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Thesis

LIQUIDITY IN THE EMU BENCHMARK GOVERNMENT BOND MARKET

THE ROLE OF INTEREST RATE VOLATILITY

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Section 1
Introduction

Interest in the market's liquidity is increasing last years as it is becoming obvious that liquidity in the market is a determinant factor for financial stability. Also the government funding needs and the fluctuation that appears in them make crucial how prices are affected by lowering the liquidity when they issue fewer bonds or by enhancing liquidity when they issue large amount of bonds. Although many studies have examined the liquidity of equity and foreign exchange markets, relatively few have examined the liquidity in government bonds markets and particularly the European government bond markets.

It is only in the last five years that researchers motivated from central banks and Bank of International Settlements have started to measure liquidity in bond markets and trying to identify the factors and the role playing each one based in a market microstructure theory. The Asian crisis and the default of the Russian debt affected the liquidity conditions in bond markets in such a degree that took a long time for liquidity conditions to return to pre-crisis levels and in some cases it was not fully restored. Now researchers are trying to quantify the results of poor liquidity in banks asset and government bonds. The use of some government bonds as benchmarks, i.e. as a base for pricing corporate bonds and extracting the yield curve makes very important whether the liquidity premium is high or low because it affects the quality of information extracting from the bonds. Also some techniques for managing risks used by banks such as Value at Risk (VAR) models do not take into account what happens when liquidity is lost.

In this paper we will measure the liquidity of government bonds of the countries that participate in European Monetary Union and particularly how the introduction of the euro may have affected the liquidity conditions in the bond market in each country. Also we will examine whether the volatility of the interest rates and the participation of the foreign investors in the government bond market had any liquidity effect.

Section 2
The importance of market liquidity

2.1. Why do we care about market liquidity?

Market liquidity is often taken for graded when the market participants price financial instruments and manage their portfolios and when central banks conduct their monetary policy. There are two reasons why market liquidity has been attracting increasing attention on the part of market participant's especially central banks. The first is relating to the long run stability of the financial system and the second is due to recent events of financial crisis.

Central banks have shown a growing interest in market liquidity from the perspective of their responsibility for both monetary and financial stability. Regarding to monetary stability, the shift towards market oriented operating procedures and the greater use of asset prices as a guide for policy have put a premium on market liquidity. For example, the reliability of estimates of market participants' expectations about inflation as derived from yield curves depends crucially on the liquidity of the underlying market. In order to allow policy-makers and market participants to extract reliable information, the liquidity of the markets must be high. Over and above all, as financial institutions are depending more and more on markets for their risk management, robust market liquidity under stress has become critical and, in turn, increasingly influenced by risk management practices (e.g. VAR models). The dislocations generated by the evaporation of liquidity in some key fixed income and foreign exchange markets in autumn 1998 are a clear illustration of the heightened significance of market liquidity for financial stability.

Another issue for the Central banks is the transmission of the monetary policy. Through the open market operations central banks are trying to conduct the monetary policy and to give signals in the market about their intentions. A deeper and more liquid money market contributes to a more effective transmission of the effects of central bank intervention. The speed of the transmission is the key for the effectiveness.

The Asian crisis in 1997 and especially the turbulence in mature markets in autumn 1998, represented a watershed in market liquidity conditions in global

financial markets. These episodes of financial distress heralded a protracted period of diminishing market liquidity. While many markets have recovered since then, questions remain about the scope, causes and possibly implications of these developments. In particular doubts have been voiced about the resilience and robustness of market liquidity in the current environment. Since the cost of losing market liquidity is large despite its implicit nature, the improvement and stability of market liquidity is not only important for market participants, but also serves as a way to enhance financial market stability. Moreover market liquidity affects directly market efficiency, so we can improve market efficiency by increasing market liquidity.

2.2 Central banks and market liquidity in government securities markets

As mentioned above central banks have an interest in matters affecting the liquidity of government securities markets and more specifically for the following reasons. First, outright purchases and repos of government securities are important as instruments for monetary policy. If market liquidity is not sufficient, central banks might not be able to provide or absorb the necessary amount of funds through their open market operations and such operations could produce unintended results as excessive price volatility if liquidity is poor.

Second obtaining the appropriate information, including the implied inflation expectations, from prices in government securities markets is important for the conduct of monetary policy. Differences in liquidity across the term structure, or between fixed coupon and inflation linked bonds, would distort the information that can be extracted from the different securities when the liquidity premium is high.

Third a high level of liquidity in government securities markets contributes to the promotion of financial efficiency and stability by providing benchmarks and hedging vehicles for other traded financial assets such as commercial papers, asset-backed securities and corporate bonds. Such traded assets are beginning to have an increasingly important role in financial system in many countries. Liquidity in government securities markets should thus make the financial intermediation process more efficient. In addition, liquidity in traded asset markets improves the ability of financial institutions to adjust their assets and liabilities rapidly in response to shocks.

Fourth, since many central banks act as agents for their governments in the issuance of government securities, they have a strong interest in the structure of the market, such as the types and maturities of securities offered, which affect secondary market liquidity. A liquid secondary market lowers funding costs for the government by reducing the liquidity premium demanded by purchasers of government securities in the primary market. That reduces the cost of public debt and also makes the government securities more attractive to investors.

2.3 Definition of market liquidity

Market liquidity is a very complex and many times obscure concept. Although almost all the observers have a sense of the liquidity many times this is more intuitive than well understood. Furthermore a precise definition for market liquidity is very difficult to obtain. This is because market liquidity is multi faceted: the definition depends on what aspect one wishes to emphasise. In research papers there are many different definitions, but a definition which seems to garner relatively wide support is the following: a market is liquid when participants can rapidly execute large volume transactions with a small or none impact on prices.

Section 3
Measures for market liquidity

3.1 Dimensions of market liquidity

The usual approach for liquidity in market microstructure research is to consider market liquidity according to at least one of three possible dimensions: tightness, depth and resiliency. Tightness is how far transaction prices (i.e. bid or ask prices) diverge for the mid-market price, in other words the general costs which included in the level of market prices. Depth denotes either the volume of trades that do not affect the prevailing market prices or the amount of orders on the order books of market makers[1] at a given time. In general, the greater the relative imbalance of buy or sell orders , the farther the market price must diverge from the standard bid or ask price

[1] A market maker is an individual or institution that regularly gives costumers both bid and asks price quotations for a given asset and trades with costumers as counterparty.

for the imbalance to be cleared. Measures of depth attempt to capture the maximum backlog that can be accommodated before such a divergence takes place. Finally, resiliency refers either to the speed with which price fluctuations resulting from trades are dissipated, or the speed with which imbalances in order flows are adjusted[2]. It is important to point that although a given measure might be very informative about liquidity conditions to one market in another market might be meaningless or irrelevant.

Another difficulty is that the measures do not always point in the same direction. For example, Muranaga and Shimizu find that an increase in a depth measure, volume of the order book, is accompanied by a worsening of tightness, as measured by the bid-ask spread, under certain assumptions about traders' access to order book information.

3.2 Tightness

Tightness is the ability of the market to match demand and supply at low cost. One of the most frequently used measures of tightness is the bid-ask spread. Bid-ask spreads can be measure in several ways, but every measure spread has a slightly different economic meaning. The quoted spread is the gap between quoted bid and ask prices and is observed before an actual transaction takes place. The realized spread is the gap between weighted averages of the bid and ask prices for executed trades over a period of time, using the transaction volumes at each price as the weights. The effective spread is based on the actual transaction price, rather than the quoted price; because it incorporates the change in the price between when it is quoted and when it is executed, the effective spread incorporates the direction of price movements. The most typical calculation of bid-ask spread is the distance between the bid or offer price and the bid-ask midpoint (or one-half of the bid-ask spread). This measure the cost of executing a small trade and a drawback of this bid-ask spread is that bid and offer quotes are only good for limited quantities and periods of time. Fleming and Sarkar, who study the U.S. treasury securities market, attempt to measure tightness more precisely by looking into these different measures of bid-ask spreads. Methods

[2] Another commonly used concept is immediacy, defined as the time necessary to execute a trade of a certain size within a certain price range. Because immediacy incorporates elements of all three of the dimensions listed, it is not a separable dimension.

have also been developed for estimating quoted bid-ask spreads when they cannot be measured directly. Scalia and Vacca estimate the fixed cost of trading associated with the existence of the spread by using an empirical model proposed by Foster and Viswanathan (1993).

3.3 Depth

Market depth is the ability of a market to absorb large trade flows without a significant impact on prices. Depth can be measured by the amounts of orders on order books, or by market impact, which is the fluctuation in quotes or bid-ask spreads resulting from order executions. Average turnover figures for a given time period (such as daily or weekly) can sometimes act as proxies for depth, because they show the order flow a market tends to accommodate in normal times. While these measures of market depth capture actual order flows, a more accurate measure of market depth would measure both actual trades by market participants and potential trading needs that may arise from portfolio adjustments. A simple estimate of the quantity of securities that can be traded is the quote size, or the quantity of securities that is explicitly bid for or offered for sale at the posted bid and offer prices. A drawback of this estimate is that market makers often do not reveal the full quantities they are willing to transact at a given price so that the measured depth underestimates the true depth. An alternative measure of market depth is the trade size. The trade size is an ex-post measure of the quantity of securities that can be traded at the bid or offer price, reflecting any negotiation over quantity that takes place. Trade size also underestimates market depth as the quantity traded is often less that the quantity that could have been traded at a given price. In addition, any measure of the quantity of securities that can be traded at the bid and offer prices does not consider the cost of executed larger trades. Another measure of liquidity suggested by Kyle (1985), considers the rise (fall) in price that typically occurs with a buyer initiated (seller initiated) trade. The Kyle lambda is defined as the slope of the line that relates the price change to trade size and typically estimated by regressing price changes on net volume for intervals of fixed time. The measure is relevant to those executing large trades or a series of trades and together with the bid-ask spread provides a fairly complete picture of market liquidity. A drawback of this measure is that the data

required for estimation is often difficult to obtain. Other proxies for market depth include the size of trades that market makers are willing to accept and the volume per trade.

3.4 Resiliency

While there is still no consensus on the appropriate measure for resiliency, one approach is to examine the speed of the restoration on normal market conditions (such as the bid-ask spread and order volume) after trades. Measuring market resiliency should be useful because it gives a picture of potential market depth, which cannot be observed from prevailing order flows.

3.5 Other measures

Other measures of liquidity that do not directly coincide with the three dimensions described above are the number and volume of trades, trade frequency, turnover ratio (the turnover ratio is the ratio of the average trading volume over a given period of time to the outstanding volume of securities), price volatility, and the number of market participants.

Section 4
Dynamics of market liquidity

4.1 What are the dynamics?

As the advances in information technology and the globalisation of financial markets have accelerated, it has become easier both for trading activity to increase or decrease rapidly within a market, and for activity to shift rapidly among markets This was especially apparent in the context of the events in global financial markets in August-October 1998, when illiquid conditions spread rapidly and unexpectedly across markets that are usually uncorrelated with each other and investor demand for liquid instruments rose dramatically. Insights into the dynamics of market liquidity are thus essential in understanding recent developments in international financial markets.

4.2 Patterns in the dynamics of market liquidity

In this section, the dynamic aspects of market liquidity are explored. Three phenomena are discussed in turn: the concentration of liquidity in specific markets or instruments, often at the expense of liquidity in closely related markets, the evaporation of liquidity from markets, and the flight to liquidity in which, because of a shift in investor preferences, the premia demanded for holding traditionally illiquid instruments rise relative to those attached to traditionally liquid ones

4.3 Concentration of market liquidity

In markets that assets can act as substitutes for one another, liquidity is often concentrated in one or a small number of the assets. For example, while in a typical government securities market there are many issues, differing in maturities, coupon levels, etc, market liquidity is usually concentrated in relatively few specific issues. Similarly, in the case of futures markets, while there are multiple contracts listed, not all contracts enjoy the same degree of liquidity; the closest-to-delivery contracts are usually the most liquid.

In 1999, with the introduction of the euro, a partially integrated government securities market has emerged among the eleven member countries. The introduction of the euro has accelerated the concentration of futures market trading in the euro area in the 10-year German government bund futures. This heightened concentration of activity has accentuated bund's broad use in managing risk in the euro area and the relatively narrow basis of the underlying on-the-run cash bonds. While studies suggest a high degree of persistence over time in the concentration of liquidity in specific instruments, liquidity can also shift rapidly among instruments over short time periods under certain conditions. For example, when there was excessive position taking in the bund future after the 1998 Russian shock, concerns over squeezes seemed to encourage market liquidity to migrate into the government securities markets of other

developed countries.[3]

4.4 Evaporation of market liquidity

Concentration of liquidity in one market could result in the evaporation of market liquidity from other markets. Muranaga and Shumizu (1999) explore this topic using simulation techniques. They find that market liquidity can affect price discovery in times of stress in at least two different ways.

In one simulation, it is found that the loss of market liquidity in response to a market shock sometimes performs the function of a built-in stabiliser in the market, by preventing a precipitous secondary drop in prices that would not have been warranted by fundamentals.[4] As uncertainty increases in response to the shock, market participants become less willing to trade, and the decline in the number of orders generated, in turn, results in a loss of market liquidity. In other words, when market liquidity is low, price discovery is not conducted as often, so a crash in prices is less likely to lead to an endogenous (secondary) crash in prices that does not reflect fundamentals. In a sense, the withdrawal of liquidity breaks the self-reinforcing dynamics of market crashes and allows time for fundamentals to reassert themselves.

In a second simulation, however, resting on a somewhat different set of assumptions, conditions are found under which secondary crashes might develop. If market participants amend their expectations of future prices in response to a price shock and uncertainty remains low, order streams do not diminish but instead, reflecting sharply lower expected future prices, become one-way, resulting in secondary crashes.

4.5 Flight to liquidity

[3] At one point in the summer of 1998, the amount outstanding of September 1998 Bund futures contracts reached more than twice the total amount of securities deliverable

[4] This result relies on the following key assumptions: first, that the degree of market liquidity does not affect the participants' expectations of future prices; second, that market participants do not amend their expectations on future price levels in response to a price shock; third, that in response to a price shock they become more uncertain over whether their expectations will be realized. Each modeled participant is given an expected future price, and expects that realized prices will fall within a statistical distribution around this expected future price. The increase in uncertainty is then modeled as an increase in the variance of this distribution.

A "flight to liquidity" can be regarded as a migration of activity into markets which are expected to continue to provide price quotes even in times of stress. During such an episode, participants are willing to pay a higher premium than usual to hold liquid assets. This usually happens as part of a broader "flight to quality", when participants pay a higher premium for assets perceived to have low levels of all kinds of risk. While activity may move to more liquid markets, however, it is not clear that liquidity increases in them. For example, during August-October 1998, prices of risky assets of all types fell as investors shifted into the safest available assets, principally government securities. However, the liquidity premia on government securities did not necessarily increase (in price terms) for all issues and indeed, for "off-the-run" issues, they generally fell. Increased yield spreads between on-the-run and off-the-run issues reflected the fact that investors placed a higher value on the liquidity of on-the-run issues[5], rather than an actual increase in the liquidity of those issues.

Section 5
Factors affecting market liquidity

Factors affecting market liquidity are complicated and it is generally not possible to characterise how each factor works independently of the others. Therefore we are focusing on two sets of factors which seem to be both of particular importance in determining market liquidity and relatively easy to observe and compare across markets: product design and market microstructure.

5.1 Effects of product design

One key element in considering the relations between product design and market liquidity is the substitutability of products. If the substitutability between a number of products is high, market liquidity might be concentrated in just one of them. For example, government securities are more homogeneous than corporate paper because there is only one issuer (the government) and because other features, such as coupon payment dates, embedded options and pricing conventions are usually identical across

[5] On-the-issues are most recently issued securities of a given maturity class. On-the-run issues become off-the-run when a new issue is created

issues. Such homogeneity should be especially high among securities with similar maturities, in which case there would be little reason to prefer one issue to another. If, for some reason, one issue becomes the preferred issue and its liquidity increases, liquidity might more and more concentrated in such an issue because trading demand from market participants who have higher preference for more liquid securities would certainly increase. This offer an example of the "self-fulfilling" nature of market liquidity. Alternatively, greater substitutability might increase the liquidity of similar issues, for example if it is easy to hedge a position in one security with a position in another.

5.2 Effects of market microstructure

Differences in market microstructure can also affect market liquidity considerably. Market microstructure contains many elements, including trade execution systems, trading commissions, disclosure of contracted price and volume information, market regulations, and these elements can be combined in many different ways across countries, products and markets. Over time, competition between different organised exchanges and between organised exchanges and OTC markets spur further changes in market microstructure, and help to ensure that market structures eventually adopt whatever efficiency gains are made available by technological advances and globalisation.

5.3 Trade execution systems

Trade execution systems can be broadly categorised into dealer markets and auction-agency markets. In a dealer or "quote-driven" market, dealers quote bid and ask prices to traders, and the traders choose whether to buy or sell at those prices. In an auction-agency or "order-driven" market, orders from traders are brought together on the order book of the auction agency, and those orders are matched according to predetermined rules. Order-driven markets have been said to provide more efficient price discovery (that is prices better reflect available information), while quote-driven markets are thought to provide greater immediacy (that is trades can be executed more quickly at posted prices). Order-driven markets disseminate more information to

market participants about order flows, allowing the participants to use this information in their trading decisions. Quote-driven markets give dealers a monopoly over information about the order flows that they handle, reducing the information available to the wider market but encouraging the dealers to trade even in uncertain market conditions. Although over-the-counter (OTC) markets tend to be quote-driven and the majority of organised exchanges are order-driven, there are exceptions to this pattern.

While some aspects of trade execution systems seem to be made necessary by characteristics of the product traded, other aspects vary from one market to another because of historical or institutional factors. For example, stocks of large companies are generally traded on organised exchanges, perhaps because the differences between issuers are so great that it would be difficult to match trades (or discover prices) bilaterally when order flows are dispersed, but exchanges are organised differently across countries. In the case of foreign exchange markets, quote-driven OTC markets are dominant in most countries. This could be because the traded product is homogenous and price discovery is relatively easy, and also because order flows, from various parties dispersed around the globe, are ample even without artificially directing them to an exchange.

As for fixed-income securities, quote-driven OTC systems seem to be fairly common, but in some countries trading also takes place in organised exchanges. Although fixed-income securities are not as homogeneous as foreign exchange, price discovery is easier for bonds than stocks because prices can be determined through arbitrage with benchmark government security yields. The price-discovery benefits of an organised exchange are therefore not always needed for bonds.

5.4 Effects of transaction costs

Transaction costs include all factors that may affect the ease of executing transactions. Explicit transaction costs include commissions for trade and transaction taxes. Implicit transaction costs can take several different forms, including the temporary divergence of transaction prices from their market-clearing levels. Implicit costs often involve a tradeoff between the cash cost of trading at a bad price and the opportunity cost of not being able to trade at the desired time. For example, if one

tries to minimise the price impact of a large-scale portfolio adjustment by conducting multiple small-lot transactions, one incurs the risk that the market price will change before the desired adjustment is completed, as well as the opportunity cost of the time a trader must devote to planning and executing the trades.

Dupont (1999) investigates how a transaction cost, for example a tax, could affect market liquidity by using a model where a dealer faces an "informed trader" and a "liquidity trader".[6] If market conditions are unfavorable to the dealer, in the sense that information asymmetry is high or demand for liquidity is weak, an increase in the transaction cost drastically reduces market liquidity: the widening of the bid-ask spread is larger than the increase in the transaction cost and the quoted depth falls. In contrast, favorable market conditions mitigate the impact of an increase in the transaction cost. These findings imply that reducing explicit transaction costs could be effective in enhancing market liquidity, although the strength of such effects depends on market conditions, while an increase in transaction costs could aggravate liquidity loss in periods of market stress and possibly cause an earlier exit of market-makers from the market.

5.5 Transparency of markets

For purposes of the analysis of market microstructure, market transparency is usually defined as the ability of market participants to observe the information in the trading process. The theoretical literature suggests that if transparency decreases: a) informed traders become better off while uninformed traders become worse off, because the former can better exploit their private information; b) traders tend to delay their transactions in order to gather information from the trading activity of other participants. One should not automatically equate greater market transparency with greater efficiency. In general, regarding the transparency of ex-ante price information in OTC-dealer markets, the market microstructure literature suggests that greater transparency would contribute to higher market liquidity, since it tends to increase

[6] A trader is considered informed if he/she knows more about fundamental asset values than other traders. A liquidity trader is defined as a trader who knows only the price process, not the underlying value of the asset, and trades for reasons unrelated to the underlying value. In this model, the dealer has no prior information about the true value of the asset.

investor activity. However, the effects on efficiency seem to depend in subtle ways on the underlying information structure. If there is little inherent information in trade flows (as may often be the case in government security markets), greater transparency may not necessarily improve efficiency. In some cases, greater transparency can be a disincentive for market makers to take on large open positions. Indeed, if a market is already highly transparent, decreasing certain kinds of transparency can sometimes be beneficial.

Section 6
Related studies about market liquidity

The majority of studies for market liquidity on government securities markets are written after the 1995 and especially after the Asian and Russian crisis. The default of Russian debt had driven to an evaporation of liquidity in government securities markets especially in Europe and in the United States. This phenomenon had as a result to try to identify the nature and the effects of liquidity in government securities markets.

The Bank of International Settlements published a report of a study group established by the Committee of the Global Financial System of the central banks of the Group of Ten countries on May 1999. The ultimate goal for central banks in studying market liquidity is to develop knowledge about its determinants that can be employed by them in the conduct of monetary policy. The report consists of several papers related to market liquidity. The study group had examined the liquidity of government securities market of Canada, Italy, Japan, U.K. and the United States. They used some typical indicators such as bid-ask spread, turnover ratio and trading volume.

A comparison of those liquidity indicators suggests some initial results: i) the measures of market liquidity differ considerably across countries ii) the national markets with large outstanding volumes are not necessarily those with narrow bid-ask spreads. This stands in contrast with the tendency for outstanding volume and the bid-ask spread to be inversely correlated both across issues within a given national market, and over time for a single maturity in a given national market iii) higher turnover ratios (the ratio of trading volume to the amount outstanding) tend to go with

a narrower bid-ask spread iv) longer maturity is generally accompanied by wider bid-ask spreads. This may be a reflection of the greater inherent variability of securities with longer remaining maturities.

Another issue is the price discovery that refers to the process by which information about an asset's fundamental value incorporated into its price. A benefit of a liquid market is that it facilitates rapid price discovery. At the intraday level, trading volume, price volatility and the bid-ask spread tend to follow U-shaped patterns, where the parameters are high just after the opening and just before the closing. The morning surge may reflect the incentive of market participants to trade based on accumulated information from the previous day. The surge in the late afternoon may be explained by the adjusting behavior of market participants to control price risk during market closure. One reason that bid-ask spread and price volatility are positively correlated could be that market makers widen the spread in order to compensate for increased inventory risk from volatile prices. In Japan, the U.K. and the U.S. figures for daily trading volume exhibit a hump-shaped intraweek pattern. The differences between intraday and intraweek patterns represent something of a puzzle. These patterns are, however, both large and persistent and seem to derive from the timing of data releases as well as differences in the participation and price response behavior of informed traders, liquidity traders and market makers.

Also the choice of the maturity distribution of new bond issues involves a trade off. On the one hand, if a government does not offer securities at the maturities desired by investors, the latter will demand an extra yield premium as compensation, thereby increasing the government's funding costs. On the other hand, if bonds are issued at too many original maturities, the size of each issue will be small, reducing liquidity. The liquidity premium demanded by investors will also increase government funding costs. In all of the countries surveyed, one or more on-the-run issues for key maturities are regarded as benchmarks, that is, issues whose yields are widely followed as macroeconomic indicators and used for pricing related securities. Market participants tend to prefer on-the-run issues for hedging and short term trading because coupon rates of on-the-run issues tend to be close to the market rate.

In one other study Robert McCauley (1999) has studied the effect of the introduction of the euro on the liquidity of European fixed income markets. Specifically he examined the effects on the wholesale money market, interest rate

swap market and the government securities market. In order to estimate liquidity he used turnover data from derivatives markets because these markets represent the most liquid pole of the closely linked cash and derivatives markets.

The prospect of the introduction of the euro completed a remarkable process of convergence of private interest rates in Europe. The interest rates most influenced by central banks, namely those prevailing in the money-market, proved the last to converge. At the introduction of the euro, there were two contenders for the benchmark 3-month interbank rate. The British Bankers Association polls 16 banks for euro deposit rates at various maturities every working day, trims the 4 highest and 4 lowest rates, and averages the remaining yields to produce a euro LIBOR. The other contender is the European Bankers Association's Euro Interbank Offered Rate (EURIBOR), defined as the rate at which Euro interbank term deposits within the Euro zone are offered by one Prime bank to another Prime bank. Euribor tended to come in a bit higher than its London competitor.

Euribor and EuroLibor compete on three fields. The first is the loan and bond contracts. The latest corporate bond issues signaled a market preference for euro area rate over the London rate. Another field of competition is in the over-the-counter derivative market. LIFFE officials are reported to have estimated in late January that 60%-80% of new contracts in 1999 had referred to Euribor. The third field of competition is in the futures market. Euribor seems to have trounced euro Libor in the futures market. By comparing derivatives transactions in euro area money market instruments with their counterparts in the dollar and yen we can see that in 1997, proto-euro area transactions had surpassed those in yen while still falling significantly short of transactions in the dollar.

The introduction of the euro has collapsed into a single swap market several distinct, albeit already closely linked, markets. In this single swap market, prime banks and corporations manage their interest rate risk by buying and selling fixed rate payments against floating rate payments. Maturities range from 1 to 2 years out to 10 years or longer. As the interest rate swap market in Europe gains liquidity its linkage to the dollar and yen fixed income markets will become stronger. Judging by indicated bid-ask spreads, swapping from euros into dollars is already on average cheaper than swapping from the euro's predecessor currencies. One clear implication

of these improvements in swap market liquidity is greater issuance and investment in euros.

In the mid to late 1990's, the European government bond market was catching up, and by some measures surpassing, its US counterpart. In the early 1993, the futures contracts on the French and German government bonds traded in roughly equal amounts, with each representing about 45% of turnover in what would become the euro area. By 1998 the German government contract represented about 80% of trading the French government contract only about 10%. Clearly, with currency concerns increasingly remote, market participants found it convenient to hedge risks or take positions in generic euro area fixed income by using the bund future. The heightened of the credit risk arising from the Russian default in 1998 placed a premium on the most liquid government bonds deliverable into futures contracts. Some observers have suggested that the widening of spreads across bonds of different sovereigns in Euro land in the summer of 1998 proves that highly variable credit (or liquidity) will necessarily leave the European government bond market fractured and relatively illiquid.

McCauley suggests that a structure that would be more conductive to liquidity would be one that overcome the imbalance between futures and underlying cash bonds by permitting more than one sovereign's bond to be delivered into a single contract. Such multiple issuer deliverability is a two-tier euro area market. As an example, the German, French and Dutch government bonds could be delivered into one contract, and the Italian, Spanish and Portuguese into another. Such a structure would recognize substantial credit differences between tiers, while suppressing or making adjustments for, small differences within tiers. However things turn out, the introduction of the euro seems to have increased the liquidity of the European fixed income markets relative to their US counterparts. The liquidity of the euro area government bond market would benefit from a broadening of the cash market basis of the fewer contracts that remain after the convergence.

Michael Fleming and Asani Sarkar (1999) had estimated various measures of market liquidity for U.S. Treasury spot and futures markets for 1993. They analyse high-frequency tick-by-tick trading data and compute the following liquidity measures: trading volume, number of trades, trade size, number of dealer/floor traders, and various measures of bid-ask spread (quoted, effective, realised). They find

that, for both spot and futures markets', trading is concentrated in the nearby expiration/on the run instruments and in specific maturities- longer maturities for the futures, and shorter maturities for the spot.

The most U.S. Treasury spot trading takes place in a relative small number of securities. Sixty two percent of interdealer trading in 1993 was in on-the-run securities; the most recently issued securities of a given maturity. The 5-year note, the most active security by dollar volume, is also the most traded security in the spot market. Also average daily trade size decreases nearly monotonically with security maturity. The futures contracts have four different expiration months: March, June, September and December. Typically, only the nearby contract, the contract for which the expiration month is closest to the trading date, records significant volume. This is an aspect of the 'concentration of liquidity' which is a feature of the futures markets. Trading volume is highly concentrated in the futures markets. The majority of trading volume is in longer maturity and activity highly concentrated in the nearby expiration. It appears that the more active the nearby contract, the less active the distant contracts.

Fleming calculates the realized bid-ask spread as the difference between the daily volume-weighted buy price and the daily volume-weighted sell price. The realised spread is proportionalised by dividing with the midpoint between the mean buy and sell prices. The quoted spread defined as the difference between the bid and the offer quotes. To produce a proportional spread measure the spread is divided by the midpoint of the bid and offer quotes.

Finally he found that the quoted spreads for on-the-run issues increase nearly monotonically with security maturity in the spot market. Median effective spreads are less than quoted spreads for every security and median realised spreads are less than effective spreads for every security except one. In the futures markets the median spread is less than the minimum tick, the minimum price change, where the mean spread is slightly larger than the minimum tick. Also the median spreads are generally higher for the distant contracts. Finally the proportional realised spreads are uniformly lower in futures markets than in the spot market.

A study for the liquidity of the Government of Canada securities market is made by Toni Gravelle (1999). The aim of his paper was to study the liquidity in the Government of Canada (GoC) securities market and to determine the factors that tend to influence the level of liquidity in the GoC securities, especially in comparison with

the US treasury market. He used the the bid-ask spread, the turnover volume, the turnover ratio, the stock outstanding to study the liquidity. Using this data for the GoC securities market, he showed that the outstanding amount of securities has a negative effect on bid-ask spreads and a positive effect on turnover ratio. Also interest rate volatility has a positive effect on bid-ask spreads and on trading volume in the futures market.

The GoC securities market is smaller in size than the U.S. Treasury market. The amount of outstanding securities and the volume of transactions are significant smaller in Canada. A better measure than the turnover volume in measuring the liquidity is the turnover ratio, defined as turnover divided by the stock outstanding. In Canada this ratio is 19.1 and in U.S. 21.9 showing that the differences in trading activity (or the size of the markets) are reduced.

In terms of turnover the data from Canada have shown that the GoC bond market has since the early 1990s become increasingly more liquid while the t-bill market has seen a continual decline in trading activity since 1996. One factor affecting the trading activity and in turn the liquidity in bonds is the effective supply. Effective supply is defined as the supply of the security in the hands of active market participants (is equal to the total supply minus the supply in the hands of buy and hold investors). A simple linear regression of the bond turnover ratio on an index of the stock of outstanding bonds plus 5 lags of the ratio variable, results in significant positive coefficient for the stock variable. The results tend to support the hypothesis that an increase in the size of the benchmark issue increases its liquidity.

Market liquidity is often measured with bid-ask spreads. The bid-ask spread reflects the costs to the dealers in providing immediacy and includes inventory management costs, trading costs, and costs associated with trading with a better informed investor (adverse-selection costs). Market makers will widen their quoted spreads when faced with increased inventory risks as their inventory control component of the spread increased. A simple linear regression of the 90-day t-bill spread on squared daily changes in 90-day yields(a proxy for yield volatility) plus four lags of the spread, results in significant positive coefficient being attached to the volatility proxy. The result is consistent with the hypothesis that periods of increased price/yield volatility have a positive impact on spreads. In a second regression the volatility proxy is replaced by the stock of outstanding t-bills. In this case the

coefficient for the outstanding stock of t-bills is significant and negative. This is consistent with the hypothesis that an increase in the size of the debt instrument would increase the effective supply, increasing the security's liquidity, which is reflected in a narrower bid-ask spread.

Gravelle studied the interaction of cash and future markets. Dealers can hedge their position using futures. This tends to ease the dealer's ability to hedge its trades, reduces the bid-ask spreads and thus increasing liquidity. Increased activity in the futures market directly generates trading volume in the cash market due to arbitrage transactions. Thus, well developed and liquid future markets tend to enhance the liquidity of the underlying cash GS market. In a regression investigating the dependence of the daily volume of future contracts on yield volatility, which is calculated as the squared of daily changes in the yield for the underlying instrument of the contract, the estimated yield volatility coefficient are both significant and positive, thus supporting the hypothesis that futures activity increases during periods of heightening interest rate risk.

Another point that Gravelle stress is that the increased market maker competition is generally assumed to enhance market liquidity. The predominant way to compete each other is setting narrower bid-ask spreads, and because narrower bid-ask spreads are generally a reflection of the costs of immediacy, this implies that increased competition leads to greater liquidity. The changes in the level of dealer concentration over time may be one of the contributing factors explaining the evolution of GoC securities market liquidity.

Michael Fleming (2001) had examined the liquidity in the U.S. Treasury market. He used the daily trading volume, the daily trading frequency, the bid ask spreads, the quote sizes, the trade sizes and the net trading volume of U.S. Treasury securities. He took the 3-month, 6-month, 1-year T-bill and the 2-year, 5-year and 10-year T-note from December 30, 1996 to March 31, 2000. The sample thus covers the Thai baht devaluation in July 1997, equity markets decline in October 1997, the financial market turmoil of fall 1998, and the Treasury's debt management announcements of early 2000.

The author had found a strong relationship between net order flow and price changes in the U.S. Treasury market, consistent with findings from the FX market. For the two year note, a simple model with price changes depending on order flow

alone produces an R^2 statistic above 30%. He also found that it is the net number of trades that matters, with trade size having little incremental power to explain price changes. Also the liquidity measures change substantially over time, and correlated with episodes of poor liquidity. Both price impact coefficients and bid ask spreads increase sharply with equity market declines in October 1997, the financial market turmoil of fall 1998, and the Treasury's refunding announcements in February 2000. These results highlight the relevance of liquidity over time and the ability of simple liquidity measures, such as bid-ask spreads, to proxy for more complicated measure, such as price impact coefficients. Quote and trade sizes correlate modestly with the other liquidity measures and with episodes of poor liquidity, as do yield spreads between on-the-run and off-the-run securities. In contrast, trading volume and trading frequency are only weekly correlated with the other measures, suggesting that they are poor proxies for liquidity.

The structural differences in the market microstructure of government securities markets and equities markets has been examined by Toni Gravelle (1999). The research has mainly focused on equity markets, and the predominant theory is that of asymmetric information in which a subset of the market participants have private information about the asset's expected value. Relevant to the structure of markets the equity markets have two predominant types: order-driven, auction-agency markets and dealership markets. Order driven is structured as two-sided auctions in which there is no intermediary. The dealership markets are either single dealer market (NYSE) or multiple dealers (NASDAQ, LSE). Government securities markets in most developed countries are structured as multiple dealer markets and function in many ways like multiple dealer equity markets.

There are three differences in the intrinsic features embodied in equity and GS that have an effect on the trading behavior of market participants. First the private information embodied in equities and in GS. In equities we can assume asymmetric information that is some participants have private (inside) information about the asset's value. In the GS markets private information about the asset's value defined as payoff-relevant private information plays a minor role in trading. This implies that variance in bid-ask spreads are unlikely to be related to the clustered arrival of informed public investors in a period.

Second every security has its own special characteristics concerning the maturity. Equities have an infinite maturity while GS have a finite one. This has an impact on the liquidity of each market because the GS markets have two types of investors: buy-and-hold and trading market participants. The first buy and hold the security until the maturity (liquidation date) where the latter buy and sell. That means that there is a floating supply of the security available for trading before its maturity date that is less than the total amount issued to the public.

Third is the degree of homogeneity within each class of securities. Every stock has different characteristics and the market-makers cannot in general hedge their inventory by taking an opposite position in a similar stock nor can they find a near perfect hedge using futures. This contrasts with GS where the yield movements move in a correlated fashion making easier the hedging with futures or repos, decreasing the inventory risk for the market-makers.

GS market participants are unlikely to have superior or private information about a security's value but this does not preclude certain market-makers from having private information about the state of the trading environment, such as customer order flow, that will help them better predict the intervening price movements. Cao and Lyons define this as payoff-irrelevant private information and show that this type of information asymmetry, coupled with market-maker's risk aversion, is an essential determinant of the price discovery process in GS markets. This implies that market-makers are much more likely to be the 'informed agent', using market microstructure terminology, in GS dealership markets than their counterparts in equity dealership markets.

Equities markets and GS markets also differ in the transparency. A market is more transparent when the amount of data on the market's internal trading process available to the public increases. Transparency can be divided in pre trade transparency when traders can directly view all, or a best, firm bid-ask quotations and in post trade transparency when all completed trades are reporting immediately to the public. The equity dealership markets such as LSE and NASDAQ are superior to GS markets in transparency.

Muranaga and Shimizu (1999) explore the factors affecting market liquidity using a simulation model of an artificial market. They find that an increase in the ratio of market participants following short term market price movements results in an

increase in the number of trades and at the same time a decrease in the volume of accumulated order flows. The results of their simulations can be summarised as follows:

- Effects of trading methods: If the proportion of traders who submit market orders based on short-term market price movements increases, market liquidity tends to decline.
- Effects of market participants' confidence: If traders underestimate risk, trade becomes more active than when risks are correctly recognised, and market depth increases; on the other hand, if traders overestimate risk, trade rapidly becomes difficult, and market depth and market resiliency decline. However, market liquidity, indicated by price indicators such as price volatility and bid-ask spread, is determined by the actual dispersion of traders' expectations regardless of the traders' subjective confidence.
- Effects of the extent of traders' risk aversion: market liquidity increases and price becomes less volatile as the degree of traders' risk-aversion declines.
- Effects of traders' sensitivity to order volume information: As sensitivity rises, probability of quote existence rises, gross order book volume increases, and supply-demand imbalance widens, suggesting improvements in market liquidity indicators such as trade frequency, average spread, and market resiliency, tend to decline.

Section 7
Our study

In our study we will examine the liquidity in the government securities of the countries that participate in the European Monetary Union. Specifically we will take bonds from Germany, Italy, France, Spain, Portugal, Belgium, Netherlands, Ireland, Finland and Austria. We will exclude Luxembourg because of the small size of the debt of the country and Greece because it became full member of European Monetary Union in 1999.

We will examine the ten year bonds for the on-the-run issues because generally these bonds are used as benchmarks and because they are the most homogenous bonds with common characteristics and that makes easier the comparison both across time and across countries. The European Monetary Union took place at January 1999, so

we will examine the pre 1999 period and the period after the 1999 monetary convergence. More specifically we will take the period from July 1996 up to June 1998, and the period from July 1999 till June 2001. We will exclude one year so as to avoid the effects from possible portfolio readjustments due to euro introduction. The data for the bid ask spread will be daily and we will take them from Bloomberg. For the volatility of the interest we will use the standard deviation of the daily changes of the ten year benchmark bond yield curves and we will try to examine the relation between interest rate volatility and liquidity. Also we will try to examine the relation between liquidity with interest rate volatility and foreign debt ratio together. The foreign debt ratio is defined as the ratio of the debt held by non residents to the total government debt.

7.1 Data analysis

The data we used for our analysis was the bid-ask spread, the volatility of the interest rates and the ratio between the foreign debt and the total debt. For the bid-ask spread we took as reference the 10 year benchmarks of the ten countries under examination from July 1996 till June 2001 on daily basis. From the DataStream we found the exact date that a 10 year government bond was benchmark for the period under examination because there was not available data directly for the benchmark bonds. On average for each country there were eight bonds benchmarks for the sample period. After that from Bloomberg we found the bid prices and the ask prices for each bond and for the specific date that was benchmark and combine them to have the full series for the benchmark's bond bid and ask price. We did it for all ten counties. We had many difficulties because the required data is not widely available and the only database that we could find them was Bloomberg. In Greece Bloomberg is not so widely used and only in dealing rooms you can find it but this is difficult because of the policy of the banks. Finally data are kindly provided by National Bank of Greece research division. Another problem we had was that the was not available in any database the daily volume perhaps because the majority of the trading is over the counter and each dealer is not willing to give such information. We calculate the

quoted bid-ask spread as the simple difference between ask and bid price in daily basis and took the average of the sample for the time before and after 1999.

We extract the volatility of the interest rates from the yield to maturity of the 10 year benchmark bonds for each country. More specific we took the daily changes of the yield curve for the period under investigation for each country and calculate the standard deviation of the daily changes for the time before 1999 and after 1999. We took the data from Datastream and the number of observations is 1044 for each country.

For the examination of the debt ratio we took the ratio between the debt held by non residents and the total debt of each country for the period from 1996 till 2000 because the data for 2001 is not available yet. The data is yearly and we took them from Eurostat because in the other databases we could not find relative data for all the ten countries. We also use data from O.E.C.D. for the foreign debt.

7.2 Liquidity measures results

To measure the liquidity we used the quoted bid ask spread, the difference between the ask price and the bid price. The data was daily for the ten countries and the prices were that of the benchmark ten year government bonds. The period we took was from July 1996 to June 2001. We divide the sample period from July 1996 to June 1998 and from July 1999 to June 2001 so as to leave out six months before and after the introduction of the euro on January 1st 1999. We do that to avoid the distorting effects of possible portfolio readjustments as we headed to the introduction of the euro and little after its entrance. For each sub period the observations was about 520 with little deviation from country to country. The statistics we took was the mean and the standard deviation of the bid ask spread for each period.

What we expected to find that an increase in the liquidity (fall in the average bid ask spread) after the introduction of the euro due to the integration of the markets and the fact that the premium for the foreign exchange risk was eliminated, that is more traders and investors would willing to buy bonds from countries that before euro they would not buy.

The results after examining the data was not all pointing to that direction. As it is clear from the Table1 in the next page in three countries out of ten- Austria, France and Portugal- the liquidity was reduced. More specifically both the mean and the standard deviation of the bid ask spread increased showing that these three countries were heading opposite from ours expectations. For the rest of the countries- Belgium, Germany, Holland, Finland, Ireland, Italy and Spain- the liquidity was increased even though in Belgium and Spain the volatility of the liquidity measured by the standard deviation of the bid ask spread was increased. We test the statistical significance of the results with the t-statistic and the result was that the mean we have calculated was statistical significant (Table 3 appendix).

In the majority of the countries the as we said the liquidity was improved as we expected. For the rest three countries are not easy to tell the reason why the liquidity worsens. Maybe in the France the fact that after the euro there have been a movement in futures towards the German bund from the French bonds, for better hedging, made the cash market shallower. That is because fewer contracts mean fewer demand for bonds in cash market to balance the position. In Austria and Portugal what we can think is that the reason for the reduce in liquidity may be due to microstructure reasons. We will proceed by trying to interpret the increase in the liquidity by the volatility of the interest rates and the participation of the foreigners in the country debt. The results are in the following Table1.

TABLE1:SAMPLE STATISTICS FOR THE BID-ASK SPREADS IN BASIS POINTS				
AUSTRIA				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,083210117	0,02144867	0,092057692	0,025135405	**0,008847576**
BELGIUM				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,095662188	0,009260809	0,090383877	0,018590901	-0,005278311
GERMANY				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,083627639	0,023462071	0,069289827	0,016918199	-0,014337812
HOLLAND				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)

AVERAGE	STDEV	AVERAGE	STDEV	
0,108781431	0,113247793	0,072802303	0,015817993	-0,035979128
FRANCE				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,072170385	0,02301368	0,081425781	0,029198664	**0,009255396**
FINLAND				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,18699187	0,040885015	0,118473581	0,02457519	-0,068518289
IRELAND				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,105447471	0,008417364	0,100598456	0,004010257	-0,004849015
ITALY				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,073050193	0,091794707	0,042898273	0,018235827	-0,03015192
PORTUGAL				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,099976905	0,006142552	0,136653846	0,081176058	**0,036676941**
SPAIN				
7/1996-6/1998		7/1999-6/2001		Δaverage(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
0,098723404	0,01205265	0,072168906	0,028777968	-0,026554498

The negative sign means that the bid ask spread reduced so the liquidity increased. For example in Germany the average bid ask spread improved by 0,01433 basis points and also the volatility of the bid ask spread improved. In Spain the average bid ask spread improved by 0,0265 basis points but the volatility of the bid ask spread increased.

7.3 Liquidity, interest rate volatility and foreign ownership of government debt

What we did first was to examine the liquidity in relation to the volatility of the interest rates and the foreign debt ratio. We have day traders that sell and buy in high frequency and investors that willing to hold their position many times up to maturity. Depending on the characteristics of the markets the one or the other type of

participants dominates in the markets. With the volatility of the interest rates we can see the risk that a market include, that is a greater volatility equals to a more risky market because of the bigger deviations from the average price. We measured this volatility calculating the standard deviation of the daily changes of the yield to maturity from the 10 year government benchmark bonds of each country. With the foreign debt ratio we tried to see the impact to the liquidity from the deletion of the foreign exchange risk. After the introduction of the euro the elimination of the foreign exchange risk must have as result the foreign investors to be more willing to buy bonds from smaller countries in the European Union than before. The invasion of the foreign traders in one market increases the competition and thus makes the market more liquid. We tried to measure this effect with the ratio of the total debt held by non residents to the total government debt of each country. Because the data for calculating this ratio was only available yearly we made our analysis on annual frequency. We anticipated an increase in the volatility of interest rates to accompanied with a bigger bid ask spread from the dealers to cover the additional risk. That does not happen because this effect is offset by the entrance of day traders- there are traders that do not want to keep the bonds till maturity but they want to take advantage of the surplus value. Higher volatility on the yield to maturity of the bonds means higher volatility in the price of the bonds and as a result higher opportunities for short run profits

We first wanted to examine how the introduction of the euro affected the volatility of the interest rates. Again we divided the sample period from July 1996 to June 1998 and from July 1999 to June 2001 to see how the standard deviation of the daily changes of the interest rates moved. As it can be seen from the table in nine countries out of ten the volatility of the interest rates is increased after the introduction of the euro and only in Italy the volatility decreased.

TABLE 2:VOLATILITY OF THE YIELD OF THE 10Y BENCHMARK

GERMANY				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,058357408	0,690549956	0,025267664	0,845916983	0,155367027

FRANCE				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,05335491	0,709732794	0,03253947	1,139169233	0,429436439

AUSTRIA				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,055751098	0,637086507	0,026716179	0,838704332	0,201617825

BELGIUM				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,05927517	0,655314418	0,02488959	0,78869565	0,133381232

FINLAND				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,066289133	0,773335413	0,025581322	0,839100027	0,065764613

IRELAND				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,074920181	0,675830894	0,024132629	0,833141246	0,157310353

ITALY				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,115611737	0,798052769	0,026920769	0,72732644	-0,070726329

HOLLAND				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,052259663	0,644556508	0,024719197	0,802842314	0,158285806

PORTUGAL				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,101887962	0,624154948	0,02771136	1,013463539	0,389308591

SPAIN				
1/7/1996-30/6/98		1/7/99-30/6/2001		Δstdev(AFTER-BEFORE)
AVERAGE	STDEV	AVERAGE	STDEV	
-0,108147397	0,642194076	0,025680897	0,754664179	0,112470103

For the purpose of our analysis because the data for the debt were annual we estimate for each country for the volatility the annual mean and standard deviation for the years 1996, 1997, 1998, 1999, 2000 and 2001. The results are in the Table 1 at the appendix. In the scatter plot 1 in the appendix you can see the relation of the differences of liquidity and volatility for every country.

For the debt ratio as we have said we used the ratio

$$\text{Debt ratio} = \frac{\textit{total}\ \text{debt held by non residents}}{\textit{total government debt}}$$

and we calculate this ratio from 1996 to 2000. For the year 2001 data were not yet available. The results are also in the Table 1 at the appendix. In Table 3 is the difference- after minus before 1999- of the debt ratio. In the majority of the countries the participation of the foreigners in the total debt of each country seems to increase. Only in Ireland the foreign debt is decreased after the 1999. In the scatter plot 2 in the appendix you can see the relation of the differences of liquidity and debt ratio for every country.

TABLE 3: DEBT RATIO	
Country	Ddebt(After-Before)1999
AUSTRIA	0,184554642
BELGIUM	0,106531516
GERMANY	0,085506963
HOLLAND	0,164450428
FRANCE	0,105863943
FINLAND	0,091838781
IRELAND	-0,064799977
ITALY	0,140031383
PORTUGAL	0,03015192
SPAIN	0,072568678

All the three differences, the liquidity- measured with the mean bid ask spread-, the volatility- measured with the standard deviation- and the debt ratio-measured by the mean debt ratio- before and after 1999 are shown in the 3-D Graph 1 in the next page.

In this graph we depict the differences of market liquidity, interest rate volatility and the foreign debt ratio. More specifically for each country we had estimated the bid ask spread, the standard deviation of the interest rates and the foreign debt ratio before and after the introduction of the euro and we took the difference after minus before to see the movement of these measures. The difference of liquidity is negative in the majority of the countries because an increase in liquidity means a lower bid ask spread.

After we estimate the annual data for the bid-ask spread as it can be seen in Table 1 in the appendix, the volatility of the interest rates in annual basis and the debt

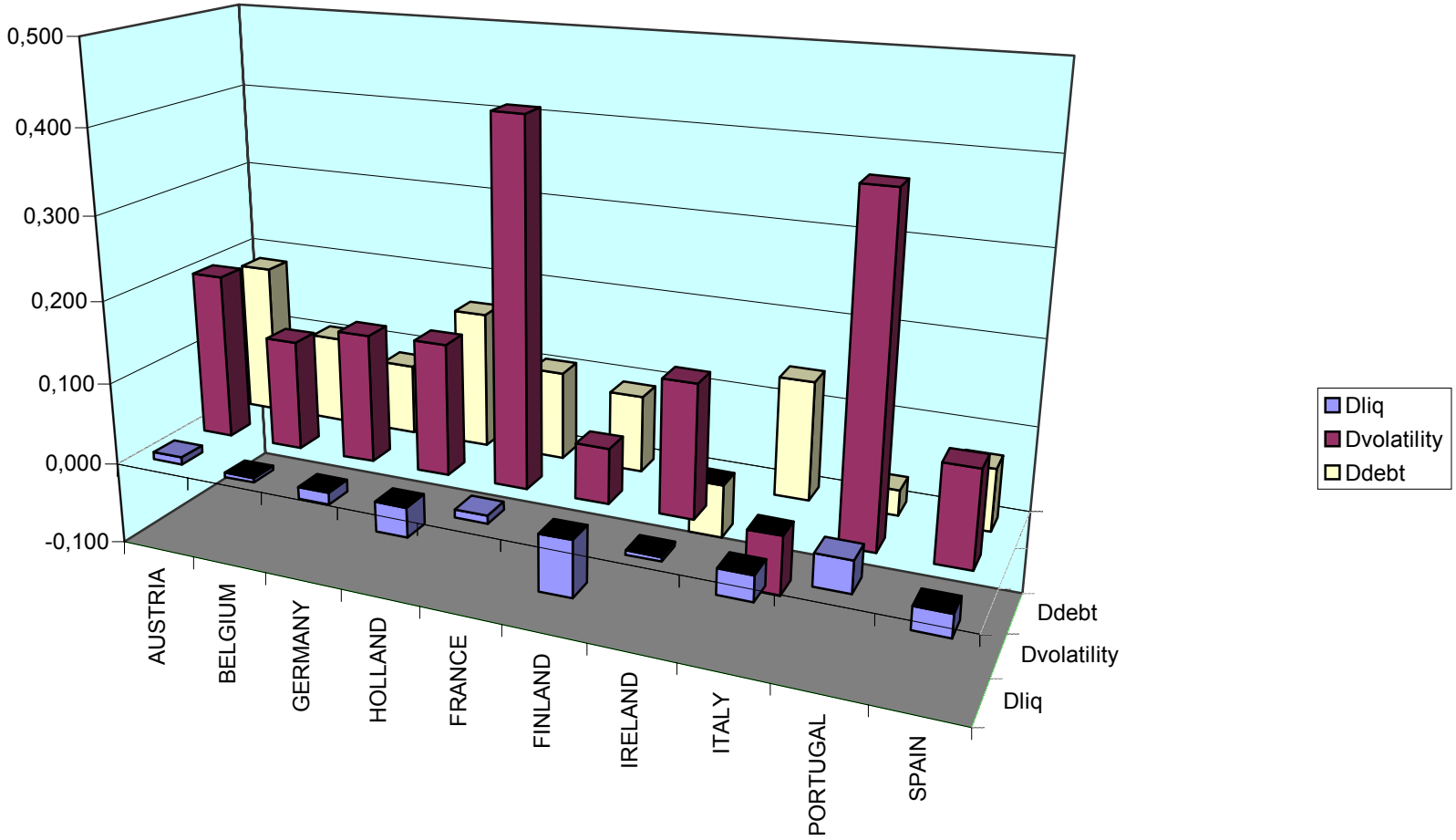
ratio also in annual basis we run a ordinary least square regression for the years 1996 to 2001. For the year 2001 that we have not have debt ratio we put a dummy variable. The regression was

$$\text{Liquidity}_{it} = a + b^* \frac{\text{Foreign Government Debt}}{\textit{Total}\ \text{Government Debt}}_{it} + c^* \text{ Volatility}_{it} + u_{it}$$

where i refer to the country and t to the year. According to the preliminary data analysis for the coefficients b and c we expected to have negative signs, which mean that a higher foreign ownership of government debt and a higher volatility goes together with higher liquidity-lower bid ask spread.

We run it with cross section data because the data was annual, with linear regression and autoregressive 1 models in first differences and in first levels. Although the coefficient for the volatility was statistical significant at 5% level and with the right sign for the debt ratio was not statistical significant. After that we decided to make our analysis with quarterly data only for the volatility of the interest rates.

Graph 1:Difference of Liquidity, Volatility of interest rates and Debt ratio after 1999



7.4 Results

We calculate the bid ask spread for every quarter from July 1996 to June 2001, so we have twenty observations for each country. We calculate the mean and the standard deviation of the bid ask spread for each country and the results are in the Table 2 in the appendix. For the volatility of the interest rates we calculate the 3 month standard deviation of the daily changes of the yield to maturity of the 10 year benchmark government bond for each country. The results are also in the Table 2 in the appendix. Then with the Rats we run a cross section data linear regression with robust errors for the heteroskedasticity, autoregressive one models, simple linear regressions in the first differences and in the first levels. We conclude in the following model:

We define the dependant variable as Y2 where Y2=Liq(t)-Liq(t-1) and liq is the bid ask spread of each country at the time t. For the independent variable we define the D2 where D2=Volstd(t)-Volstd(t-1) and volstd is the standard deviation of the daily changes of the yield to maturity. Then we run a cross section data linear regression with robust errors and one lag in the Y2 to fix the serial correlation. The number of observations is 199 and the usable one 180. The coefficient for the D2, the volatility of the interest rates, is -0,02336 with negative sign as we expected from the preliminary analysis, with standard error 0,0111, t-statistic -2,0896 and a significant level of 0,03664. The results of the linear regression from the Rats are the following:

```
Dependent Variable Y3 - Estimation by Least Squares
Panel(20) of Quarterly Data From 1//1996:04 To
10//2001:02
Usable Observations    180       Degrees of Freedom   168
Total Observations    199        Skipped/Missing       19
Centered R**2     0.109784       R Bar **2   0.051497
Uncentered R**2   0.111097       T x R**2      19.997
Mean of Dependent Variable       -0.001228714
Std Error of Dependent Variable  0.032067483
Standard Error of Estimate       0.031230888
Sum of Squared Residuals         0.1638618816
Durbin-Watson Statistic          2.171791
```

Variable	Coeff	Std Error	T-Stat	Signif
**********				
1. AUS	-0.000164138	0.003610766	-0.04546	0.96374223
2. BEL	-0.002006181	0.004104239	-0.48881	0.62497836
3. GER	0.001264470	0.003542521	0.35694	0.72113619
4. HOL	-0.001261630	0.014958048	-0.08434	0.93278247
5. FRA	0.000271566	0.003831437	0.07088	0.94349462
6. FIN	-0.006655390	0.004600619	-1.44663	0.14800078
7. IRL	-0.000832333	0.001117051	-0.74512	0.45620119
8. ITA	-0.001826370	0.006644526	-0.27487	0.78341742
9. POR	0.000313467	0.012007347	0.02611	0.97917261
10. SPA	-0.001923420	0.003975838	-0.48378	0.62854406
11. D1	-0.023364379	0.011180879	-2.08967	0.03664720
12. Y3{1}	-0.334335336	0.230249648	-1.45206	0.14648609

From the results we can derive the following:

The bid ask spread is related negatively with the volatility of the interest rates. That means that an increase in the volatility of the interest rate will result in an increase in the liquidity in the government bond markets, a lower bid ask spread. Although an increase in volatility means more risk and thus we may anticipate bigger bid ask spread from the dealers to cover the additional risk that does not happen. That is because this effect is offset by the entrance of day traders- there are offensive traders that do not want to keep the bonds till maturity but to take advantage of the surplus value. Higher volatility on the yield to maturity of the bonds means higher volatility in the price of the bonds and as a result higher opportunities for short run profits. In Ireland, Belgium, Germany, Spain, Holland and Finland the number of day traders must have been increased, so the increase in volatility of the prices lead to an increase in liquidity. That did not happen in Austria, France and Portugal where we had an increase in the volatility but a decrease in the liquidity. In Italy where we had an increase in liquidity and a decrease in volatility of the prices it happened what we first

suspect that with the lowering of the risk-lower volatility- the dealers will reduce the spread because of the less uncertainty.

After that we tried to find with the instrumental variable methodology the appropriate instruments to run an instrumental variable regression. We done that to cover the possibility that the independent variable may correlated with the residuals. These instruments must be both (1) correlated with the explanatory variables in the equation, and (2) uncorrelated with the disturbances. We could not be able to find the appropriate instruments so the only cautiousness we keep for the results is the fact that the independent variable do not have time lag with the residuals.

Section 8
Conclusion

We used daily data to measure the liquidity of the ten year government bonds and more specifically the quoted bid ask spread and how it was affected by the introduction of the euro. We measured the bid ask spread from July 1996 to June 1998 and from July 1999 to June 2001. We find that the bid ask spread reduced, i.e. the liquidity increased, for Germany, Belgium, Holland, Finland, Ireland, Italy and Spain. For Austria, France and Portugal the liquidity seems to reduced. All these results are statistical significant.

After we tried to see if there is any relation between the bid ask spread the volatility of the interest rates and the participation of the foreigners to the government debt. As volatility of interest rates we define the standard deviation of the daily changes of the 10 year benchmark yield to maturity. For the volatility we find that it increased in all countries except in Italy. To measure the participation of the foreigners we took take ratio total debt held by non residents to total government debt. We find that this participation is increased in all countries under examination after the introduction of the euro except in Ireland. The data we had for the debt was daily so we run several cross section data linear regressions and the results was that the interest rate volatility affects the liquidity but the debt ratio has no statistical power to interpret the liquidity. After that we decide to examine alone the volatility of the interest rates in relation to the liquidity. We used three month data and run several regressions to fix serial correlation and other problems. Finally we find that the volatility affects the liquidity with a negative coefficient and a significant level of

3,6%. The negative coefficient means that the increase in volatility has as result a lower bid ask spread that is higher liquidity.

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APPENDIX

TABLES AND GRAPHS

TABLE 1						
		Liquidity measure		Debt ratio	Volatility of 10Y benchmark	
Country	Year	mean	stdev		mean	stdev
AUSTRIA	1996	0,099924	0,00087	0,340795	-0,0302005	0,670052508
	1997	0,076448	0,023038	0,343907	-0,0305536	0,636243249
	1998	0,083175	0,015876	0,437322	-0,1037577	0,933322589
	1999	0,076784	0,008776	0,558926	0,12096101	1,139719295
	2000	0,099228	0,005653	0,494885	-0,0148538	0,743775313
	2001	0,093231	0,045362		-0,0036367	0,890470219
BELGIUM	1996	0,1	0,00087	0,251669	-0,0477831	0,672357218
	1997	0,098123	0,005942	0,258237	-0,0241443	0,700363235
	1998	0,093113	0,011199	0,227959	-0,1099624	0,910295344
	1999	0,075946	0,025154	0,323618	0,1260021	1,04101747
	2000	0,096911	0,010698	0,399351	-0,0177223	0,668143708
	2001	0,074846	0,023633		-0,0076673	0,773084469
GERMANY	1996	0,050606	0,004583	0,423708	-0,0010115	0,047282171
	1997	0,092299	0,018147	0,466772	-0,0017854	0,039545494
	1998	0,099962	0,00062	0,509861	-0,0054713	0,040782564
	1999	0,08139	0,021879	0,518544	0,00562452	0,053256439
	2000	0,067568	0,015721	0,54295	-0,0018062	0,037763018
	2001	0,067692	0,015826		0,00026552	0,038377791
HOLLAND	1996	0,080303	0,002746	0,2362	-0,0203481	0,679514227
	1997	0,135659	0,155247	0,238143	-0,0215833	0,685498612
	1998	0,058571	0,034404	0,263445	-0,1106875	0,876567967
	1999	0,083615	0,02278	0,357124	0,13066816	1,059349004
	2000	0,070849	0,015996	0,446121	-0,0329586	0,712420339
	2001	0,061846	0,007344		0,01236217	0,782513788
FRANCE	1996	0,062348	0,004255	0,15034	-0,0481021	0,728551267
	1997	0,072405	0,023173	0,174929	-0,0309706	0,736300617
	1998	0,072031	0,022885	0,239882	-0,1135335	1,125775233
	1999	0,096705	0,030463	0,253072	0,13663904	1,152583849
	2000	0,080595	0,027873	0,283925	-0,024187	1,188074871
	2001	0,062016	0,004027		-0,0034772	1,101038622
FINLAND	1996	0,206061	0,013911	0,528887	-0,0505587	0,909689144
	1997	0,208523	0,026231	0,504901	-0,0408561	0,772756622
	1998	0,125296	0,005001	0,494626	-0,1156475	0,898248452
	1999	0,123127	0,014649	0,561244	0,12618212	1,07152865
	2000	0,1146	0,030538	0,656222	-0,0305625	0,763755161
	2001	0,122558	0,011407		0,00754366	0,816335455
IRISH	1996	0,109542	0,011015	0,54091	-0,0397643	0,714568292
	1997	0,105837	0,007084	0,471358	-0,0674614	0,706991776
	1998	0,100235	0,003312	0,432192	-0,1194585	0,803567026
	1999	0,10113	0,005164	0,447748	0,12990537	1,054062637
	2000	0,100584	0,003959	0,43492	-0,0325889	0,71658606
	2001	0,100538	0,004188		0,00503923	0,863743396

ITALY	1996	0,057727	0,038987	0,285464	-0,1346043	0,895490695
	1997	0,09444	0,120971	0,310904	-0,1087753	0,870037301
	1998	0,037773	0,025285	0,380221	-0,1257942	0,761623232
	1999	0,033308	0,015391	0,444144	0,13144781	1,011620888
	2000	0,046564	0,020273	0,432287	-0,0216576	0,594992448
	2001	0,043385	0,011175		-0,0047635	0,697041123
PORTUGAL	1996	0,100079	0,000891	0,355639	-0,1337329	0,676680656
	1997	0,100366	0,005168	0,463716	-0,0751939	0,624132732
	1998	0,1	0,007659	0,523725	-0,1212057	0,738674123
	1999	0,099961	0,006918	0,527473	0,1285042	1,257995799
	2000	0,148649	0,085027	0,541469	-0,02034	0,780187074
	2001	0,149385	0,101246		0,00168882	1,037335822
SPAIN	1996	0,099924	0,00087	0,121073	-0,1301739	0,734472509
	1997	0,10144	0,011104	0,130554	-0,0732852	0,650343282
	1998	0,090308	0,017105	0,147775	-0,1290998	0,699545006
	1999	0,079502	0,034498	0,237794	0,1310726	1,109490457
	2000	0,072162	0,026515	0,15897	-0,0234649	0,607700755
	2001	0,078692	0,007913		-0,001506	0,63476993

Notes:
1. Source: Bloomberg, Eurostat, Datastream and author's calculations
2. Liquidity is measured in basis points
3. Volatility is the standard deviation of daily changes of the yield to maturity

TABLE 2					
		Liquidity measure		Volatility of 10Y benchmark	
Country	Year	mean	stdev	mean	stdev
AUSTRIA	Q3 1996	0,1	0	-0,108769763	0,524225652
	Q4 1996	0,0998485	0,0012309	-0,072570806	0,720488351
	Q1 1997	0,1	0	-0,008586566	0,739700501
	Q2 1997	0,0907692	0,010048	-0,026232211	0,740747293
	Q3 1997	0,0668182	0,0191479	-0,038424366	0,497639948
	Q4 1997	0,0482812	0,0038025	-0,0482402	0,547828339
	Q1 1998	0,0668254	0,0188222	-0,104248314	0,734938061
	Q2 1998	0,0928333	0,0099305	-0,038264737	0,559580759
	Q3 1998	0,0931818	0,0093082	-0,229211062	0,930160788
	Q4 1998	0,0798413	0,0012599	-0,042329189	1,327868854
	Q1 1999	0,0788889	0,00444	0,051238343	1,227515746
	Q2 1999	0,0747541	0,0114901	0,196285466	1,135581778
	Q3 1999	0,0757576	0,0082389	0,197978172	1,279316069
	Q4 1999	0,0776923	0,0091462	0,037370525	0,897481968
	Q1 2000	0,0986154	0,0070438	0,012147698	0,958005808
	Q2 2000	0,0984375	0,0087684	0,019710464	0,80468882
	Q3 2000	0,1	0	0,00517762	0,670389812
	Q4 2000	0,0998462	0,0012403	-0,096450807	0,463565542
	Q1 2001	0,086	0,0089791	-0,06534564	0,604793389
	Q2 2001	0,1004615	0,0629343	0,100342691	0,768131465
BELGIUM	Q3 1996	0,1	0	-0,131751567	0,504278942
	Q4 1996	0,1	0	-0,086961521	0,686258392
	Q1 1997	0,099375	0,0024398	0,028006018	0,864948052
	Q2 1997	0,0998462	0,0033036	-0,047469041	0,700343113
	Q3 1997	0,1	0,0035082	-0,041474271	0,589006622
	Q4 1997	0,0933333	0,0090014	-0,034413007	0,635154906
	Q1 1998	0,0782813	0,0048973	-0,110738397	0,728922448
	Q2 1998	0,0940625	0,0128135	-0,040537908	0,482091401
	Q3 1998	0,1	0	-0,245118575	0,878725377
	Q4 1998	0,1	0	-0,04242625	1,330630058
	Q1 1999	0,0657813	0,0256846	0,074657329	1,09748402
	Q2 1999	0,0507937	0,0062994	0,193337437	0,94508548
	Q3 1999	0,09	0,0194541	0,184970087	1,195292984
	Q4 1999	0,0957576	0,0119048	0,050507877	0,918063648
	Q1 2000	0,0941538	0,0091672	-0,008112738	0,833294947
	Q2 2000	0,0995313	0,0045179	0,014094079	0,782033642
	Q3 2000	0,0978462	0,0062481	0,009793807	0,544874851
	Q4 2000	0,0961538	0,0173828	-0,086664511	0,443876077
	Q1 2001	0,0807692	0,0199458	-0,061572239	0,588946723
	Q2 2001	0,0689231	0,0256249	0,093243454	0,745973183
GERMANY	Q3 1996	0,05	0	-0,113414582	0,575212613
	Q4 1996	0,0512121	0,0064486	-0,076386943	0,862386561
	Q1 1997	0,0685937	0,024551	0,03255985	0,853890038
	Q2 1997	0,1	0	-0,056551841	0,739204146
	Q3 1997	0,1	0	-0,033784478	0,592880303
	Q4 1997	0,1	0	-0,060220335	0,576468125
	Q1 1998	0,1	0	-0,113507557	0,729324979

	Q2 1998	0,1	0	-0,044228091	0,541009584
	Q3 1998	0,1	0	-0,304790832	0,934239943
	Q4 1998	0,0998485	0,0012309	0,001019868	1,3880575
	Q1 1999	0,0774603	0,0269987	0,061338203	1,227040833
	Q2 1999	0,1	0	0,185570391	1,194766862
	Q3 1999	0,0612121	0,0069093	0,207157695	1,332157018
	Q4 1999	0,0872727	0,0187736	0,065458466	0,992762418
	Q1 2000	0,0625	0,009759	-0,030247949	0,898703803
	Q2 2000	0,0733846	0,0192254	-0,002741952	0,767601786
	Q3 2000	0,0612308	0,0069614	0,013515452	0,618947517
	Q4 2000	0,0730769	0,0187852	-0,111997959	0,50871623
	Q1 2001	0,0624615	0,0096874	-0,050786673	0,616295127
	Q2 2001	0,0729231	0,0188516	0,108367602	0,728985593
HOLLAND	Q3 1996	0,08	0	-0,116932722	0,494095624
	Q4 1996	0,0806061	0,0038745	-0,066124418	0,649729095
	Q1 1997	0,0879687	0,0101073	0,031133577	0,815645472
	Q2 1997	0,2913846	0,2523011	-0,054697836	0,645542174
	Q3 1997	0,08	0	-0,017357427	0,563462983
	Q4 1997	0,0817187	0,0082721	-0,044315579	0,708975401
	Q1 1998	0,08125	0,0048795	-0,110939115	0,664194932
	Q2 1998	0,0863492	0,0276675	-0,037914474	0,591686412
	Q3 1998	0,0415152	0,0308965	-0,264271266	0,851873039
	Q4 1998	0,0271212	0,0208854	-0,028530304	1,240729529
	Q1 1999	0,0640625	0,0343982	0,067877996	1,158972684
	Q2 1999	0,0953125	0,0140259	0,208920672	0,994064735
	Q3 1999	0,0869697	0,0096028	0,175292135	1,034383847
	Q4 1999	0,0878788	0,0098473	0,069864754	1,062214649
	Q1 2000	0,074	0,0178361	-0,027615089	0,94618951
	Q2 2000	0,0659375	0,0121784	-0,002069242	0,748203825
	Q3 2000	0,0646154	0,0199278	0,005616047	0,616990171
	Q4 2000	0,0787692	0,0057303	-0,107765981	0,458267065
	Q1 2001	0,06	0,0017678	-0,041129343	0,658970619
	Q2 2001	0,0636923	0,0099325	0,122549237	0,687868929
FRANCE	Q3 1996	0,0619697	0,0040076	-0,10081385	0,52957425
	Q4 1996	0,0627273	0,0044877	-0,056380877	0,848103633
	Q1 1997	0,0626563	0,0044516	-0,033869901	0,785871702
	Q2 1997	0,0810769	0,0296397	-0,024527566	0,820265813
	Q3 1997	0,079403	0,0275725	-0,041658486	0,651487778
	Q4 1997	0,062439	0,0043477	-0,023816773	0,694855535
	Q1 1998	0,0852381	0,0304195	-0,110284323	0,683326422
	Q2 1998	0,0790164	0,0282079	-0,035921262	0,644398184
	Q3 1998	0,0622727	0,0042228	-0,256692013	1,00652103
	Q4 1998	0,0626154	0,0044289	-0,04996197	1,778769056
	Q1 1999	0,1036923	0,0264321	0,088947724	1,204724298
	Q2 1999	0,0784375	0,0276726	0,167366304	1,141711488
	Q3 1999	0,1247692	0,0050335	0,190014339	1,088905313
	Q4 1999	0,0792308	0,0276873	0,099248185	1,196007016
	Q1 2000	0,0843077	0,0305148	-0,02082952	1,418146204
	Q2 2000	0,0777778	0,0284233	0,006378152	1,529948835
	Q3 2000	0,0798361	0,0288382	0,015848244	0,855152139

	Q4 2000	0,0803175	0,0281682	-0,098144863	0,787998757
	Q1 2001	0,0615625	0,0036596	-0,054267723	0,990888165
	Q2 2001	0,0624615	0,0043412	0,11861997	1,074519172
FINLAND	Q3 1996	0,1984848	0,0127993	-0,076659267	0,97362898
	Q4 1996	0,2136364	0,0104714	-0,107373729	0,869136236
	Q1 1997	0,2225	0,0059094	0,031349242	0,882533612
	Q2 1997	0,2129231	0,0045836	-0,079506314	0,813221781
	Q3 1997	0,2141538	0,0105907	-0,076142132	0,630907696
	Q4 1997	0,1725581	0,0437032	-0,037522578	0,759347112
	Q1 1998	0,1253226	0,0050303	-0,140158395	0,666891418
	Q2 1998	0,1247541	0,0050354	-0,035745551	0,518976264
	Q3 1998	0,1251515	0,005036	-0,201430255	0,75920289
	Q4 1998	0,1259375	0,0049501	-0,084787849	1,392603649
	Q1 1999	0,1246032	0,0050243	0,074517974	1,130945178
	Q2 1999	0,124375	0,005	0,18363515	1,009470057
	Q3 1999	0,1225758	0,0166697	0,199353223	1,185129673
	Q4 1999	0,1210606	0,0227447	0,04652705	0,962974523
	Q1 2000	0,1201786	0,0166778	-0,043778484	0,920461809
	Q2 2000	0,1151563	0,0312182	0,018084107	0,882527918
	Q3 2000	0,1004615	0,045119	0,007683275	0,629252182
	Q4 2000	0,1233846	0,0092326	-0,104238732	0,573574553
	Q1 2001	0,1241538	0,009502	-0,032331082	0,591782542
	Q2 2001	0,1209375	0,0129368	0,110355565	0,77297789
IRELAND	Q3 1996	0,1084615	0,0110723	-0,127990443	0,512284522
	Q4 1996	0,1106061	0,0109374	-0,061335579	0,851756565
	Q1 1997	0,1090625	0,0090359	0,05201003	0,85707796
	Q2 1997	0,1066154	0,0053843	-0,076465503	0,654421806
	Q3 1997	0,1072727	0,0064559	-0,135769938	0,647819541
	Q4 1997	0,1001613	0,0022117	-0,106136327	0,65240215
	Q1 1998	0,1003175	0,0047411	-0,127524896	0,573816831
	Q2 1998	0,1004762	0,0037796	-0,012981458	0,59173704
	Q3 1998	0,0998485	0,0012309	-0,258929998	0,665150063
	Q4 1998	0,1003175	0,0025198	-0,077028803	1,201488257
	Q1 1999	0,1	0	0,042669026	1,064597648
	Q2 1999	0,1045946	0,0098867	0,224160983	0,917252149
	Q3 1999	0,1006061	0,0034547	0,181218185	1,116474032
	Q4 1999	0,1007692	0,0044398	0,070357882	1,117194609
	Q1 2000	0,1006154	0,0034807	-0,030528209	0,998608057
	Q2 2000	0,1014062	0,006635	0,014324148	0,716244117
	Q3 2000	0,1003077	0,0024807	-0,008196841	0,594871182
	Q4 2000	0,1	0	-0,105954548	0,453482741
	Q1 2001	0,1001538	0,0027908	-0,048975413	0,656204184
	Q2 2001	0,1009231	0,0052211	0,117687972	0,743837478
ITALY	Q3 1996	0,05	0	-0,139066602	0,75646835
	Q4 1996	0,0654545	0,0542411	-0,188517141	0,978299531
	Q1 1997	0,1465625	0,1840912	0,075099566	0,981840485
	Q2 1997	0,1129231	0,1131333	-0,220851527	0,871713801
	Q3 1997	0,0557576	0,0527129	-0,149728429	0,861779785
	Q4 1997	0,0634375	0,0671936	-0,135747143	0,744553163

	Q1 1998	0,0539683	0,0373104	-0,127343378	0,58340292
	Q2 1998	0,036875	0,0249364	-0,033668596	0,456126164
	Q3 1998	0,0287879	0,0073412	-0,218662233	0,586027715
	Q4 1998	0,0319048	0,0126819	-0,122153866	1,193672707
	Q1 1999	0,0295313	0,00375	0,091530473	1,014960234
	Q2 1999	0,033125	0,0176271	0,189270825	0,975099294
	Q3 1999	0,0315152	0,007492	0,16735048	1,1567092
	Q4 1999	0,0389394	0,0228795	0,077305968	0,900941326
	Q1 2000	0,0261538	0,0189318	-0,023805047	0,78650186
	Q2 2000	0,04	0,0149071	0,026186942	0,659089899
	Q3 2000	0,0604615	0,0130421	0,006897959	0,458189581
	Q4 2000	0,0595385	0,0087376	-0,095910085	0,40122176
	Q1 2001	0,0436923	0,0078201	-0,040643087	0,514875383
	Q2 2001	0,0430769	0,013798	0,095047409	0,619285268
PORTUGAL	Q3 1996	0,1	0	-0,140206463	0,516232766
	Q4 1996	0,1001667	0,001291	-0,215733443	0,814706622
	Q1 1997	0,1015385	0,0096077	0,013670423	0,76979437
	Q2 1997	0,1003125	0,0017678	-0,121495101	0,560132508
	Q3 1997	0,1	0	-0,103614933	0,531209286
	Q4 1997	0,1	0,005	-0,08734467	0,617917895
	Q1 1998	0,0996774	0,0059966	-0,165327039	0,559443054
	Q2 1998	0,0988889	0,0129828	0,007893173	0,549463554
	Q3 1998	0,1014	0,0060643	-0,240550651	0,591508978
	Q4 1998	0,1001667	0,001291	-0,086219055	1,094428873
	Q1 1999	0,0992188	0,0133696	0,070710222	0,914810079
	Q2 1999	0,1	0	0,197947377	1,095683356
	Q3 1999	0,1	0	0,19808774	1,263966229
	Q4 1999	0,1006154	0,0039039	0,046572299	1,649114811
	Q1 2000	0,0989231	0,0276769	-0,011224138	1,17719783
	Q2 2000	0,101875	0,0528813	0,038065769	0,748134078
	Q3 2000	0,1564615	0,1010017	-0,004657301	0,534825771
	Q4 2000	0,2366154	0,0529527	-0,103544435	0,470034156
	Q1 2001	0,2470769	0,0235666	-0,062119323	0,635596038
	Q2 2001	0,0516923	0,0268427	0,117598929	1,026299881
SPAIN	Q3 1996	0,1	0	-0,186037524	0,623442383
	Q4 1996	0,0998485	0,0012309	-0,203386991	0,81448839
	Q1 1997	0,1071429	0,0197915	0,063076702	0,71280907
	Q2 1997	0,1	0	-0,178520298	0,718907844
	Q3 1997	0,0993651	0,0056434	-0,102750392	0,531369328
	Q4 1997	0,0993939	0,006295	-0,072409057	0,614676023
	Q1 1998	0,099375	0,0063932	-0,157980377	0,562686762
	Q2 1998	0,0846875	0,0203125	-0,023272998	0,47805403
	Q3 1998	0,0798485	0,0143036	-0,213642832	0,546456924
	Q4 1998	0,0974242	0,0157197	-0,120774622	1,052423485
	Q1 1999	0,0942188	0,0182404	0,11527789	1,026747813
	Q2 1999	0,0929231	0,0110004	0,168026595	1,214140523
	Q3 1999	0,0422727	0,0402605	0,188093166	1,204788018
	Q4 1999	0,0892424	0,0283012	0,052974047	0,993994129
	Q1 2000	0,0750769	0,0241171	-0,021228407	0,815608084
	Q2 2000	0,0625	0,0365148	0,019034288	0,660481173

	Q3 2000	0,0798462	0,0208785	0,009197289	0,498895497
	Q4 2000	0,0710769	0,0184664	-0,100862609	0,3676359
	Q1 2001	0,0795385	0,003721	-0,035953037	0,544390695
	Q2 2001	0,0778462	0,0105315	0,091273894	0,56718002

Notes:

1. Source:Bloomberg, Datastream and author's calculations
2. Liquidity is measured in basis points
3. Volatility is the standard deviation of daily changes of the yield to maturity

TABLE3

BID-ASK SPREAD FROM 1/7/96-30/6/98										
	AUSTRIA	BELGIUM	FINLAND	FRANCE	GERMANY	HOLLAND	IRELAND	ITALY	PORTUGAL	SPAIN
Mean	0,08321	0,095662	0,186992	0,07217	0,083628	0,108781	0,105447	0,07305	0,099977	0,098723
Median	0,1	0,1	0,21	0,06	0,1	0,08	0,1	0,05	0,1	0,1
Maximum	0,11	0,13	0,23	0,13	0,1	0,63	0,13	0,9	0,14	0,2
Minimum	0,04	0,07	0,12	0,06	0,04	0,03	0,08	0	0,02	0,01
Std. Dev.	0,021449	0,009261	0,040885	0,023014	0,023462	0,113248	0,008417	0,091795	0,006143	0,012053
Skewness	-0,983739	-1,175754	-0,777511	1,827028	-0,735837	3,984078	0,565718	4,173949	-4,678403	-0,724442
Kurtosis	2,511994	4,359844	1,789406	4,579203	1,546792	17,16695	3,403583	26,03863	85,89958	31,68157
Observations	514	521	492	493	521	517	514	518	433	517

BID-ASK SPREAD FROM 1/7/99-30/6/01										
	AUSTRIA	BELGIUM	FINLAND	FRANCE	GERMANY	HOLLAND	IRELAND	ITALY	PORTUGAL	SPAIN
Mean	0,092058	0,090384	0,118474	0,081426	0,06929	0,072802	0,100598	0,042898	0,136654	0,072169
Median	0,1	0,1	0,12	0,06	0,06	0,08	0,1	0,04	0,1	0,08
Maximum	0,38	0,12	0,13	0,13	0,1	0,13	0,13	0,13	0,25	0,13
Minimum	0,04	0,02	0,01	0,06	0,05	0,05	0,09	0,01	0,01	0
Std. Dev.	0,025135	0,018591	0,024575	0,029199	0,016918	0,015818	0,00401	0,018236	0,081176	0,028778
Skewness	7,882791	-1,979325	-3,371039	0,824509	1,263411	0,289251	5,702664	1,181692	0,361491	-1,128671
Kurtosis	91,33061	6,540416	13,45444	1,776085	2,604186	2,274758	37,89494	6,220438	1,730073	3,21193
Observations	520	521	511	512	521	521	518	521	520	521
t-statistic	**6,09122**	**-5,80033**	**-32,01850**	**5,59224**	**-11,31427**	**-7,15484**	**-11,79966**	**-7,33338**	**10,26785**	**-19,41520**

Note: t statistic was calculated as $$t = \frac{\mu_2 - \mu_1}{\sqrt{\frac{\sigma_2^2}{N_2} + \frac{\sigma_1^2}{N_1}}}$$ where μ is the mean σ the standard deviation and N the number of observarions and the subscripts 1 refer to the first period and 2 to the second

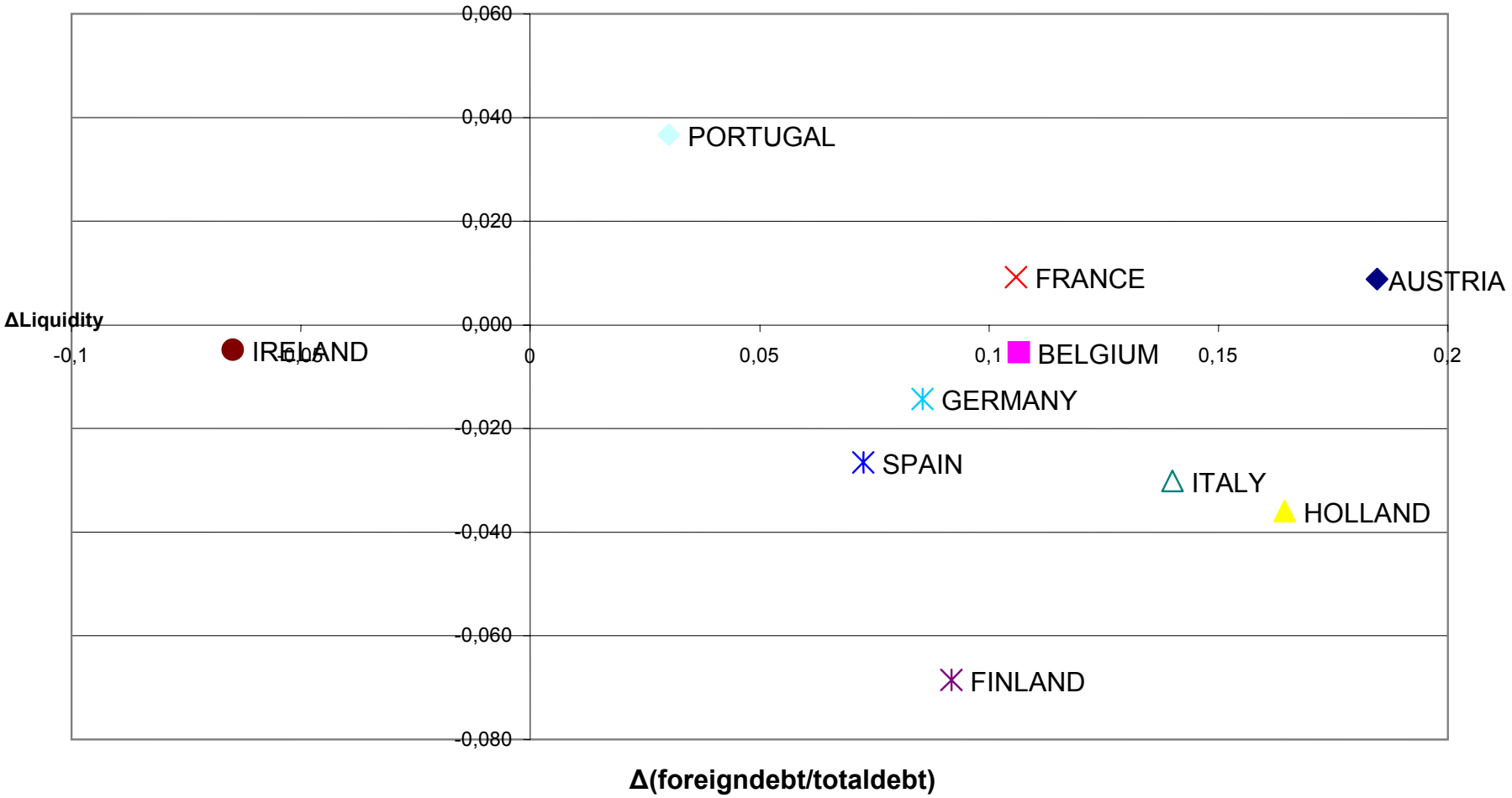
Table 4				
Ten Year Benchmark Government Bonds				
		Issuance		
Country	Coupon Rate	Year	Maturity	Benchmark change
Austria	6,500%	1995	17/11/2005	Dec-95
	6,125%	1996	9/2/2006	Mar-96
	6,250%	1996	31/5/2006	Jul-96
	5,875%	1996	15/7/2006	Nov-96
	5,625%	1997	17/1/2007	Feb-97
	5,750%	1997	11/4/2007	Jun-97
	5,625%	1997	15/7/2007	Sep-97
	5,000%	1998	15/1/2008	Feb-98
	4,000%	1999	15/7/2009	Apr-99
	5,500%	1999	15/1/2010	Dec-99
	5,250%	2001	4/1/2011	May-01
Belgium	6,500%	1994	31/3/2005	Feb-95
	7,000%	1995	15/5/2006	Mar-96
	6,250%	1996	28/3/2007	Jan-97
	5,750%	1997	28/3/2008	Dec-97
	3,750%	1999	28/3/2009	Feb-99
	5,750%	2000	28/9/2010	Feb-00
	5,000%	2001	28/9/2011	May-01
Finland	9,500%	1993	15/3/2004	Jul-93
	7,250%	1996	18/4/2006	Jul-96
	6,000%	1997	25/4/2008	Dec-97
	5,000%	1998	25/4/2009	Dec-98
	5,750%	2000	23/2/2011	Feb-00
France	7,750%	1995	25/10/2005	Aug-95
	7,250%	1995	25/4/2006	Feb-96
	6,500%	1995	25/10/2006	Oct-96
	5,500%	1996	25/4/2007	Apr-97
	5,500%	1997	25/10/2007	Oct-97
	5,250%	1998	25/4/2008	Mar-98
	8,500%	1998	25/10/2008	Nov-98
	4,000%	1998	25/4/2009	Jan-99
	4,000%	1999	25/10/2009	Jul-99
	5,500%	2000	25/4/2010	Mar-00
	5,500%	2000	25/10/2010	Sep-00
	6,500%	2001	25/4/2011	Jun-01
Germany	6,500%	1995	14/10/2005	Nov-95
	6,000%	1996	5/1/2006	Feb-96
	6,000%	1996	16/2/2006	Mar-96
	6,250%	1996	26/4/2006	Jun-96
	6,000%	1997	4/1/2007	Feb-97
	6,000%	1997	4/7/2007	May-97
	5,250%	1998	4/1/2008	Feb-98
	4,750%	1998	4/7/2008	Aug-98
	3,750%	1999	4/1/2009	Feb-99

	4,000%	1999	4/7/2009	Apr-99
	4,500%	1999	4/7/2009	Aug-99
	5,375%	1999	4/1/2010	Nov-99
	5,250%	2000	4/7/2010	Jun-00
	5,250%	2000	4/1/2011	Dec-00
	5,000%	2001	4/7/2011	Jun-01
Holland	6,750%	1995	15/11/2005	Dec-95
	6,000%	1995	15/1/2006	Feb-96
	5,750%	1997	15/2/2007	Feb-97
	5,250%	1998	15/7/2008	Feb-98
	3,750%	1999	15/7/2009	Feb-99
	5,500%	2000	15/7/2010	Feb-00
	5,000%	2001	15/7/2011	Apr-01
Italy	10,500%	1996	1/9/2005	Sep-95
	9,500%	1996	1/2/2006	Jun-96
	8,750%	1996	1/7/2006	Nov-96
	6,750%	1997	1/2/2007	Feb-97
	6,750%	1997	1/7/2007	Oct-97
	6,000%	1997	1/11/2007	Feb-98
	5,000%	1998	1/5/2008	Jul-98
	4,500%	1998	1/5/2009	Jan-99
	4,250%	1999	1/11/2009	Oct-99
	5,500%	2000	1/11/2010	Jul-00
	5,250%	2001	1/8/2011	Jun-01
Ireland	8,000%		18/8/2006	Jun-95
	6,000%		18/8/2008	Oct-97
	4,000%		18/4/2010	Jul-99
Portugal	11,875%	1995	23/2/2005	Mar-95
	9,500%	1996	23/2/2006	Jul-96
	6,625%	1997	23/2/2007	Mar-97
	5,375%	1998	23/6/2008	Jun-98
	3,950%	1999	15/7/2009	Jul-99
	5,850%	2000	20/5/2010	Jun-00
	5,150%	2001	15/6/2011	Apr-01
Spain	10,150%	1995	31/1/2006	Dec-95
	8,800%	1996	30/4/2006	Oct-96
	7,350%	1996	31/3/2007	Feb-97
	6,000%	1997	31/1/2008	Nov-97
	5,150%	1998	30/7/2009	Jan-99
	4,000%	1999	31/1/2010	Jan-00
	5,400%	2000	30/7/2011	Feb-01
	5,350%	2001	31/10/2011	Oct-01

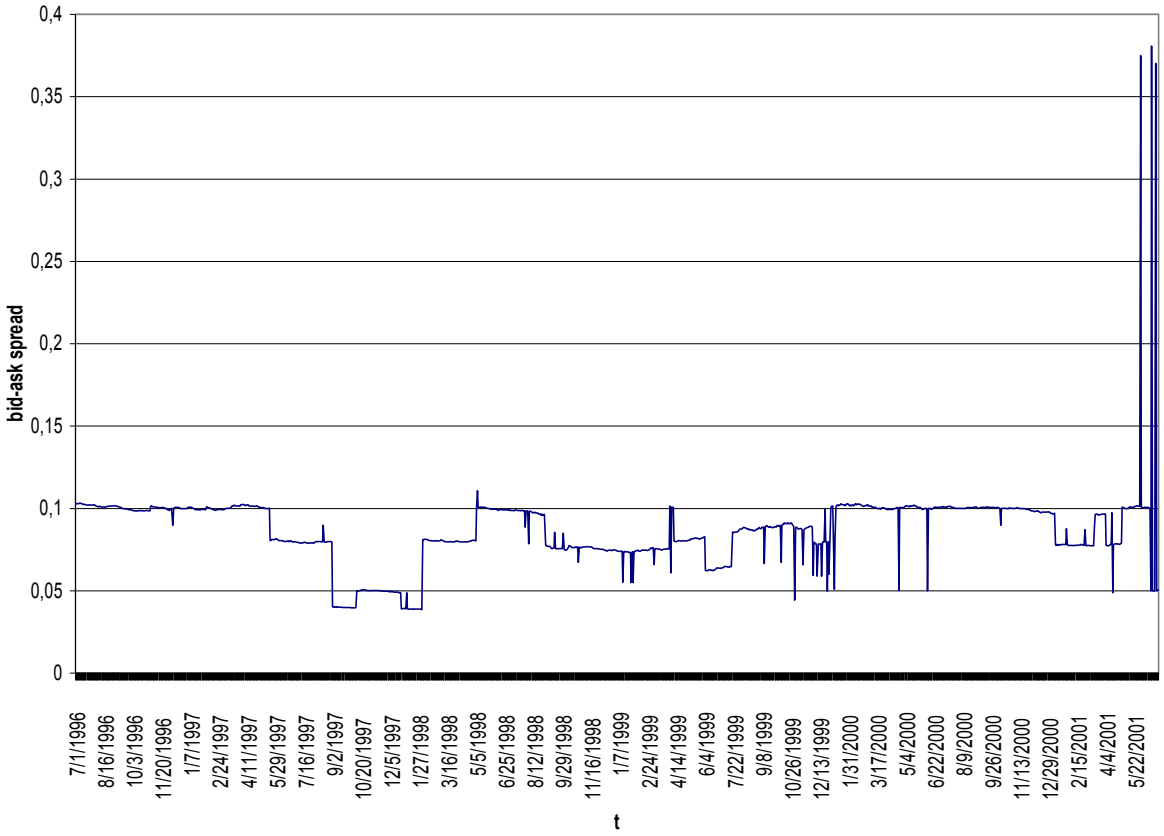
Notes:
1. Source Datastream
2. Maturity date in DD/MM/YYYY format

Scatter plot 1: Difference of Liquidity and Volatility after 1999

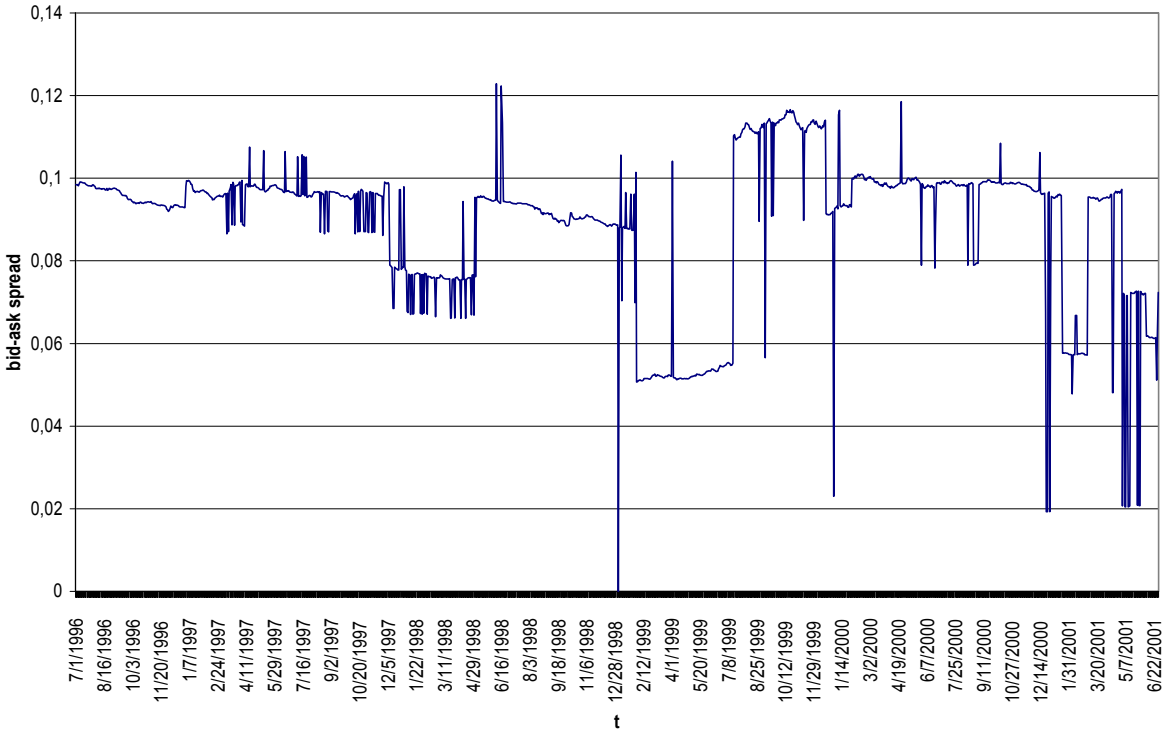
Scatter plot 2: Difference of Liquidity and Debt ratio after 1999



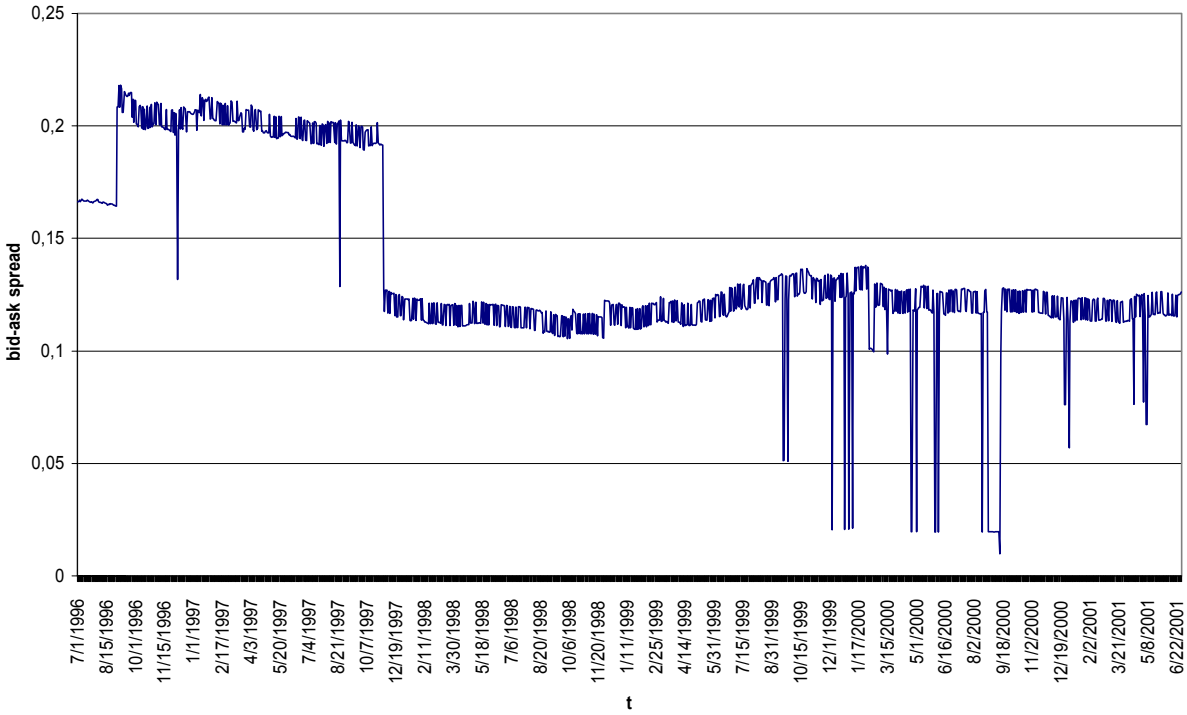
AUSTRIA BID-ASK SPREAD



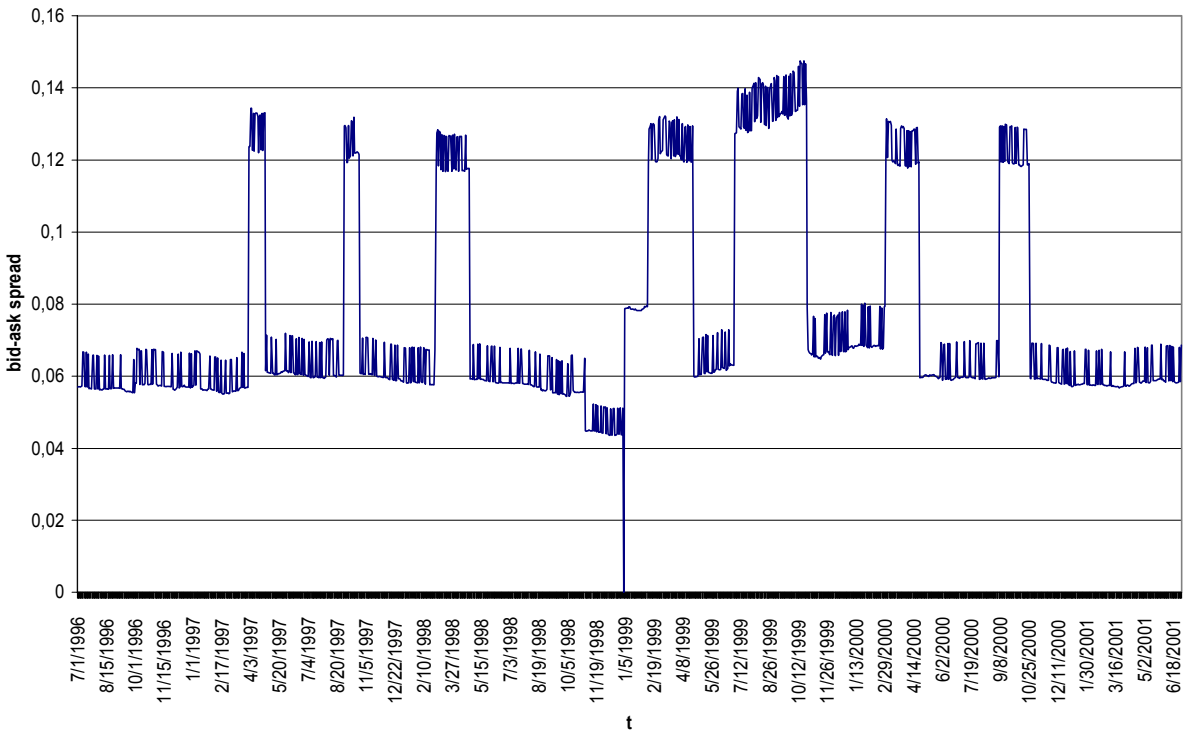
BELGIUM BID-ASK SPREAD



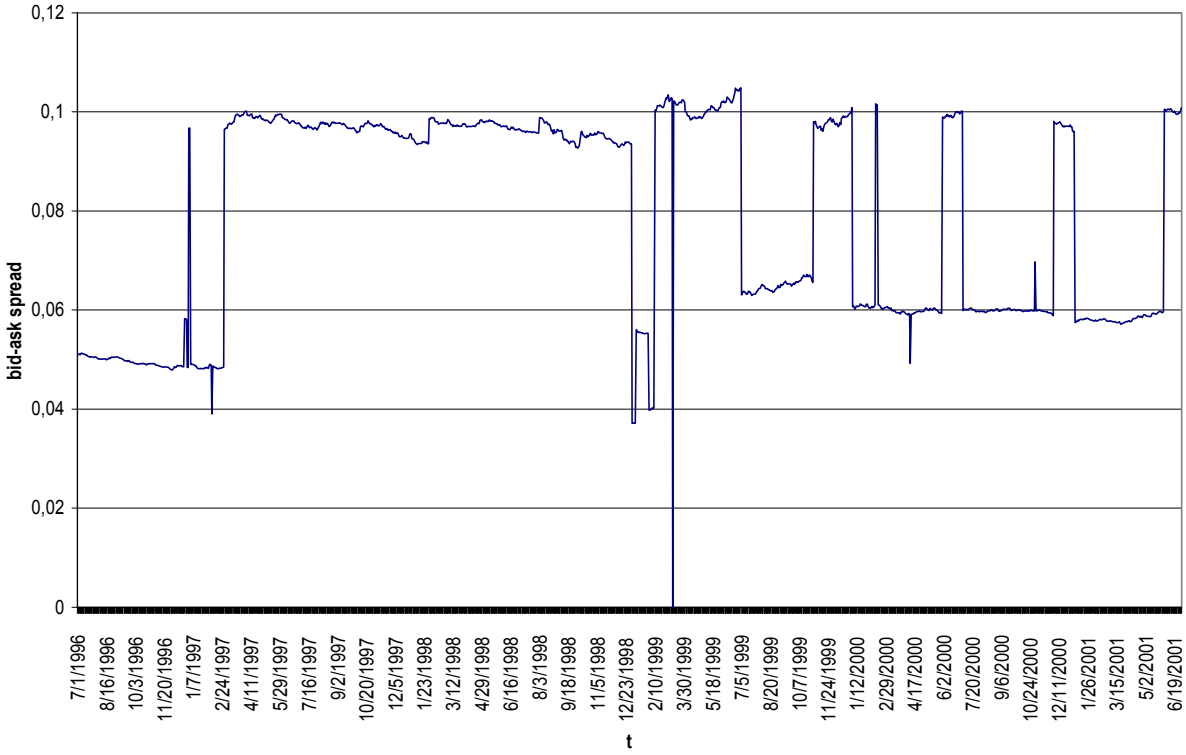
FINLAND BID-ASK SPREAD



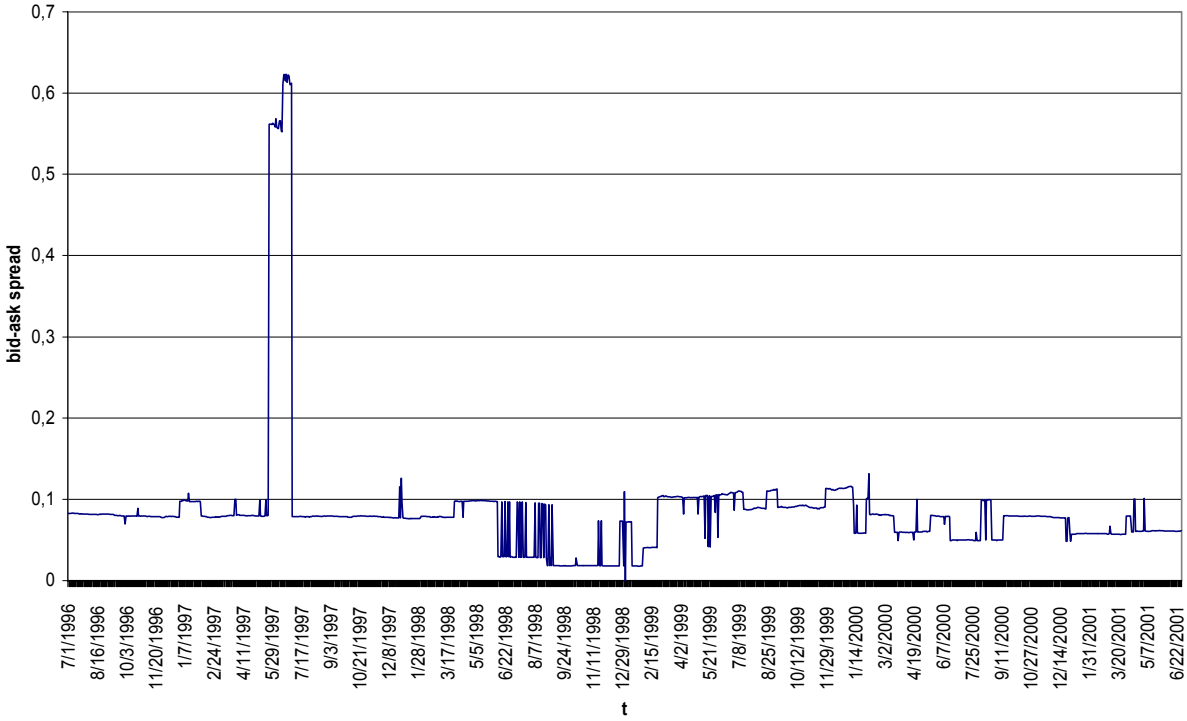
FRANCE BID-ASK SPREAD



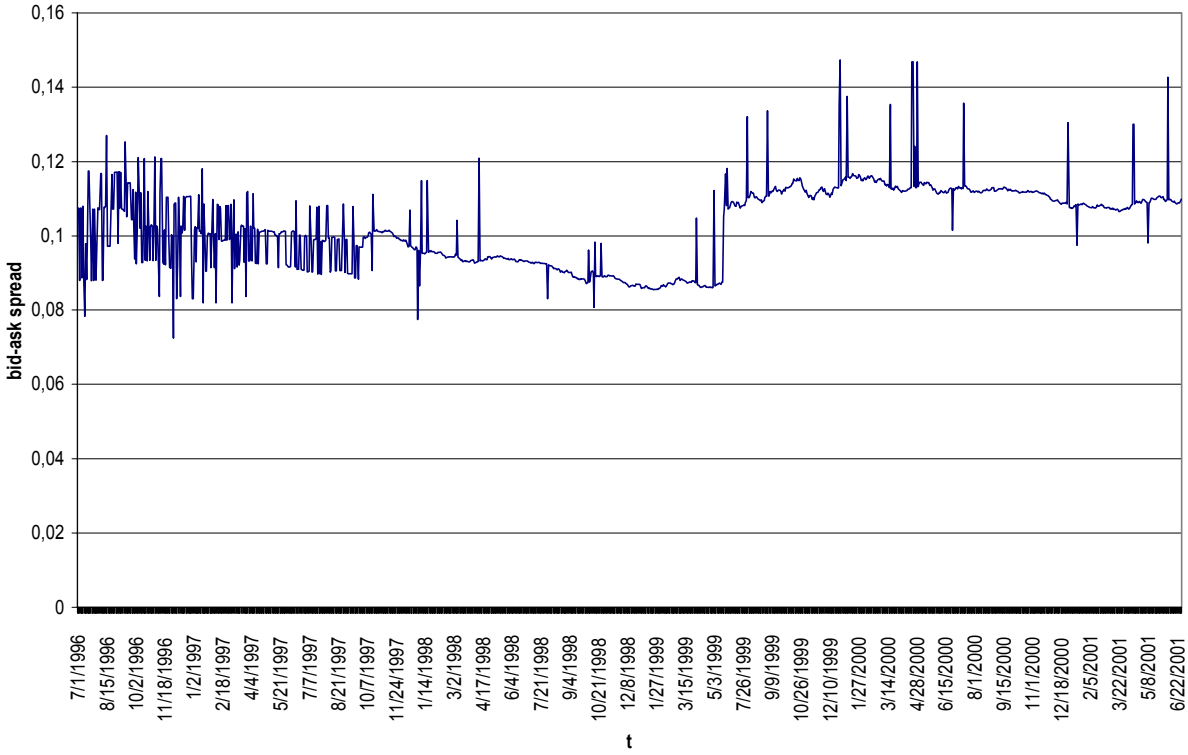
GERMANY BID-ASK SPREAD



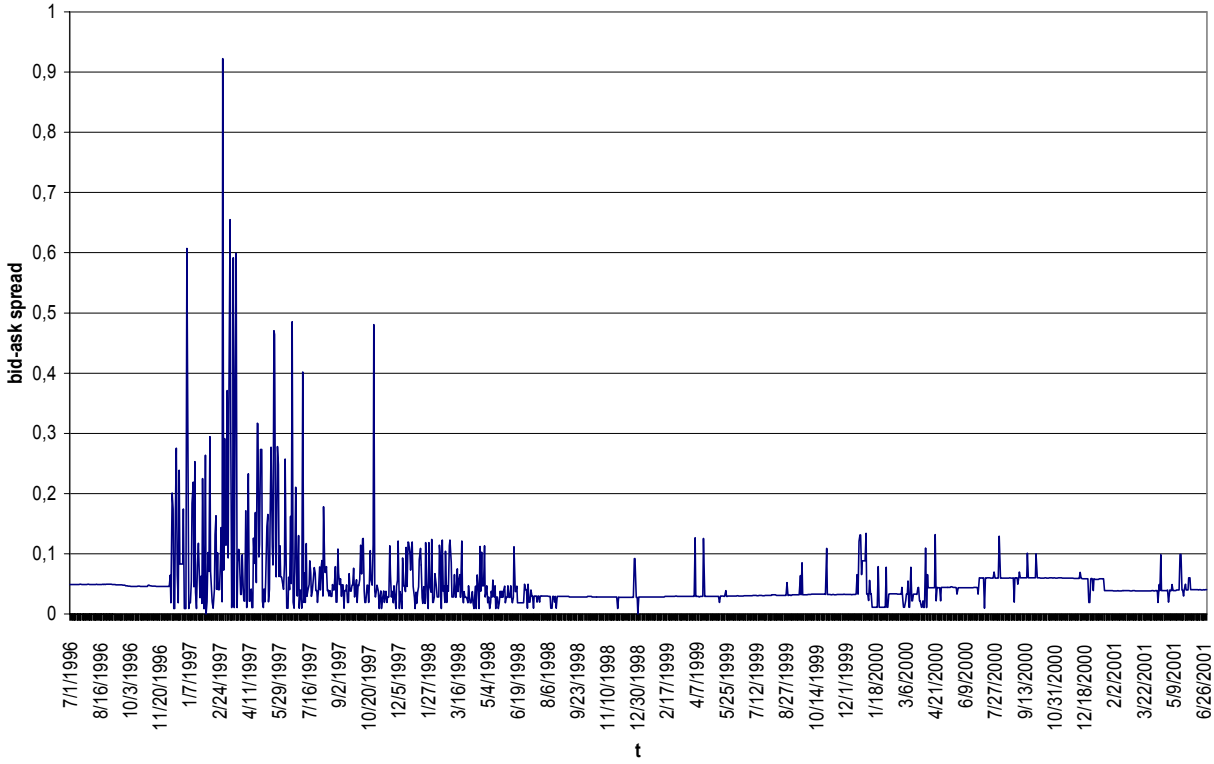
HOLLAND BID-ASK SPREAD



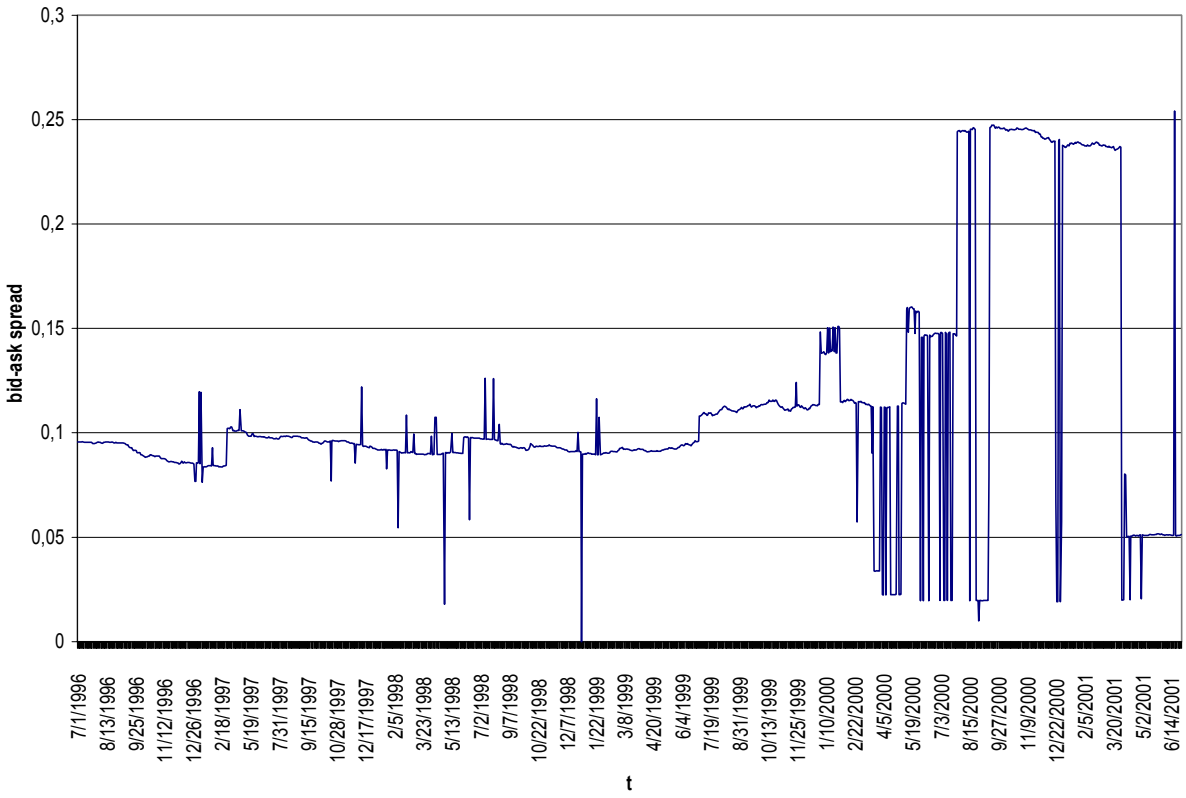
IRISH BID-ASK SPREAD



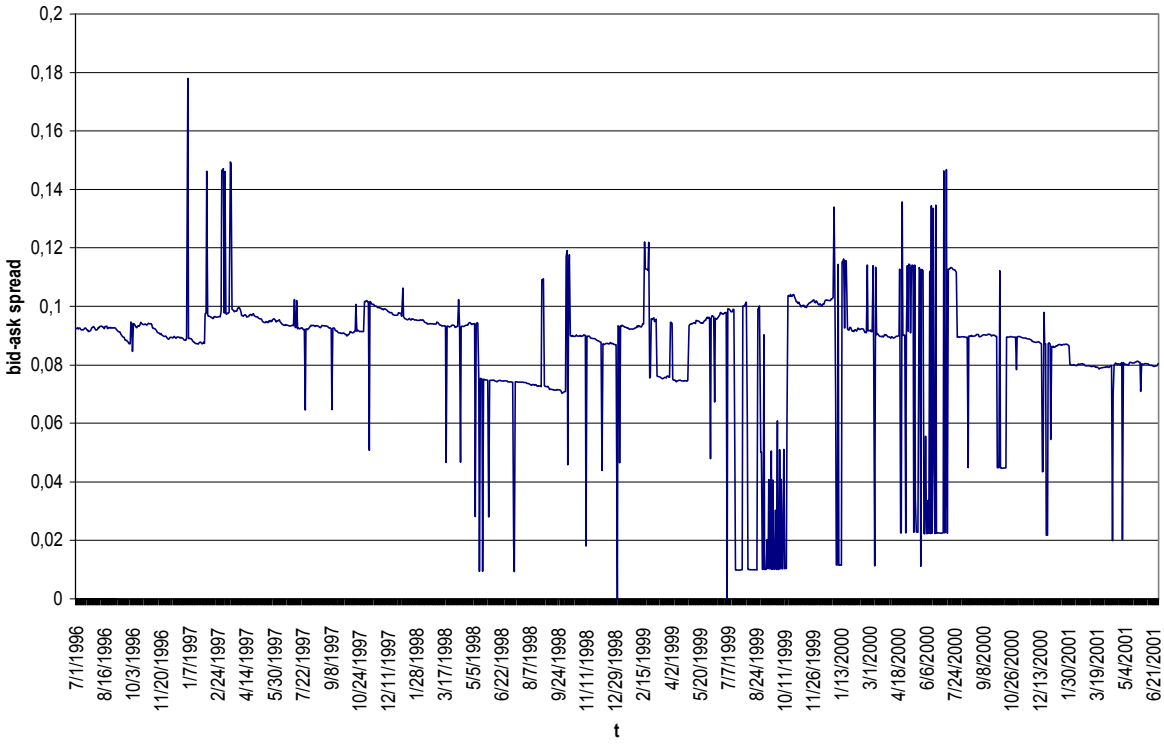
ITALY BID-ASK SPREAD



PORTUGAL BID-ASK SPREAD

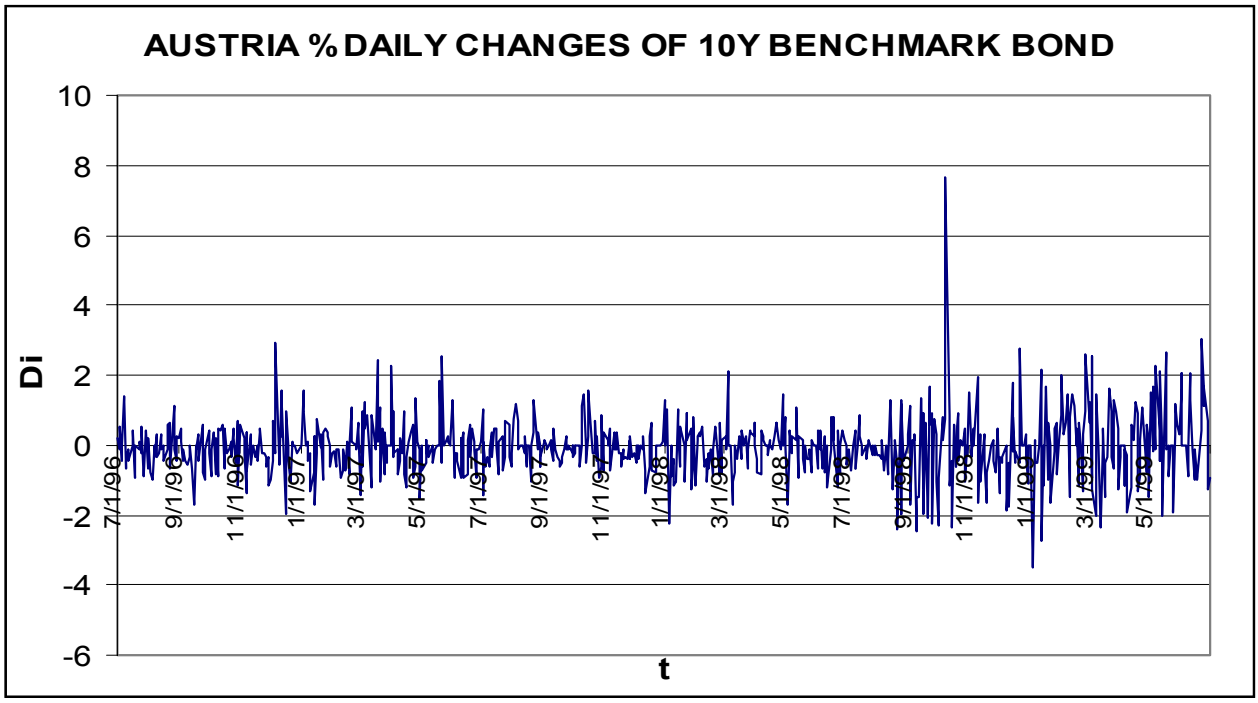


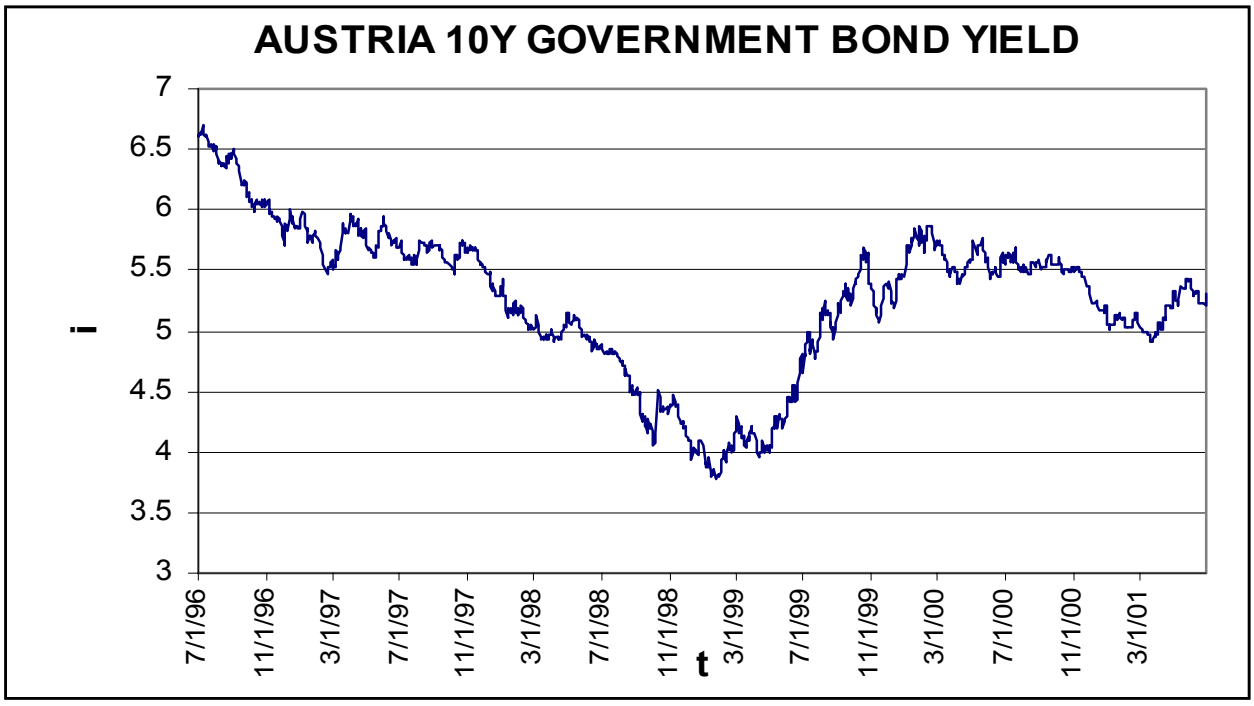
SPAIN BID-ASK SPREAD



AUSTRIA 10Y BENCHMARK BOND YIELD

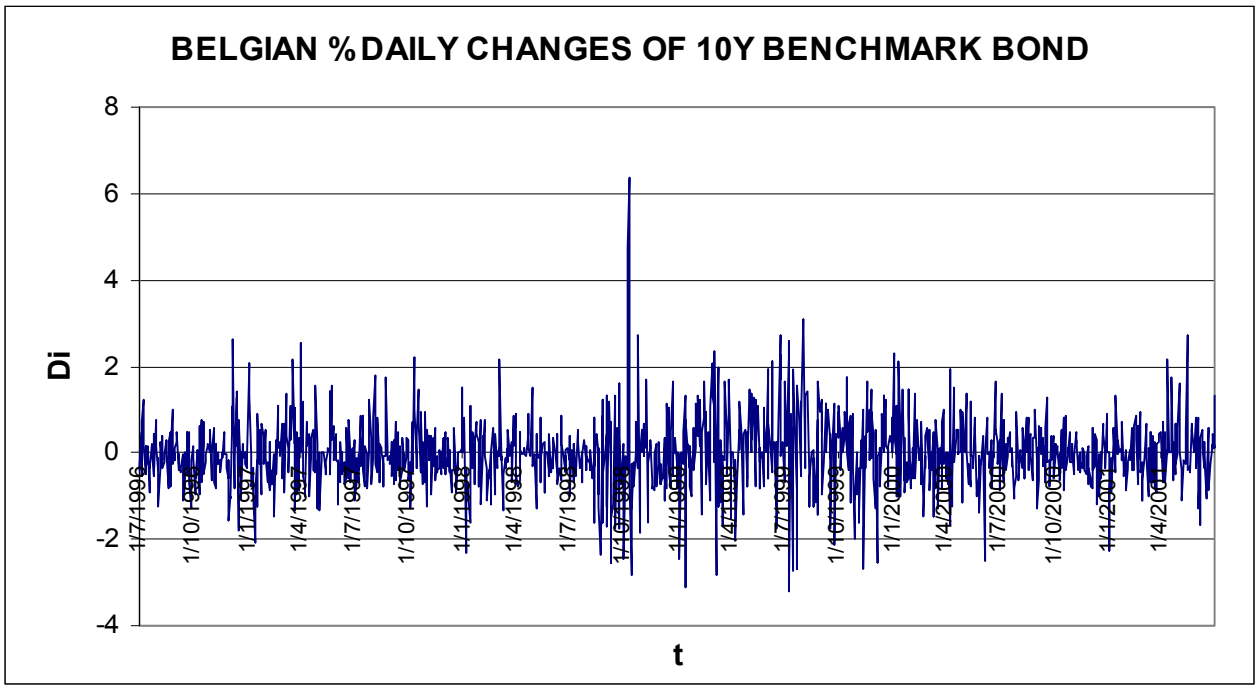
AUSTRIA			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.055751098	0.637086507	0.026716179	0.838704332

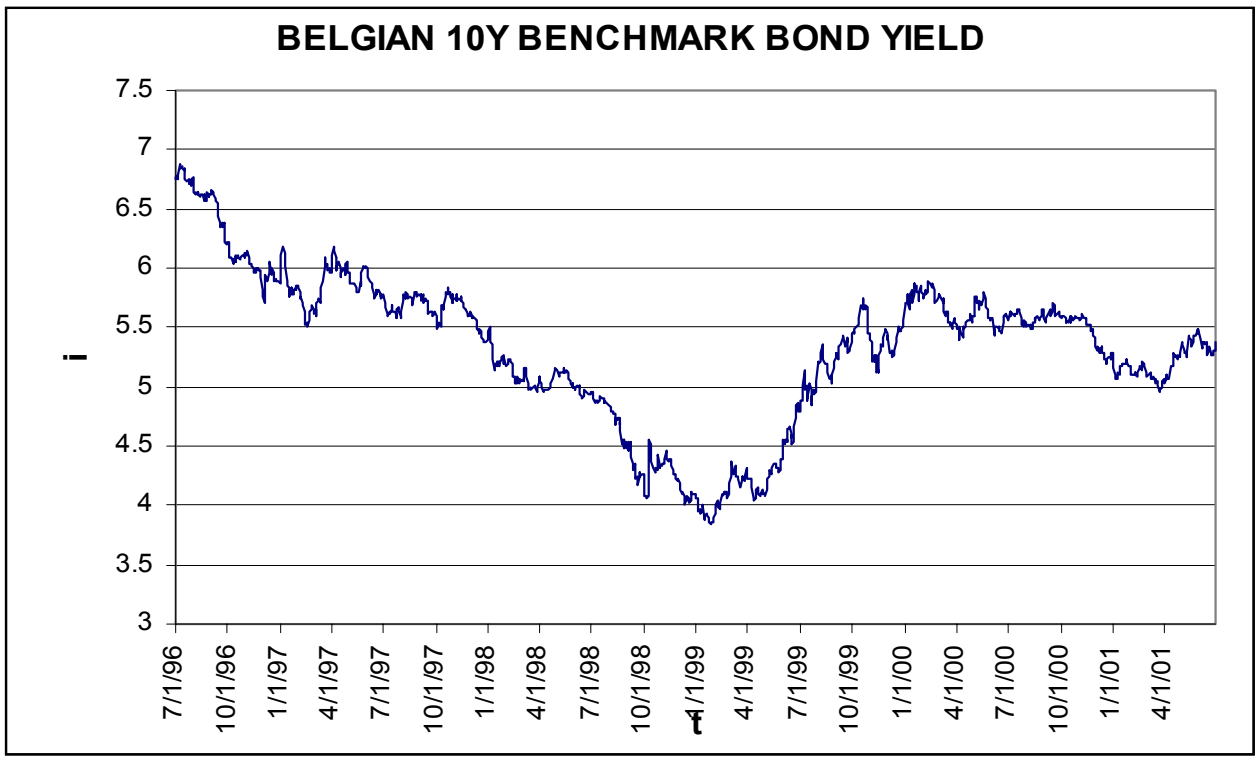




BELGIUM 10Y BENCHMARK BOND YIELD

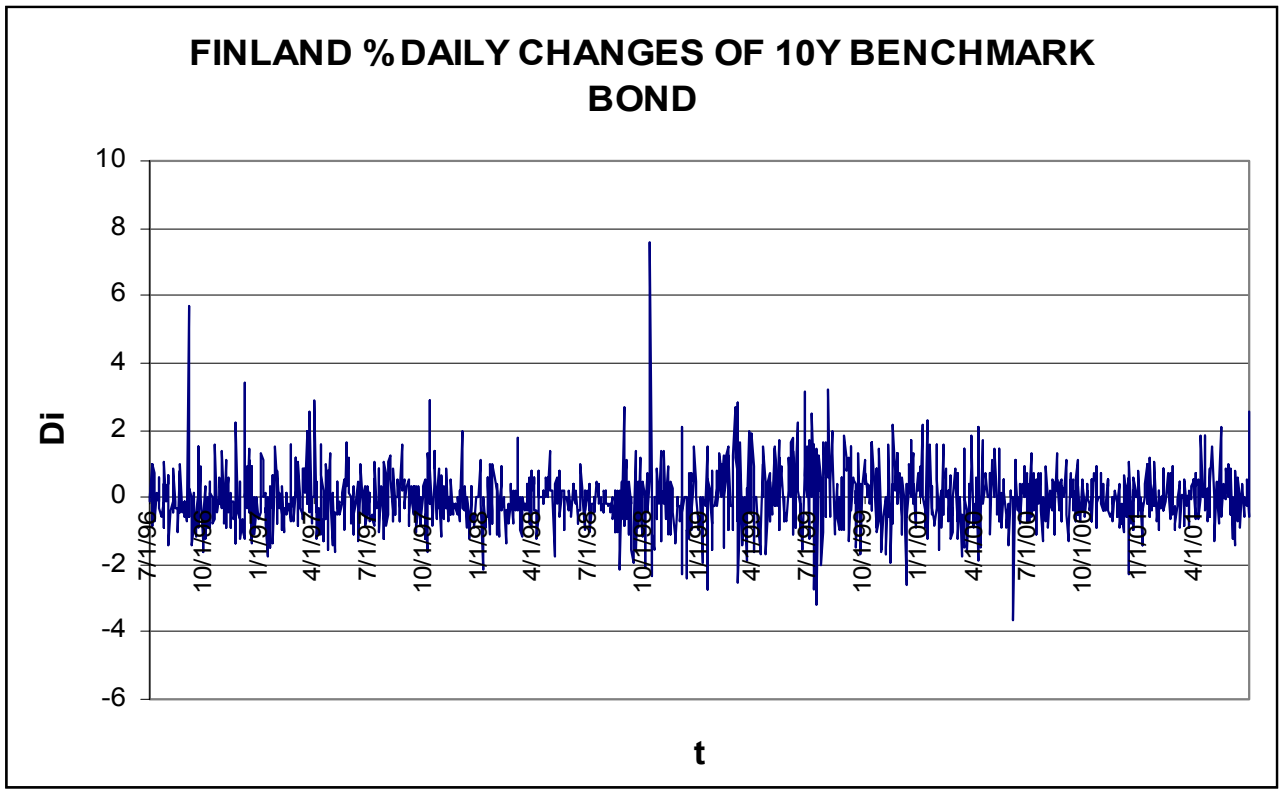
BELGIUM			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.05927517	0.655314418	0.02488959	0.78869565

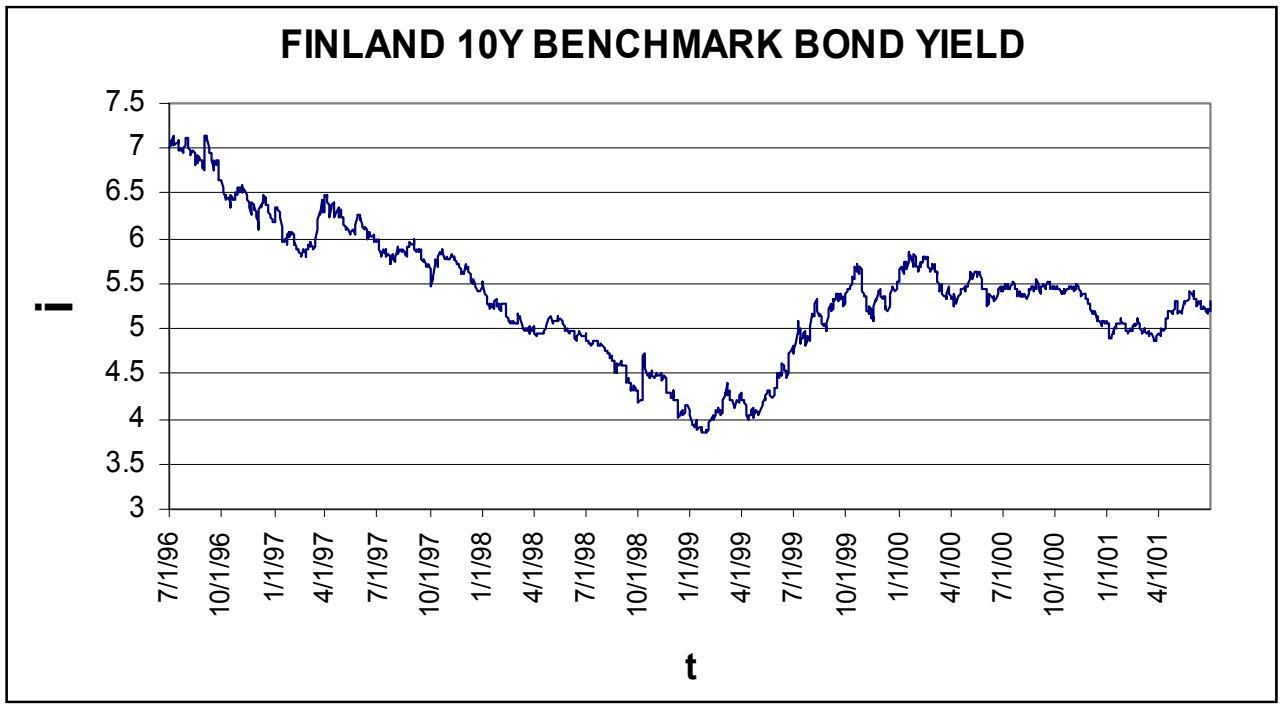




FINLAND 10Y BENCHMARK BOND YIELD

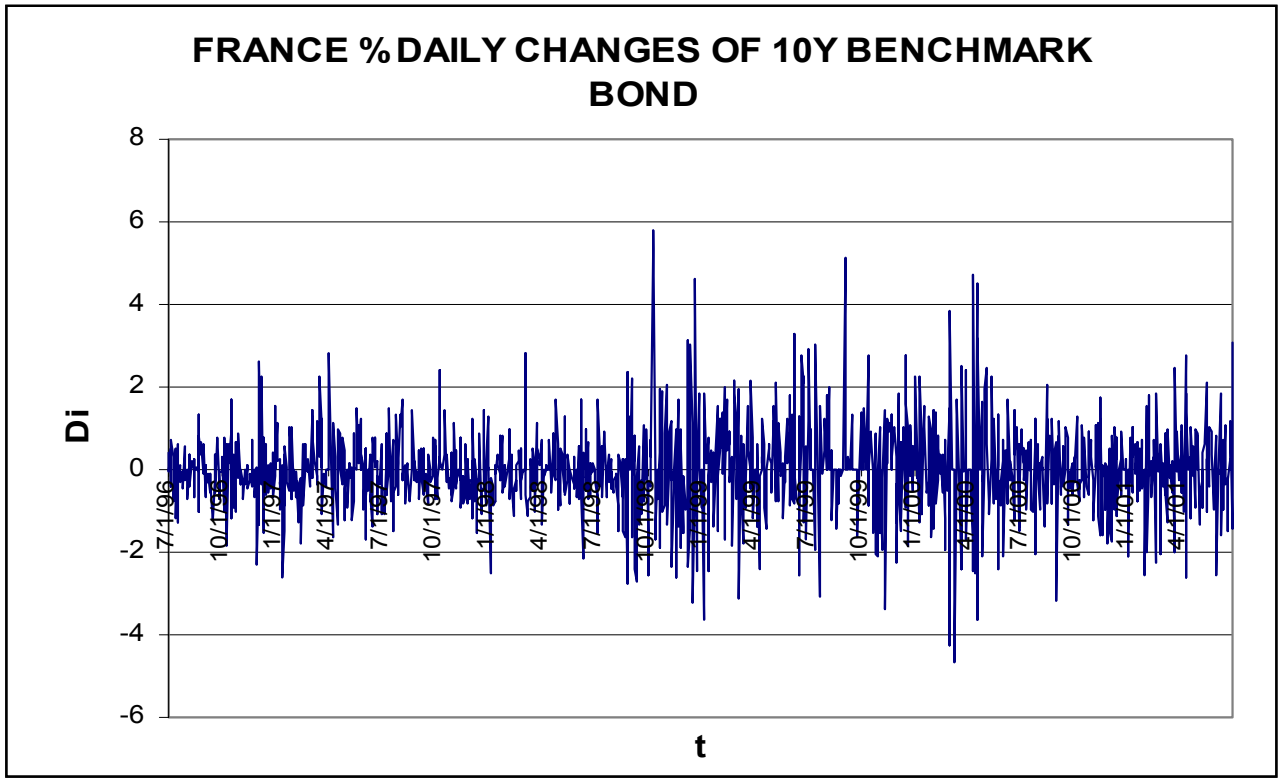
FINLAND			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.066289133	0.773335413	0.025581322	0.839100027

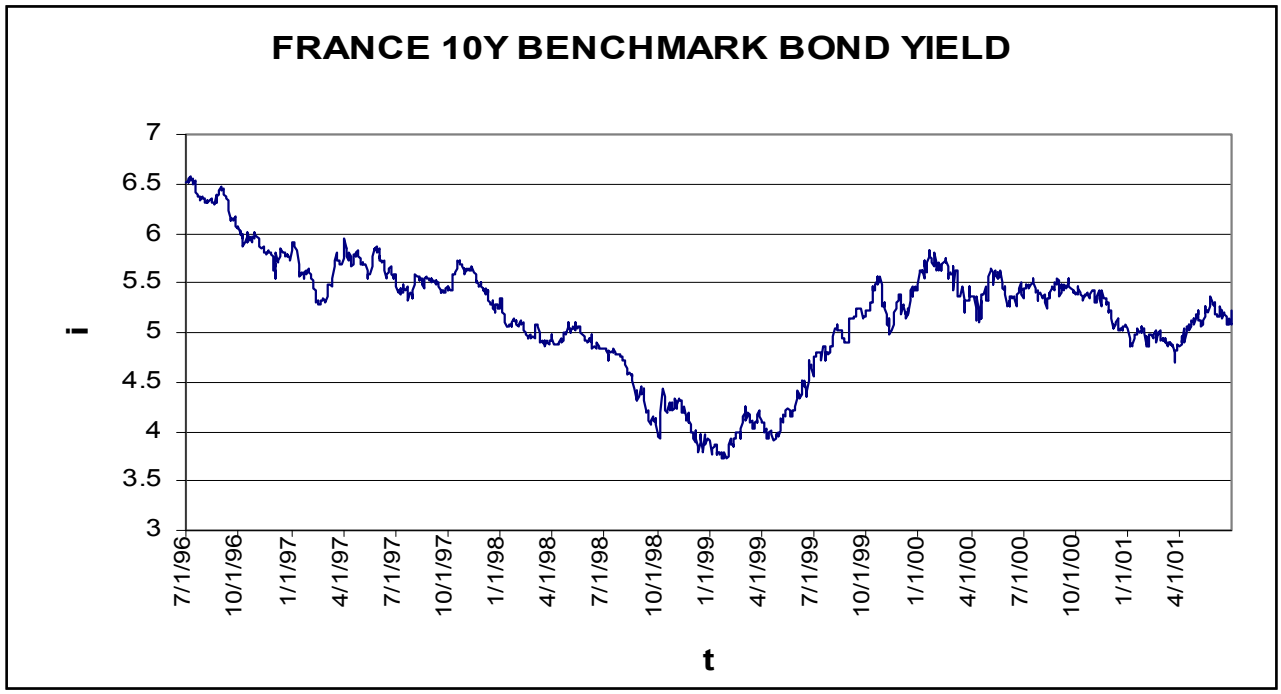




FRANCE 10Y BENCHMARK BOND YIELD

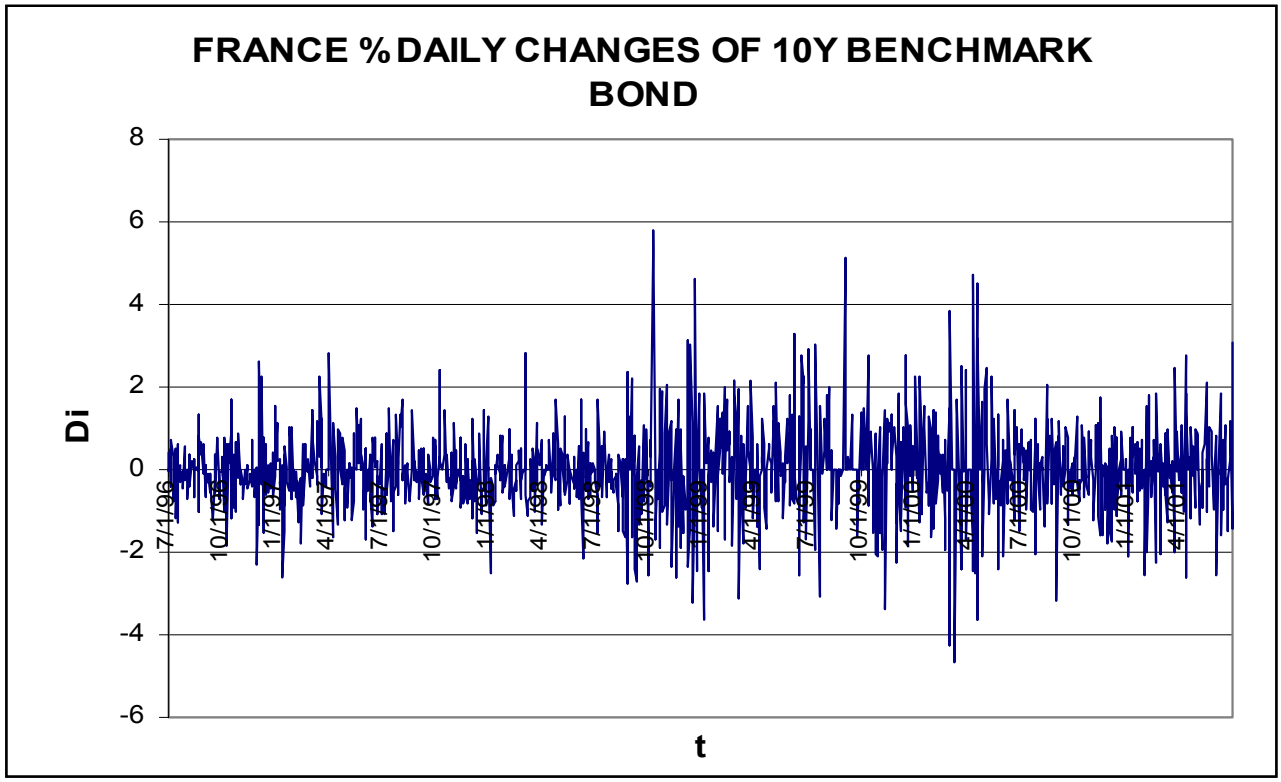
FRANCE			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.05335491	0.709732794	0.03253947	1.139169233

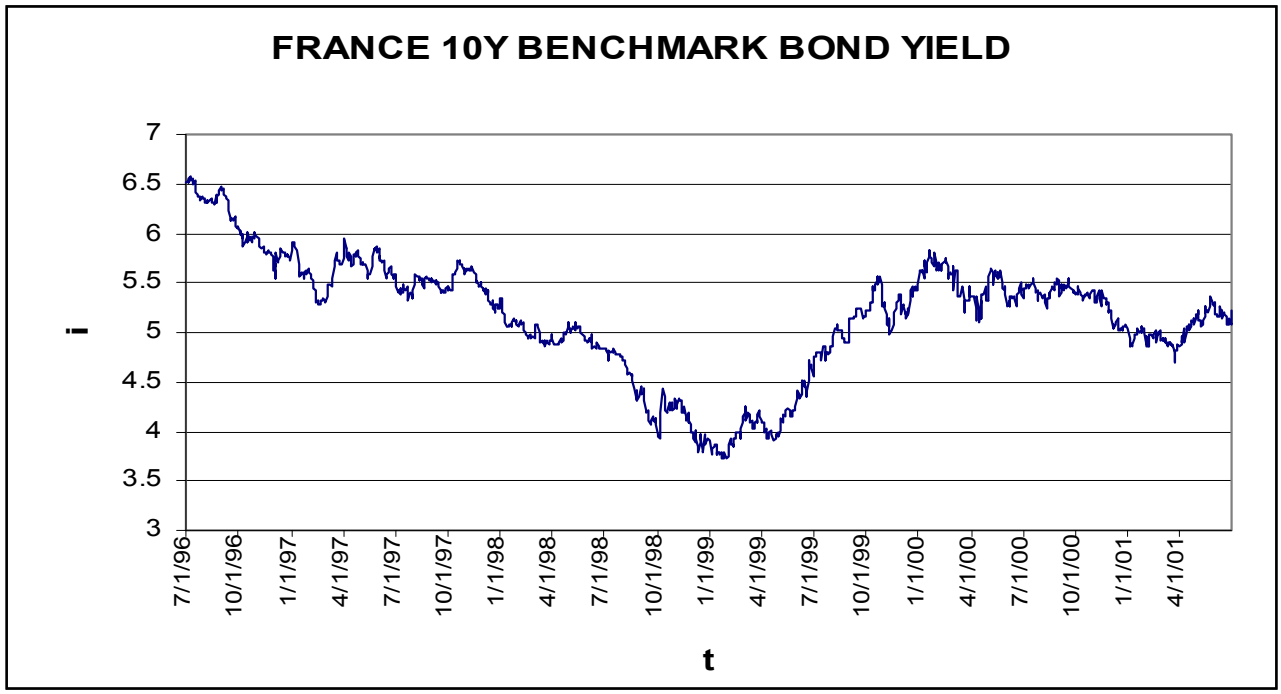




FRANCE 10Y BENCHMARK BOND YIELD

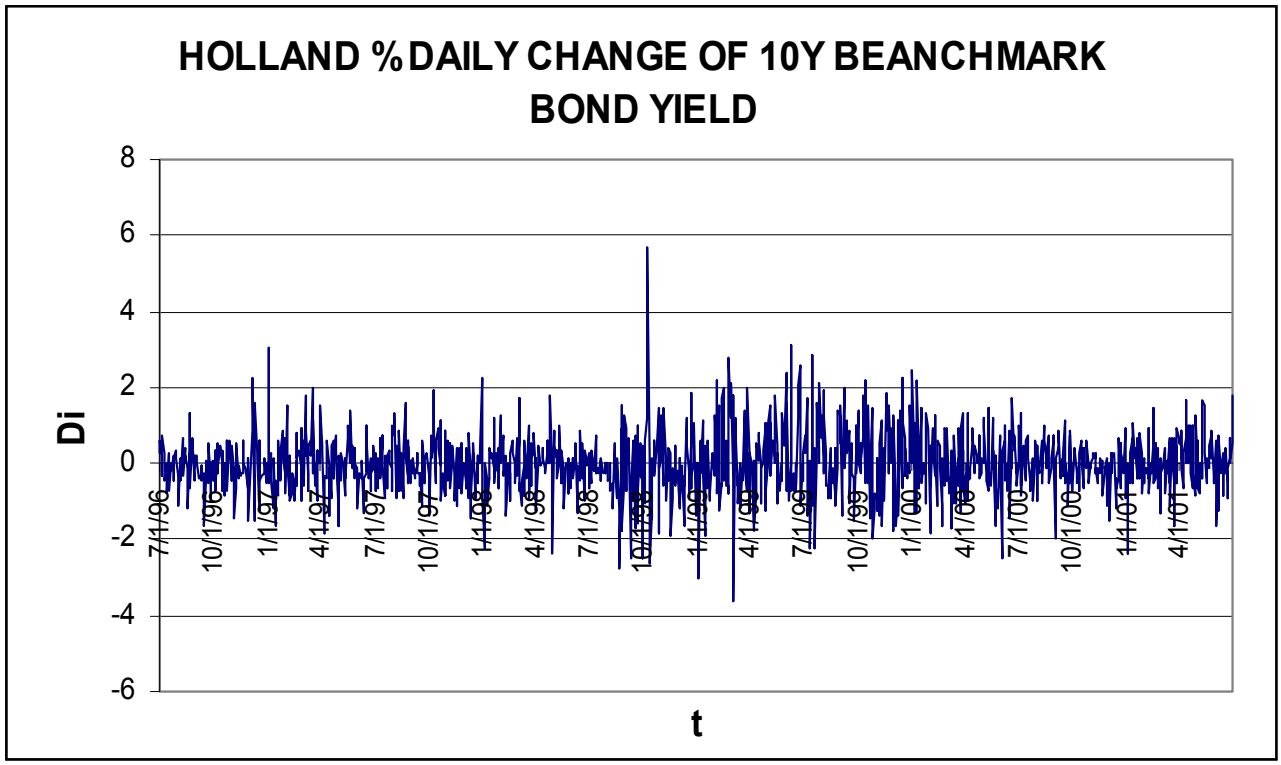
FRANCE			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.05335491	0.709732794	0.03253947	1.139169233

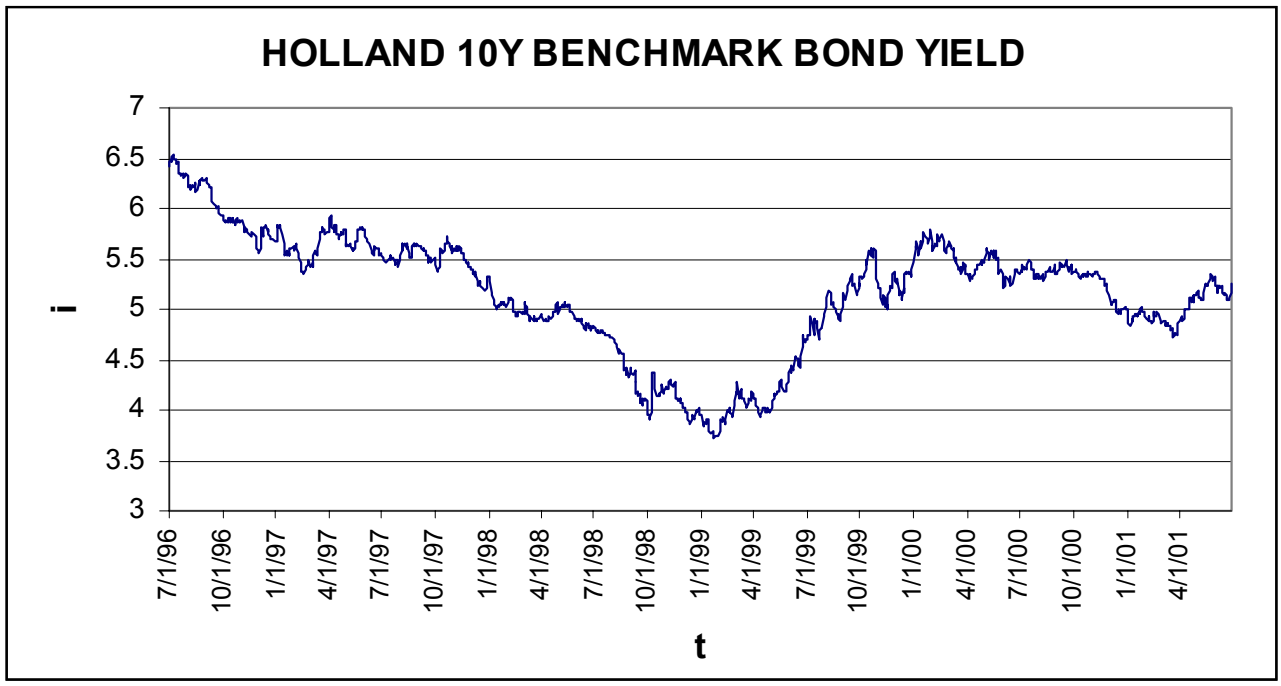




HOLLAND 10Y BENCHMARK BOND YIELD

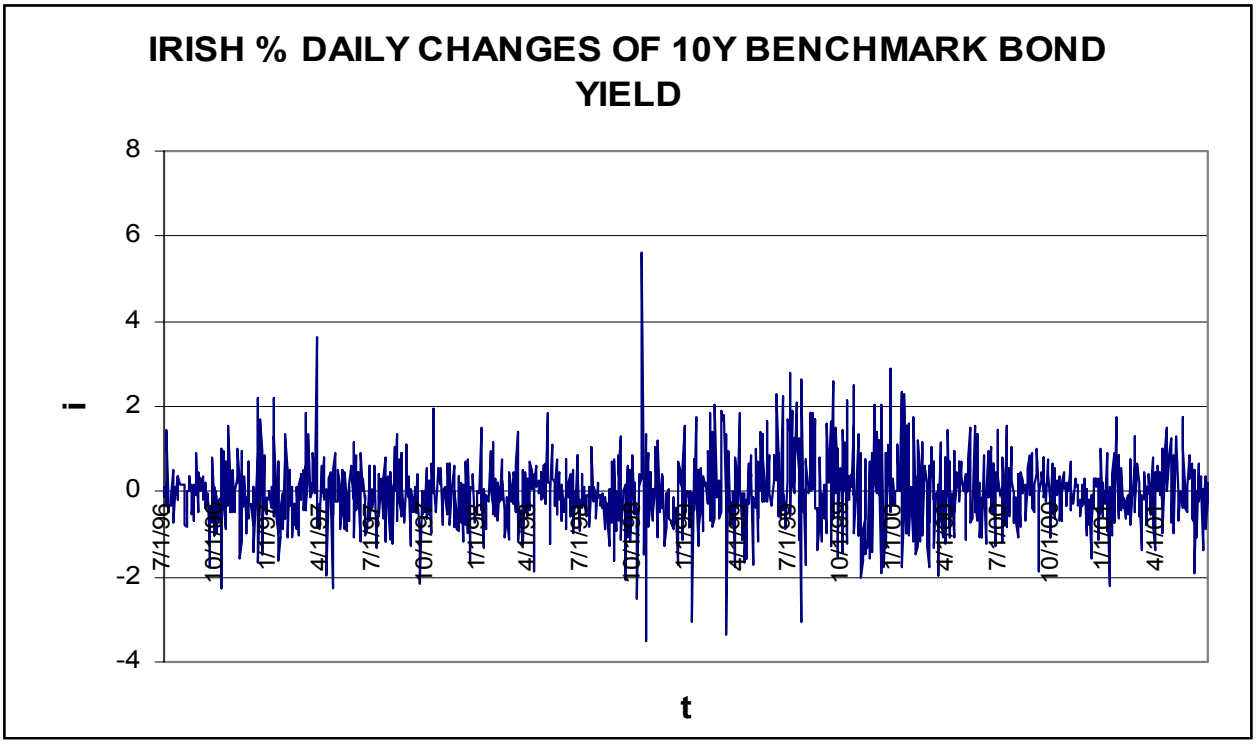
HOLLAND			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.052259663	0.644556508	0.024719197	0.802842314

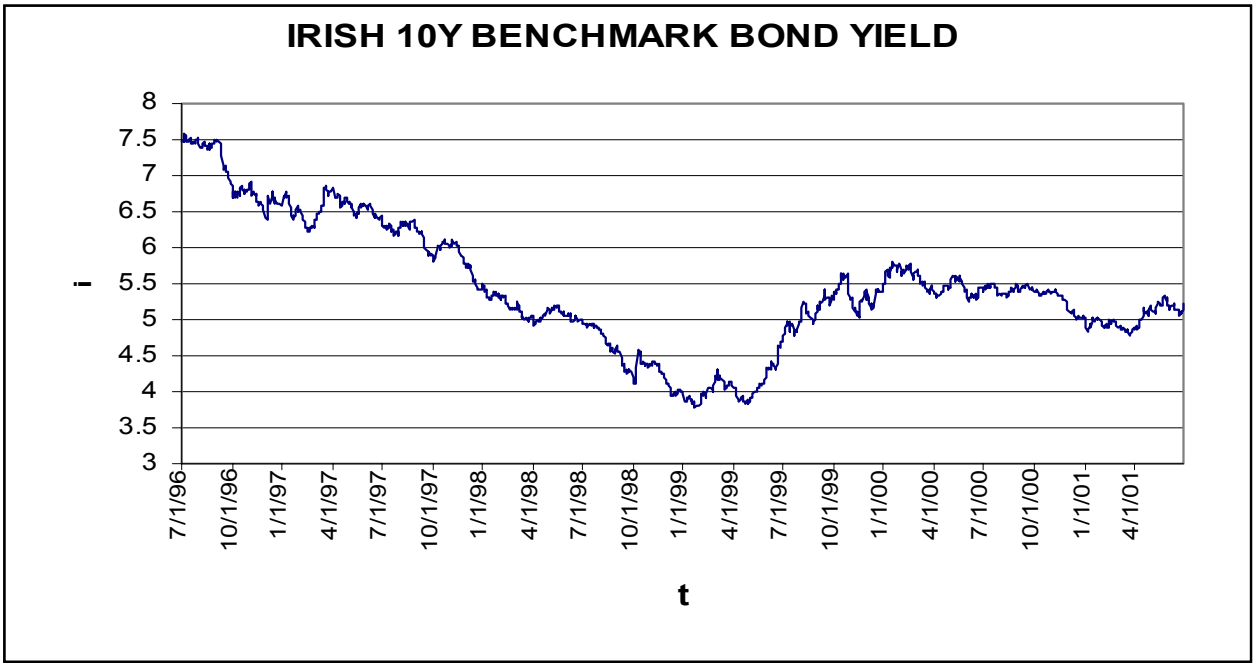




IRISH 10Y BENCHMARK BOND YIELD

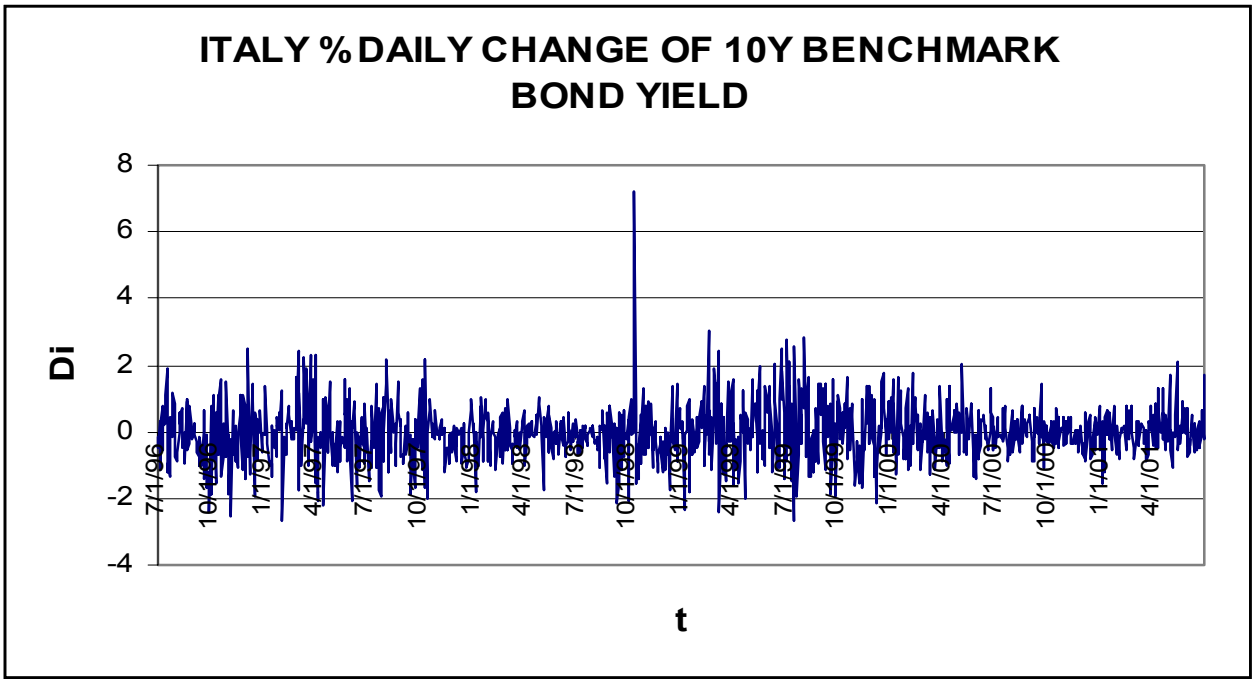
IRELAND			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.074920181	0.675830894	0.024132629	0.833141246

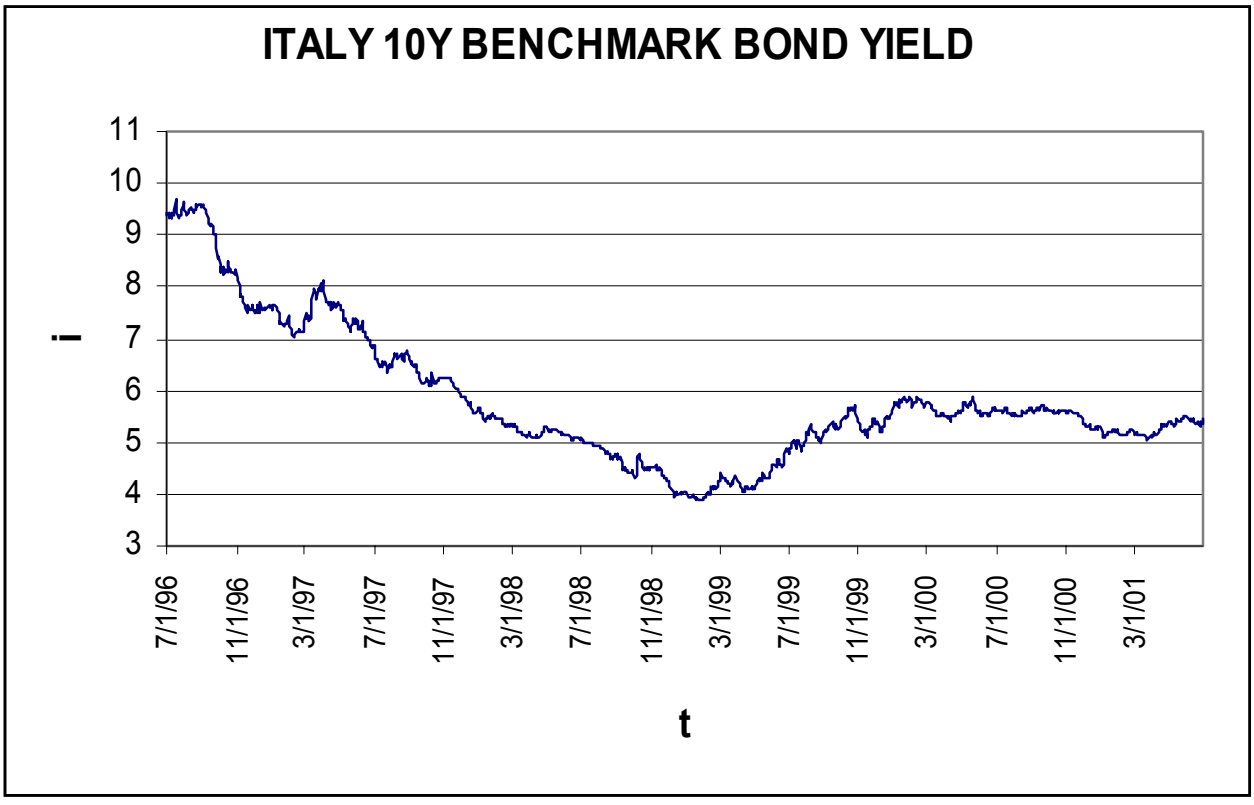




ITALY 10Y BENCHMARK BOND YIELD

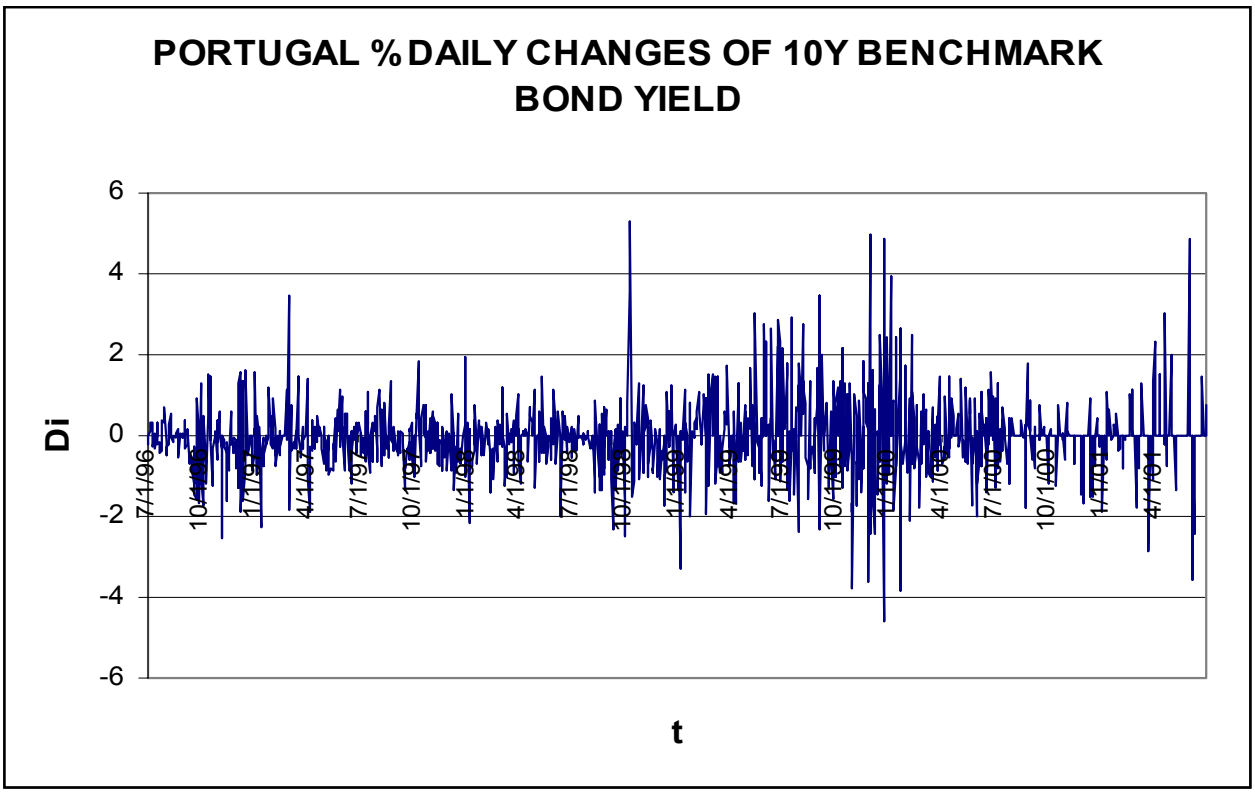
ITALY			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.115611737	0.798052769	0.026920769	0.72732644

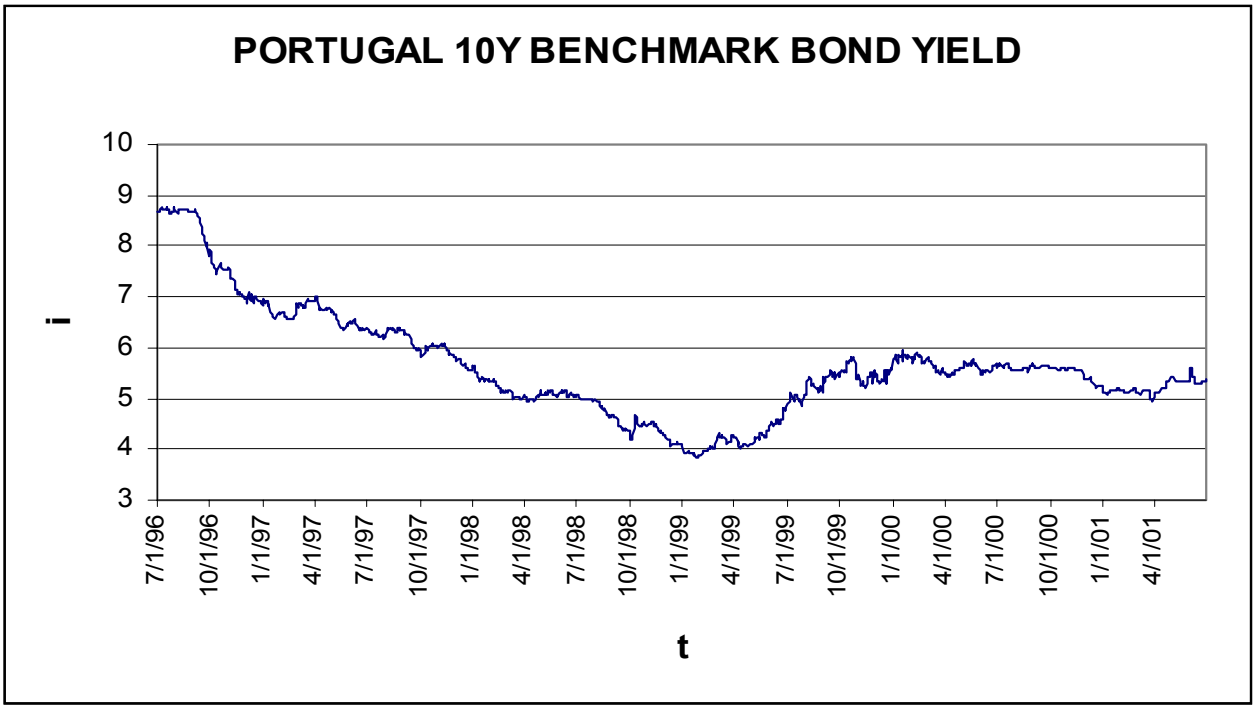




PORTUGAL 10Y BENCHMARK BOND YIELD

PORTUGAL			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.101887962	0.624154948	0.02771136	1.013463539





SPAIN 10Y BENCHMARK BOND YIELD

SPAIN			
1/7/1996-30/6/68		1/7/99-30/6/2001	
AVERAGE	STDEV	AVERAGE	STDEV
-0.108147397	0.642194076	0.025680897	0.754664179