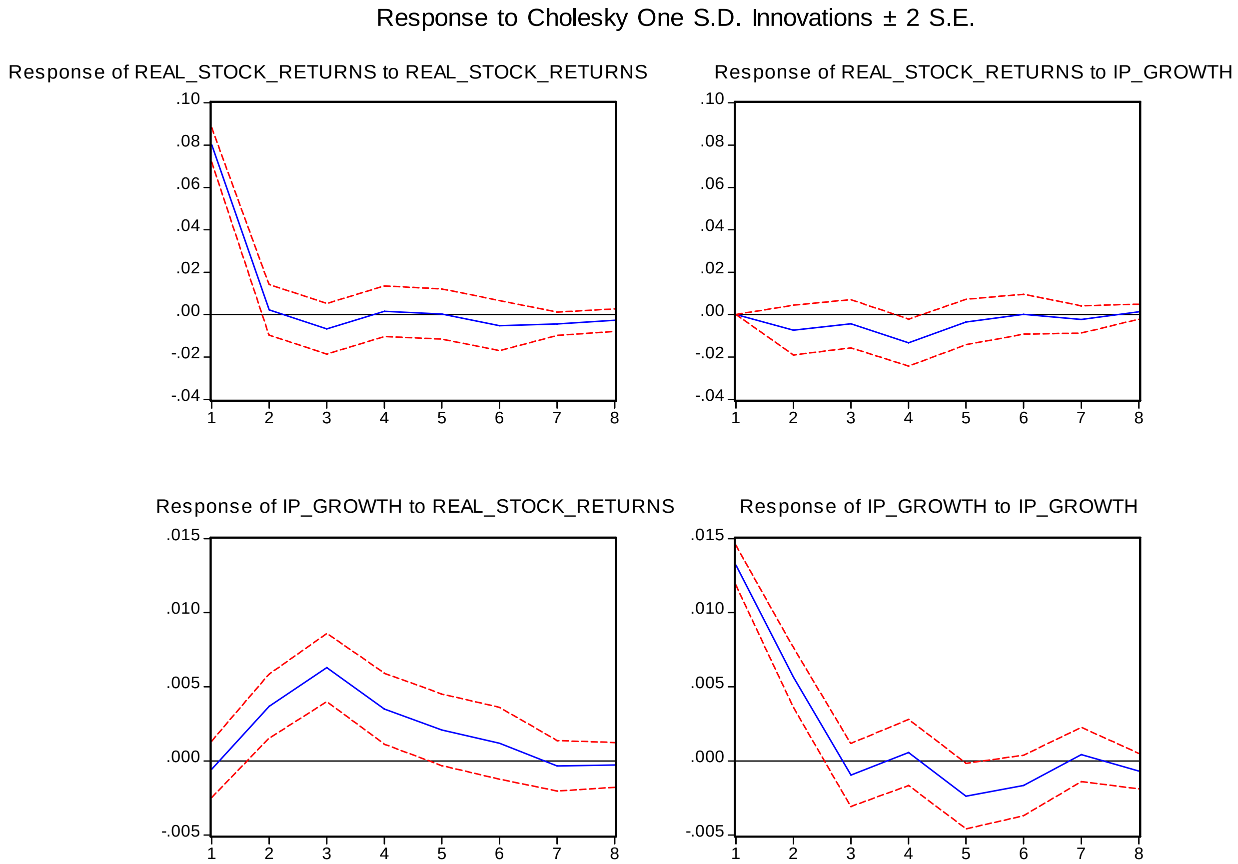
Variance Decomposition of IP growth:

Period	S.E.	REAL STOCK RETURNS	IP GROWTH
1	0.013223	0.179490	99.82051
2	0.014849	6.311072	93.68893
3	0.016158	20.53651	79.46349
4	0.016546	24.09675	75.90325
5	0.016846	24.78836	75.21164
6	0.016968	24.92400	75.07600
7	0.016977	24.93607	75.06393
8	0.016993	24.91390	75.08610

As we can see from the tables above, 25% of the 4-quarter up to 8-quarter forecast error variance in IP growth is explained by innovations in real stock returns. **Figure 1** shows that a shock in real stock returns affects positively the growth in industrial production for 1 up to 7-steps ahead forecast. The positive relationship between shocks in real stock returns and growth in Industrial Production tends to rise up to 3-step ahead forecast, then starts to decay (remaining positive) and tends to zero for 7-step ahead forecast.

Figure 1

Simulated dynamic (impulse) responses of real stock returns and Industrial Production growth.



Imposing the same approach for the rest of the variables under examination we come to the following conclusions summarized in the table below.

Table 3

Pairwise Granger Causality Tests
Date: 05/15/07 Time: 16:54
Sample: 1957Q3 2006Q3
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause TERM STRUCTURE	192	2.04482	0.08994
TERM STRUCTURE does not Granger Cause IP GROWTH		4.62943	**0.00139**

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause REAL GDP GROWTH	192	2.09678	0.08300
REAL GDP GROWTH does not Granger Cause TERM STRUCTURE		3.05406	**0.01819**

Pairwise Granger Causality test
Sample: 1957 Q3 2006 Q3
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause STOCK VOLATILITY	195	0.29939	0.58490
STOCK VOLATILITY does not Granger Cause REAL GDP GROWTH		8.24715	**0.00454**

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	193	3.48410	**0.00905**
IP GROWTH does not Granger Cause STOCK VOLATILITY		0.09658	0.98345

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	188	1.36297	0.21604
IP GROWTH does not Granger Cause INFLATION		1.88479	0.06523

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause REAL GDP GROWTH	188	0.95544	0.47269
REAL GDP GROWTH does not Granger Cause INFLATION2		1.28772	0.25281

Next, we compute a VAR model consisting of five endogenous variables: Stock returns, stock Volatility, Term Structure of Interest rates, Inflation, Industrial Production growth or Real GDP growth (as a measure of real economic activity). The above time series have been already tested concerning the hypothesis of the existence of a unit root. The Augmented Dickey Fuller as well as the Phillip Perron tests rejected the null hypothesis (that there is a unit root) for all the above series. The statistical tables of the above tests are presented in Appendix A.

The VAR model has the following form: $Z_t = a + \beta_j \sum_{i=1}^{k} Z_{t-i} + u_t$ where Z_t is a 5×1 matrix consisting of the endogenous variables, β is a 6×6 matrix and Z_{t-i} is a 5×1 matrix which contains the Lags of the endogenous variables. The number of lags was defined with the use of the Akaike Information criterion.

Having defined a VAR(5) model, we proceed to the variance decomposition analysis so as to define the percentage of the forecast error variance in industrial production that can be explained by innovations in Real stock returns, stock volatility, term structure of Interest rates and inflation.

Table 4

Variance decomposition of IP growth (optimal lag length according to AIC:8)

Period	S.E.	IP GROWTH	REAL STOCK RETURNS	STOCK VOLATILITY	TERM STRUCTURE	INFLATION
1	0.011625	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.012717	92.23937	2.958418	0.025453	4.226077	0.550686
3	0.014575	71.86455	17.37557	6.413140	3.450357	0.896383
4	0.015187	66.62274	19.32834	7.674014	5.497083	0.877829
5	0.015648	65.95711	19.00134	7.563808	6.597140	0.880598
6	0.015965	63.97330	18.25885	7.290173	8.827931	1.649744
7	0.016149	63.20510	18.12903	7.135684	9.182571	2.347619
8	0.016342	61.90891	18.84690	6.969042	9.462367	2.812779

We run again a VAR(4) model using as a measure of real economic activity this time the growth in real GDP. The results of the variance decomposition of growth in real GDP are summarized in the following table: The statistical tables of the VAR(8) and VAR(4) models as well as the Impulse response and the variance decomposition analysis that have not been presented are available for the readers in Appendix B.

Table 5

Variance decomposition of real GDP growth (Optimal lag Length according to AIC :4)

Period	S.E.	REAL GDP GROWTH	REAL STOCK RETURNS	STOCK VOLATILITY	TERM STRUCTURE	INFLATION
1	0.011658	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.012735	83.80649	11.40508	4.275983	0.183581	0.328865
3	0.012934	81.27453	11.92946	5.121075	1.288049	0.386880
4	0.012949	81.27141	11.90336	5.117041	1.297803	0.410393
5	0.013129	80.79839	11.94052	4.987478	1.324061	0.949552
6	0.013294	79.70028	11.88563	5.037494	2.056644	1.319948
7	0.013399	78.90204	12.13211	5.005115	2.637314	1.323416
8	0.013463	78.22293	12.24172	5.048319	3.085273	1.401754

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Real Stock returns
United States	IP Growth	1	100	0
		2	93.01472	6.985279
		3	79.11379	20.88621
		4	75.51496	24.48504
		5	74.98438	25.01562
		6	74.90905	25.09095
		7	74.90135	25.09865
		8	74.91811	25.08189

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Stock Volatility
United States	IP Growth	1	100	0
		2	99.90433	0.095668
		3	94.9226	5.077397
		4	92.44394	7.556063
		5	91.52133	8.478671
		6	90.89059	9.109405
		7	90.76976	9.230239
		8	90.76958	9.230419

Country	Variables explained	Period	IP growth	term structure
United States	IP Growth	1	100	0
		2	95.85967	4.140332
		3	94.6071	5.392903
		4	94.06816	5.931844
		5	93.29119	6.708812
		6	92.22053	7.779472
		7	90.5795	9.420502
		8	89.83607	10.16393

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Inflation
United States	IP Growth	1	100	0
		2	98.35424	1.645758
		3	98.34805	1.651951
		4	97.58962	2.410376
		5	96.89263	3.107372
		6	94.78265	5.217352
		7	93.52678	6.473218
		8	93.26193	6.738075

Japan

In the table below, we present the results of the Granger causality tests between the variables under examination and real economic activity (measured by the growth of Industrial Production.) Because of the limited data set concerning the real GDP growth, the only measure of real economic activity that is used is IP growth.

Pairwise Granger Causality Tests
Date: 05/17/07 Time: 23:29
Sample: 1970Q3 2005Q1
Lags: 4 (specified with the use of the AIC criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Real Stock returns	135	1.07045	0.37401
Real Stock returns does not Granger Cause IP growth		3.18840	**0.01563**

Sample: 1970Q3 2005Q1
Lags: 4 (specified with the use of the AIC criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Term Structure of Interest rates	135	2.09688	0.08507
Term structure of interest does not Granger Cause IP growth		3.15197	**0.01655**

Lags: 4 (specified with the use of the AIC criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Stock volatility	135	1.64441	0.16719
Stock volatility does not Granger Cause IP growth		1.75229	**0.14265**

Lags: 4 (specified with the use of the AIC criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Inflation	135	6.08829	0.00016
Inflation does not Granger Cause IP growth		6.94502	**4.4E-05**

Table 6

Summary statistics of Variance decomposition analysis

			By innovations in				
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Japan	**Industrial Production growth**	1	100	0	0	0	0
		2	92.74687	2.907748	0.197416	3.272311	0.875658
		3	80.44118	6.895368	1.298259	7.733329	3.631861
		4	76.79625	10.41933	1.576246	7.643695	3.564483
		5	68.679	13.46849	3.46456	6.958321	7.429627
		6	66.75574	13.31626	5.53491	6.573891	7.819198
		7	67.18803	12.92527	5.630743	6.67155	7.584405
		8	67.07739	12.67451	5.821479	6.738456	7.688163

The Forecast error Variance has been computed with the use of the five variable VAR system Z_t with a constant and four lags according to the Akaike Information criterion. The above table shows percentage of 1 up to 8 period forecast error variance in variable i explained by innovations in variable j,

$$\left[\sum_{s=1}^{8} c_{i,j}(s)^2 / \sum_{j=1}^{4}\sum_{s=1}^{8} c_{i,j}(s)^2\right] \times 100$$

where $C_{i,j}(s)$ is obtained from the orthogonalised moving average representation of Z_t:

$$Z_t = \sum_{s=0}^{\infty} c(s)u(t-s) \quad (1)$$

In equation (1) Z_t is a 5×1 vector consisting of IP growth, real stock returns ,stock volatility, term structure of interest rates, and Inflation. The sample period is from q3 1970 until q1 2005.

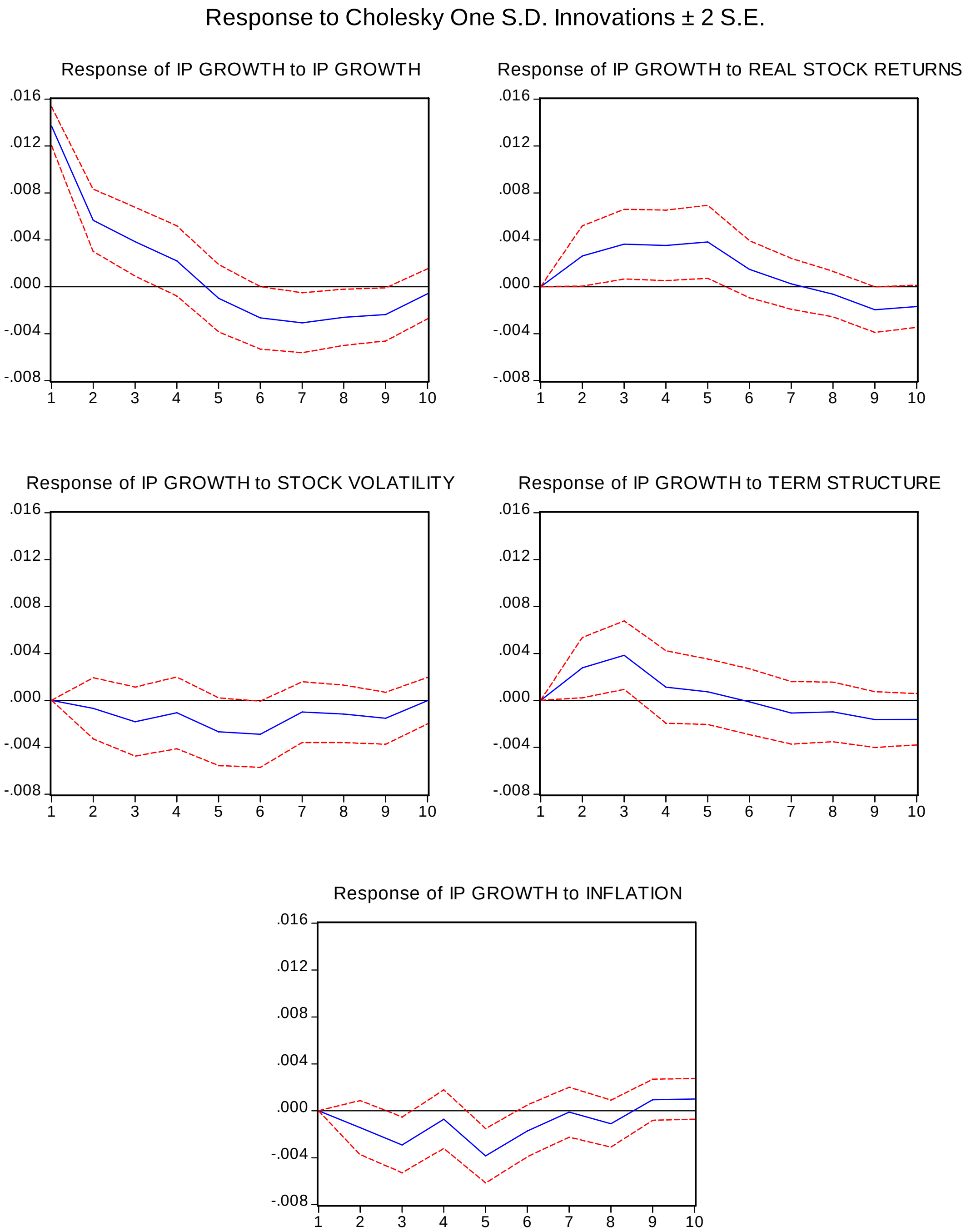
According to the Granger causality tests, all the variables under examination, except for stock volatility, seem to cause IP growth. This causal relationship is verified by the VAR model[19] (that has been already described and is presented in Appendix B) as well as the bivariate Var's the structural analysis of which is presented in the table below where the lagged values of real stock returns, term structure and inflation are found to be significantly correlated with contemporaneous value of IP growth. **Table 6,** indicates that, in the presence of all financial variables in the VAR system, 67,08% of the 8 period forecast error variance of IP growth is explained by its own past innovations

[19] And its structural analysis

while 12,67% , 5,82% , 6,74% , 7,69% of the variance of IP growth is explained by real stock returns, stock volatility, term structure and inflation respectively.
According to the bivariate VAR's which consist of IP growth and one financial variable each time, the above variables seems to lose a significant part of their predictive power when tested altogether.

Figure II

Simulated impulse responses of IP growth to shocks in each variable



Summary statistics of Variance decomposition analysis when real economic activity is measured the percentage change of Industrial production

			By Innovations in					By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**	**Country**	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
		1	100	0			1	100	0
		2	96.51504	3.484957			2	99.31608	0.683916
		3	93.67741	6.322587			3	97.59111	2.408888
Japan	**IP Growth**	4	89.28969	10.71031	**Japan**	**IP Growth**	4	96.89417	3.105828
		5	83.82068	16.17932			5	94.19136	5.808636
		6	83.27518	16.72482			6	92.27584	7.72416
		7	83.4375	16.5625			7	91.55452	8.445484
		8	83.67047	16.32953			8	91.11316	8.886836

							By Innovations in		
Country	**Variables explained**	**Period**	**IP growth**	**term structure**	Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
		1	100	0			1	100	0
		2	95.60677	4.393232			2	95.60572	4.394276
		3	90.43579	9.564207			3	88.1012	11.8988
Japan	**IP Growth**	4	89.01264	10.98736	**Japan**	**IP Growth**	4	87.07793	12.92207
		5	88.52875	11.47125			5	80.126	19.874
		6	88.57858	11.42142			6	78.60605	21.39395
		7	88.38198	11.61802			7	79.21054	20.78946
		8	87.87331	12.12669			8	79.43067	20.56933

Germany

We start running Granger Causality tests, using first the growth in Industrial Production as a measure of real economic activity. The data sample covers the period Q2 1965 until Q2 2006. Then, we change the measure of real economic activity using this time the growth of real GDP per capita. The financial variables under examination are again real stock returns, stock volatility, term structure of interest rates and inflation. After running the Granger causality tests we proceed further by estimating a VAR (5) model from which we compute the forecast error variance in IP growth and GDP growth explained by the above variables as well as the responses of IP growth and GDP growth to shocks in each of the variables under examination. The number of the lagged values of the endogenous variables that are used for the estimation of the VAR(5) are defined with the use of the Akaike Information Criterion.

Production Granger Causality tests when real economic activity is measured as the percentage change of Industrial

Pairwise Granger Causality Tests
Date: 05/20/07 Time: 17:39
Sample: 1965Q2 2006Q2
Lags: 3 According to the Akaike Information criterion

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Real Stock returns	161	2.58371	0.05537
Real Stock returns does not Granger Cause IP growth		3.45145	**0.01812**

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Stock volatility	164	0.24296	0.62275
Stock Volatility does not Granger Cause IP growth		0.05770	0.81047

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Inflation	160	1.02339	0.39720
Inflation does not Granger Cause IP growth		2.18500	0.07332

Pairwise Granger Causality Tests
Date: 05/20/07 Time: 18:24
Sample: 1975Q3 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause TERM STRUCTURE	122	1.06392	0.34842
TERM STRUCTURE does not Granger Cause IP GROWTH		7.35499	**0.00098**

Granger Causality tests when real economic activity is measured as the percentage change of GDP per capita

Pairwise Granger Causality Tests
Date: 05/20/07 Time: 18:34
Sample: 1965Q2 2006Q2
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
GDP growth per capita does not Granger Cause Real Stock returns	161	1.15791	0.32780
Real Stock returns does not Granger Cause GDP growth per capita		1.10828	0.34763

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
GDP growth per capita does not Granger Cause Stock volatility	164	0.43186	0.51202
Stock Volatility does not Granger Cause GDP growth per capita		0.10996	0.74062

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
GDP growth per capita does not Granger Cause Inflation	160	0.44121	0.77867
Inflation does not Granger Cause GDP growth per capita		0.08902	0.98577

Pairwise Granger Causality Tests
Date: 05/20/07 Time: 18:55
Sample: 1975Q3 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
GDP growth per capita does not Granger Cause Term Structure	122	3.37237	0.03768
Term Structure does not Granger Cause GDP growth per capita		3.27416	**0.04134**

Table7

Summary statistics of Variance decomposition analysis (Optimal Lag length according to AIC:1)

			By innovations in				
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Germany	**Industrial Production growth**	1	100	0	0	0	0
		2	97.33051	0.251079	0.050885	2.167744	0.199777
		3	95.6101	0.246598	0.170064	3.776386	0.196851
		4	94.21651	0.243804	0.28527	5.060222	0.194193
		5	93.09299	0.242471	0.389836	6.082529	0.192171
		6	92.18554	0.242051	0.481172	6.900669	0.190572
		7	91.45132	0.242145	0.559142	7.558099	0.189298
		8	90.85631	0.242496	0.624722	8.088193	0.188278

Table 8

Summary statistics of Variance decomposition analysis

			By innovations in				
Country	Variables explained	Period	**GDP growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Germany	**GDP growth(per capita)**	1	100	0	0	0	0
		2	98.37303	0.010022	0.239256	0.515546	0.86215
		3	97.67865	0.07168	0.442857	0.94709	0.859726
		4	97.1621	0.12459	0.554629	1.304175	0.854507
		5	96.77719	0.156696	0.619356	1.59625	0.850505
		6	96.48104	0.177351	0.658505	1.835704	0.8474
		7	96.2478	0.191175	0.683485	2.032596	0.844946
		8	96.06109	0.200857	0.700236	2.19484	0.842981

Figure III

Simulated impulse responses of IP growth to shocks in each variable

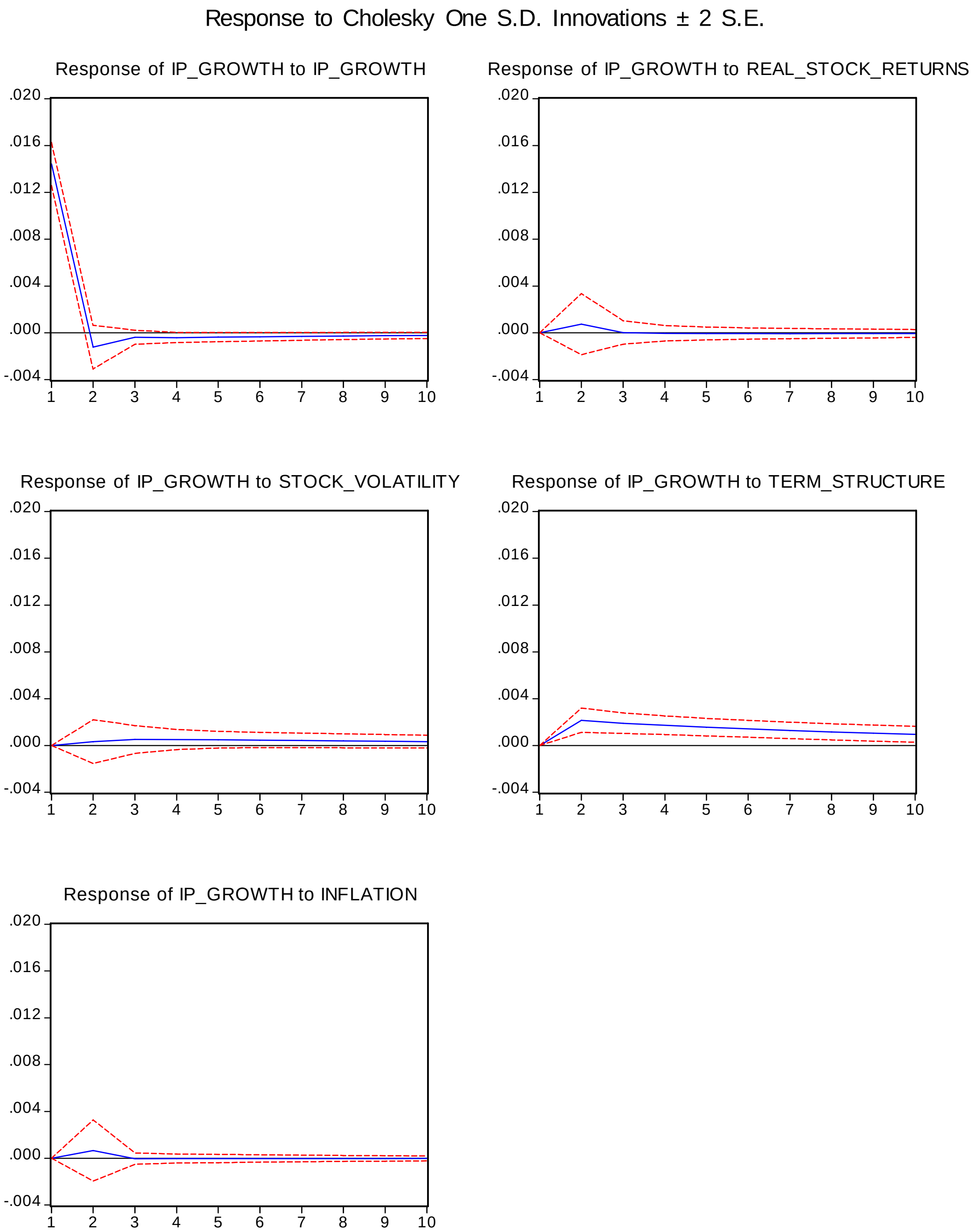
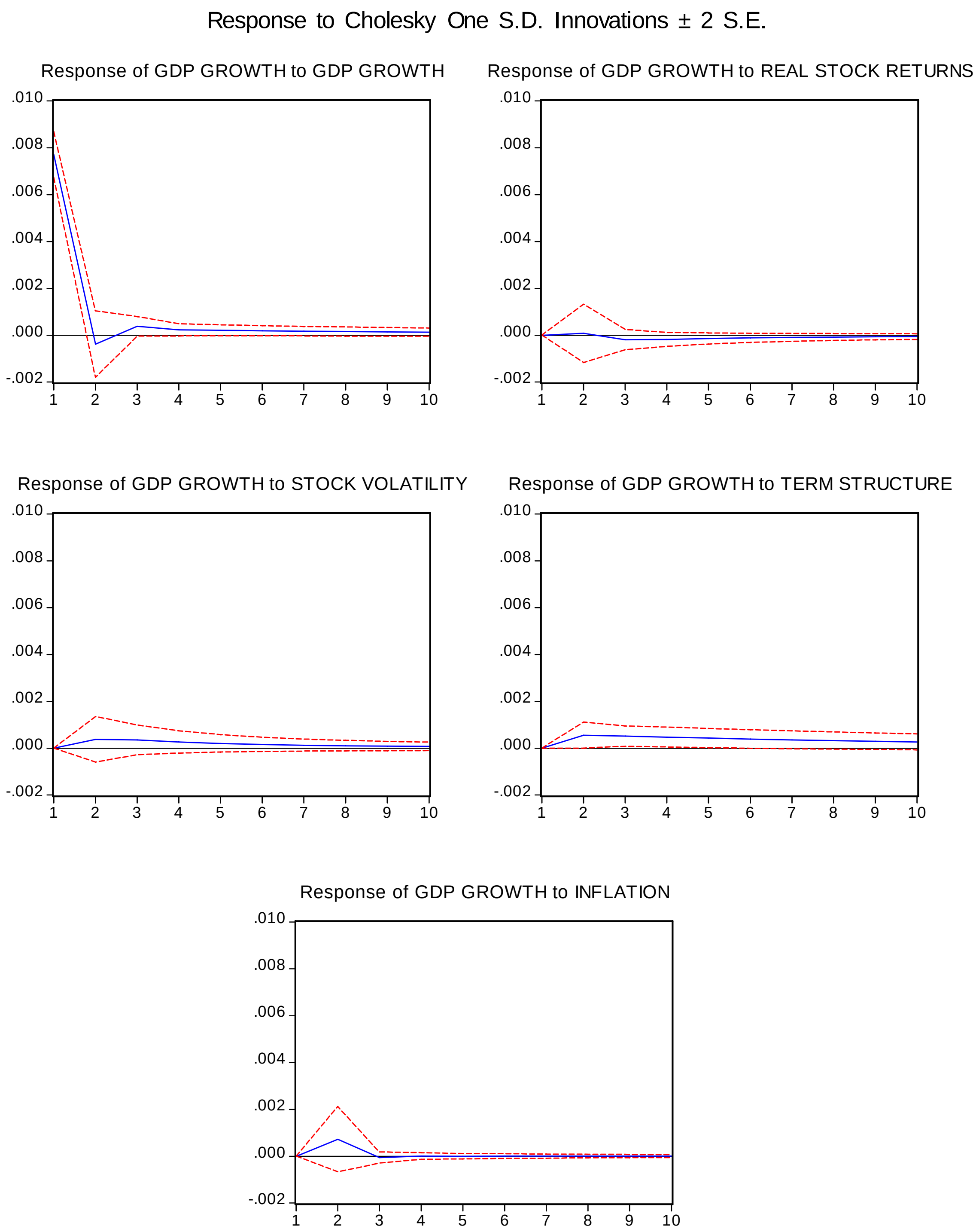


Figure IV

Simulated impulse responses of GDP growth to shocks in each variable



Conclusions

According to Granger Causality tests, when real economic activity is measured with the use of growth in Industrial Production, only two of the four financial variables (real Stock returns, and term structure of Interest rates) seems to Granger cause it. On the other hand, when economic activity is measured by growth in Real GDP per capita, only one of the four financial Variables (term structure of Interest rates) granger causes it.

The above findings are far more obvious according to the Structural Analysis of the bivariate Vector autoregressive models (presented in the tables at the end of this analysis) which have as endogenous variables the IP growth and one financial variable each time in one case and the GDP growth along with one financial variable in the other. Those tables verify the fact that lagged values of real stock returns as well as lagged values of term structure are significantly correlated with current values of IP growth and lagged values of term structure are significantly correlated with current values of real GDP growth. Through the structural analysis of the bivariate VAR's we observe that 7.91% and 10.28% of the 8 period ahead forecast error variance in IP growth is explained by variations in real stock returns and term structure respectively while 5% of the 8 period forecast error variance in real GDP growth is explained by variations in term structure.

Table 7 summarizes the results of the variance decomposition in IP growth analysis when all the variables under examination are included in the VAR. According to those results, the largest fraction of the 8 period forecast error variance of IP growth (90,86%) is explained by its own past innovations while only 0,24% , 0,62% and 0,19 of its variance is explained by innovations in real stock returns, stock volatility and inflation respectively. From the above results we find out that although lagged values of real stock returns seem to be significantly correlated with current values of IP growth according to Granger causality tests and structural analysis of bivariate VAR, with all the variables in the VAR it looses its predictive power. The only exception is the term structure of Interest rates which explains 8,08% of the variance in IP growth. The same results appear in the diagrams of figure III. A shock either in stock volatility or in inflation has no impact on IP growth for 1 up to 10 period ahead forecasts. On the other hand, a shock in term structure of Interest rates affects positively the growth in industrial production for 1 up to 2 period ahead forecasts. The positive relationship starts to decay (remaining positive) after 3 periods ahead forecast, and tends to zero as time goes by.

As we said above, when real economic activity is measured by the use of real GDP growth, only the term structure of Interest rates is found to be significant correlated with the values of IP growth. The fact that in the case of Germany, real stock returns, stock volatility and inflation don't have any predictive power over real GDP growth (and thus they cannot predict real economic activity) can be easily confirmed by taking a glance at the variance decomposition analysis of the Var consisting of real GDP per capita and term structure.

Finally, according to table 8, when all the variables under examination are included in the VAR term structure seems to loose its predictive power. This ascertainment is also verified by the simulated response of GDP growth to each of the four variables for a forecasting horizon of one up to ten periods ahead.

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Real Stock returns
Germany	**IP Growth**	1	100	0
		2	99.32033	0.67967
		3	94.4053	5.5947
		4	92.61477	7.38523
		5	92.32818	7.67182
		6	92.12642	7.873582
		7	92.08146	7.918537
		8	92.08239	7.917611

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Stock Volatility
Germany	**IP Growth**	1	100	0
		2	99.98033	0.019674
		3	99.96429	0.03571
		4	99.95598	0.044016
		5	99.95227	0.047728
		6	99.9507	0.049298
		7	99.95005	0.049947
		8	99.94979	0.050214

Country	Variables explained	Period	IP growth	term structure
Germany	**IP Growth**	1	100	0
		2	99.30972	0.69028
		3	96.96893	3.03107
		4	94.48604	5.513962
		5	92.55831	7.441689
		6	91.20807	8.791929
		7	90.30439	9.695609
		8	89.71326	10.28674

Country	Variables explained	Period	By Innovations in IP growth	By Innovations in Inflation
Germany	**IP Growth**	1	100	0
		2	99.98944	0.010556
		3	99.87965	0.120346
		4	98.27997	1.720031
		5	95.07008	4.929916
		6	94.8059	5.194099
		7	94.79748	5.202524
		8	94.66586	5.334137

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of real GDP

Country	Variables explained	Period	By Innovations in GDP growth	By Innovations in Real Stock returns
Germany	GDP growth	1	100	0
		2	99.02276	0.977244
		3	98.3365	1.663496
		4	98.08777	1.912228
		5	98.00306	1.996941
		6	98.00078	1.999217
		7	97.99402	2.00598
		8	97.98965	2.010346

Country	Variables explained	Period	By Innovations in GDP growth	By Innovations in Stock Volatility
Germany	GDP growth	1	100	0
		2	99.95984	0.040164
		3	99.94572	0.054282
		4	99.93992	0.060076
		5	99.93757	0.062428
		6	99.93662	0.063383
		7	99.93623	0.063771
		8	99.93607	0.063929

Country	Variables explained	Period	GDP growth	term structure
Germany	GDP growth	1	100	0
		2	95.6204	4.379595
		3	95.38654	4.613456
		4	95.03333	4.966667
		5	94.99158	5.00842
		6	94.9732	5.026798
		7	94.97278	5.027223
		8	94.9729	5.027102

Country	Variables explained	Period	By Innovations in GDP growth	By Innovations in Inflation
Germany	GDP growth	1	100	0
		2	99.88015	0.119852
		3	99.81259	0.187408
		4	99.8181	0.181903
		5	99.80138	0.198616
		6	99.75962	0.240377
		7	99.74369	0.256306
		8	99.74325	0.25675

Canada

Granger Causality tests when real economic activity is measured as the percentage change of Industrial Production

Pairwise Granger Causality Tests
Date: 05/20/07 Time: 23:05
Sample: 1973Q3 2006Q2
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Real Stock returns	131	1.93401	0.16673
Real Stock returns does not Granger Cause IP growth		9.90233	**0.00205**

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause Stock Volatility	128	0.66418	0.61809
Stock Volatility does not Granger Cause IP growth		0.38865	0.81642

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause Term Structure of Interest rates	128	1.25251	0.29264
Term Structure of Interest rates does not Granger Cause IP GROWTH		3.46599	**0.01024**

Lags: 7

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause Inflation	125	2.81906	0.00970
Inflation does not Granger Cause IP GROWTH		2.54697	**0.01811**

Granger Causality tests when real economic activity is measured as the percentage change of Real GDP per capita

Pairwise Granger Causality Tests
Date: 05/21/07   Time: 01:09
Sample: 1973Q3 2006Q2
Lags: 1(with the use of the Akaike Information Criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause REAL STOCK RETURNS	131	0.43316	0.51163
REAL STOCK RETURNS does not Granger Cause REAL GDP GROWTH		15.4693	**0.00014**

Lags: 8(with the use of the Akaike Information Criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause STOCK VOLATILITY	124	2.69718	0.00962
STOCK VOLATILITY does not Granger Cause REAL GDP GROWTH		1.79954	0.08498

Lags: 8(with the use of the Akaike Information Criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause Term Structure of Interest rates	124	1.10729	0.36418
Term Structure of Interest rates does not Granger Cause REAL GDP GROWTH		3.99587	**0.00035**

Lags: 8 (with the use of the Akaike Information Criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause Inflation	124	1.45077	0.18407
Inflation does not Granger Cause REAL GDP GROWTH		1.69993	0.10664

Table 9

Summary statistics of Variance decomposition analysis (Optimal Lag length according to AIC: 1)

Country	Variables explained	Period	By innovations in				
			Industrial Production growth	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Canada	**Industrial Production growth**	1	100	0	0	0	0
		2	93.13453	5.414853	0.00063	1.447079	0.002909
		3	90.4321	5.53938	0.246728	3.732485	0.049305
		4	88.22463	5.402599	0.316557	5.921103	0.135112
		5	86.50291	5.299933	0.311619	7.667014	0.218523
		6	85.2053	5.231176	0.315501	8.963968	0.28405
		7	84.24563	5.182991	0.337475	9.902234	0.331668
		8	**83.54398**	**5.14823**	**0.366779**	**10.57558**	**0.365432**

Table 10

Summary statistics of Variance decomposition analysis (Optimal Lag length according to AIC: 1)

Country	Variables explained	Period	By innovations in				
			Real GDP growth	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Canada	**Real GDP growth**	1	100	0	0	0	0
		2	90.76205	8.359159	0.047177	0.83097	0.000645
		3	88.77523	8.664049	0.290932	2.227478	0.042312
		4	87.45751	8.514339	0.367575	3.560675	0.099903
		5	86.48328	8.419171	0.363503	4.586489	0.147555
		6	85.76531	8.372976	0.372298	5.308944	0.180476
		7	85.24845	8.346665	0.402649	5.800334	0.201905
		8	**84.88526**	**8.328917**	**0.439367**	**6.130754**	**0.215701**

Figure V

Simulated impulse responses of IP growth to shocks in each variable

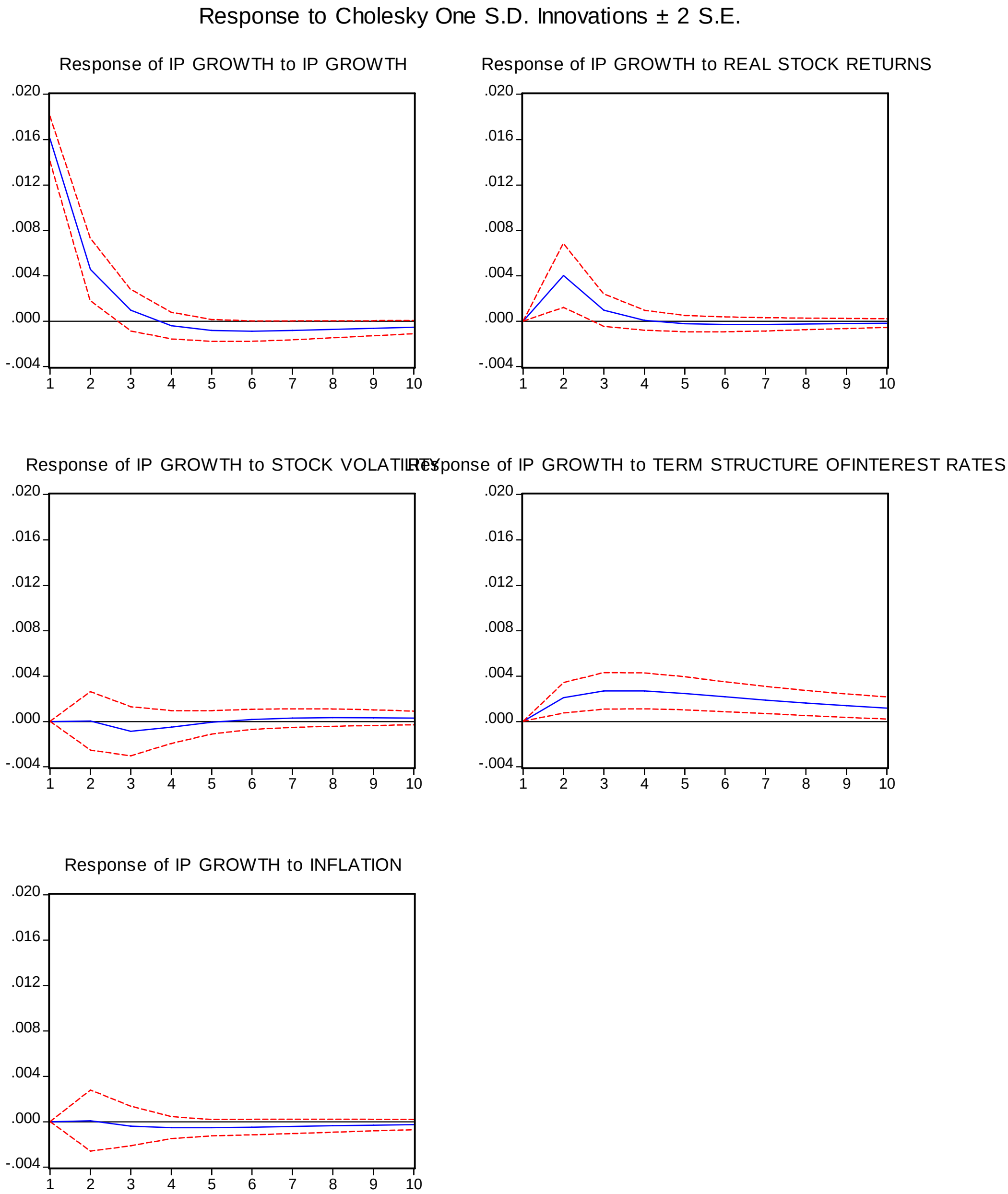
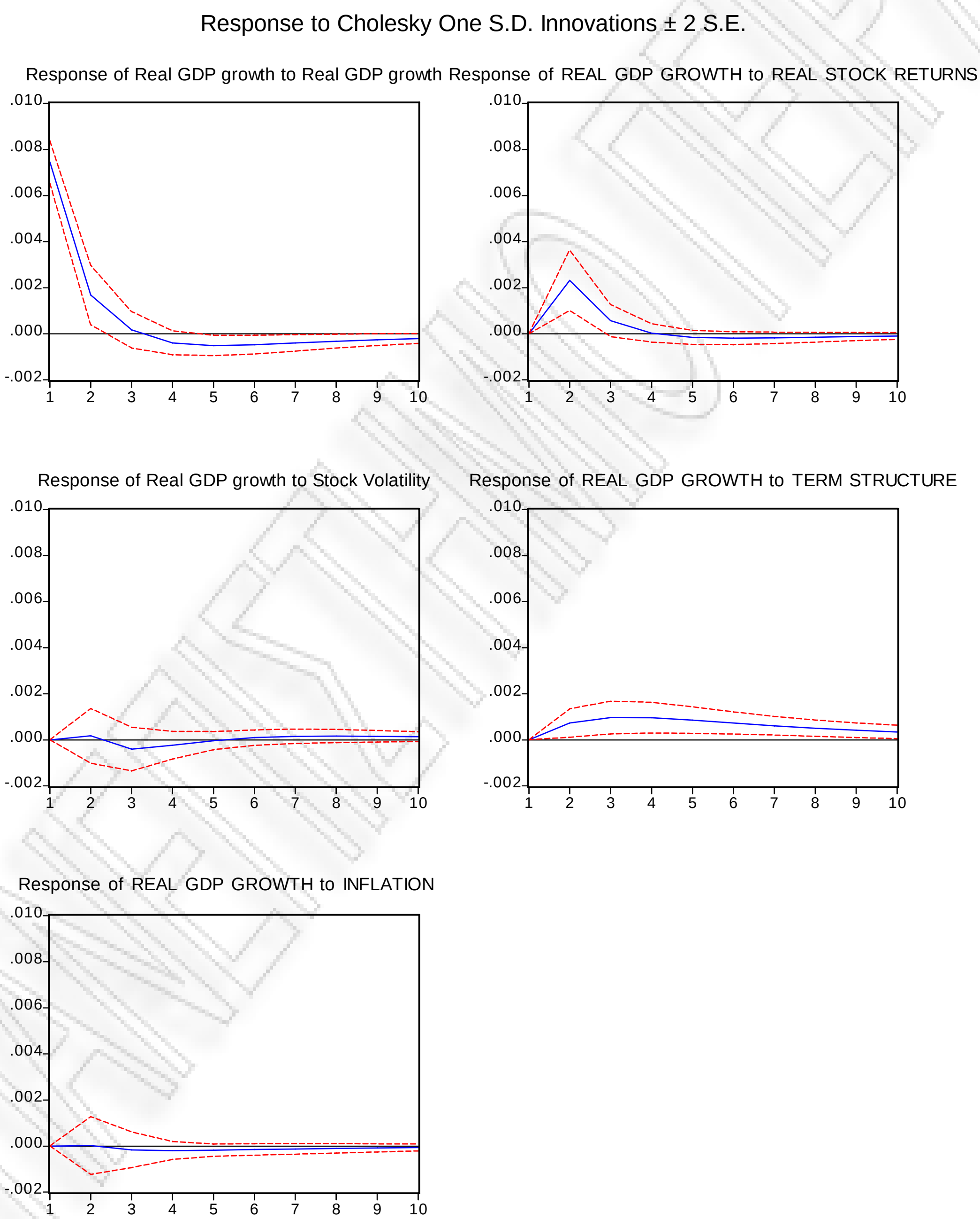


Figure VI

<u>Simulated Impulse responses of GDP growth to shocks in each variable</u>



Conclusions

According to the Granger causality tests, when real economic activity is measured as the percentage change of Industrial Production, stock returns, term structure of Interest rates and inflation are found to be significantly correlated with IP growth. Those tests, examine the causal relationship between real activity and one of the four financial variables under examination each time.

Using a bivariate VAR model consisting of IP growth and one variable each time we can verify the findings of the Granger Causality tests. When real stock returns is the only variable that is used for the explanation of real economic activity in a VAR (2) model, 7,2% of variance in IP growth can be explained by innovations in real stock returns.

Variance decomposition of IP growth explained by Innovations in real Stock returns

Period	S.E.	IP_GROWTH	REAL STOCK RETURNS
1	0.016514	100.0000	0.000000
2	0.018127	93.71085	6.289153
3	0.018368	92.94705	7.052950
4	0.018406	92.82846	7.171537
5	0.018412	92.80960	7.190396
6	0.018413	92.80659	7.193408
7	0.018413	92.80611	7.193889
8	0.018413	**92.80603**	**7.193966**

The same applies for term structure of Interest rates and inflation. When term structure of Interest rates is used as the only variable for the explanation of IP growth, about 13% of the 8 period forecast error variance in IP growth is explained by innovations of term structure of interest rates. When inflation is used for the explanation of IP growth 10,66% of the 8 period forecast error variance in IP growth can be explained by innovations in inflation. Financial Volatility does not seem to can explain IP growth.

Variance decomposition of IP growth explained by Innovations in inflation

Period	S.E.	IP GROWTH	INFLATION
1	0.014799	100.0000	0.000000
2	0.015560	99.98624	0.013761
3	0.015952	96.65190	3.348100
4	0.016565	95.16099	4.839006
5	0.017144	93.42272	6.577278
6	0.017534	90.89684	9.103162
7	0.017875	91.20129	8.798709
8	0.018081	**89.33820**	**10.66180**

Variance decomposition explained by Innovations in Term Structure

Period	S.E.	IP growth	Term Structure of Interest rates
1	0.015370	100.0000	0.000000
2	0.015861	99.70628	0.293720
3	0.016135	98.61915	1.380853
4	0.016636	95.62369	4.376308
5	0.017546	92.90539	7.094613
6	0.018112	89.29011	10.70989
7	0.018495	87.49066	12.50934
8	0.018909	**87.01810**	**12.98190**

With all the variables under examination in the VAR system, the explanatory power of the term structure of interest rates concerning the variation in IP growth remains stable, while the explanatory power of real stock returns reduces to 5% and the power of inflation becomes almost zero (0,36%). Figure V shows that a shock either in stock volatility or in inflation has very little or no impact on IP growth for 1 up to 10 period ahead forecasts. On the other hand, a shock in term structure of Interest rates affects positively the growth in industrial production for 1 up to 2 period ahead forecasts. The positive relationship starts to decay (remaining positive) after 3 periods ahead forecast, and tends to zero as time goes by.

When real economic activity is measured by the use of real GDP growth the conclusions are almost the same: Term structure of Interest rates and real stock returns are found to be significant correlated with the values of IP growth. The fact that in the case of Canada stock volatility and inflation don't have any predictive power over real GDP growth (and thus they cannot predict real economic activity) can be easily confirmed by taking a glance at the variance decomposition analysis concerning the real GDP per capita and the simulated response of GDP growth to each of the four variables, for a forecasting horizon of one up to ten periods ahead.

Comparing the two measures of real economic activity we are leaded to the following conclusion: When growth in real GDP per capita is used as a measure of real economic activity, real stock returns explains better than the other variables its variation. When growth in Industrial Production is used a measure of real economic activity, the variable that has the better explanatory power concerning the variation of IP growth, is the term structure of Interest rates. In both scenarios, inflation and stock volatility explain very little or no variation in economic activity.

ITALY

Due to lack of data concerning the growth of real GDP, we will use IP growth as the only measure of real economic activity. The data sample covers the period from Q2 1973 until Q2 2006. The only exception is the term structure of Interest rates which covers the period from Q1 1981 until Q2 2006.

Granger Causality tests

Pairwise Granger Causality Tests
Date: 05/21/07 Time: 20:08
Sample: 1973Q2 2006Q2
Lags: 1 (According to the Akaike Information criterion)

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Real Stock returns	131	0.03691	0.84795
Real Stock returns does not Granger Cause IP growth		1.77050	0.18569

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Stock market volatility	131	0.53387	0.46632
Stock volatility does not Granger Cause IP growth		0.40076	0.52783

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	124	0.95179	0.47768
IP GROWTH does not Granger Cause INFLATION		1.85132	0.07540

Sample: 1981Q2 2006Q2
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP growth does not Granger Cause Term Structure	99	1.56993	0.21347
Term Structure does not Granger Cause IP growth		0.11222	0.89397

Variance decomposition analysis. (Testing the percentage of variance in IP growth explained by past innovations in each of the financial variables.)

Period	S.E.	IP GROWTH	REAL STOCK RETURNS
1	0.017256	100.0000	0.000000
2	0.018458	98.79859	1.201408
3	0.018603	98.62895	1.371052
4	0.018620	98.60801	1.391991
5	0.018623	98.60548	1.394522
6-10	0.018623	98.60517	1.394827

Period	S.E.	IP GROWTH	STOCK MARKET VOLATILITY
1	0.017348	100.0000	0.000000
2	0.018450	99.80455	0.195451
3	0.018604	99.65393	0.346074
4	0.018630	99.58346	0.416543
5	0.018636	99.55657	0.443428
6-10	0.018637	99.54730	0.452699

Period	S.E.	IP GROWTH	INFLATION
1	0.016316	100.0000	0.000000
2	0.016877	99.32882	0.671177
3	0.016942	98.61249	1.387506
4	0.017078	97.14112	2.858883
5	0.017224	96.52643	3.473569
6	0.017324	95.76107	4.238933
7	0.017386	95.70412	4.295885
8	0.017411	95.65974	4.340261
9	0.017510	95.75729	4.242714
10	0.017543	95.43205	4.567955

Period	S.E.	IP GROWTH	TERM STRUCTURE OF INTEREST RATES
1	0.013476	100.0000	0.000000
2	0.013704	99.89452	0.105485
3	0.013723	99.78202	0.217977
4	0.013731	99.69247	0.307527
5	0.013736	99.62480	0.375204
6	0.013740	99.57414	0.425858
7	0.013743	99.53629	0.463706
8	0.013745	99.50802	0.491983

Conclusions

As we can see from the above tests, none of the lagged values of Inflation seems to be significantly correlated with the current values of IP growth. Term structure of Interest rates, stock volatility, real stock returns as well as inflation; don't seem to have any explanatory power over IP growth. **Table 11** summarizes the results of the variance decomposition analysis concerning the Industrial Production growth indicating that, in the presence of all financial variables in the VAR system, the largest fraction of the 8 period forecast error variance of IP growth (97,02%) is explained by its own past innovations while only 1,07% , 1,19% , 0,25% and 0.47% of its variance is explained by innovations in real stock returns, stock volatility term structure of Interest rates and Inflation respectively confirming the fact that the above variables have very little or no predictive power over the it. The same results appear in the diagrams of figure VII. A shock either in real stock returns, stock volatility, and term structure of Interest rates or in inflation has no impact on IP growth for 1 up to 10 period ahead forecasts.

Figure VII

Simulated impulse responses of IP growth to shocks in each variable

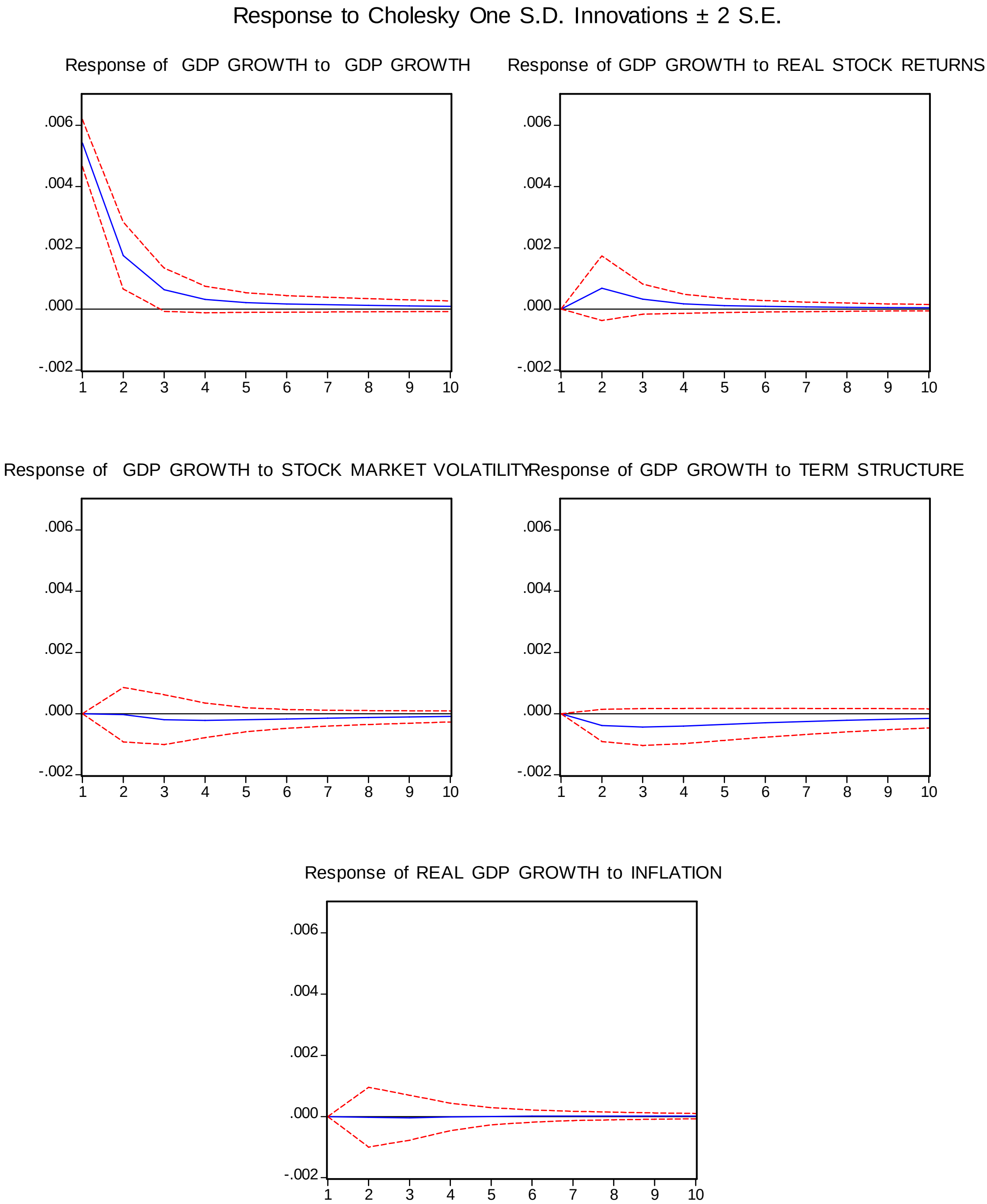


Table 11

Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
	1	100	0	0	0	0
	2	98.12254	1.082765	0.280749	0.089953	0.423995
	3	97.524	1.074089	0.783956	0.149738	0.468219
Industrial Production growth	4	97.23734	1.072859	1.031202	0.187376	0.471223
	5	97.11431	1.072613	1.131141	0.211202	0.470736
	6	97.06012	1.072166	1.170423	0.226827	0.470467
	7	97.03366	1.07186	1.186763	0.237368	0.470344
	8	97.01913	1.071717	1.194272	0.244609	0.470271

Percentage of 8 period Forecast error variance explained by Innovations in each variable based on five variable Innovation accounting using Growth in Industrial Production, Real Stock returns, Stock return volatility, inflation and term structure of Interest rates. (Optimal Lag length according to AIC:1)

United Kingdom

We start running Granger Causality tests using first, growth in Industrial Production as a measure of real economic activity. The data sample covers the period Q4 1962 until Q2 2006. Then, we change the measure of real economic activity using this time the growth of real GDP per capita. The financial variables under examination are again real stock returns, stock volatility, term structure of interest rates and inflation. After running the Granger causality tests we proceed further by estimating a VAR (5) model from which we compute the forecast error variance in IP growth and GDP growth explained by the above variables as well as the responses of IP growth and GDP growth to shocks in each of the variables under examination. The number of the lagged values of the endogenous variables that are used for the estimation of the VAR(5) are defined with the use of the Akaike Information Criterion.

Granger Causality tests when real economic activity is measured as the percentage change of Industrial Production

Pairwise Granger Causality Tests
Date: 05/26/07 Time: 17:51
Sample: 1962Q4 2006Q1
Lags: 7

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause REAL STOCK RETURNS	167	3.24255	0.00310
REAL STOCK RETURNS does not Granger Cause IP GROWTH		3.62188	**0.00122**

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
Term Structure does not Granger Cause IP GROWTH	172	3.88255	**0.02248**
IP GROWTH does not Granger Cause Term Structure		4.18846	0.01679

Pairwise Granger Causality Tests
Date: 05/26/07 Time: 18:06
Sample: 1962Q4 2006Q1
Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
Inflation does not Granger Cause IP GROWTH	166	2.97487	**0.00404**
IP GROWTH does not Granger Cause Inflation		1.77994	0.08522

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause STOCK VOLATILITY	111	2.0E-05	0.99648
STOCK VOLATILITY does not Granger Cause IP GROWTH		4.10420	**0.04524**

Granger Causality tests when real economic activity is measured as the percentage change of real GDP

Pairwise Granger Causality Tests
Date: 05/26/07 Time: 19:03
Sample: 1962Q4 2006Q1
Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause REAL STOCK RETURNS	166	2.34696	0.02097
REAL STOCK RETURNS does not Granger Cause POUND REAL GDP		3.03594	**0.00344**

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause IP GROWTH	172	3.88255	0.02248
IP GROWTH does not Granger Cause TERM STRUCTURE		4.18846	**0.01679**

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
POUND REAL GDP GROWTH does not Granger Cause INFLATION	166	4.98851	1.7E-05
INFLATION does not Granger Cause REAL GDP GROWTH		2.40667	**0.01799**

Sample: 1978Q2 2006Q1
Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause REAL GDP GROWTH	109	0.34564	0.79237
REAL GDP GROWTH does not Granger Cause STOCK VOLATILITY		0.31002	0.81810

According to the above Granger Causality Tests, lagged values of real stock returns, term structure of interest rates and inflation seem to be significantly correlated with real economic activity no matter how economic activity is measured. Stock Volatility seems to granger cause real economic activity only when economic activity is measured as the percentage change of Industrial production Index.

These findings broadly confirm the theoretical explanations on the relationship between these variables and output growth. The predictive power of lagged values of the financial variables under examination can be easily verified through the structural analysis of a VAR model.

The results of the Variance decomposition analysis of a VAR consisting of five endogenous variables that present the percentage of the variance in real economic activity measured either by GDP growth or IP growth explained by innovations in each financial variable, are summarized in tables 12 and 13.

According to **table 12**, in the presence of all financial variables in the VAR system, 66,5% of the 8 period forecast error variance in IP growth is explained by its own past innovations. Real Stock returns, term structure of interest rates and inflation explain 7,69% , 13,45% and 10,54% respectively of 8 period forecast error variance in IP growth confirming in this way the significant correlation between all the above variables and real economic activity. Stock Volatility seems to loose its explanatory power with all the variables in the VAR.

When real economic activity is measured as the percentage change of real GDP the results are almost the same: According to **table 13**, 67,45% of the 8 period forecast error variance in GDP growth is explained by its own past innovations while real Stock returns, inflation and term structure of interest rates explain 11,43% , 6,44% and 8,13% of variation in IP growth. What is worth to be mentioned in table 13, is the fact that although stock volatility does not granger cause GDP growth according to Granger causality tests, with all the variables under examination in a VAR stock volatility can explain 6,54% of its variation.

The same results appear in the diagrams of figure VII and IX. A shock either in real stock returns, stock volatility, term structure of interest rates or in inflation, has a deep impact on IP growth and GDP growth for 1 up to 10 period ahead forecasts.

Summary statistics of Variance decomposition analysis (Optimal lag length according to AIC:8)

Table 12

Country	Variables explained	Period	By innovations in: Industrial Production growth	Real Stock returns	Stock Volatility	Term Structure of Interest rates	Inflation
United Kingdom	**Industrial Production growth**	1	100	0	0	0	0
		2	93.03958	0.829154	0.178934	4.370622	1.58171
		3	88.02791	2.439326	0.601678	6.012975	2.918108
		4	80.96794	3.206778	0.889864	6.780521	8.154897
		5	74.82048	6.538162	1.22445	6.316796	11.10011
		6	72.07946	6.851512	1.306997	8.313809	11.44822
		7	69.64882	6.509015	1.576104	11.37931	10.88675
		8	66.51243	7.687696	1.817073	13.4452	10.53759

Table 13

Summary statistics of Variance decomposition analysis ((Optimal lag length according to AIC:8)

Country	Variables explained	Period	By innovations in: Real GDP growth	Real Stock returns	Stock Volatility	Term Structure of Interest rates	Inflation
United Kingdom	**Real GDP growth**	1	100	0	0	0	0
		2	95.67688	0.141046	3.536684	0.643171	0.002219
		3	86.93339	7.352713	4.07744	0.611166	1.025295
		4	76.94749	9.920409	4.658609	2.846328	5.627159
		5	74.15082	10.82386	6.092977	2.7546	6.177742
		6	73.16482	10.65714	6.136965	3.402335	6.63874
		7	69.50386	10.31688	6.523639	5.468096	8.187525
		8	67.45216	11.43486	6.536481	6.447693	8.1288

Figure VIII

Dynamic Impulse responses of IP growth in each variable

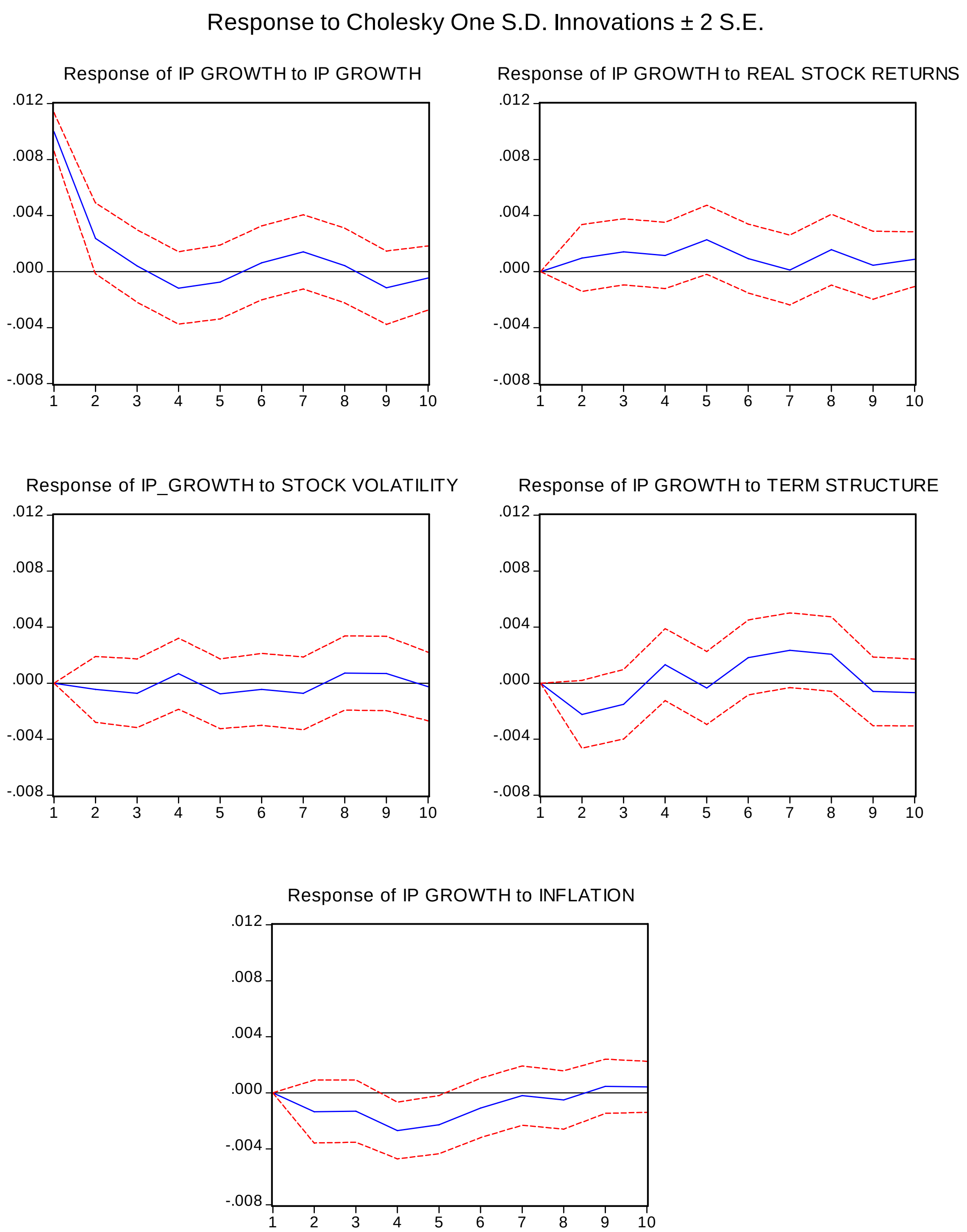
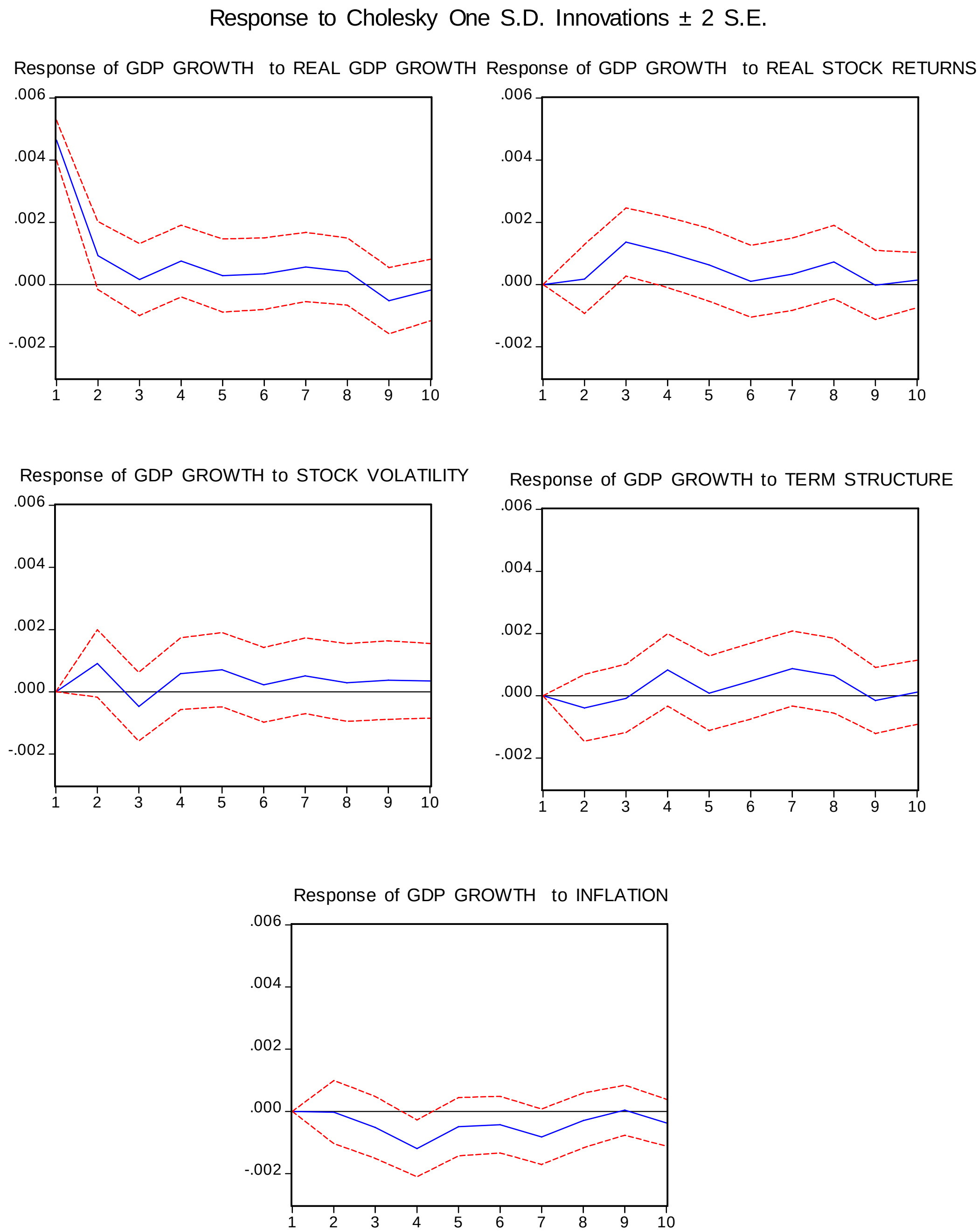


Figure IX

Dynamic Impulse responses of GDP growth in each variable



France

Granger Causality tests when real economic activity is measured as the percentage change of Industrial Production

As far as France is concerned, the data sample covers the period from Q2 1988 until Q1 2007. According to unit root tests, term structure of interest rates is not a stationary time series and thus we omit this variable from our analysis.

Pairwise Granger Causality Tests
Date: 06/19/07 Time: 00:38
Sample: 1988Q2 2005Q1
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	67	0.60236	0.44054
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.33699	0.56361

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause STOCK VOLATILITY	67	0.29208	0.59076
STOCK VOLATILITY does not Granger Cause IP GROWTH		0.39983	0.52943

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger INFLATION	67	0.01623	0.89901
INFLATION does not Granger Cause IP GROWTH		0.30672	0.58163

Granger Causality tests when real economic activity is measured as the percentage change of Real GDP

Pairwise Granger Causality Tests
Date: 05/31/07 Time: 17:48
Sample: 1988Q2 2005Q1
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause REAL STOCK RETURNS	67	0.76263	0.38577
REAL STOCK RETURNS does not Granger Cause REAL GDP GROWTH		2.41101	0.12542

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause REAL GDP GROWTH	67	2.92519	0.09205
REAL GDP GROWTH does not Granger Cause STOCK VOLATILITY		0.60901	0.43804

Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
REAL GDP GROWTH does not Granger Cause Inflation	65	0.81802	0.48917
Inflation does not Granger Cause REAL GDP GROWTH		0.73405	0.53594

According to the above Granger Causality tests, when real economic activity is measured as the percentage change of Industrial Production, none of the variables under examination seems to be significantly correlated with IP growth. If we construct bivariate VAR models consisting of IP growth and one financial variable each time we can easily verify the above conclusion.

Table 14 shows that in the presence of all the variables under examination in the VAR, 98.49% of the variations in IP growth are explained by its own innovations confirming the fact that real stock returns, stock volatility and inflation have no predictive power over real economic activity. The same applies for the rest of the financial variables.

Table 14

Summary statistics of Variance decomposition analysis when all the variables under examination are included (Optimal lag length:1)

Country	Variables explained	Period	By innovations in **Industrial Production growth**	**Real Stock returns**	**Term Structure**	**Inflation**
France	**Industrial Production growth**	1	100	0	0	0
		2	98.87516	0.624361	0.250545	0.249932
		3	98.57656	0.63681	0.534349	0.252284
		4	98.52668	0.646306	0.569166	0.257851
		5	98.50273	0.64701	0.592457	0.257806
		6	98.49485	0.647345	0.599908	0.257895
		7	98.49188	0.647498	0.602714	0.257906
		8	98.49077	0.647547	0.603776	0.25791

Table 15

Summary statistics of Variance decomposition analysis

Country	Variables explained	Period	By innovations in **Real GDP growth**	**Real Stock returns**	**Term Structure**	**Inflation**
France	**Real GDP growth**	1	100	0	0	0
		2	95.747	1.99069	1.896831	0.365483
		3	93.05701	2.03238	4.502057	0.408549
		4	91.95233	2.17142	5.470662	0.405587
		5	91.45843	2.203366	5.934788	0.403419
		6	91.28269	2.214217	6.099629	0.403461
		7	91.22217	2.217883	6.156419	0.403529
		8	91.20242	2.218877	6.175116	0.403589

As far as the Real GDP growth is concerned, Granger Causality tests have shown that none of the financial variables under examination is significantly correlated with this measure of real economic activity. If we construct bivariate VAR models consisting of the growth in real GDP and one financial variable each time, we are lead to different conclusions. The tables below present the 1 up to 8 periods forecast error variance in IP growth explained by variations in GDP growth and one of the financial variables each time:

Period	S.E.	REAL GDP GROWTH	REAL STOCK RETURNS
1	0.004304	100.0000	0.000000
2	0.004707	96.95863	3.041370
3	0.004750	96.87319	3.126812
4	0.004756	96.85019	3.149807
5	0.004757	96.84780	3.152203
6	0.004757	96.84744	3.152563
7	0.004757	96.84739	3.152610
8	0.004757	96.84738	**3.152616**

Period	S.E.	REAL GDP GROWTH	STOCK VOLATILITY
1	0.004287	100.0000	0.000000
2	0.004620	97.31055	2.689445
3	0.004703	94.98566	5.014344
4	0.004733	93.81120	6.188799
5	0.004745	93.34174	6.658259
6	0.004749	93.17742	6.822582
7	0.004751	93.12478	6.875225
8	0.004751	93.10898	**6.891024**

Period	S.E.	REAL GDP GROWTH	INFLATION
1	0.004307	100.0000	0.000000
2	0.004471	99.28262	0.717380
3	0.004627	99.27302	0.726981
4	0.004739	96.45414	3.545863
5	0.004767	96.04315	3.956852
6	0.004786	95.83719	4.162807
7	0.004807	95.05162	4.948378
8	0.004811	94.95066	**5.049342**

According to the above tables, the variations in two of the three variables explain a portion equal to or greater than 5% of the variation in GDP growth indicating that those variables have some explanatory power over real economic activity. Real Stock returns explain only 3,15% of the variation in real GDP growth and thus we can say that this variable has very little or no explanatory power

With all the variables in the VAR, the results from its structural analysis are almost the same: Concerning the 8 period forecast error variance in real GDP growth, 2.21%, 6.17 and 0.40% of its variations is explained by variations in real stock returns, stock volatility and term inflation respectively. Inflation seems to loose its explanatory power when tested with all the variables in the VAR.

Figures IX and X present the dynamic responses of IP growth and Real GDP growth respectively to shock in real Stock returns, Stock Volatility, and Inflation. Figure IX verifies the fact that all the variables under examination have no (or very little) explanatory power over IP growth whereas figure X verifies the fact that a shock either in stock volatility has some impact on real GDP growth.

Figure IX

Simulated impulse responses of IP growth to shocks in each variable.

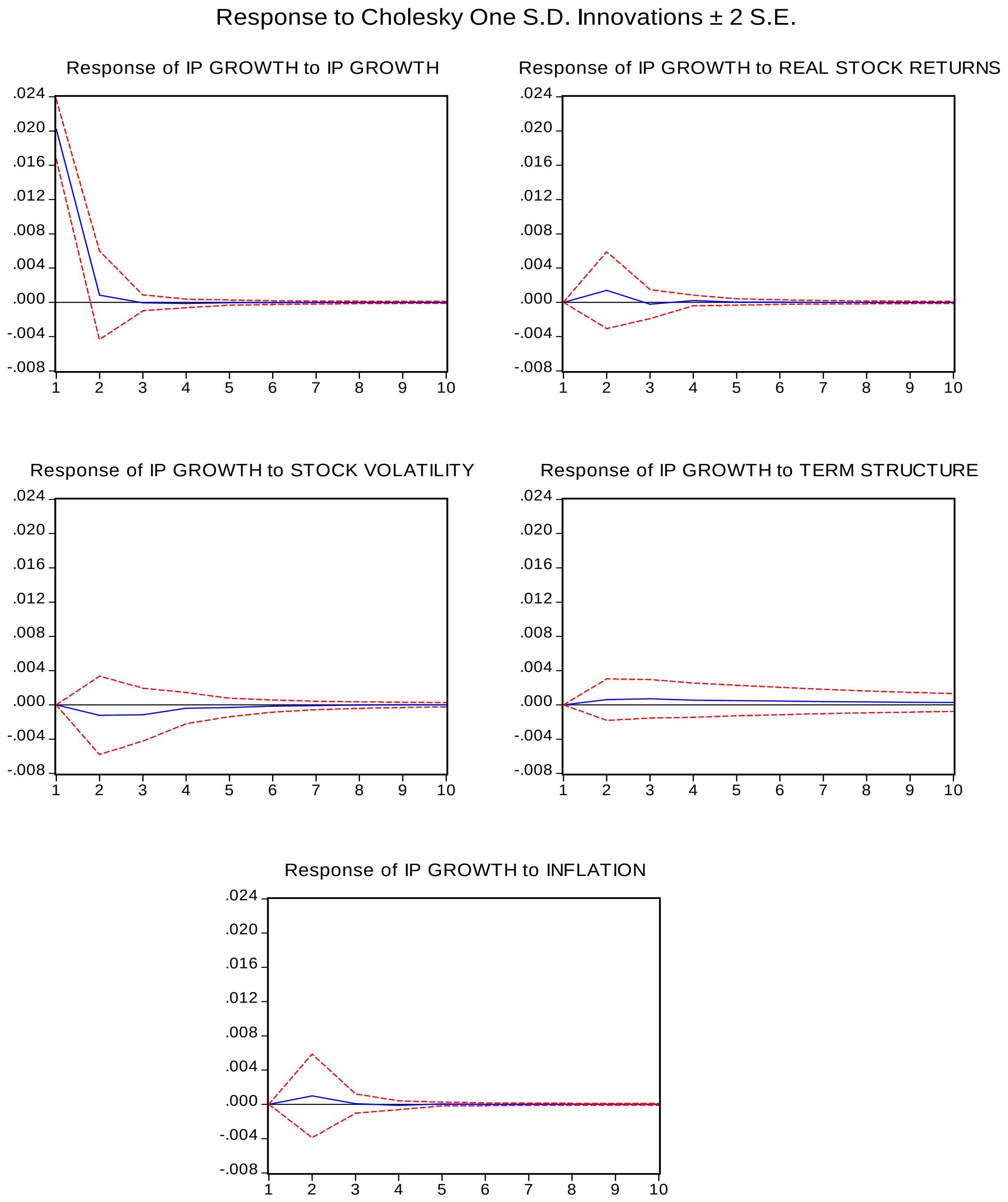
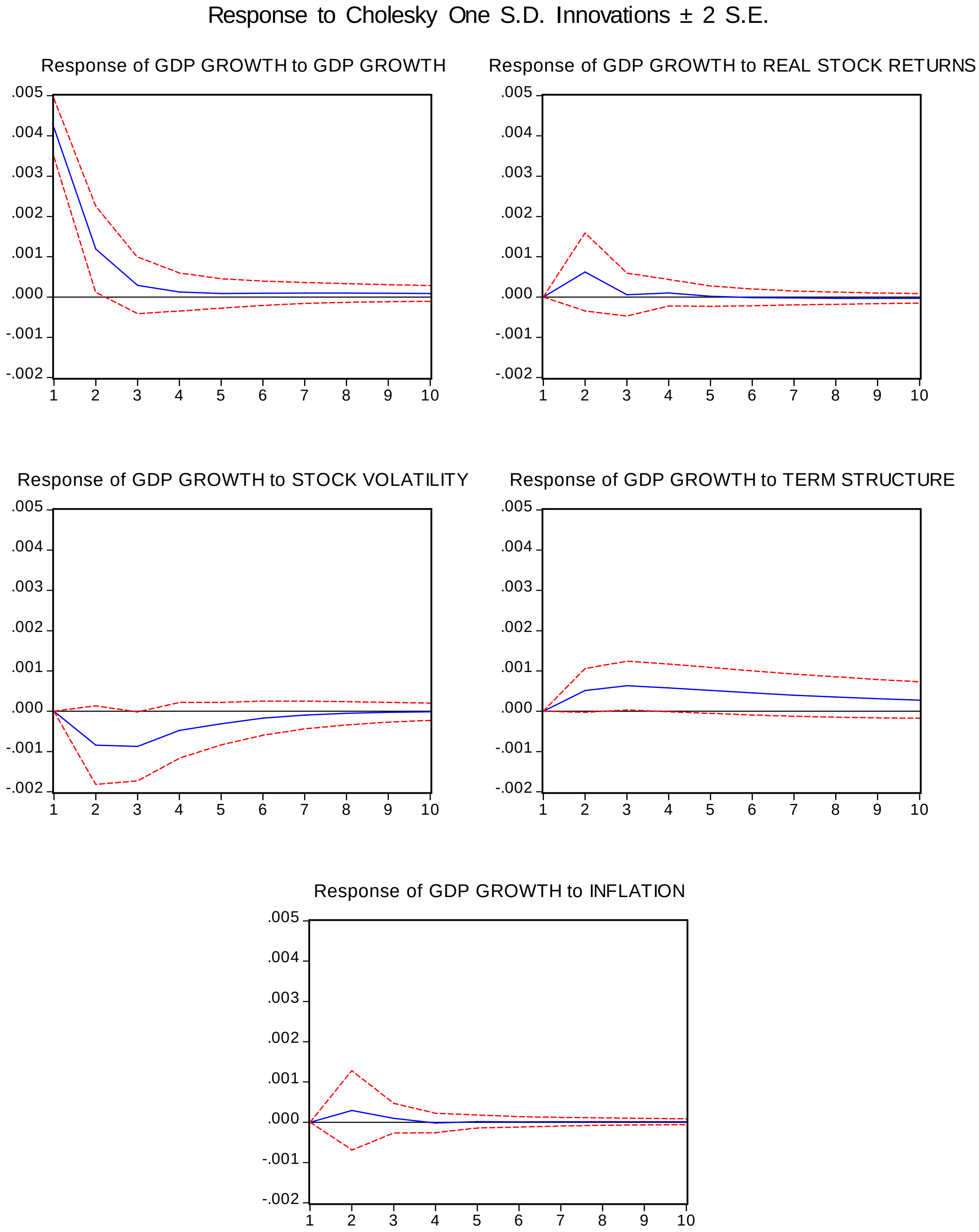


Figure X

Simulated impulse responses of real GDP growth to shocks in each variable



AUSTRIA

The data sample covers the period from Q2 1973 until Q2 2006. Due to lack of data concerning the term structure of Interest rates, only real stock returns, stock volatility and term structure of Interest rates are going to be examined.

Pairwise Granger Causality Tests
Date: 05/30/07 Time: 13:11
Sample: 1973Q2 2006Q2
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause REAL STOCK RETURNS	132	0.79779	0.37342
REAL STOCK RETURNS does not Granger Cause IP GROWTH		1.15608	0.28429

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause STOCK VOLATILITY	131	3.40330	**0.03635**
STOCK VOLATILITY does not Granger Cause IP GROWTH		0.17005	0.84381

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause INFLATION	129	2.36951	0.05635
INFLATION does not Granger Cause IP GROWTH		1.02392	0.39786

Table 1

Summary statistics of Variance decomposition analysis(Optimal lag length according to AIC:1)

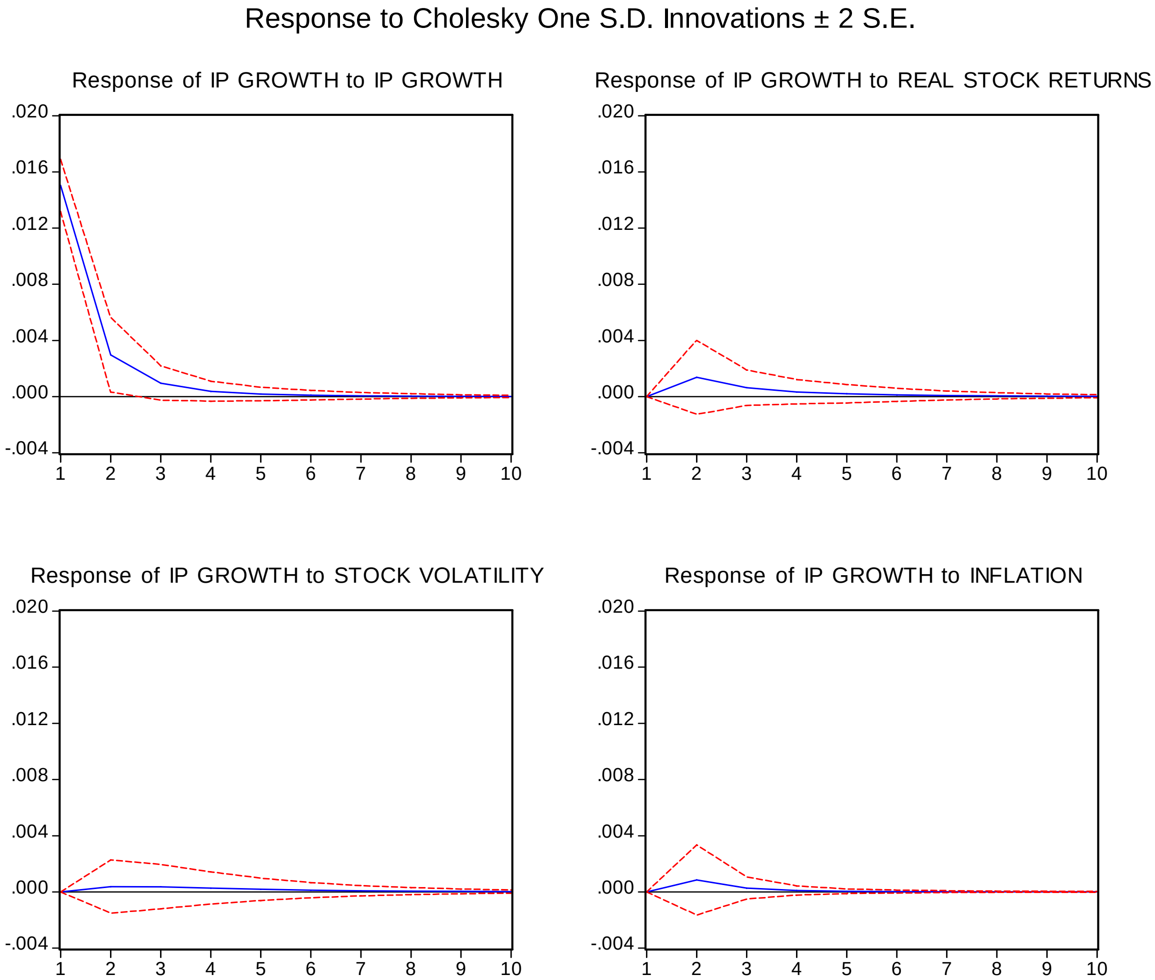
Country	Variables explained	Period	By innovations in: **Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Inflation**
Austria	**Industrial Production growth**	1	100	0	0	0
		2	98.85062	0.787522	0.059256	0.302599
		3	98.59799	0.952895	0.116594	0.332518
		4	98.51623	0.999599	0.147961	0.336206
		5	98.48488	1.015799	0.162471	0.336848
		6	98.47217	1.022039	0.168788	0.337006
		7	98.46691	1.02456	0.171473	0.337055
		8	98.46472	1.025599	0.172604	0.337074

According to the Granger causality tests, none of the above variables seems to be significantly correlated with IP growth. The variance decomposition analysis of a VAR(4) consisting of real stock returns, stock volatility, inflation and IP growth as well as the impulse response of IP growth to shocks in innovations of the above variables reveal the same conclusions: As we can see from **table 1**, the largest part of the 8 period forecast error variance in IP growth is explained by the variations its own lags while only 1,02% , 0,17% and 0.33% of its variations is explained by variations in real stock returns, stock volatility and inflation.

Figure I shows that a shock in the variables under examination has very little, almost no impact on IP growth.

Figure 1

Dynamic Impulse responses of IP growth to shocks in each variable



Belgium

Pairwise Granger Causality Tests
Date: 06/14/07 Time: 10:48
Sample: 1973Q2 2006Q2
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	129	2.89656	**0.02491**
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.50291	0.73365

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	132	1.62846	0.20421
IP GROWTH does not Granger Cause STOCK VOLATILITY		0.84494	0.35970

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause IP GROWTH	129	4.33972	**0.00259**
IP GROWTH does not Granger Cause TERM STRUCTURE		0.18452	0.94606

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause INFLATION	131	2.53300	0.08346
INFLATION does not Granger Cause IP GROWTH		5.02645	**0.00794**

Table 3

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**
Belgium	**IP Growth**	1	100	0
		2	99.57231	0.427691
		3	99.41449	0.58551
		4	96.02892	3.971075
		5	92.37092	7.629077
		6	92.3674	7.632596
		7	92.36911	7.630888
		8	92.36312	7.636884

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
Belgium	**IP Growth**	1	100	0
		2	98.22676	1.77324
		3	98.22664	1.773361
		4	98.25525	1.744751
		5	98.25734	1.742661
		6	98.25715	1.742854
		7	98.25514	1.744861
		8	98.25453	1.745471

Country	**Variables explained**	**Period**	**IP growth**	**term structure**
Belgium	**IP Growth**	1	100	0
		2	97.70979	2.290209
		3	97.09838	2.901615
		4	89.38422	10.61578
		5	88.8752	11.1248
		6	88.76986	11.23014
		7	88.73759	11.26241
		8	88.72995	11.27005

		By Innovations in		
Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
Belgium	**IP Growth**	1	100	0
		2	99.98975	0.010245
		3	98.74799	1.252007
		4	92.39041	7.609586
		5	90.51406	9.485937
		6	90.29807	9.701933
		7	90.29492	9.705075
		8	89.79246	10.20754

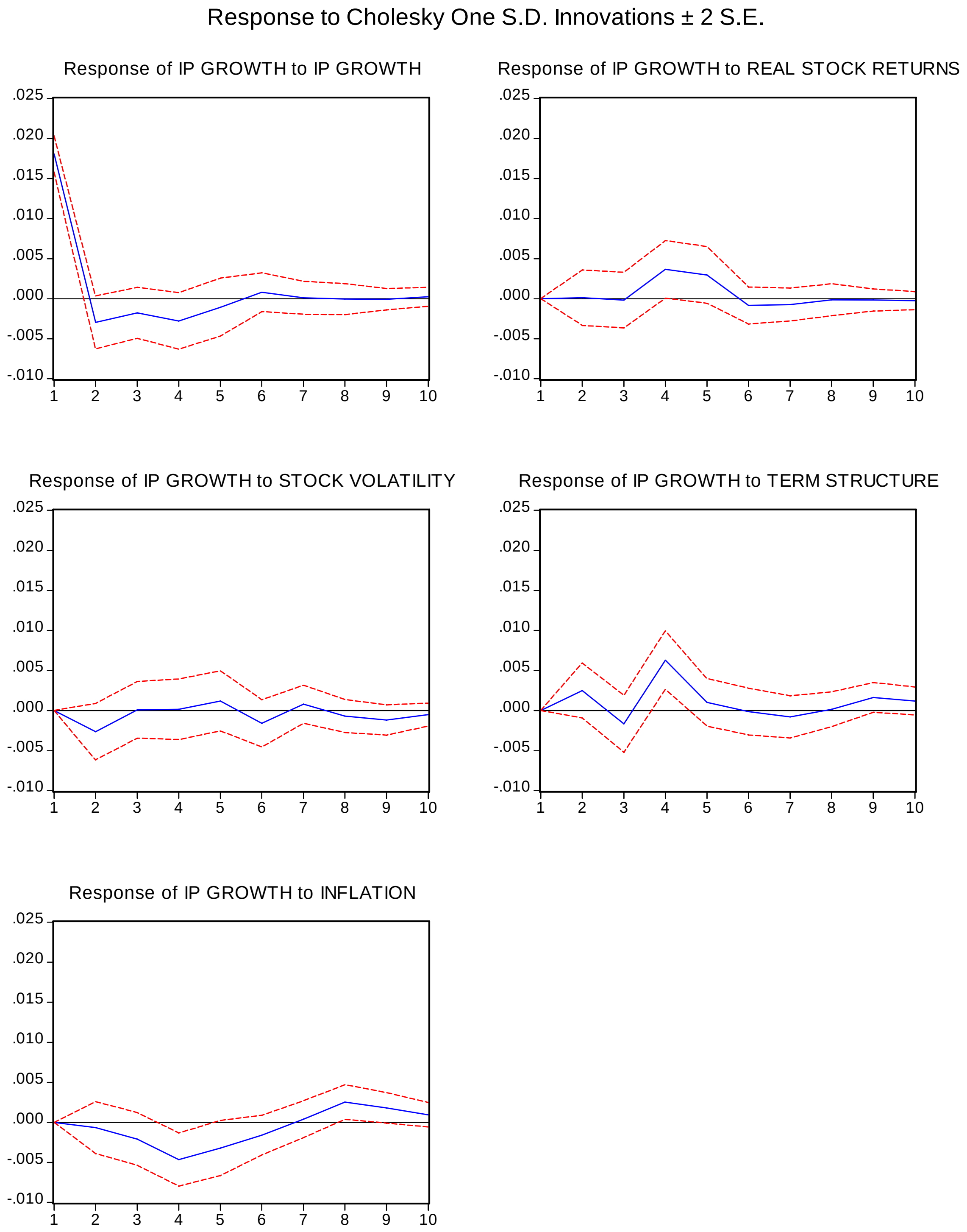
Table 4

Summary statistics of Variance decomposition analysis when all the variables under examination are included in the VAR (Optimal Lag length:4)

			By innovations in				
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Belgium	**Industrial Production growth**	1	100	0	0	0	0
		2	96.09694	0.00358	1.997031	1.777041	0.125406
		3	94.20842	0.013133	1.94078	2.510705	1.326964
		4	78.44006	3.035736	1.584051	10.96263	5.977531
		5	74.8634	4.76674	1.81345	10.64881	7.907599
		6	73.95467	4.855482	2.337924	10.50462	8.347304
		7	73.64883	4.951381	2.455913	10.59978	8.344089
		8	72.57891	4.883777	2.521213	10.45004	9.566066

Figure 2

Dynamic responses of IP growth to shocks in each variable



Conclusions

Granger Causality tests show that the lagged values of the three out of four variables under examination Granger Cause Industrial Production. Next, we construct bivariate models consisting of IP growth and one financial variable each time and through their structural analysis (variance decomposition) we try to verify the fact that the lagged values of real stock returns, term structure of inflation seem to be statistically significant predictors of real economic activity.

Table 3 shows that, when real stock returns is the only explanatory variable concerning the IP growth, 7.63% of the variations in IP growth is explained by variations in real stock returns. Following the same technique, when term structure of interest rates or inflation is used as the only explanatory variable for the explanation of real economic activity, 11.27% and 10.20% respectively of the 8 period ahead forecast error variance in IP growth is explained by variations in term structure and inflation. With all the variables in the VAR (Table 4), term structure and inflation sustain their explanatory power (explaining 10.45% and 9.56% respectively of the 8 period ahead forecast error variance in IP growth) while real stock returns seems to loose part of its predictive power explaining less than but very close to 5% of the variations in IP growth. According to Granger causality test and the structural analysis of the VAR, lagged values of stock volatility are not significantly correlated with current values of IP growth.

Figure 2 shows that a shock in real stock returns has no impact on IP growth up to three steps ahead forecast. Then a shock in stock returns seems to influence positively IP growth. This positive relationship starts decaying after 4 steps ahead forecast and becomes almost zero after 6 steps. As far as inflation is concerned, a shock in this variable affects negatively IP growth for 1 up to 7 periods ahead forecast. This negatively relationship takes its highest value after 4 steps ahead forecast. Then, it starts decaying and becomes positive after 8 periods ahead forecast. Finally a shock in term structure of interest rates affects IP growth up to six periods ahead forecast. The direction of the relationship between shocks in term structure and IP growth (positive or negative) changes from 1 up to six steps ahead forecast.

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Ireland

Pairwise Granger Causality Tests
Date: 06/06/07 Time: 17:37
Sample: 1973Q2 2006Q2
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	130	3.14740	0.14565
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.70413	0.98334

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	130	0.06262	0.93933
IP GROWTH does not Granger Cause STOCK VOLATILITY		2.41773	0.09328

Lags: 5

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	127	1.51071	0.19179
IP GROWTH does not Granger Cause INFLATION		0.35992	0.87492

Sample: 1986Q3 2006Q2
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause TERM STRUCTURE	79	0.47591	0.49238
TERM STRUCTURE does not Granger Cause IP GROWTH		0.23956	0.62593

Table 5

Summary statistics of Variance decomposition analysis

Country	Variables explained	Period	By Innovations in: Industrial Production growth	Real Stock returns
Ireland	**Industrial Production growth**	1	100	0
		2	98.35696	1.643039
		3	98.35686	1.643143
		4	98.35684	1.643162
		5	98.35684	1.643162
		6	98.35684	1.643162
		7	98.35684	1.643162
		8	98.35684	1.643162

Country	Variables explained	Period	By Innovations in: Industrial Production growth	Stock Volatility
Ireland	**Industrial Production growth**	1	100	0
		2	99.94782	0.05218
		3	99.90832	0.09168
		4	99.90736	0.092644
		5	99.90499	0.095013
		6	99.90488	0.095117
		7	99.90479	0.095207
		8	99.90479	0.095213

Country	Variables explained	Period	By Innovations in: Industrial Production growth	Inflation
Ireland	**Industrial Production growth**	1	100	0
		2	99.48186	0.518137
		3	99.21237	0.787631
		4	99.21304	0.786961
		5	96.37247	3.627531
		6	95.88703	4.112971
		7	95.88103	4.118974
		8	95.76425	4.235751

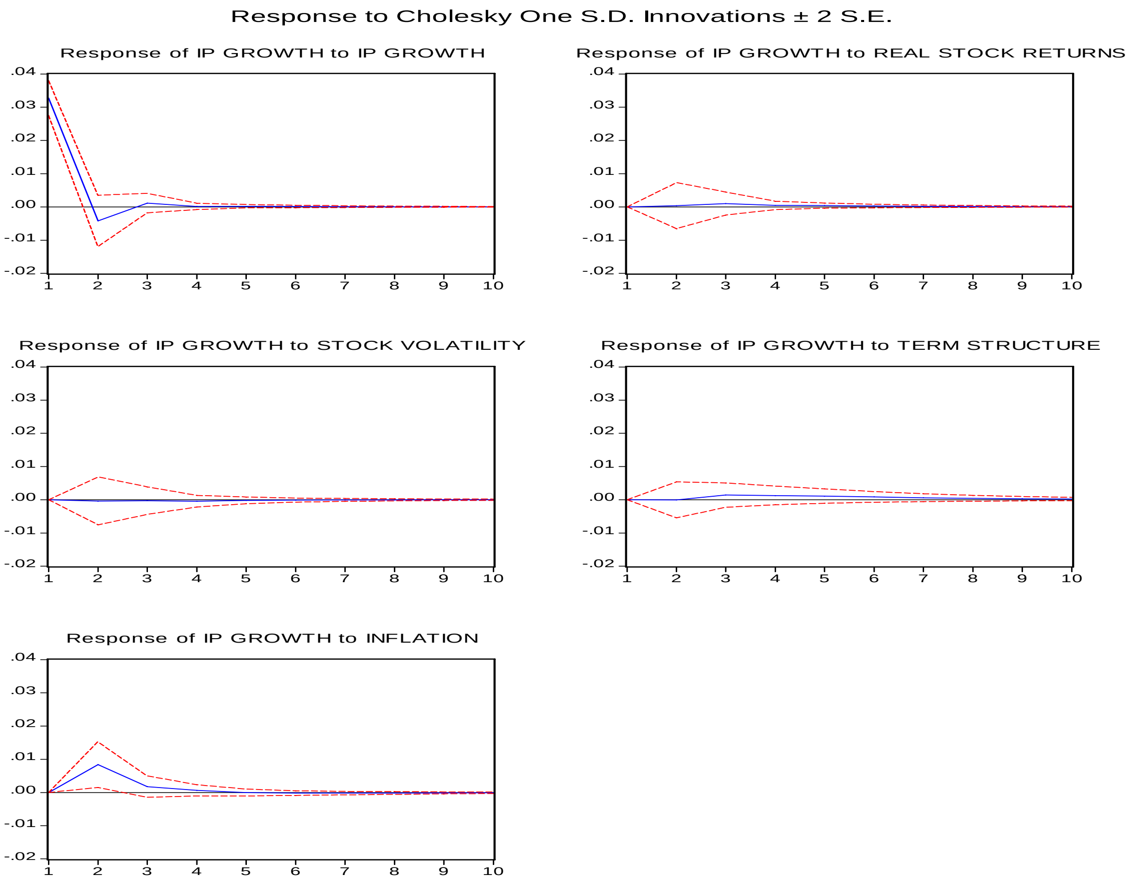
Country	Variables explained	Period	By Innovations in: Industrial Production growth	Term Structure
Ireland	**Industrial Production growth**	1	100	0
		2	99.85962	0.140384
		3	99.80263	0.197372
		4	99.76979	0.230206
		5	99.75183	0.24817
		6	99.74193	0.258072
		7	99.73647	0.263526
		8	99.73347	0.26653

Table 6

Summary statistics of Variance decomposition analysis(Optimal Lag length according to AIC:1)

Country	Variables explained	Period	By innovations in: Industrial Production growth	Real Stock returns	Stock Volatility	Term Structure of Interest rates	Inflation
Ireland	**Industrial Production growth**	1	100	0	0	0	0
		2	93.72832	0.016246	0.013713	1.46E-05	6.241709
		3	93.21588	0.1063	0.025099	0.173601	6.479122
		4	93.01065	0.122829	0.04681	0.319881	6.499827
		5	92.89151	0.136552	0.05174	0.428827	6.491367
		6	92.82425	0.141848	0.05352	0.490862	6.489522
		7	92.78723	0.144579	0.053877	0.523961	6.490357
		8	92.76836	0.145815	0.053952	0.540538	6.491334

Figure 3



Conclusions

The Granger Causality tests show that none of the variables under examination seems to be significantly correlated with current values of IP growth. Next, we construct bivariate VARs consisting of IP growth and one financial variable each time and through their structural analysis we come to the following conclusions: Real stock returns explain 1,6% of the 8 period forecast error variance in IP growth. Moreover, 0,096% of the variations in IP growth can be attributed to stock volatility while 4,23% and 0,26% of the 8 period forecast error variance in IP growth is explained by inflation and term structure respectively. These findings confirm the fact that the above variables have very little, almost negligible (inflation) or no explanatory power (real stock returns, stock volatility and term structure) over IP grwth.

With all the variables in the VAR the results of its structural analysis (Variance Decomposition, Impulse response) are almost the same: Real Stock returns explain 0,14% of the 8 period forecast error variance in IP growth. 0,053% of the variations in IP growth is explained by variations in Stock volatility while 0,54% and 6,49% of the variations in IP growth is explained by variations in term structure and inflation respectively.

Figure 3 shows that a shock either in real stock returns, stock volatility and term structure has no impact on IP growth for 1 up to 10 periods ahead forecast. On the other hand, a shock in inflations affects positively the growth in Industrial production for 1 up to 2 periods ahead forecast. Then, the positive relationship starts to decay and tends to zero as the time goes by. Consequently, with all the variables in the VAR, lagged values of inflation seem to be significantly correlated with IP growth.

Portugal

The data sample covers the period from Q3 1988 until Q2 2006. Due to lack of data concerning the term structure of interest rates we omit this variable from our analysis. The data sample of the term structure which is available for our analysis covers the period from Q1 1994 until Q2 2006 which means that this data range is not sufficient so as to give us consistent results.

Pairwise Granger Causality Tests
Date: 05/31/07 Time: 13:33
Sample: 1988Q3 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause REAL STOCK RETURNS	70	3.74531	**0.02888**
REAL STOCK RETURNS does not Granger Cause IP GROWTH		1.80364	0.17284

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause STOCK VOLATILITY	68	1.91012	0.12066
STOCK VOLATILITY does not Granger Cause IP GROWTH		1.54448	0.20115

Lags: 5

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause INFLATION	67	2.91583	**0.02077**
INFLATION does not Granger Cause IP GROWTH		1.60499	0.17379

Table 7

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**
Portugal	**IP Growth**	1	100	0
		2	99.98584	0.014161
		3	96.05247	3.947527
		4	96.13734	3.862662
		5	95.85683	4.143166
		6	95.78233	4.217666
		7	95.73795	4.262054
		8	95.71025	4.289749

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
Portugal	**IP Growth**	1	100	0
		2	98.29963	1.700366
		3	97.97968	2.02032
		4	95.93986	4.060143
		5	95.84121	4.158788
		6	95.03591	4.964093
		7	95.14593	4.85407
		8	95.21619	4.783808

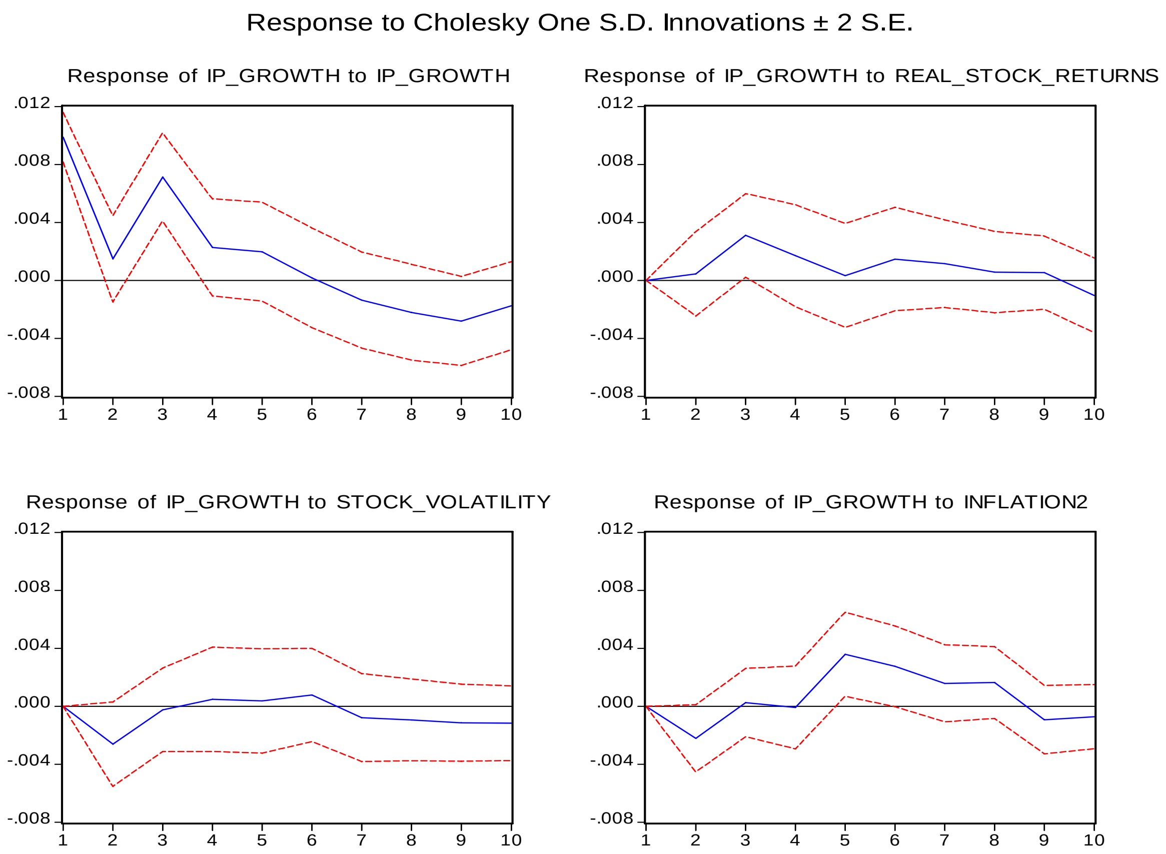
Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
Portugal	**IP Growth**	1	100.00	0.00
		2	99.01	0.99
		3	99.24	0.76
		4	99.11	0.89
		5	94.81	5.19
		6	93.32	6.68
		7	92.59	7.41
		8	92.12	7.88

Table 8

Summary statistics of Variance decomposition analysis when all the variables are included in the VAR (Optimal lag length according to AIC:5)

			By innovations in			
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Inflation**
Portugal	**Industrial Production growth**	1	100	0	0	0
		2	89.40166	0.184687	6.061489	4.352165
		3	87.44331	5.738629	3.959496	2.858564
		4	86.28571	7.076977	3.907382	2.729936
		5	80.83741	6.525944	3.640198	8.996445
		6	76.80264	7.240258	3.755288	12.20181
		7	75.40361	7.64794	3.929362	13.01909
		8	74.61837	7.496541	4.164504	13.72058

Dynamic responses of IP growth to shocks in each variable



Conclusions

Due to lack of data concerning the growth of real GDP we will use only IP growth as a measure of real economic activity. Granger causality tests show that none of the above variables seems to Granger cause real economic. On the other hand, it is proved that it is Industrial production growth the lagged values of which can help in the prediction of real stock returns and inflation.

The fact that the lagged values of the above financial variables are not able to predict a substantial part of real economic activity is NOT verified by the coefficients of the VARs and their structural analysis. Table 8 shows the percentage of the variation in IP growth explained by its own innovations and the innovations of one variable each time. According to this table, inflation manages to explain more than 5% of the variations in IP growth. With all the variables in the VAR the results are almost the same: Real Stock returns, Stock volatility and inflation explain 7.49%, 4.16% and 13.72% respectively, of the 8 periods ahead forecast error variance in IP growth. According to these findings, the predictive power of lagged values of inflation strengthens while now real stock returns seems to be significantly correlated with IP growth explaining more than 5% of its 8 period ahead forecast error variance.

Spain

Granger Causality Tests when real economic activity is measured as the percentage change of Industrial Production

Pairwise Granger Causality Tests
Date: 06/11/07 Time: 22:53
Sample: 1987Q3 2006Q3
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	76	0.37974	0.53966
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.58922	0.44520

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	76	0.32337	0.57133
IP GROWTH does not Granger Cause STOCK VOLATILITY		0.68540	0.41043

Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE OF does not Granger Cause IP_GROWTH	74	1.21940	0.30951
IP GROWTH does not Granger Cause TERM STRUCTURE		0.60530	0.61385

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	76	0.37984	0.53960
IP GROWTH does not Granger Cause INFLATION		0.63573	0.42785

Granger Causality tests when real economic activity is measured as the percentage change of real GDP

Pairwise Granger Causality Tests
Date: 06/11/07 Time: 23:10
Sample: 1987Q3 2006Q3
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause REAL GDP GROWTH	76	2.15365	0.14653
REAL GDP GROWTH does not Granger Cause REAL STOCK RETURNS		0.75715	0.38707

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause REAL GDP GROWTH	76	0.10974	0.74139
REAL GDP GROWTH does not Granger Cause STOCK VOLATILITY		0.00446	0.94696

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause REAL GDP GROWTH	73	4.38088	**0.00341**
REAL GDP GROWTH does not Granger Cause TERM STRUCTURE		0.45028	0.77180

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause REAL GDP GROWTH	76	0.80741	0.37184
REAL GDP GROWTH does not Granger Cause INFLATION		0.54159	0.46413

Table 9

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of real Industrial production

Country	Variables explained	Period	By Innovations in Industrial Production growth	By Innovations in Real Stock returns
Spain	**Industrial Production growth**	1	100	0
		2	99.50971	0.490291
		3	99.49818	0.501823
		4	99.49737	0.502628
		5	99.49733	0.502666
		6	99.49733	0.502668
		7	99.49733	0.502669
		8	99.49733	0.502669

Country	Variables explained	Period	By Innovations in Industrial Production growth	By Innovations in Stock Volatility
Spain	**Industrial Production growth**	1	100	0
		2	99.6932	0.306797
		3	99.58376	0.416244
		4	99.54997	0.450032
		5	99.53965	0.460352
		6	99.5365	0.463502
		7	99.53554	0.464464
		8	99.53524	0.464757

Country	Variables explained	Period	Industrial Production growth	term structure
Spain	**Industrial Production growth**	1	100	0
		2	99.59864	0.401364
		3	98.75553	1.244472
		4	97.4114	2.588599
		5	96.2773	3.7227
		6	95.18709	4.812906
		7	94.52838	5.471619
		8	94.0785	5.921502

Country	Variables explained	Period	By Innovations in Industrial Production growth	By Innovations in Inflation
Spain	**Industrial Production growth**	1	100	0
		2	99.51637	0.483627
		3	99.51575	0.48425
		4	99.51575	0.484255
		5	99.51575	0.484255
		6	99.51575	0.484255
		7	99.51575	0.484255
		8	99.51575	0.484255

Table 10

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of real GDP

			By Innovations in	
Country	**Variables explained**	**Period**	**Real GDP growth**	**Real Stock returns**
Spain	**Real GDP growth**	1	100	0
		2	97.2892	2.710795
		3	97.07529	2.924706
		4	97.06862	2.931381
		5	97.06854	2.931463
		6	97.06854	2.931463
		7	97.06854	2.931463
		8	97.06854	2.931463

			By Innovations in	
Country	**Variables explained**	**Period**	**Real GDP growth**	**Stock Volatility**
Spain	**Real GDP growth**	1	100	0
		2	99.89562	0.104381
		3	99.87229	0.127711
		4	99.86485	0.13515
		5	99.8626	0.137399
		6	99.86192	0.138084
		7	99.86171	0.138293
		8	99.86164	0.138356

			By innovations in	
Country	**Variables explained**	**Period**	**Real GDP growth**	**term structure**
Spain	**Real GDP growth**	1	100	0
		2	98.97021	1.029791
		3	98.18697	1.813034
		4	85.42185	14.57815
		5	83.9782	16.0218
		6	83.76481	16.23519
		7	83.66411	16.33589
		8	83.66376	16.33624

			By Innovations in	
Country	**Variables explained**	**Period**	**Real GDP growth**	**Inflation**
Spain	**Real GDP growth**	1	100	0
		2	98.98124	1.018757
		3	98.95609	1.043908
		4	98.95599	1.044009
		5	98.95599	1.04401
		6	98.95599	1.04401
		7	98.95599	1.04401
		8	98.95599	1.04401

Table 11

Variance decomposition of IP growth and real GDP growth when all the variables under examination are included in the VAR

Country	Variables explained	Period	Industrial Production growth	Real Stock returns	Stock Volatility	Term Structure of Interest rates	Inflation
Spain	**Industrial Production growth**	1	100	0	0	0	0
		2	99.34208	0.232461	0.104824	0.001914	0.318716
		3	95.99721	1.109009	0.134659	0.822652	1.936469
		4	95.06121	1.130984	0.282267	1.596777	1.928763
		5	93.59243	1.528029	0.340029	2.557821	1.981692
		6	93.15356	1.625349	0.351289	2.885975	1.983827
		7	92.82167	1.733634	0.420655	3.047745	1.9763
		8	92.74307	1.753372	0.448412	3.079221	1.975927

Summary statistics of Variance decomposition analysis

			By innovations in				
Country	Variables explained	Period	**Real GDP growth**	**Real Stock returns**	**Stock Volatility**	**Term Structure of Interest rates**	**Inflation**
Spain	**Real GDP growth**	1	100	0	0	0	0
		2	96.83494	1.837311	0.068329	0.694657	0.564763
		3	93.53356	1.998145	0.938826	2.96347	0.565995
		4	88.77538	2.829132	1.783213	6.058664	0.553611
		5	87.61939	3.172615	1.800991	6.709496	0.697503
		6	86.99993	3.376516	1.935683	6.984393	0.703474
		7	86.79903	3.40019	2.073515	7.020852	0.706409
		8	86.56730	3.41618	2.294684	7.012733	0.709099

Optimal lag length according to AIC:2)

Figure 5

Dynamic responses of IP growth to shocks in each variable

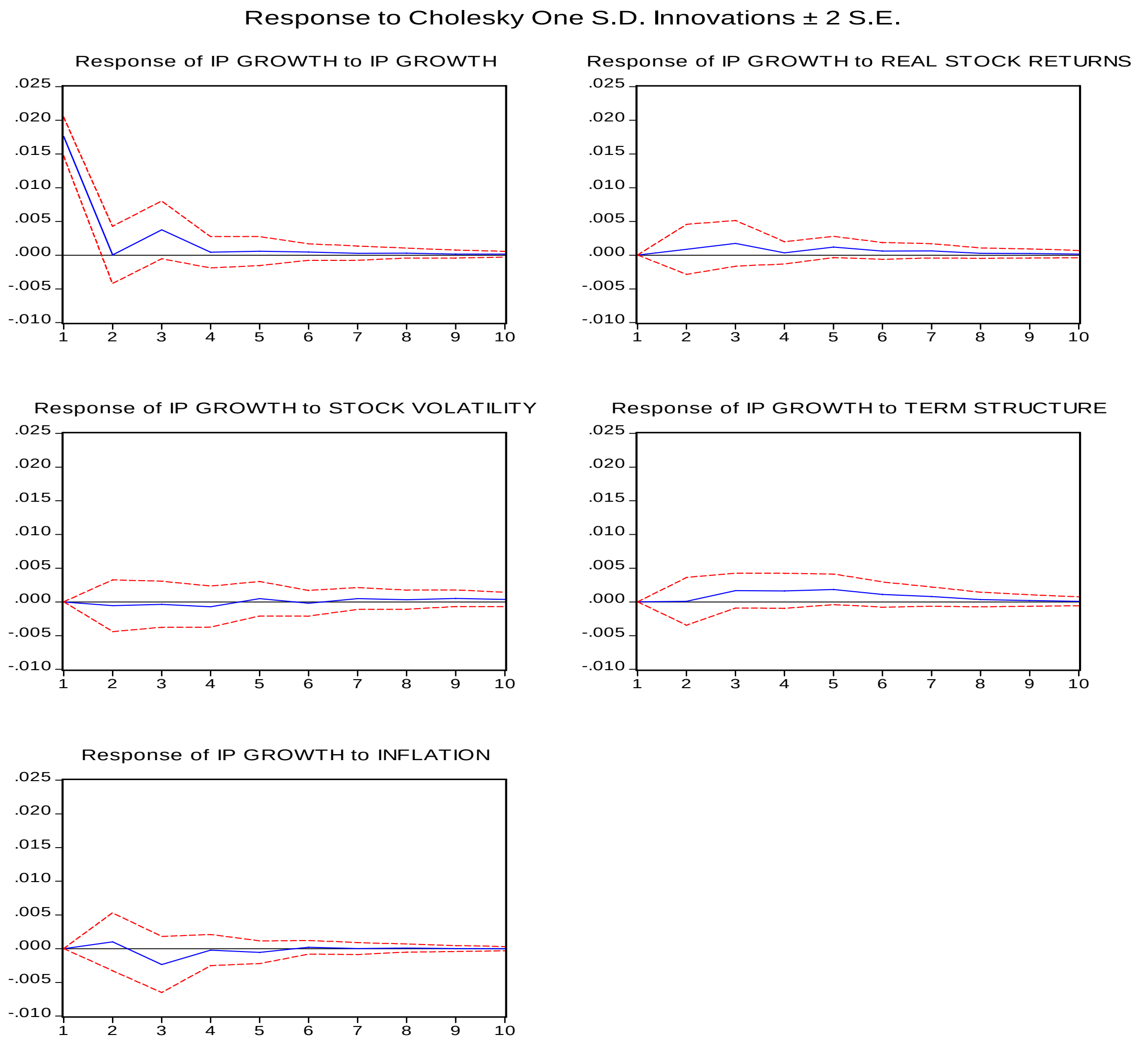
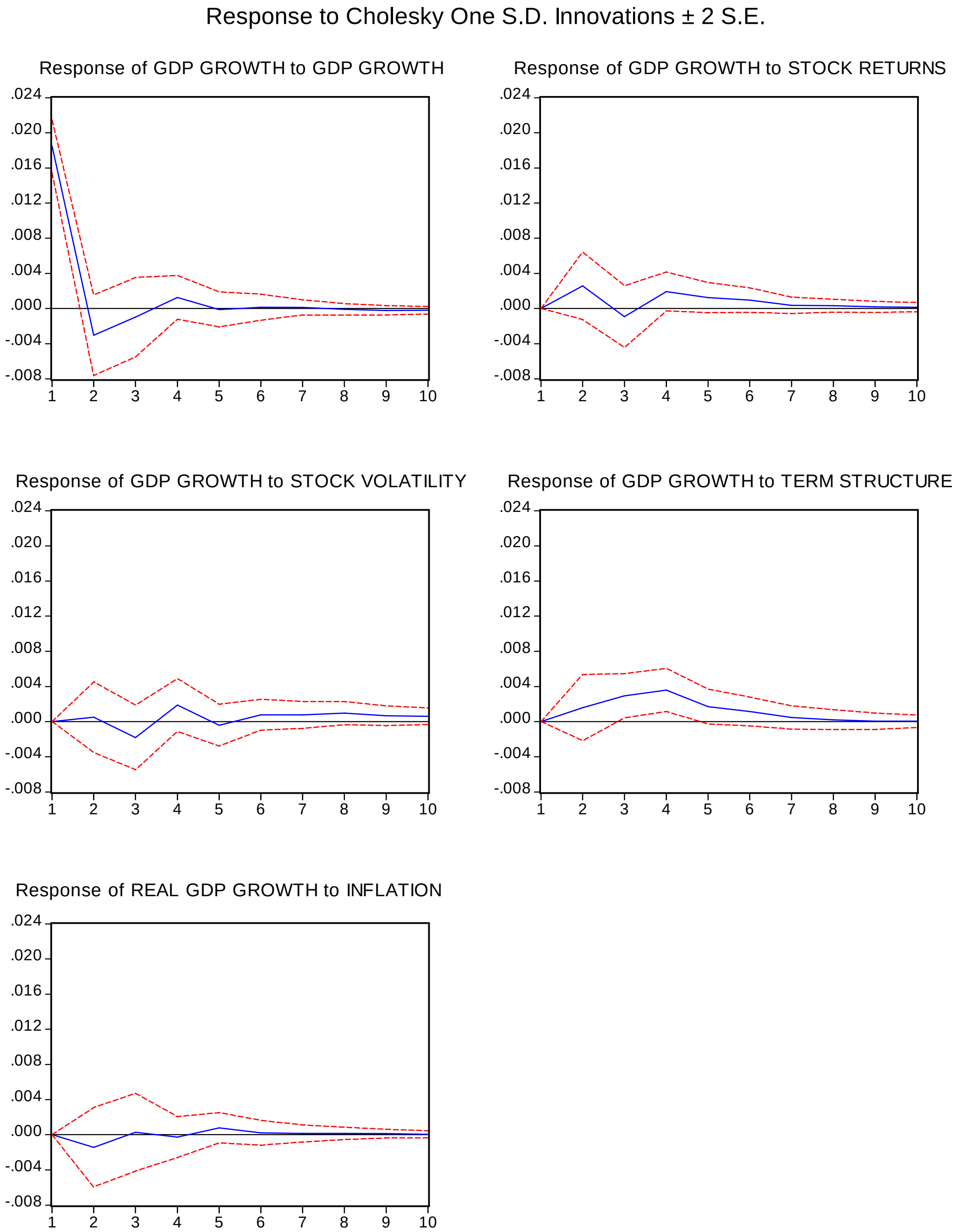


Figure 6

Dynamic responses of real GDP growth to shocks in each variable



Conclusions

According to the Granger causality tests, when real economic activity is measured as the percentage change of Industrial production none of the variables under examination seems to Granger Cause Industrial production. Those results are verified by the structural analysis of bivariate VAR's consisting of Industrial Production and one variable each time. Table 4 shows that the contribution of the variables under examination to the explanation of the variance in IP growth. With all the variables in the VAR the results are almost the same: For the 8 period ahead forecast error variance in IP growth, only 1.75% , 0.44%, 3.07% and 1,97% of its variations are explained by variations in real stock returns, stock volatility, term structure of interest rates and inflation respectively, indicating that those variables have very little, almost no explanation power on real economic activity. Figure 5 shoes that a shock either in real stock returns, stock volatility, term structure and inflation has very little or no impact on IP growth for 1 up to 10 periods ahead forecast

When real economic activity is measured as the percentage change of real GDP the things are quite different: According to the Granger Causality tests, Lagged values of term structure of interest rates seem to Granger cause real GDP growth. Table 10 shows that term structure of interest rates explains about 16% of the 8 period ahead forecast error variance in IP growth, confirming the predictive power of the above variable. With all the variables in the VAR the explanatory power of term structure reduces to the half explaining about 7% of the variations in IP growth. Figure 6 shows that a shock in term structure of interest rates affects positively the growth in real GDP up to 4 periods ahead forecast. Then the positive relationship starts to decay remaining positive and tends to zero after periods ahead forecast.

Finland

The data sample covers the period from q2 1988 until q2 2006 except for term structure of interest rates. For this variable the data obtained by data stream are available from q2 1991 and onwards. Before proceeding to the construction of VAR's we run the unit root tests as always so as to ensure that all the variables are stationary. Stock Volatility and real GDP growth proved to be non stationary and thus we omitted them from our analysis.

Granger Causality Tests when real economic activity is measured as the percentage change of Industrial Production

Pairwise Granger Causality Tests
Date: 06/12/07 Time: 00:57
Sample: 1988Q2 2006Q2
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	68	5.58926	**0.00070**
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.35470	0.83974

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause IP GROWTH	55	1.08697	0.34507
IP GROWTH does not Granger Cause TERM STRUCTURE		0.60164	0.55183

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	70	3.80346	**0.02741**
IP GROWTH does not Granger Cause INFLATION		4.95276	0.00995

Table 13

Summary statistics of Variance decomposition analysis when all the variables are included in the VAR (Optimal lag length according to AIC:4)

			By innovations in			
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Term Structure**	**Inflation**
Finland	**Industrial Production growth**	1	100	0	0	0
		2	89.11379	5.55395	4.412549	0.91971
		3	71.72616	21.73607	5.584453	0.953325
		4	57.87393	32.34621	6.429883	3.349979
		5	61.15823	29.1225	6.650478	3.068797
		6	59.00327	28.36584	6.535288	6.095604
		7	58.37473	28.10418	7.153536	6.367558
		8	57.73138	28.37472	7.23729	6.656609

Dynamic responses of IP growth to shocks in each variable

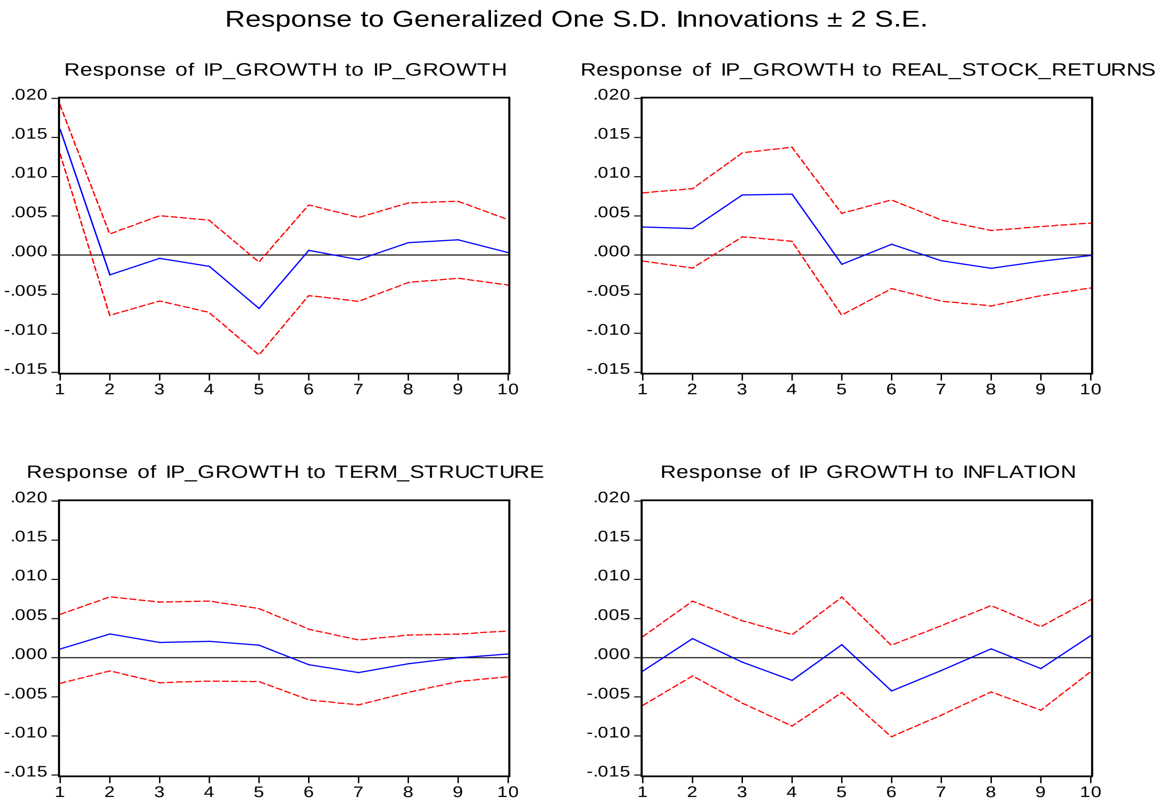


Table 12

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**
Finland	**IP Growth**	1	100	0
		2	90.7246	9.275403
		3	81.91919	18.08081
		4	73.95314	26.04686
		5	74.84095	25.15905
		6	74.80964	25.19036
		7	74.63425	25.36575
		8	74.65561	25.34439

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
Finland	**IP Growth**	1	Stock Volatility has not been included in our analysis	
		2		
		3		
		4		
		5		
		6		
		7		
		8		

Country	**Variables explained**	**Period**	**IP growth**	**term structure**
Finland	**IP Growth**	1	100	0
		2	97.21964	2.780358
		3	96.61241	3.387591
		4	96.54921	3.450787
		5	96.50682	3.493184
		6	96.35749	3.642509
		7	96.19959	3.800411
		8	96.10134	3.898661

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
Finland	**IP Growth**	1	100	0
		2	90.50621	9.493794
		3	90.66905	9.330953
		4	90.57905	9.420955
		5	90.55685	9.443148
		6	90.56741	9.432586
		7	90.56376	9.436241
		8	90.56409	9.435909

Conclusions

According to Granger causality tests, lagged values of real stock returns and inflation seem to Granger cause real economic activity. The predictive power of these variables is verified by the variance decomposition of the VARs which consist of IP growth and one financial variable each time. Table 12 shows that 25% of the 8 period ahead forecast error variance in IP growth is explained by innovations in stock returns while about 10% of the variations in IP growth is explained by variations in inflation.

With all the variables under examination in the VAR, the above variables seem to sustain their explanatory power explaining more than 5% of the 8 period ahead forecast variance in IP growth. The explanatory power of inflation reduces but still remains significant while the contribution of real stock returns to the explanation of the variations of IP growth increases. The impulse response analysis shows that a shock in real stock returns affects positively IP growth up to three steps ahead forecast. Then, this positive relationship starts decaying and after 4 steps ahead forecast tends to zero.

Sweden

The data sample covers the period between Q2 1983 until Q2 2006.

Granger Causality tests

Pairwise Granger Causality Tests
Date: 06/12/07 Time: 15:22
Sample: 1982Q3 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	94	3.65725	**0.02976**
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.14959	0.86128

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	95	2.18818	0.14249
IP GROWTH does not Granger Cause STOCK VOLATILITY		0.30332	0.58314

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
TERM STRUCTURE does not Granger Cause IP GROWTH	95	1.67282	0.19912
IP GROWTH does not Granger Cause TERM STRUCTURE		0.32615	0.56933

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	88	2.59239	**0.01519**
IP GROWTH does not Granger Cause INFLATION		1.33920	0.23869

<u>Table 14</u> Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

Country	Variables explained	Period	By Innovations in IP growth	Real Stock returns
Sweden	IP Growth	1	100	0
		2	98.11477	1.885227
		3	94.17692	5.823083
		4	93.94598	6.054021
		5	93.93571	6.064293
		6	93.93411	6.065887
		7	93.93401	6.065993
		8	93.934	6.065999

Country	Variables explained	Period	By Innovations in IP growth	Stock Volatility
Sweden	IP Growth	1	100	0
		2	98.35057	1.64943
		3	98.22571	1.774292
		4	98.16865	1.831349
		5	98.15733	1.842669
		6	98.15418	1.845819
		7	98.15343	1.846572
		8	98.15324	1.846764

Country	Variables explained	Period	IP growth	term structure
Sweden	IP Growth	1	100	0
		2	99.01981	0.980189
		3	98.85629	1.143707
		4	98.75325	1.246753
		5	98.71469	1.28531
		6	98.69746	1.302538
		7	98.69025	1.309749
		8	98.68716	1.312839

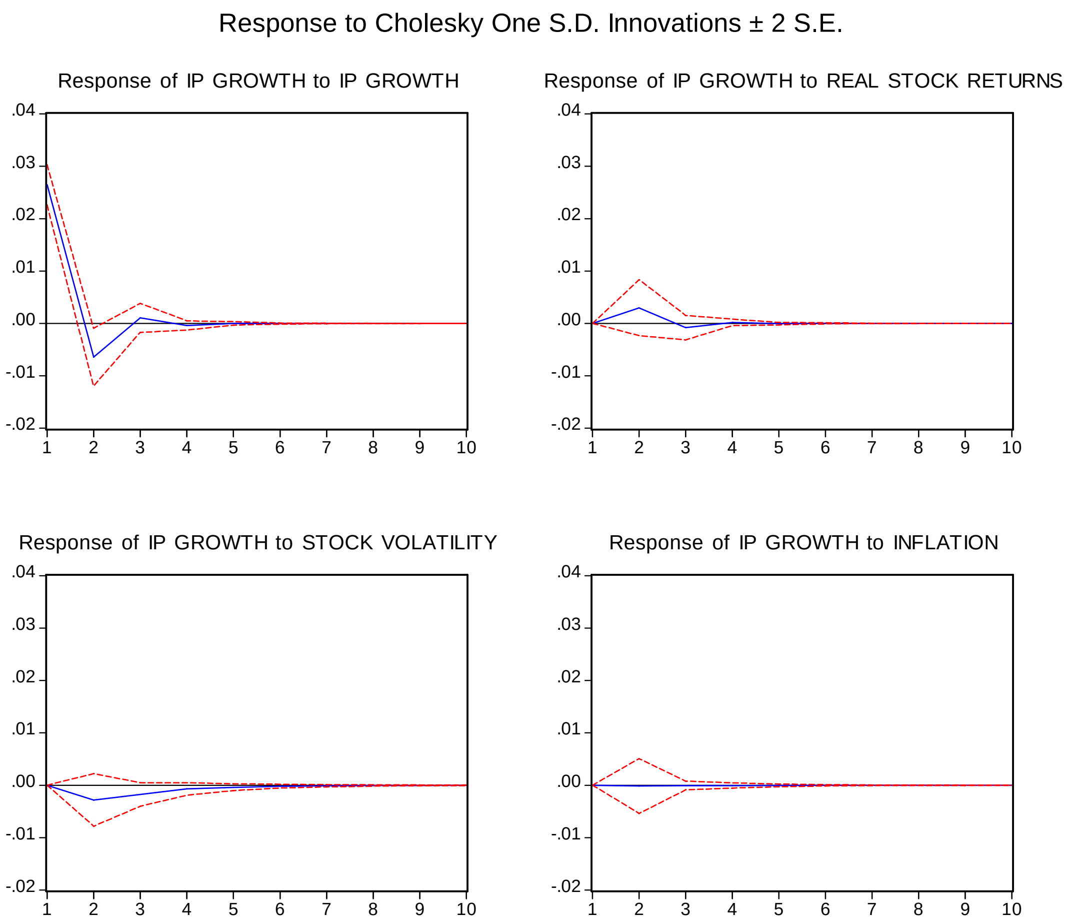
Country	Variables explained	Period	By Innovations in IP growth	Inflation
Sweden	IP Growth	1	100	0
		2	99.49245	0.507554
		3	96.69604	3.303957
		4	95.32515	4.674853
		5	94.75659	5.243406
		6	94.4333	5.566698
		7	94.64193	5.35807
		8	94.14597	5.85403

Table 15 (Optimal lag length according to AIC:1)

Summary statistics of Variance decomposition analysis when all the variables are included in the VAR

			By innovations in			
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Inflation**
Sweden	**Industrial Production growth**	1	100	0	0	0
		2	97.77079	1.181862	1.044025	0.00332
		3	97.28964	1.261995	1.444615	0.003753
		4	97.22136	1.265678	1.508898	0.004067
		5	97.20277	1.265611	1.527487	0.004131
		6	97.1987	1.265573	1.531576	0.004149
		7	97.19769	1.265559	1.532597	0.004153
		8	97.19745	1.265556	1.532838	0.004154

Dynamic responses of IP growth to shocks in each variable



Conclusions

Granger causality tests reveal a causal relationship between lagged values of real stock returns and inflation. The predictive power of these variables is verified by the variance decomposition of the VARs which consist of IP growth and one financial variable each time. Table 14 shows that 6.06% of the 8 period ahead forecast error variance in IP growth is explained by innovations in stock returns while about 5.85% of the variations in IP growth is explained by variations in inflation. From the above results it is maid clear that although the coefficients of the bivariate VAR's denote that the relationship between lagged values of the above variables and real economic activity is statistically significant, their contribution to the explanation of the variations in IP growth is little.

With all the variables under examination in the VAR, inflation as well as real stock returns seems to loose their explanatory power explaining less than 5% of the 8 period ahead forecast variance in IP growth. The impulse response analysis shows that a shock either in real stock returns or inflation affects very little IP growth.

Denmark

The data sample covers the period from Q1 1973 until Q2 2006. Due to lack of data concerning the case of term structure of interest rates, only real stock returns, stock volatility and inflation are going to be examined for their predictive power.

Pairwise Granger Causality Tests
Date: 05/30/07 Time: 19:15
Sample: 1973Q1 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause REAL STOCK RETURNS	131	0.23769	0.78880
REAL STOCK RETURNS does not Granger Cause IP GROWTH		11.4655	**2.7E-05**

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause STOCK VOLATILITY	131	0.03069	0.96979
STOCK VOLATILITY does not Granger Cause IP GROWTH		4.62546	**0.01152**

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
IP GROWTH does not Granger Cause INFLATION		0.27331	0.97336
INFLATION does not Granger Cause IP GROWTH		0.85443	0.55731

Conclusions

As we can see from the Granger Causality tests, the lagged values of real stock returns and stock volatility seem to be significantly correlated with the current value of IP growth. Table 16, presents the percentage of the 1 up to 8 period forecast error variance in IP growth explained by variations in one of the variables under examinations each time It is worth to be mentioned once again that the above series have been tested as far as their stationarity is concerned. The number of lags that is used for the estimation of the bivariate VAR's has been chosen according to the Akaike Information criterion.

According to table 16, real stock returns can explain 8,5% of the variations in IP growth for a forecasting horizon of 8 periods. Stock volatility on the other hand, can explain about 5,5% of the variations in IP growth. Finally, inflation seems to be unable to explain or predict IP growth. These findings are consistent with the results of the Granger Causality tests.

With all the variables in the VAR, the results of its structural analysis (Variance Decomposition, Impulse response) are almost the same: Real Stock returns explain 6,37% of the 8 period forecast error variance in IP growth. On the other hand, the explanatory power of stock volatility rises. Specifically, 8,57% of the variations in IP growth is explained by variations in Stock volatility while only 1,8% of the variations in IP growth is explained by variations in inflation indicating that it has very little or no explanatory power.

The diagrams below depict the response of IP growth to shocks in each variable. According to those diagrams a shock either in real stock returns or in stock volatility has an impact on IP growth for a forecasting horizon of 8 and 6 periods respectively while the impact of a shock in inflation over IP growth is negligible.

Table 16

Summary statistics of Variance decomposition analysis

Country	Variables explained	Period	By Innovations in: Industrial Production growth	By Innovations in: Real Stock returns
Denmark	**Industrial Production growth**	1	100	0
		2	91.50946	8.49054
		3	91.55296	8.447043
		4	91.58408	8.415922
		5	91.50876	8.49124
		6	91.50159	8.498405
		7	91.50032	8.499676
		8	91.49988	**8.500121**

Country	Variables explained	Period	By Innovations in: Industrial Production growth	By Innovations in: Stock Volatility
Denmark	**Industrial Production growth**	1	100	0
		2	95.34526	4.65474
		3	94.60412	5.395876
		4	94.57928	5.420717
		5	94.57652	5.423485
		6	94.56277	5.437226
		7	94.56011	5.439888
		8	94.56038	**5.439619**

Country	Variables explained	Period	By Innovations in: Industrial Production growth	By Innovations in: Inflation
Denmark	**Industrial Production growth**	1	100	0
		2	99.97638	0.023622
		3	99.88755	0.112448
		4	99.75288	0.247122
		5	99.30997	0.690026
		6	99.25894	0.741064
		7	99.0937	0.906304
		8	99.08035	0.919653

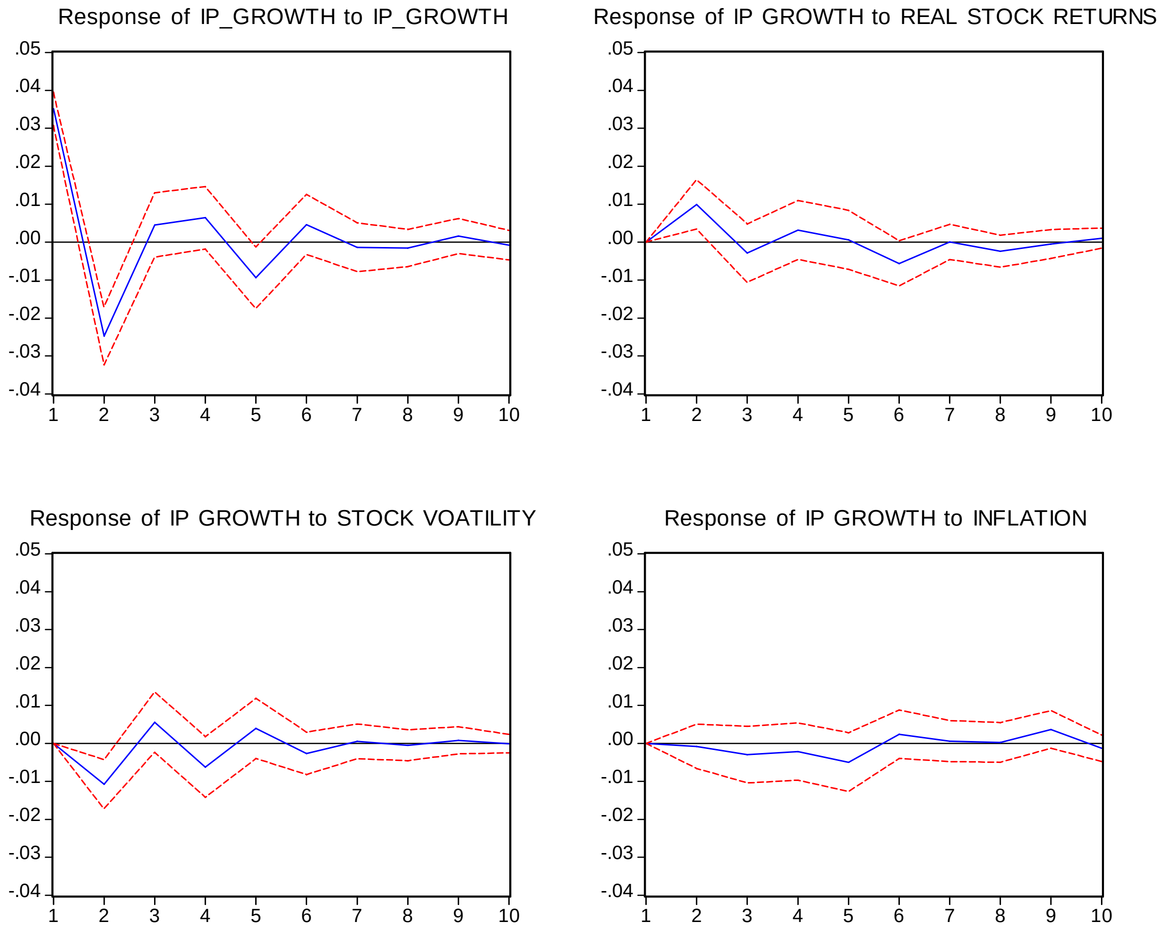
Table 17 — **Optimal lag length according to AIC:4**

Summary statistics of Variance decomposition analysis

			By innovations in			
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Inflation**
Denmark	**Industrial Production growth**	1	100	0	0	0
		2	89.58252	4.772048	5.615635	0.029797
		3	87.6606	5.014774	6.888198	0.436431
		4	85.78774	5.25518	8.333101	0.623984
		5	84.84648	4.984227	8.537822	1.631475
		6	83.41653	6.165893	8.591107	1.826473
		7	83.4083	6.159366	8.593833	1.838497
		8	83.21722	**6.373648**	**8.574232**	**1.8349**

Dynamic responses of IP growth in each variable

Response to Cholesky One S.D. Innovations ± 2 S.E.



Netherlands

The data sample covers the period from Q1 1973 until Q2 2006.As far as the term structure of interest rates is concerned, it is proved by the unit root tests (Dickey Fuller and Phillip Perron) that this time series is not stationary. For this reason we exclude it from our analysis. Real economic activity is measured as the percentage change of Industrial Production

Granger Causality Tests

Pairwise Granger Causality Tests
Sample: 1973Q1 2006Q2
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	131	0.84258	0.43301
IP GROWTH does not Granger Cause REAL STOCK RETURNS		1.27445	0.28316

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	132	7.99303	**0.00545**
IP GROWTH does not Granger Cause STOCK VOLATILITY		0.15007	0.69911

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Probability
INFLATION does not Granger Cause IP GROWTH	125	1.70072	0.10632
IP GROWTH does not Granger Cause INFLATION		1.09765	0.37057

Table 18

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

			By Innovations in					By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**	**Country**	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
Netherlands	**IP Growth**	1	100	0	**Netherlands**	**IP Growth**	1	100	0
		2	99.3249	0.675098			2	96.03771	3.962292
		3	98.91027	1.089727			3	95.3769	4.623101
		4	98.90025	1.099754			4	95.1487	4.851297
		5	98.90013	1.09987			5	95.08221	4.917795
		6	98.90013	1.099869			6	95.06198	4.938023
		7	98.90012	1.09988			7	95.05588	4.944121
		8	98.90012	1.099881			8	95.05404	4.945963

							By Innovations in		
Country	**Variables explained**	**Period**	**IP growth**	**term structure**	Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
Netherlands	**IP Growth**	1			**Netherlands**	**IP Growth**	1	100	0
		2					2	96.10316	3.896836
		3					3	94.7949	5.205096
		4					4	94.80895	5.191045
		5					5	94.72136	5.278643
		6					6	94.74179	5.258209
		7					7	92.62488	7.375123
		8					8	92.18711	7.812889

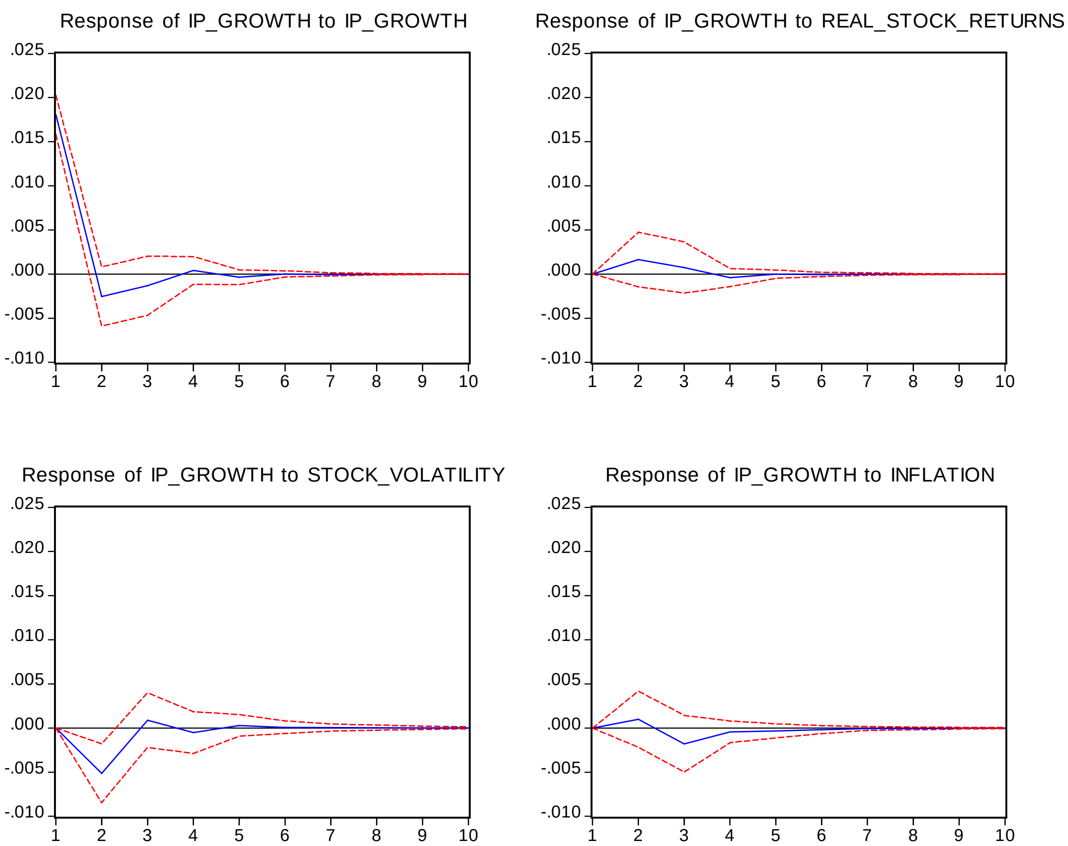
Table 19 (Optimal lag length according to AIC: 2)

Summary statistics of Variance decomposition analysis when all the variables are included in the VAR

			By innovations in			
Country	Variables explained	Period	**Industrial Production growth**	**Real Stock returns**	**Stock Volatility**	**Inflation**
Portugal	**Industrial Production growth**	1	100	0	0	0
		2	91.70934	0.755439	7.260294	0.274924
		3	90.62126	0.892546	7.347126	1.139072
		4	90.47463	0.934156	7.4027	1.188511
		5	90.42926	0.933392	7.420835	1.216517
		6	90.41793	0.933913	7.421839	1.226315
		7	90.41656	0.933895	7.422304	1.227243
		8	90.41557	0.933884	**7.422739**	1.227805

Dynamic responses of IP growth to shocks in each variable

Response to Cholesky One S.D. Innovations ± 2 S.E.



Conclusions

As we can see from the Granger Causality tests, lagged values of stock volatility seem to be significantly correlated with the current value of IP growth. Table 18, presents the percentage of the 1 up to 8 period forecast error variance in IP growth explained by variations in one of the variables under examinations each time. It is worth to be mentioned once again that the above series have been tested as far as their stationarity is concerned. The number of lags that is used for the estimation of the bivariate VAR's has been chosen according to the Akaike Information criterion.

According to table 18, real stock returns can explain 1.09% of the variations in IP growth for a forecasting horizon of 8 periods. Stock volatility on the other hand, can explain about 5,0% of the variations in IP growth while inflation explains 7.81% of the variations in IP growth. Although Granger causality tests don't reveal an important relationship between IP growth and inflation, the structural analysis of a bivariate VAR indicates that lagged values of inflation are correlated with current values of IP growth explaining a significant part of its 8 period forecast error variance.

With all the variables in the VAR, inflation seems to loose its explanatory power while stock volatility tends to explain over 5% of the variations in IP growth.

Greece

The data sample covers the period from q4 1988 until 2006q2. Due to lack of data concerning the term structure of interest rates we are going to omit this variable from our analysis.

Granger Causality tests

Pairwise Granger Causality Tests
Date: 07/08/07 Time: 18:17
Sample: 1988Q4 2006Q2
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
REAL STOCK RETURNS does not Granger Cause IP GROWTH	66	4.10230	**0.00545**
IP GROWTH does not Granger Cause REAL STOCK RETURNS		0.60721	0.65906

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Probability
STOCK VOLATILITY does not Granger Cause IP GROWTH	64	0.98173	0.44733
IP GROWTH does not Granger Cause STOCK VOLATILITY		1.80941	0.11579

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Probability
Inflation does not Granger Cause IP GROWTH	64	2.56642	**0.03002**
IP GROWTH does not Granger Cause inflation		0.98546	0.44492

Table 20

Summary statistics of Variance decomposition analysis when real economic activity is measured as the percentage change of Industrial production

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Real Stock returns**
Greece	**IP Growth**	1	100	0
		2	96.37011	3.62989
		3	96.01067	3.989334
		4	95.20098	4.799021
		5	88.71805	11.28195
		6	89.83476	10.16524
		7	88.35936	11.64064
		8	88.39807	11.60193

			By Innovations in	
Country	**Variables explained**	**Period**	**IP growth**	**Stock Volatility**
Greece	**IP Growth**	1	100	0
		2	99.04722	0.95278
		3	98.17216	1.827841
		4	96.72003	3.279965
		5	96.58446	3.415536
		6	96.64515	3.354851
		7	96.24544	3.754562
		8	95.7077	4.292302

By Innovations in				
Country	**Variables explained**	**Period**	**IP growth**	**Inflation**
Greece	**IP Growth**	1	100	0
		2	99.43004	0.569961
		3	95.10864	4.891361
		4	92.07599	7.924009
		5	88.87181	11.12819
		6	85.39269	14.60731
		7	83.69709	16.30291
		8	83.62604	16.37396

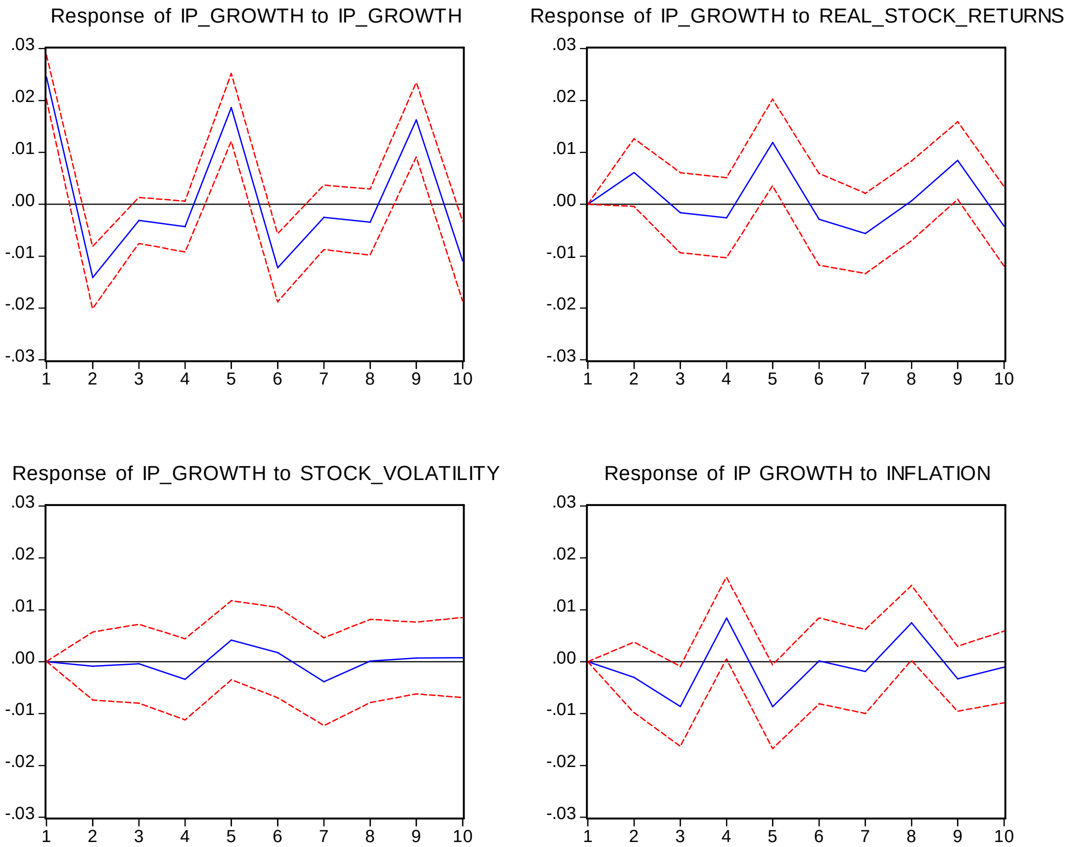
Table 21

Summary statistics of Variance decomposition analysis when all the variables are included in the VAR

Country	Variables explained	Period	By innovations in: Industrial Production growth	Real Stock returns	Stock Volatility	Inflation
GREECE	**Industrial Production growth**	1	100	0	0	0
		2	94.43067	4.384787	0.091579	1.092967
		3	86.64109	4.263554	0.100793	8.994564
		4	79.49034	4.482582	1.222401	14.80468
		5	72.42543	11.59844	1.828713	14.14742
		6	74.27402	11.02677	1.827756	12.87145
		7	72.3265	12.41332	2.589247	12.67094
		8	70.37573	11.99142	2.497522	15.13533

Dynamic responses of IP growth to shocks in each variable

Response to Cholesky One S.D. Innovations ± 2 S.E.



Conclusions

As we can see from the Granger Causality tests, lagged values of real stock returns and inflation seem to be significantly correlated with the current value of IP growth. Table 20, presents the percentage of the 1 up to 8 period forecast error variance in IP growth explained by variations in one of the variables under examinations each time. It is worth to be mentioned once again that the above series have been tested as far as their stationarity is concerned. The number of lags that is used for the estimation of the bivariate VAR's has been chosen according to the Akaike Information criterion.

According to table 20, real stock returns can explain 11.60% of the variations in IP growth for a forecasting horizon of 8 periods. Stock volatility on the other hand, can explain about 4.29% of the variations in IP growth while inflation explains about 16% of the variations in IP growth.

With all the variables in the VAR, those who seem to be significantly correlated with IP growth (real stock returns, inflation) don't loose their explanatory power while stock volatility tends to explain less than 5% of the variations in IP growth. The above findings are verified by the Impulse response analysis.

G-7 Countries

Consolidated conclusions

Ip growth explained by lagged values of the variables below

Countries	Real Stock returns	Stock Volatility	Term Structure of interest rates	inflation
United States	√	√	√	X
Japan	√	X	√	√
Germany	√	X	√	X
Canada	√	X	√	√
Italy	X	X	X	X
United Kingdom	√	√	√	√
France	X	X	Not availabe	X

Real GDP growth explained by lagged values of the variables below

Countries	Real Stock returns	Stock Volatility	Term Structure of interest rates	inflation
United States	√	√	√	X
Germany	X	X	√	X
Canada	√	X	X	√
United Kingdom	√	X	√	√
France	X	X	Not available	X

Predictive power of the financial variables under examination when all the variables are used in the VAR

Consolidated conclusions

Ip growth explained by lagged values of the variables below

Countries	Real Stock returns	Stock Volatility	Term Structure of interest rates	inflation
United States	√	√	√	X
Japan	√	X	√	√
Germany	X	X	√	X
Canada	√	X	√	X
Italy	X	X	X	X
United Kingdom	√	X	√	√
France	X	X	X	X

Real GDP growth explained by lagged values of the variables below

Countries	Real Stock returns	Stock Volatility	Term Structure of interest rates	inflation
United States	√	√	√	X
Germany	X	X	√	X
Canada	√	X	X	√
United Kingdom	√	X	√	√
France	X	X	Not available	X

EU-15 countries

Consolidated conclusions

Countries	Real Stock returns	Stock Volatility	Term Structure of interest rates	inflation
	Ip growth explained by lagged values of the variables below			
Austria	X	X	Not available	X
Belgium	√	X	√	√
Ireland	X	X	X	X
Portugal	√/X	X	Not available	X/√
Spain	X	X	X	X
Finland	√	Not available	X	√
Sweden	√	X	X	√
Denmark	√	√	Not available	X
Netherlands	X	√	Not available	X/√
Greece	√	X	Not available	√
France	X	X	Not available	X
Italy	X	X	X	X
United Kingdom	√	√	√	√
Germany	√	X	√	X

Predictive power of the variables under examination when all the variables are used in the VAR

Consolidated conclusions

Countries	Ip growth explained by lagged values of the variables below			
	Real Stock returns	**Stock Volatility**	**Term Structure of interest rates**	**inflation**
Austria	X	X	Not available	X
Belgium	√	X	√	√
Ireland	X	X	X	√
Portugal	√	X	X	√
Spain	X	X	X	X
Finland	√	Not available	X	√
Sweden	X	X	Not available	X
Denmark	√	√	Not available	X
Netherlands	X	√	Not available	X
Greece	√	X	Not available	√
France	X	X	X	X
Italy	X	X	X	X
United Kingdom	√	X	√	√
Germany	X	X	√	X

Out of sample empirical Test

The methology that we followed for the out of sample analysis has been already described in a previous chapter. We can briefly repeat the basic 4 steps[20,21]:

1) We estimated an autoregressive integrated moving average model (ARIMA) for each time series of the growth rate of Industrial production. Growth rate of industrial production is used as a measure of real economic activity. We used IP growth than real GDP growth due to the better availability of data of IP growth.
2) We also estimated in sample bivariate models of the growth rate of Industrial production that include both, lagged values of IP growth and lagged values of one financial variable each time. Then, we estimated models consisting of IP growth (as an independent variable) that include both, lagged values of IP growth and lagged values of all the variables under examination.
3) The above models were used to generate one step ahead forecast for a preassigned out of sample period.
4) Finally we compared the relative significance of the forecasting errors of the two models.

As in the case of our in sample analysis, for the out of sample analysis we used once again quarterly data. The length of the lag for Industrial production growth was set to 4. The lag length of the rest financial variables under examination (real stock returns, stock volatility, term structure of Interest rates and inflation) was defined with the use of the Akaike Information criterion.

In order to evaluate the forecasting properties of the bivariate models of the growth rate of IP growth, consisting of lagged values of IP growth and lagged values of one of the financial variables each time as well as the forecasting properties of the models consisting of lagged values of IP growth and lagged values of all the other variables,

[20] This technique was adopted by the article of Jongmoo Jay Choi, Shmuel Hauser and Kenneth J. Kopecky in their article with title:"Does the stock market predict real activity?" With this technique, they studied the out of sample performance of real stock returns as a predictive variable of real stock returns for the G7 countries.

[21] James H. Stock and Mark W. Watson "Forecasting output and inflation: The role of asset prices" use the same steps for their out of sample analysis.

we used 75% of the data for in sample estimation and 25% for out of sample evaluation.[22]
As far as the autoregressive models are concerned[23] we took under consideration the heteroskedasticity between residuals and thus we used the Newey-West option so as to estimate the coefficients of the above linear models. The results of the out of sample forecasting power of the variables under examination are summarized in the table below:

[22] 'Does the Stock market predict real economic activity? evidence from the G-7 countries.' Choi, Hauser and Kopecky: Journal of Banking and Finance.

[23] $Y_t = \alpha_0 + \sum_{i=1}^{m} a_i Y_{t-i} + e_{1t}$ and $Y_t = b_0 + \sum_{i=1}^{m} b_i Y_{t-i} + \sum_{j=1}^{n} C_j S_{t-j} + e_{2t}$

Table 1

Quarterly data

Country	In/out of sample period	Variables examined for their forecasting performance	Mean squared forecast estimation (MSFE)*
United States	**75/25**	real stock returns	**0.765**
		stock volatility	
		term structure of Interest rates	5.297
		Inflation	1.444
		all the variables under examination	1.475
Japan	**75/25**	real stock returns	1.107
		stock volatility	
		term structure of Interest rates	1.271
		Inflation	1.129
		all the variables under examination	1.106
United Kingdom	**75/25**	real stock returns	1.792
		stock volatility	2.153
		term structure of Interest rates	1.209
		Inflation	
		all the variables under examination	6.841
Canada	**75/25**	real stock returns	1.329
		stock volatility	
		term structure of Interest rates	
		Inflation	
		all the variables under examination	44.972
Germany	**75/25**	real stock returns	**0.950**
		stock volatility	1.046
		term structure of Interest rates	1.058
		Inflation	1.192
		all the variables under examination	1.064
Belgium	**75/25**	real stock returns	1.084
		stock volatility	
		term structure of Interest rates	
		Inflation	1.030
		all the variables under examination	1.185
Portugal	**75/25**	real stock returns	1.245
		stock volatility	
		term structure of Interest rates	
		Inflation	
		all the variables under examination	1.258
Finland	**75/25**	real stock returns	**0.997**
		stock volatility	

		term structure of Interest rates Inflation	1.900
		all the variables under examination	1.899
Sweden	**75/25**	real stock returns stock volatility term structure of Interest rates Inflation all the variables under examination	1.288 22.483 1.635
Netherlands	**75/25**	real stock returns stock volatility term structure of Interest rates Inflation all the variables under examination	 1.169 7.812 2.155
Denmark	**75/25**	real stock returns stock volatility term structure of Interest rates Inflation all the variables under examination	**0.606** **0.465** **0.731**
Greece	**75/25**	real stock returns stock volatility term structure of Interest rates Inflation all the variables under examination	**0.812** 1.940 **0.761**

Final conclusions

In this thesis we tried to examine the ability and the degree up to which lagged values of a number of financial variables (real stock returns, stock volatility, term structure of Interest rates and inflation) can predict current levels of real economic activity (measured either as the percentage change of real GDP or as the percentage change of Industrial production) for two different groups of countries: G-7 countries and EU-15 countries. In order to identify and quantify a statistically significant relationship between lagged values of the variables under examination and real economic activity we used in sample as well as out of sample analysis.
Starting from the in sample analysis and the G-7 countries, we are lead to the following conclusions: When real economic activity is measured as the percentage change of Industrial production, real stock returns seem to predict real economic activity in five out of seven countries. The two countries for which lagged values of stock returns seem to have no predictive power over current values of IP growth are Italy and France. Our findings are very similar to those of Choi , Hauser and Kopecky "Does the stock market predict real activity?- 1999 Journal of Banking and Finance". Choi , Hauser and Kopecky used in sample cointegration and error correction models as well as out of sample forecast evaluation procedures. The cointegration tests showed that there is a long run equilibrium relationship between IP growth and lagged values of real stock returns for all the G-7 countries except Italy. Our analysis mentioned one more country (France) the stock market of which seems unable explain real economic activity.
As far as the Stock volatility derived from historical data is concerned, we found out that only for the case of United States and United Kingdom lagged values of this variable seem to be correlated with current values of real economic activity. Unfortunately we didn't find related articles which examine the predictive power of stock volatility over IP growth for the G-7 countries. Fabio Fornari and Antonio Mele in a working paper with title "Financial Volatility and real economic activity" examine the predictive power of financial volatility for the case of the United States and they conclude in the ability of financial volatility to predict roughly 30% of post-war economic activity in the US. This figure increases to roughly 50% in the last twenty-five years. Our empirical analysis verifies the fact that for United States there is a causal relationship between stock volatility and real economic activity.

Lagged values of term structure of interest rates predict IP growth in five out of six countries. (France is not examined due to lack of data) Our findings concerning United Stated and United Kingdom confirm the findings of David Peel and Mark Taylor[24] who proved that the slope of the yield curve in the above countries is strongly associated with the temporary rather than the permanent components of real economic activity, suggesting that the yield curve affects economic activity primarily through the demand side. There are many other articles that examine the predictive performance of term structure which basically focus on the economy of the United State and are presented in the first part of this thesis. Between them we should mention once again the empirical work of Estrella and Hardouvelis[25] who found out that a positive slope of the yield curve is associated with future increase in real economic activity. Finally, as far as inflation is concerned, we observe that only in Japan, Canada and United Kingdom its lagged values are correlated with real economic activity.

When real economic activity is measured as the percentage change of real GDP, the results are slightly different: The predictive power of real Stock returns is diminished in the case of Germany while in the case of US, UK and Canada the predictive power remains unchanged. In the case of United Kingdom, Stock volatility seems unable predict real economic activity when it is measured as the percentage change of real GDP while lagged values of stock returns are no more correlated with real economic activity in Canada. Finally, inflation stops having predictive power over the real economic activity of United States.

As a first conclusion we can say that when we use IP growth rather than real GDP growth as a measure of real economic activity, the predictive power of the variables under examination is confirmed for more countries than it is confirmed when economic activity is measured with the use of real GDP.

As far as the group of the EU-15 countries is concerned, (we omitted Switzerland from our analysis due to lack of data) there isn't any previous empirical work studying the predictive power of stock returns, stock volatility, term structure and inflation over real economic activity and thus our findings cannot be compared with the results of other researchers. In this group of countries real economic activity is measured only as the percentage change of Industrial Production. Real Gdp growth is not used due to limited availability of data.

For the case of real stock returns, we find that from the 14 countries that are examined in this group, only in seven of them lagged values of real stock returns are correlated with real

[24] "The slope yield curve and real economic activity: tracing the transmission mechanism" 1998 Journal of economics letters

[25] 'The term structure as predictor of real Economic activity-1991 Jurnal of Finance

economic activity These countries are Belgium, Portugal, Finland, Sweden, Denmark, United Kingdom and Germany. This proportion stands only in the case where the predictive power of the above variable is tested with the use of the Granger causality test. When the predictive power of real economic activity is tested with the use of the structural analysis (forecast error variance decomposition and Impulse response analysis) of a VAR consisting of the above 5 variables the number of countries for which lagged values of real stock returns are correlated with IP growth reduces to 6. (Portugal is excluded)

The predictive power of stock volatility is confirmed only in 3 out of 14 countries (Denmark, Netherlands and United Kingdom) while when we examine inflation its predictive power is verified in 4 out of 14 countries with the help of Granger causality tests and in 6 out of 14 with the help of the structural analysis of a VAR(5).

Finally, as far as term structure of Interest rates is concerned we should mention that due to lack of data, we omitted from our analysis Austria, Portugal, Denmark, Netherlands, France and Greece. Concerning the remaining countries, only in three of them (Belgium, United Kingdom and Germany) there is a causal relationship between term structure and real economic activity.Among the two groups of countries, the variable that manages to have the better predictive behaviour over real economic activity is real stock returns. Its lagged values help to forecast real economic activity (when measured as the percentage change of Industrial production) in 10 out of 17 countries. The variable which follows is inflation, then term structure and finally stock volatility.

In order to have a more clear view we should search for common characteristics between the countries whose real economic activity can be forecasted with the use of lagged values of one or more of the variables that were used in our thesis. This work is left for the posterity.

Except for the in sample analysis, we also conducted out of sample forecasting procedures so as to re-examine the predictive power of real stock returns, stock volatility, term structure of interest rates and inflation. From our analysis, we omitted those countries in which the above financial variables had no predictive power over real economic activity (France, Italy, Austria, Ireland and Spain) according to the -In sample analysis-. At this point, it is worth to be mentioned that in the out of sample tests we used only IP growth as a measure of real economic activity. The results are summarised in table 1 presented before when we were referred to the way we conducted the out of sample tests. The column labelled 'Mean squared forecast estimation (MSFE)' denotes the ratio of the candidate forecast of IP growth when except for lagged values of IP growth, lagged values of the variables under examination are also included relative to the benchmark forecast of Industrial production growth when only lagged values of IP growth are used . If the MSFE is less than one, the candidate forecast is estimated to have performed better than the benchmark. According to this column we can extract some useful conclusions:

Only in United States, Germany, Finland, Denmark and Greece lagged values of real stock returns (The length of lags was defined with the use of the Akaike Information criterion) have significant effect on the predictions of quarterly IP growth. Our findings concerning real stock returns are very close to those of Choi, Hauser and Kopecky who followed the AGS procedure so as to identify the out of sample forecasting performance of real stock returns. According to them, in the UK, Japan, France and Italy lagged stock returns had no significant effect on the predictions of IP growth while in US, Canada and Germany they had. Our analysis confirmed this significant effect in the case of United States and Germany and rejected it in the case of Canada. What we have to take into account, is the fact that although lagged values of real stock returns seemed to be significantly correlated with real economic activity in 10 out the 17 countries that were examined with the use of the in sample analysis, with the use of the out of sample analysis the number of countries falls to the half.

As far as stock volatility is concerned, only in the case of Denmark its lagged values had significant additional effect on IP growth. Inflation and term structure of interest rates had no significant additional effect on any of the two groups of countries while when all the variables under examination were included in the candidate forecast of IP growth only in the case of Denmark and Greece they managed to have better performance on the prediction of IP growth.

If we compare the two methods, we are lead to the conclusion that the variables that were examined, although they seem to forecast real economic activity according to the results of the in-sample tests, yet they are not prescient in every of the countries in which they managed to predict IP growth, because IP growth is sometimes so predictable that the above variables can make only a relatively minor contribution to understanding its future evolution.[26]

[26] This conclusion arises from the conclusion of Choi, Hauser and Kopecky-‘Does the stock market predict real activit? 1999 Journal of Banking and Finance

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Appendix A

(Unit root tests)

Appendix A

Unit root tests

United States

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.898187	**0.0000**
Test critical values:	1% level	-3.465202	
	5% level	-2.876759	
	10% level	-2.574962	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.883686	**0.0000**
Test critical values:	1% level	-3.463924	
	5% level	-2.876200	
	10% level	-2.574663	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.218716	**0.0008**
Test critical values:	1% level	-3.463924	
	5% level	-2.876200	
	10% level	-2.574663	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.16313	**0.0000**
Test critical values:	1% level	-3.463749	
	5% level	-2.876123	
	10% level	-2.574622	

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.483940	**0.0000**
Test critical values:	1% level	-3.463749	
	5% level	-2.876123	
	10% level	-2.574622	

Null Hypothesis: REAL GDP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=14)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.07731	**0.0000**
Test critical values:	1% level	-3.463749	
	5% level	-2.876123	
	10% level	-2.574622	

Japan

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.367040	**0.0000**
Test critical values:	1% level	-3.479281	
	5% level	-2.882910	
	10% level	-2.578244	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.67017	**0.0000**
Test critical values:	1% level	-3.478189	
	5% level	-2.882433	
	10% level	-2.577990	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.803883	**0.0000**
Test critical values:	1% level	-3.478189	
	5% level	-2.882433	
	10% level	-2.577990	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.578461	**0.0002**
Test critical values:	1% level	-3.478547	
	5% level	-2.882590	
	10% level	-2.578074	

Null Hypothesis: INFLATION2 has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.412549	**0.0000**
Test critical values:	1% level	-3.479281	
	5% level	-2.882910	
	10% level	-2.578244	

Germany

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.652153	**0.0000**
Test critical values:	1% level	-3.470427	
	5% level	-2.879045	
	10% level	-2.576182	

Null Hypothesis: GDP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.31744	**0.0000**
Test critical values:	1% level	-3.470427	
	5% level	-2.879045	
	10% level	-2.576182	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.63634	**0.0000**
Test critical values:	1% level	-3.470679	
	5% level	-2.879155	
	10% level	-2.576241	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.009528	**0.0000**
Test critical values:	1% level	-3.470427	
	5% level	-2.879045	
	10% level	-2.576182	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.598161	**0.0000**
Test critical values:	1% level	-3.472534	
	5% level	-2.879966	
	10% level	-2.576674	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.396573	**0.0129**
Test critical values:	1% level	-3.484653	
	5% level	-2.885249	
	10% level	-2.579491	

Canada

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.407650	**0.0000**
Test critical values:	1% level	-3.482035	
	5% level	-2.884109	
	10% level	-2.578884	

Null Hypothesis: REAL GDP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.488672	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: REAL_STOCK_RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.00941	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.011537	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.954150	**0.0421**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: INFLATION2 has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.852867	**0.0001**
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

Italy

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.897008	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.71836	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: STOCK MARKET VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.275268	**0.0000**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.81137	**0.0000**
Test critical values:	1% level	-3.482035	
	5% level	-2.884109	
	10% level	-2.578884	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.722521	0.0738
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

United Kingdom

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.895233	**0.0000**
Test critical values:	1% level	-3.490210	
	5% level	-2.887665	
	10% level	-2.580778	

Null Hypothesis: REAL GDP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.28247	**0.0000**
Test critical values:	1% level	-3.490210	
	5% level	-2.887665	
	10% level	-2.580778	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.55058	**0.0000**
Test critical values:	1% level	-3.490210	
	5% level	-2.887665	
	10% level	-2.580778	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.323378	**0.0000**
Test critical values:	1% level	-3.490210	
	5% level	-2.887665	
	10% level	-2.580778	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.181882	**0.0237**
Test critical values:	1% level	-3.490772	
	5% level	-2.887909	
	10% level	-2.580908	

France

Null Hypothesis: INFLATION2 has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.659526	**0.0000**
Test critical values:	1% level	-3.494378	
	5% level	-2.889474	
	10% level	-2.581741	

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.660663	**0.0000**
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Null Hypothesis: REAL GDP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.316236	**0.0000**
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.576068	**0.0000**
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.024720	**0.0023**
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.873353	0.3427
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.900384	**0.0035**
Test critical values:	1% level	-3.536587	
	5% level	-2.907660	
	10% level	-2.591396	

Austria

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.614162	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.320980	**0.0000**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.455095	**0.0108**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.667160	0.0859
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.285203	**0.0000**
Test critical values:	1% level	-3.481623	
	5% level	-2.883930	
	10% level	-2.578788	

Belgium

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.19016	**0.0000**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.08761	**0.0000**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.517991	**0.0000**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null HYPOTHESIS: Term Structure has a unit root
Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.024947	**0.0352**
Test critical values:	1% level	-3.480425	
	5% level	-2.883408	
	10% level	-2.578510	

Null Hypothesis: INFLATION2 has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.771691	**0.0000**
Test critical values:	1% level	-3.481623	
	5% level	-2.883930	
	10% level	-2.578788	

Ireland

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.86093	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.78220	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.786711	**0.0000**
Test critical values:	1% level	-3.480818	
	5% level	-2.883579	
	10% level	-2.578601	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.938522	**0.0000**
Test critical values:	1% level	-3.482035	
	5% level	-2.884109	
	10% level	-2.578884	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.403071	**0.0137**
Test critical values:	1% level	-3.515536	
	5% level	-2.898623	
	10% level	-2.586605	

Portugal

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.363749	**0.0008**
Test critical values:	1% level	-3.530030	
	5% level	-2.904848	
	10% level	-2.589907	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.384915	**0.0000**
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.126616	**0.0016**
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.975970	**0.0451**
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.135825	**0.0016**
Test critical values:	1% level	-3.531592	
	5% level	-2.905519	
	10% level	-2.590262	

Spain

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.224968	**0.0000**
Test critical values:	1% level	-3.519050	
	5% level	-2.900137	
	10% level	-2.587409	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.68174	**0.0001**
Test critical values:	1% level	-3.519050	
	5% level	-2.900137	
	10% level	-2.587409	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.609588	**0.0003**
Test critical values:	1% level	-3.519050	
	5% level	-2.900137	
	10% level	-2.587409	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.570847	**0.0087**
Test critical values:	1% level	-3.520307	
	5% level	-2.900670	
	10% level	-2.587691	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.558213	**0.0000**
Test critical values:	1% level	-3.519050	
	5% level	-2.900137	
	10% level	-2.587409	

Finland

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.107510	**0.0000**
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.419429	**0.0000**
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.309056	0.1720
Test critical values:	1% level	-3.524233	
	5% level	-2.902358	
	10% level	-2.588587	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.066770	**0.0023**
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.218193	**0.0000**
Test critical values:	1% level	-3.525618	
	5% level	-2.902953	
	10% level	-2.588902	

Sweden

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.13551	**0.0001**
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.444141	**0.0000**
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.453670	**0.0000**
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

Null Hypothesis: TERM STRUCTURE has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.597615	**0.0076**
Test critical values:	1% level	-3.503049	
	5% level	-2.893230	
	10% level	-2.583740	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.550563	**0.0000**
Test critical values:	1% level	-3.503049	
	5% level	-2.893230	
	10% level	-2.583740	

GREECE

Null Hypothesis: IP GROWTH has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.649613	**0.0003**
Test critical values:	1% level	-3.533204	
	5% level	-2.906210	
	10% level	-2.590628	

Null Hypothesis: REAL STOCK RETURNS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.393984	**0.0000**
Test critical values:	1% level	-3.528515	
	5% level	-2.904198	
	10% level	-2.589562	

Null Hypothesis: STOCK VOLATILITY has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.809033	**0.00622**
Test critical values:	1% level	-3.528515	
	5% level	-2.904198	
	10% level	-2.589562	

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.309793	**0.0000**
Test critical values:	1% level	-3.528515	
	5% level	-2.904198	
	10% level	-2.589562	

Appendix B
(Tables of Data and Definitions)

Table 1

Country	Variables	Source	Data Frequency	Length
United States	real Stock returns	Datastream	Quarterly	1957q3-2006q3
	Stock Volatility	Datastream	Quarterly	1957q3-2006q3
	Term Structure of Interest rates	IFS	Quarterly	1957q3-2006q3
	Inflation	IFS	Quarterly	1957q3-2006q3
	IP growth	IFS	Quarterly	1957q3-2006q3
	Real GDP growth	Datastream	Quarterly	1957q3-2006q3
United Kingdom	real Stock returns	Datastream	Quarterly	1978q2-2006q1
	Stock Volatility	Datastream	Quarterly	1978q2-2006q1
	Term Structure of Interest rates	IFS	Quarterly	1978q2-2006q1
	Inflation	IFS	Quarterly	1978q2-2006q1
	IP growth	IFS	Quarterly	1978q2-2006q1
	Real GDP growth	Datastream	Quarterly	1978q2-2006q1
Japan	real Stock returns	Datastream	Quarterly	1970q3-2005q1
	Stock Volatility	Datastream	Quarterly	1970q3-2005q1
	Term Structure of Interest rates	IFS	Quarterly	1970q3-2005q1
	Inflation	IFS	Quarterly	1970q3-2005q1
	IP growth	IFS	Quarterly	1970q3-2005q1
	Real GDP growth	Datastream	Quarterly	1970q3-2005q1
Germany	real Stock returns	Datastream	Quarterly	1975q3-2006q2
	Stock Volatility	Datastream	Quarterly	1975q3-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1975q3-2006q2
	Inflation	IFS	Quarterly	1975q3-2006q2
	IP growth	IFS	Quarterly	1975q3-2006q2
	Real GDP growth	Datastream	Quarterly	1975q3-2006q2
France	real Stock returns	Datastream	Quarterly	1988q2-2007q1
	Stock Volatility	Datastream	Quarterly	1988q2-2007q1
	Term Structure of Interest rates	IFS	Quarterly	1988q2-2007q1
	Inflation	IFS	Quarterly	1988q2-2007q1
	IP growth	IFS	Quarterly	1988q2-2007q1
	Real GDP growth	Datastream	Quarterly	1988q2-2007q1
Italy	real Stock returns	Datastream	Quarterly	1981q2-2006q2
	Stock Volatility	Datastream	Quarterly	1981q2-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1981q2-2006q2
	Inflation	IFS	Quarterly	1981q2-2006q2
	IP growth	IFS	Quarterly	1981q2-2006q2
	Real GDP growth	Datastream	Quarterly	1981q2-2006q2
Canada	real Stock returns	Datastream	Quarterly	1973q3-2006q2
	Stock Volatility	Datastream	Quarterly	1973q3-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1973q3-2006q2
	Inflation	IFS	Quarterly	1973q3-2006q2
	IP growth	IFS	Quarterly	1973q3-2006q2
	Real GDP growth	Datastream	Quarterly	1973q3-2006q2

Austria	real Stock returns	Datastream	Quarterly	1973q2-2006q2
	Stock Volatility	Datastream	Quarterly	1973q2-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1991q3-2006q2
	Inflation	IFS	Quarterly	1973q2-2006q2
	IP growth	IFS	Quarterly	1973q2-2006q2
	Real GDP growth	Datastream	Quarterly	
Belgium	real Stock returns	Datastream	Quarterly	1973q2-2006q2
	Stock Volatility	Datastream	Quarterly	1973q2-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1973q2-2006q2
	Inflation	IFS	Quarterly	1973q2-2006q2
	IP growth	IFS	Quarterly	1973q2-2006q2
	Real GDP growth	Datastream	Quarterly	
Ireland	real Stock returns	Datastream	Quarterly	1986q3-2006q2
	Stock Volatility	Datastream	Quarterly	1986q3-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1986q3-2006q2
	Inflation	IFS	Quarterly	1986q3-2006q2
	IP growth	IFS	Quarterly	1986q3-2006q2
	Real GDP growth	Datastream	Quarterly	
Denmark	real Stock returns	Datastream	Quarterly	1973q1-2006q2
	Stock Volatility	Datastream	Quarterly	1973q1-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1973q1-2006q2
	Inflation	IFS	Quarterly	1973q1-2006q2
	IP growth	IFS	Quarterly	1973q1-2006q2
	Real GDP growth	Datastream	Quarterly	
Portugal	real Stock returns	Datastream	Quarterly	1988q3-2006q2
	Stock Volatility	Datastream	Quarterly	1988q3-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1988q3-2006q2
	Inflation	IFS	Quarterly	1988q3-2006q2
	IP growth	IFS	Quarterly	1988q3-2006q2
	Real GDP growth	Datastream	Quarterly	
Spain	real Stock returns	Datastream	Quarterly	1987q3-2006q3
	Stock Volatility	Datastream	Quarterly	1987q3-2006q3
	Term Structure of Interest rates	IFS	Quarterly	1987q3-2006q3
	Inflation	IFS	Quarterly	1987q3-2006q3
	IP growth	IFS	Quarterly	1987q3-2006q3
	Real GDP growth	Datastream	Quarterly	
Finland	real Stock returns	Datastream	Quarterly	1988q2-2006q2
	Stock Volatility	Datastream	Quarterly	1988q2-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1988q2-2006q2
	Inflation	IFS	Quarterly	1988q2-2006q2
	IP growth	IFS	Quarterly	1988q2-2006q2
	Real GDP growth	Datastream	Quarterly	
Sweden	real Stock returns	Datastream	Quarterly	1982q3-2006q2
	Stock Volatility	Datastream	Quarterly	1982q3-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1982q3-2006q2

	Inflation	IFS	Quarterly	1982q3-2006q2
	IP growth	IFS	Quarterly	1982q3-2006q2
	Real GDP growth	Datastream	Quarterly	
Greece	real Stock returns	Datastream	Quarterly	1988q4-2006q2
	Stock Volatility	Datastream	Quarterly	1988q4-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1988q4-2006q2
	Inflation	IFS	Quarterly	1988q4-2006q2
	IP growth	IFS	Quarterly	1988q4-2006q2
	Real GDP growth	Datastream	Quarterly	
Netherlands	real Stock returns	Datastream	Quarterly	1973q1-2006q2
	Stock Volatility	Datastream	Quarterly	1973q1-2006q2
	Term Structure of Interest rates	IFS	Quarterly	1986q2-2006q2
	Inflation	IFS	Quarterly	1973q1-2006q2
	IP growth	IFS	Quarterly	1973q1-2006q2
	Real GDP growth	Datastream	Quarterly	

Variables	Definition		Source
Real GDP growth	Real GDP growth is defined as the log difference between Real GDP prices in t and t-1	Real Gdp growth = ln((Real Gdp(t))/((Real GDP(t-1))	Real GDP prices (denominated in billions of domestic currency) that were used for the calculation of Real GDP growth were made available from DataStream
IP Growth	IP growth is defined as the log difference between prices of Industrial production in t and t-1	IP growth = ln((Industrial Production(t))/((Industrial Production(t-1))	Prices of Industrial Production that were used for the calculation of IP growth were made available from IFS
Real Stock returns	Stock return is defined as the log difference between stock Index prices in t and t-1	Stock return= ln((Stock Index price(t))/((Stock Index price(t-1))	Stock Index prices that were used for the calculation of Stock returns were taken from DataStream*
Stock Volatility	Stock Volatility is defined as the standard deviation of the return provided by the stock in 1 year with continuous compounding. When the time interval is small (T), is approximately equal to the standard deviation of the percentage change in the stock price in time T. In order to identify the 3 month volatility of stock returns we are going to calculate the daily volatility estimated by 60 daily observations of stock returns and then we will multiple this by the squared root of 60.	Three Month Stock Market Volatility = (**1/60***Σ(Ri-E(R)^2)*(60^1/2)**	Stock prices that were used for the calculation of Stock returns and then the calculation of Stock Volatility were taken from DataStream**
Term structure	Term Structure is defined the difference between Long term interest rate and short term interest rate. As a Long term interest rate we used the 10 year Government Bond of each country*** while as short term interest rate we used the three month treasury bill. For the countries where no data on T-Bills were available we used the three month interbank lending interest rate****	Term Structure= Long term interest rate - short term interest rate	10 Year Government Bonds as well as 3 month T-Bills or 3 Month interbank lending rateS were taken from Datastream and IFS.

Inflation	Inflation is defined as the percentage change of Consumer Price Index (CPI)	Inflation = (CPI(t)-CPI(t-1))/CPI(t-1)	CPI was taken by IFS

* Real Stock prices were obtained by dividing the period's nominal Stock price Index by the corresponding consumer price Index. This method is the method that was used by Choi, Hauser and Kopecky "Does the stock market predict real activity? Journal of Banking and Finance" so as to convert nominal prices into real

** " Hull:Option Futures and other Derivatives"

*** As most of the researchers who focused on the relationship between term Structure and real economic activity (e.g. Estrella nad Hardouvelis (1991) "The term strucutre as a predictor of real economic activity Journal of Finance")

****As Koukouritakis and Michelis did in their article:"Term Structure Linkages among the new EU countries and the EMU"