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# MONETARY INTEGRATION AND THE COST OF BORROWING.

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## Abstract

With the beginning of the European Monetary Union (EMU), euro-area sovereign securities' adjusted spreads over Germany (corrected from the foreign exchange risk) experienced an increase that caused a lower than expected decline in borrowing costs. The objective of this paper is to study what explains that rising. In particular, if it took place a change in the price assigned by markets to domestic (credit risk and/or market liquidity) or to international risk factors. The empirical evidence supports the idea that a change in the market value of liquidity occurred with the EMU. International and default risk play a smaller role.

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## 1. Introduction.

Euro-area sovereign securities' markets experienced important changes with the European Monetary Union (EMU) (see Danthine et al. 2001, and the BIS Study group on fixed income markets, 2001). Before the introduction of the euro, yield differentials within European sovereign borrowers were mostly determined by four factors: expectations of exchange rate fluctuations, differences in tax-regimes among countries, credit risk differences, and market liquidity differences. The removal of foreign exchange risk in January 1999 and the elimination (or reduction to insignificant levels) of different tax treatments during the course of the 90s eliminated two of these factors, and created the conditions for a much more integrated and competitive public debt market.

Therefore, the main effects of the introduction of the euro in government bond markets were, on the one hand, an increase in the degree of substitutability among securities issued by different treasuries and a higher competition between issuers to attract investors that fostered some reorganisation of the market structure<sup>1</sup>. On the other, a gain in the importance of credit risk and market liquidity in yield differentials. Before Monetary Union differences in these factors were perhaps not completely priced due to market segmentation.

As a result, euro-area government bond markets began to be considered as one single market comparable, in terms of size, to the US or Japanese markets. Nevertheless, segmentation did not completely disappeared. In 2004, public debt management is still decentralized under the responsibility of 12 sovereign issuers, with differences in rating, and characterized by different issuing techniques (see Favero, Missale and Piga, 1999). These facts still distinguish euro-area debt market from its corresponding US and Japanese counterparts. One evidence of this segmentation is the persistence of yield differentials.

This persistence motivates the goal of this paper which is to examine what happened to euro-area countries' yield spreads on government bonds after the introduction of the euro. The Pre-EMU literature speculated that with the elimination of currency risk, yield spreads would narrow and would primarily reflect default risk. Conversely, market

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<sup>1</sup> Blanco (2001) reports that on the side of the issuers, some significant changes were observed since the start of the Monetary Union such as the harmonisation of market conventions in the computation of yields, the introduction of a single trading calendar and pre-announced auction calendars, or the increase in issue sizes. In some countries, the creation of large issues was facilitated by the introduction of programmes of exchange of old illiquid bonds for new bonds and by the concentration of issuance activity in a smaller number of benchmark securities. With the aim to attract more investors, some of the smaller issuers, such as Austria, Belgium, the Netherlands and Portugal, resorted to syndication procedures. Others, such as the French Treasury introduced new instruments such as constant maturity and inflation-indexed bonds.

participants and member state debt managers appeared to believe that EMU yield differentials would mostly be due to liquidity factors. Therefore, in order to reduce borrowing costs, debt managers introduced substantial innovations that should have enhanced the liquidity of their bonds.

The analysis in this paper will be threefold: First, European yield spreads will be decomposed into their two main domestic components (market liquidity and credit risk differences) that still remained after the currency risk removal. Second, it will be studied if there had been a change in the price assigned by markets to them after the introduction of the euro that could explain the observed yield spreads behaviour. Third, we will examine the effects of international risk factors on yield differentials. The main goal of all this analysis will be to explain which could have been the factors behind the observed average increase of 11.98 basis points in yield spreads, during the first three years after the start of the Monetary Union, once they are corrected from the exchange rate factor (we will follow Favero, Giavazzi and Spaventa, 1997 and correct pre-EMU spreads by estimating the foreign exchange factor as the differential between the 10 years swap rate in the currency of denomination of the bond and the 10 years swap rate in Deutsche marks)

The sample is composed of daily data from January 1996 to December 2001 (therefore, the same extension, three years, will be considered for both the pre-EMU and the EMU period) and includes all EMU countries except Luxembourg (it has a public debt market that is negligible), and Greece (it did not join the Monetary Union until January 2001).

We will present the results from two different specifications. In the first specification, the objective will be to implement a decomposition between the liquidity premium and the credit-risk component of adjusted spreads by modelling their behaviour to a number of factors that potentially only affect one of them. It will be a static panel estimation that will only include domestic risk factors. The credit rating will be used to identify differences in default risk, and both the bid/ask spread (a proxy of market tightness) and relative debt levels (a proxy of market depth) will be the variables used to capture market liquidity.

Nevertheless, following the short literature on this topic, the analysis will also build on findings on the empirical literature on sovereign bond yield spreads on emerging markets, according to which spreads are also sensitive to international risk factors (mainly US risk factors and interest rates). Therefore, a second specification, drawn on Codogno, Favero and Missale (2003) will be presented. It will be a dynamic model estimated separately for each euro-country (credit risk differences will be captured by the relative debt-to-GDP ratio, market liquidity differences by both the bid/ask spreads differentials and the on-the run/off-the run spreads differentials, and international risk factors by

the spread between 10-year fixed interest rates on US swaps and the yield on 10-year US bonds). To the best of our knowledge a daily dataset for two of the most important measures of liquidity, the bid/ask spreads and on-the run/off-the run yield differentials, that corresponds to the trading activity that takes place in the whole euro-securities' market, has not been used so far in an empirical analysis.

The results of both specifications are highly consistent and provide evidence that market size scale economies increased with the Currency Union and that the rise was higher the smaller (and potentially more illiquid) the debt market was. A change in the market assessment of liquidity rather than default or international risk factors (which would play a smaller role) might be behind the observed increase in adjusted spreads with Monetary Integration, even though the effect differs according to the size of the market. Hence, the empirical evidence allows to claim that the removal of the exchange rate barrier has penalised small markets. In the actual context of increased competition among euro-area government securities' markets, their success might be limited by the extent of their liquidity and market size.

The rest of the paper is organized as follows: Section 2 explains the foreign exchange correction applied in the pre-EMU period. Section 3 outlines some evidence concerning Monetary Integration in Europe and the evolution of the relative cost of borrowing. Section 4 focuses on the different factors, domestic and international, to which adjusted spreads might be sensitive. Section 5 describes the data. Section 6 explains the models and estimation methodology. Section 7 reports the results. Lastly, section 8 draws conclusions.

## **2. Foreign exchange risk correction in the pre-EMU period.**

An appropriate measure of exchange rate changes could be provided by a comparison of the yields of government assets denominated in two different currencies (say, one in Spanish pesetas, the other in D-marks) and the yields in the same currencies with the same life to maturity issued by the same (non-government) subject, or by two otherwise comparable issuers. Candidates for this measure are: (1) long-term bonds issued by the same supra-national organisation (such as the World Bank or the European Investment Bank), (2) long-term bonds issued by the private sector, and (3) the fixed interest rates on swap contracts .

Giovannini and Piga (1994) study the differential between the interest rate on an Italian government bond issued in the Eurodollar market and a comparable World Bank bond issued in the global market. Alesina et al. (1992) compare interest rates on public and private financial instruments denominated in the same currencies in 12 OECD countries.

And Favero, Giavazzi and Spaventa (1997), Arnold and Lemmen (2001), Blanco (2001) and Codogno, Favero and Missale (2003) compare government bond yield differentials and the interest rate swap (IRS) differentials.

Supra-national issues are by definition free of any specific default risk. However, the market for bonds issued by supra-national organisations is far less liquid and deep than that for government bonds. More importantly, supra-national issues in some currencies are intermittent. On the other hand, corporate bond yields display a quite volatile cyclical behaviour and are not default risk-free. As for interest rate swaps, there may be problems also, as they may be affected by the emergence of financial difficulties of the banking sector of one country (see Favero, Giavazzi and Spaventa, 1997).

However, on balance, the drawbacks of the interest differential on supranational issues or corporate issues seem to be greater. Then, even though it is not a perfect measure, the spread on fixed interest rate swap contracts can therefore be used as an indicator of the exchange rate determinant of the yield spread on government bonds as it seems to be the best indicator of this yield spread component.

Since the early 1980s, interest rate swaps have become one of the most popular vehicles utilized by many companies and financial institutions to hedge against interest rate risk. An interest rate swap is an agreement between two parties to exchange a series of interest payments without exchanging the underlying debt (that is denominated in the same currency), which means that the default risk of the underlying asset does not translate into the level of the fixed interest rate on the swap contract. In a typical fixed/floating interest rate swap, the first party promises to pay to the second at designated intervals a stipulated amount of interest calculated at a fixed rate on “the notional principal”. The second party promises to pay to the first at the same intervals a floating amount of interest on the notional principal calculated according to a floating-rate index<sup>2</sup>. IRS are liquidated by differences, “cash-flow netting”. Essentially, then, an interest rate swap is a series of forward contracts on some reference interest rate, such as the Libor (see Bicksler and Chen, 1986).

The fixed rate is the one that is used to price the interest rate swaps<sup>3</sup>. IRS usually present a spread over the on-the-run government bond yield at the same maturity, and its price basically accounts for the counterparty credit risk, the

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<sup>2</sup> In this paper, the 6-month money Libor rate (in the respective currency) before the EMU and the Euribor after its implementation.

<sup>3</sup> I.e. if a 10-year Spanish Peseta IRS is 11.50-11.60, that means that one should pay a 11.60% fixed interest rate in exchange of the six-month Spanish Peseta Libor in the euro-market, or the six-month Libor in order to receive a 11.50% fixed rate.

liquidity, the market risk of the swap contract, and the exchange-rate risk of the currency of denomination of the swap. Nevertheless, it can be assumed that the first three components cancel out when the differential between the 10-year swap rate of one European country  $i$  over, for example, Germany is taken<sup>4</sup>. Hence, the swap rate differential can be used as an appropriate measure to capture the exchange-rate change component of yield spreads.

So, let's denominate:

$I_{i,10}$  = 10-year Yield on sovereign bonds of country  $i$

$IRS_{i,10}$  = 10-years Interest Rate Swap rate of currency  $i$

Where, considering that differences in tax-regimes have been reduced to insignificant levels during the course of the 90s:

$$I_{i,10} = f(DR_{i,10}, L_{i,10}, ER_{i,10}) \quad (1)$$

$DR_{i,10}$  = Default risk of country  $i$  10-year sovereign bonds.

$L_{i,10}$  = Liquidity of country  $i$  10-year sovereign bonds.

$ER_{i,10}$  = Exchange rate risk of currency  $i$  over a 10-year horizon.

Therefore the 10-year yield differential of country  $i$  over Germany will be:

$$[I_{i,10} - I_{GE,10}]_t = f([DR_{i,10} - DR_{GE,10}]_t, [L_{i,10} - L_{GE,10}]_t, [ER_{i,10} - ER_{GE,10}]_t) \quad (2)$$

Then, approximating:

$$[IRS_{i,10} - IRS_{GE,10}]_t = [ER_{i,10} - ER_{GE,10}]_t \quad (3)$$

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<sup>4</sup> With regard to the counterparty credit risk, not only most of the participants present in the different currency segments of the underlying swap market (the euro-deposit market) are the same, but also the counterparty credit risk associated to swap rates is currently very low given the set of collateralisation and documentation standards recently developed by dealers and customers (see Liu, Longstaff and Mandell (2002), Duffie and Singleton (1997) and He (2000)). Secondly, market risk derives from the uncertainty associated to the floating leg of the swap contract (the six-month Libor rate). However, because market risk is usually highly correlated within euro-currencies IRS contracts, it can also be ignored when differentials are taken. Finally, with respect to the liquidity of swaps contracts, it is reasonable to assume that, although they are currently very liquid (see BIS statistics), their liquidity will be highly correlated with the liquidity of the underlying government bonds. Therefore, it may vary within currencies. In this case, the estimated foreign exchange component (the swap rate differential) of total yield differentials would be biased upward and, consequently, the credit and liquidity component of government bonds would be downward biased. However, if we look at the data (see tables 1) we observe an increase in the yield spread in the EMU period for countries in which the swap differential was not significant in the pre-EMU period. It is the case of Austria, Belgium, France and the Netherlands. This fact indicates that the aforementioned biases do not fully explain the rise in the price of liquidity and credit risk, when yield spreads are corrected for the foreign exchange factor and support the utilization of the swap rate differential as an appropriate measure to capture the exchange-rate change component of yield spreads.

The variable “*ADJUSTED SPREAD<sub>it</sub>*”, i.e. the difference between the total yield differential and the swap rate differential, that will be used as the dependant variable, will mainly account<sup>5</sup> for credit risk and market liquidity differences of country *i* sovereign securities’ over Germany.

$$YIELD\ SPREAD_{it} = [I_{i,10} - I_{GE,10}]_t = f([DR_{i,10} - DR_{GE,10}]_t, [L_{i,10} - L_{GE,10}]_t, [ER_{i,10} - ER_{GE,10}]_t) \quad (2)$$

$$\begin{aligned} ADJUSTED\ SPREAD_{it} &= ASPREAD_{it} = \\ &= [I_{i,10} - I_{GE,10}]_t - [IRS_{i,10} - IRS_{GE,10}]_t = \\ &= f([DR_{i,10} - DR_{GE,10}]_t, [L_{i,10} - L_{GE,10}]_t) \end{aligned} \quad (4)$$

### 3. Monetary integration and the relative cost of borrowing: Some evidence.

The aforementioned elimination of two of the main components of yield differentials prompted an important convergence in total yield differentials over 10-year German bond yields during the period January 1999-December 2001. This is shown in figure 1 and table 1a: the average spread over German yields decreased from 58.22 to 25.24 basis points. Nevertheless, the convergence only implied a sizeable reduction of the relative borrowing costs for the countries that used to present wider spreads, lower rating and higher foreign exchange risk. It is the case of Italy, Spain, Portugal, and to a lesser extent of Finland, and Ireland. Conversely, the countries that took less advantage of the elimination of the exchange rate risk, Austria, Belgium, France, and the Netherlands, experienced an increase in their relative borrowing costs (15.34, 13.24, 11.08 and 16.92 basis points, on average, respectively, see table 1b). To sum up, while average gross yield spreads (relative to Germany) declined since EMU, they rose in 4 of the 9 countries.

Moreover, what is really puzzling is that once adjusted for the swap differential (see figure 2), with the Currency Union spreads rose for all 9 countries. The average value is 25.21 basis points in the EMU period compared with 13.23 basis points in the pre-EMU one (see figure 3 and tables 1a and 1b). This fact clearly supports the idea that a change in either domestic (market liquidity or credit risk values) or international risk factors or in-the-market-pricing of them might have occurred with the euro, resulting in higher than the expected borrowing costs. The answer to what can explain these rising yield spreads is clearly important and will be the main goal of this paper.

One possible explanation, which is supported by both market participants and member state debt managers beliefs, could be that in the actual context of increased competition among euro-area government securities markets their

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<sup>5</sup> We are not considering the effect of international risk factors in this decomposition.



success might be limited by the extent of their liquidity and market size. In particular, as the German sovereign debt market is the second-biggest market in the euro-area (only surpassed by the Italian), a concentration of trading activity in the German market might have occurred and, consequently, wider liquidity differences vis-à-vis German bonds might have been translated in higher adjusted spreads<sup>6</sup>.

More precisely, table 2 shows that, in the European context, while 3 countries, Italy, Germany, and France, represented the 71.61 % of the euro-area market, another four countries, Austria, Finland, Portugal, and Ireland, only accounted for the 5.43 % of the total. Therefore, given (1) these observed large size differences among euro-area sovereign debt markets and (2) the fact that, with the removal of the foreign exchange risk barrier, captive domestic markets might have tended to decrease, it is likely that market size and liquidity differences within markets became more important.

Some literature supports the importance of market size in the success of a debt market. Martin and Rey (2004) show that, in general, size matters for asset trade, which means that a larger country will benefit from higher asset prices than a smaller one, and point out that these market size effects are reminiscent of the home market effect in the new trade and geography literatures (Helpman and Krugman, 1985). As in the trade literature, they come from the combination of imperfect substitution and transaction costs. McCauley and Remolona (2000) note that if important fixed costs are involved in the production of information about the future path of interest rates, the size of the whole debt market matters. In particular, they calculate that there may be a size threshold that lays around \$100-200 billions. Below this level, they state that sustaining a liquid government market may not be easy. In the euro-area, only five countries (Italy, Germany, France, Spain and Belgium) surpassed that threshold<sup>7</sup>. Economides and Siow (1988) point out, that there might be a trade-off between liquidity and the size of the market. The smaller the size of a market, the lower the outstanding volume traded in it. Therefore, the more difficult will it be for investors to process and evaluate information about securities traded in that market, and the higher the transaction costs and the liquidity premium. Moreover, if size matters for liquidity, “ex-ante” traders would prefer bigger and liquid markets (they will present lower price volatility, bigger scale economies and higher probability of a favourable match) rather than small and illiquid markets. Consequently, liquidity will be “self-reinforcing”: traders prefer to participate in liquid markets and the more traders

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<sup>6</sup> The existence of a very liquid futures bond market in Germany also represents an additional advantage of holding German bonds.

<sup>7</sup> Austria, Finland, Greece, Ireland, and Portugal present an overall amount of public sector outstanding debt below the \$100 billion level, while The Netherlands entire amount of outstanding public debt is between \$100 and \$200 billions.

participate in a market, the more liquid a market will be. This self-fulfilling nature of liquidity is also outlined by Plantin (2003)<sup>8</sup>.

#### **4. Domestic and international risk factors explaining adjusted yield spreads.**

Once the dependent variable ( $ASPREAD_{it}$ ) that allows to separate the liquidity and credit risk components from expected exchange-rate depreciation has been defined, a decomposition between the liquidity premium and the credit-risk component is attempted by modelling their behaviour to a number of factors that potentially only affect one of them. This will be the objective of the first specification that will be presented, which will only include domestic risk factors. It will be a static panel estimation where the credit rating will be used to identify differences in default risk, and both the bid/ask spread (a proxy of market tightness) and relative debt levels (a proxy of market depth) will be the variables used to control for market liquidity.

Nevertheless, following the short literature on this topic, the analysis will also build on findings on the empirical literature on sovereign bonds spreads on emerging markets, according to which spreads are also sensitive to international risk factors (mainly US risk factors and interest rates). Therefore, a second specification<sup>9</sup> will be presented. It will be a dynamic model estimated separately for each euro-country (credit risk differences will be captured by relative debt-to-GDP ratio, market liquidity differences by both the bid/ask spreads differentials and the on-the run/off the run spreads differentials, and international risk factors by the spread between 10-year fixed interest rates on US swaps and the yield on 10-year US bonds)<sup>10</sup>. Then, the results of the two specifications will be compared in order to analyse the effects of the introduction of international risk factors in the model.

With regard to domestic risk factors, a crucial issue in this paper is the identification of the two main domestic sources of risk that compose yield spreads since the start of Monetary Integration: (1) differences in credit risk and (2) differences in market liquidity, which, on the other hand, are crucial for policymaking.

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<sup>8</sup> The central intuition of his model is that liquidity is self-fulfilling because deals creates positive externalities by increasing the depth of the secondary market, and thus the price of a future resale.

<sup>9</sup> Even though the specification is based on Codogno, Favero and Missale (2003), there are some important differences though. First, the models do not control for the same variables. Second, their sample period for the daily estimation spans only the 2002 year (which is not included in the analysis presented in this paper). Third, their liquidity variables have been drawn from MTS, so they only correspond to the trading activity that takes place in that electronic platform rather than in the whole euro-securities' market. Consequently, the results can hardly be compared.

<sup>10</sup> A dynamic panel estimation with the same variables has also been estimated but the results do not provide relevant information and are not reported in the paper.

Therefore, a first point will be to assess whether EMU has increased credit risk by denying governments the emergency exit of money creation and by forbidding both the ECB and the EU to bail out troubled governments or if, conversely, the maximum threshold that countries have for both their budget deficit and level of public indebtedness (resulting in broad improvements in budgetary balances) has actually resulted in a decrease in perceived credit risk. With this goal, in the first specification the credit rating will be used as a proxy to measure differences in credit risk. This variable presents the advantage over other measures, such as the debt-to-GDP ratio, that it potentially affects the creditworthiness of the governments but not the liquidity of their public debt issues. It then seems the right variable to be used in the first specification where the relative level of indebtedness is used as a proxy of market depth. Conversely, the debt-to-GDP ratio will be used as a proxy to measure differences in credit risk in the second specification, where other variables rather than the relative level of indebtedness will control for market liquidity. The debt-to-GDP ratio might be a better proxy to capture default risk (ratings present the problem that they might be ex-post measures of fiscal sustainability) and it has been broadly used in the literature by other authors (Bayoumi, Goldstein and Woglom (1995) among them)<sup>11</sup>.

Secondly, the introduction of the euro reduced some segmentation among euro-area government bond markets. The exchange risk removal tumbled an important barrier that previously fostered somehow captive domestic markets and might partially explain the home bias that existed in cross-border investments in the European Union (Adjaouté et al. (2000) document the extent of the home bias, both in the bond and in the equities' markets, for the major European countries --the UK, France, Germany, Spain, the Netherlands, and Italy-- during the period 1980-1999)<sup>12</sup>. The increased degree of sovereign securities' substitutability since the EMU intensified the competition between sovereign issuers to attract investors as since then they competed much more closely for the same pool of funding. With this more competitive scenario in which the Monetary Union resulted, market liquidity differences might have become a more relevant component of yield spreads. This is the second point that will be assessed in this study.

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<sup>11</sup> In particular, these authors find support for the market discipline hypothesis in the U.S. bond markets. This hypothesis assumes that yields rise smoothly at an increasing rate with the level of borrowing. However, if these incentives prove ineffective, credit markets will eventually respond by denying the irresponsible borrower further access to credit. Nevertheless, the model presented in this paper and Bayoumi et al. model do not control for the same variables and cannot be compared.

<sup>12</sup> They document that the United Kingdom held the highest share of foreign assets on total financial wealth (24%), whereas Spain had the smallest share of foreign assets (5%), and the Netherlands, Germany and Italy had a share of foreign assets around 17%. Moreover, as expected, for bill and bonds, the level of diversification was substantial only for banks in the UK, France and the Netherlands, i.e. the countries where intermediaries played an important role as market-makers in the eurobond markets. These results are consistent with Tesar and Werner (1995), who present evidence on long-term international investment patterns in Canada, Germany, Japan, the UK, and the US during the 1970-1990. At the beginning of the 1990s, the UK led the former sample in international portfolio diversification, with foreign security holdings of 32%, compared with 10% in Germany.

Because market liquidity is an elusive concept, the definition provided by the Bank for International Settlements (1999) is presented. They define “a liquid market as a market where participants can rapidly execute a large volume of transactions with a small impact on prices<sup>13</sup>”. In the two specifications that will be presented, three proxy variables will be used to measure this effect: (i) the bid/ask spread (in both of them), (ii) the overall outstanding volume of sovereign debt (in the first one), and (iii) the on-the run/off-the run spread (in the second).

*(i) The bid/ask spread.*

This variable is often used as a measure of liquidity because it reflects the cost incurred by a typical investor to unwind an asset position and measures one of the most important dimensions of liquidity: tightness, i.e. how far transaction prices differ from mid-market prices. Additionally, the liquidity of an asset is generally understood as the ease of its conversion into money. Therefore, because the conversion of an asset into money involves certain costs (searching costs, delays, broker’s commissions, etc...), the higher these costs, the lower the degree of liquidity. It is important to note that as far as market dealers reduce their liquidity risk, the bid/ask spread should narrow with trading activity.

*(ii) The overall outstanding volume of sovereign debt.*

The overall outstanding volume of sovereign debt is frequently used as a measure of liquidity because big size markets may present low information costs because of the fact that their securities are likely to trade frequently and a relative large number of investors may own or have analysed their features. It can therefore be used as a proxy of market depth<sup>14</sup>. In this sense, Inoue (1999) outlines that in G10 countries, the larger the outstanding stock of publicly issued central government debt, generally the higher the turnover in cash and futures trading. And the higher the turnover, the better the liquidity, as measured by the bid/ask spread of benchmark 10-year securities. Besides, it does exist a high correlation between the size of the overall government debt market and the size of the bonds issued by one market. The bigger the size of the market the easier to offer bond issues of a bigger size. Therefore, as it has not been possible

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<sup>13</sup> Likewise, they point out that the usual approach is to consider market liquidity according to at least one of three possible dimensions: tightness, depth and resiliency. *Tightness* is how far transaction prices diverge from mid-market prices, and can generally be measured by the bid/ask spread. *Depth* denotes either the volume of trades possible without affecting prevailing market prices, or the amount of orders on the order books of market makers at a given time. *Resiliency* refers to the speed with which price fluctuations resulting from trades are dissipated, or the speed with which imbalances in order flows are adjusted. However, other measures, though they do not directly coincide with these three dimensions, are often regarded as readily observable proxies of market liquidity: the number and volume of trades, trade frequency, turnover ratio, price volatility, the number of market participants, the yield spread between the “on the run” and the “off the run” issues, the outstanding volume of a specific security, or the overall outstanding volume of securities traded in one market, among them.

<sup>14</sup> Bernoth , Von Hagen and Schuknecht (2004) also use the ratio of the total debt of the issuer country over the total debt of the EU as a measure of liquidity.

to carry out the empirical analysis with real debt issue volume data that exactly match the spreads, we will work under the assumption that bond issue volumes are highly correlated with the overall government-issuer debt market size. Moreover, some literature emphasizes this idea that it might be a trade-off between the size of the whole market and its liquidity which, on the other hand, would present a self-fulfilling nature (McCauley and Remolona (2000), Economides and Siow (1988), Plantin (2003) or Martin and Rey (2004)).

*(iii) The on-the run/off-the run spread.*

The yield spread between more and less liquid securities is also a liquidity measure used in the Treasury market (see Fleming, 2003). Since liquidity has value, more liquid securities tend to have higher prices (lower yields) than less liquid securities. The yield spread is often calculated as the difference between the yield of an off-the run (older securities of a given maturity) and that of an on-the run (benchmark) security with similar cash-flows characteristics. Positive spreads indicate that on-the run securities are trading at a yield discount (or price premium) to off-the run securities. This spread provides insight into the value of liquidity not provided by other measures.

To sum up, the three described variables will be used in our models to control for market liquidity and to the best of our knowledge a daily dataset for two of the most important measures of liquidity, the bid/ask spreads and on-the run/off-the run yield differentials, that corresponds to the trading activity that takes place in the whole euro-securities' market, has not been used so far in an empirical analysis. However, for the sake of fairness, it has to be noted that measuring the liquidity premium still remains a difficult issue because market liquidity and credit risk interact with each other. The lack of liquidity amplifies the effect of risk. This is because liquidity variables, such as the bid-ask spread, reflect the risk borne by market makers in managing unbalanced positions. As credit risk increases so does the risk they face. A (credit-related) flight-to-quality argument might also be used to interpret the significance of the on-the run/off-the run differentials<sup>15</sup>. It goes without saying that the relative level of indebtedness can also be used as a proxy to control for credit or default risk. In these circumstances, the results of the analysis should then be taken with some prudence. All the more so the empirical evidence qualifies market liquidity rather than default or international risk as the main force that might have driven the observed changes in adjusted spreads.

Lastly, a third point that will be assessed in this paper is the relevance of international risk factors on yield spreads. Hence, the analysis will also build on the findings of some recent works according to which yields spreads on eurozone

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<sup>15</sup> See Vayanos (2004) among others.

government securities are sensitive to international risk factors. Their results are in concordance to the empirical literature on sovereign bonds spreads in emerging markets which shows that yields on US government bonds/ or the slope of the US yield curve are the main determinants of sovereign spreads. The spread between 10-year fixed interest rates on US swaps and the yield on 10-year US bonds is the variable that will be used to control for global risk. Then, the importance of domestic factors (credit risk and market liquidity) will be assessed by testing whether the impact of exogenous international factors depends on local fiscal fundamentals or market liquidity differences. Even though domestic factors will also enter in the model in a linear form.

## 5. Data description.

As it has been defined in section 2 the dependent variable is  $ASPREAD_{it}$ , i.e. the difference between the total yield differential of 10-year government bonds and the 10-year interest rate swap differential. The sample is composed by daily data that span January 1, 1996 to December 31, 2001. Yields and swap rates are obtained from Datastream and correspond to the “on the run” (benchmark) 10-year issue for each market at every moment of time. They are quoted rates at market close. Datastream creates continuous yield series by taking the yield from the current benchmark in each market and using this to update a separate time series. As a benchmark changes, data are taken from a new stock on the first day of the month. Table 4 presents the starting benchmark dates used by Datastream as well as the characteristics of the different benchmarks that compose the yield and swap series.

With regard to the credit rating, a scale (see Blanco 2001) has been calculated using both Standard & Poor’s and Moody’s ratings that have been obtained from Bloomberg (see table 3)<sup>16</sup>.

With regard to the bid/ask spreads series, daily time-series have been created by calculating the spread between the bid and ask quotations provided by Bloomberg for the “on the run” (benchmark) 10-year issue for each market at every moment of time, using the same benchmarks and starting dates that Datastream uses to create the 10-year yields and

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<sup>16</sup> While S&P and Moody’s rate debt using different codes, their rating categories can be ordered in comparable levels of risk. For instance, The AAA and AA+ ratings of S&P are equivalent, respectively, to the Moody’s Aaa and Aa1 ratings. Taking into account this fact, debt has been included in categories 1, 3, 5, 7 and 9 if it is equivalently rated by both agencies, corresponding respectively, to the first, second, third, fourth, and fifth-best rate levels. Categories 2, 4, 6 and 8 include debt that is not equivalently rated by these agencies, but that only differ by just one level (category 2 includes debt rated in the first level by one agency and in the second by the other). And categories 3, 5, 7 and 9 also include debt that is not equivalently rated by these agencies, but that differ in two levels (category 3 would include debt rated in the first level by one agency and in the third by the other).

swap rates series and that are indicated in table 4. Bloomberg provides for all the different issues daily quoted prices calculated as the average bid and ask quotations at the close.

A similar methodology has been implemented to build the on-the run/off-the run spreads daily time-series. These series have been created by calculating the differences between the “on the run” (benchmark) 10-year issue and the “off the run” (immediately older security) 10-year issue yields provided by Bloomberg for each market at every moment of time, also using the same benchmarks and starting dates that Datastream uses to create the 10-year yields and swap rates series (see table 4).

The overall outstanding amounts of public debt data have been drawn from the Bank for International Settlements (BIS; see table 2) and the GDP from Eurostat (the Central Statistics Office in the case of Ireland). However, as these series are only provided with quarterly frequency, both for the construction of the relative level of indebtedness and the relative debt-to-GDP ratio daily time-series, the rest of the data has been extrapolated assuming a daily constant rate of increase of those volumes, which on the other hand, present very slight differences within countries throughout the studied period. For this reason, it can be assumed that the extrapolation will not produce important biases on the data and can be applied in this case.

And finally, the spread between the 10-year fixed interest rates on US swaps and the yield on 10-year US bonds,  $USSPREAD_{it}$ , has been calculated from daily data obtained from Datastream.

All the variables included in the estimation that capture domestic risk factors (i.e., except  $USSPREAD_{it}$ ) are in relative terms to the German ones, as our dependant variable ( $ASPREAD_{it}$ ) is the difference between the total yield differential and the swap differential of country  $i$  over Germany. Therefore,  $BIDASKDIF_{it}$  is the difference between the bid/ask spread in country  $i$  and the bid/ask spread in Germany,  $ONOFFDIF_{it}$  is the difference between the on the run /off the run spread in country  $i$  and that in Germany,  $OUTDEBTRAT_{it}$  is the ratio of the overall outstanding amount of sovereign debt in country  $i$  to the overall amount in Germany,  $LNDEBTGDP_{it}$  is the (log) deviation of country  $i$  debt-to-GDP ratio from Germany’s debt-to-GDP ratio and  $RATINGDIF_{it}$  is the difference between the rating scale value of country  $i$  and that of Germany.

The sample spans January 1996 to December 2001. Hence, it has been considered the same extension, 3 years, both for the pre-EMU and the EMU period. Finally, as previously indicated, all the EMU countries except Luxembourg and Greece have been included in the estimations, thus the analysis will include 9 countries or groups.

## 6. Modelling adjusted yield spreads behaviour.

### 6.1. Static panel model with domestic risk factors.

As in our earlier paper (Gómez-Puig, 2003), the first specification will only include variables controlling for domestic risk factors. The main objective of this analysis will be to study if there had been a change in the price assigned by markets to the two main sources of domestic risk (credit risk and/ or market liquidity) since the beginning of the Currency Union that could explain the observed adjusted yield spreads rise. Therefore, this specification will be a static panel estimation where, in addition to the variables already mentioned, country dummy variables and monthly dummy variables will be introduced, in order to capture the potential existence of both specific features by countries and temporal effects. With regard to temporal effects they could actually be the consequence of the existence of exogenous or international risk factors which have not been introduced directly in the model. Besides, as the goal is to analyse if the marginal effect of the different variables varies with the beginning of the EMU, it will also be introduced a dummy (*DPRE*) that takes the value 1 in the pre-EMU period (and 0, otherwise), and the coefficients of the interactions between this dummy and the rest of variables will be calculated. Finally, in order to assess if there exists a varying relationship between the relative debt levels and the yield  $ASPREADS_{it}$  (if liquidity is self-fulfilling, relative indebtedness levels and yield spreads might present a negative non-linear relationship, i.e. a bigger market might lead to an increasingly lower liquidity premium) a quadratic specification for the variable  $OUTDEBTRAT_{it}$ <sup>17</sup> will be formulated.

Therefore the estimated model will be:

$$y_{it} = \alpha_i + \beta X_{it} + \gamma DPRE_{it} + \delta MONTHLYDUMMIES_t + \lambda COUNTRYDUMMIES_i + \varepsilon_{it} \quad (5)$$

where previously defined:

$$OUTDEBTRAT2_{it} = (OUTDEBTRAT_{it})^2$$

the independent variables vector will be:

$$X_{it} = (BIDASKDIF_{it}, OUTDEBTRAT_{it}, OUTDEBTRAT2_{it}, RATINGDIF_{it})^{18} \quad (6)$$

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<sup>17</sup> The model has also been estimated with a cubic formulation. However, the estimated coefficients for this variable were not significant in the EMU period and very small in the pre-EMU. For this reason, they are not presented in the paper.

<sup>18</sup> In the case of the variable  $RATINGDIF_{it}$ , because the numerical values that have been assigned to the agencies' ratings are arbitrary, the model has also been estimated with some transformations of this variable: a quadratic, a square root, a logarithm, and an exponential form. However, the results were very similar in all cases.



In addition,

$$\beta = \beta_1 + \beta_2 DPRE_{it} \quad (7)$$

therefore, the marginal effect of a variable will be:

$$\beta = \beta_1 \text{ (in the EMU period), and}$$

$$\beta = \beta_1 + \beta_2 \text{ (in the pre-EMU)}$$

## ***6.2. Dynamic regression models with both domestic and international factors.***

The second specification will present several differences compared to the previous one. Firstly, as some aspects of both credit risk and market liquidity do not change over the period considered, the objective will be to identify the relative importance of liquidity and default premiums in explaining fluctuations, rather than levels of yield differentials. With this aim a lag of the dependent variable will be introduced in the model, which will allow for a slow dynamic adjustment to a long-term equilibrium value of the variable  $ASPREAD_{it}$ . Secondly, this specification will control for both international and domestic risk factors. Lastly, it will be implemented separately for each one of the 9 euro participating countries that are included in the sample.

The international risk variable that allows adjusted spreads to be explained in terms of exogenous risk premiums (specifically, banking risk premiums in the United States),  $USSPREAD_{it}$ , appears in the regression both linearly, and interacted with the domestic risk variables:  $LNDEBTGDP_{it}$ ,  $ONOFFDIF_{it}$  and  $BIDASKDIF_{it}$ . This captures the idea that international risk affects adjusted yield differentials because Eurozone government bonds are imperfect substitutes, either because of differences in market liquidity or in default risk. Therefore, the interaction term identifies changes in adjusted spreads that can be entirely attributed to domestic risk differentials. However, the linear term is also necessary, as international factors might affect the adjusted yield spread either because of “structural” differences in market liquidity or differences in non-varying unobservable fundamentals, such as the reputation of the issuing governments.

On the other hand, the independent effect of domestic risk variables on adjusted spreads is also controlled by entering these variables ( $LNDEBTGDP_{it}$ ,  $ONOFFDIF_{it}$  and  $BIDASKDIF_{it}$ ) linearly in the regressions.

Finally, as in the previous specification, in order to analyse if the marginal effect of the different variables varies with the start of the EMU, it will also be introduced a dummy ( $DPRE$ ) that takes the value 1 in the pre-EMU period (and 0, otherwise), and the coefficients of the interactions between this dummy and the rest of variables will be calculated.

Therefore, the following empirical model on daily data will be implemented separately for each of the 9 countries that compose the sample:

$$y_{it} = \alpha_i + \beta X_{it} + \gamma DPRE_{it} + \varepsilon_{it} \quad (8)$$

where previously defined the international ( $IRV_{it}$ ) and domestic risk variables ( $DRV_{it}$ ):

$$IRV_{it} = USSPREAD_{it} \quad (9)$$

$$DRV_{it} = LNDEBTGDP_{it}, ONOFFDIF_{it} \text{ and } BIDASKDIF_{it} \quad (10)$$

the independent variables vector will be:

$$X_{it} = (y_{it-1}, IRV_{it}, DRV_{it}, DRV_{it} * IRV_{it}) \quad (11)$$

In addition,

$$\beta = \beta_1 + \beta_2 DPRE_{it} \quad (7)$$

hence, the marginal effect of a variable will be:

$$\beta = \beta_1 \text{ (in the EMU period), and}$$

$$\beta = \beta_1 + \beta_2 \text{ (in the pre-EMU)}$$

## 7. Results.

The estimation methods used in both specifications, Feasible Generalized Least Squares (FGLS) in the static panel estimation and a regression with Newey-West standard errors in the dynamic estimations for each euro-country, are robust to the possible existence of autocorrelation and heterocedasticity in the error terms.

The results of both specifications are highly consistent and provide evidence that market size scale economies might have increased with the Currency Union and that this increase might be higher the smaller (and potentially more illiquid) the debt market is. A change in the market assessment of liquidity rather than default or international risk might be behind the observed increase in adjusted spreads with Monetary Integration, even though the effect differs according to the size of the market.

Tables 5 and 6 present respectively the values and standard errors of the estimated coefficients that correspond to the first and second specification. For each exogenous variable, these tables display the corresponding marginal effects for the EMU period ( $\beta_1$ ) and the pre-EMU ( $\beta_1 + \beta_2$ ) that have been calculated from the estimated coefficient values.

In particular, table 5 presents the results for the static panel estimation that only accounts for domestic risk factors. Because of their extension, the coefficients of the monthly dummy variables are not presented, although they are significant except for the periods: Feb-96, Apr-99, Dec-99/Jan-00, and Dec-01. These results support the idea of a possible omission in the model of a common exogenous variable (a international/ global risk variable, for instance) to which adjusted spreads might be sensitive. With regard to the country dummies, as it is shown, they are all significant at the 5 percent confidence level except in the case of Austria (where it is significant at the 10 percent though). Therefore, specific factors in every different country are relevant, which means that a separate estimation for each of them (as it will be implemented in the second specification) might provide wider information.

The main conclusions that can be drawn from table 5 are that a change in the market assessment of liquidity measured by both the bid/ask spreads and relative market size levels, rather than credit risk, could be the factor behind the adjusted spreads rise in the EMU period. In particular, the results support the existence of a positive relationship in the case of the bid/ask spreads and a negative non-linear relationship between relative debt levels and adjusted spreads. In both cases, the marginal effect has been accentuated with the EMU.

More precisely, even though the results support the idea that government securities adjusted yield differentials do carry a credit risk premium to compensate investors for bearing default risk, it does not increase with the Monetary Integration. Conversely, with regard to the variables that capture market liquidity, the bid/ ask spread marginal impact is not only positively significant in both periods, but it also rises in the EMU period. In the case of the relative level of indebtedness, the results do support the existence of a negative non-linear relationship in both periods. Adjusted spreads decrease at an increasing rate with market size, i.e. a bigger market leads to an increasingly lower liquidity premium (which would be consistent with the self-fulfilling theory about market liquidity). Moreover, the negative marginal impact of relative debt level on adjusted spreads rises in absolute terms with the Currency Union, even though this increase is bigger the smaller (and potentially more illiquid) the market is. Therefore, especially for small markets, market size scale economies seem to have risen with the Monetary Union. Actually, after January 1999 (see figure 3 and table 1b) the adjusted spread over 10-year German bonds has increased in all countries (the average increase was 11.98 basis points), and table 2 shows that with an average market share of 22.05%, the German market is the second biggest in the euro-area, surpassed only by the Italian. Hence, an improvement of relative German market liquidity might be behind the adjusted spreads changes. In fact, the countries with a larger debt market relative to Germany (Italy, France and Spain) are the ones that have experienced the lowest rise in their adjusted spread with the introduction of the euro

(see table 1b)<sup>19</sup>. Actually, other authors as Bernoth, von Hagen and Schuknecht (2004) also outline that after the start of EMU it can be observed that German government bond yields are still below those of bonds issued by governments with much better debt positions. In their opinion, the fact that German bonds enjoy a yield advantage compared to others may be due to the size of the German bond market and the fact that German bonds can be traded immediately at lower transaction costs and with a smaller risk of price changes due to individual transactions<sup>20</sup>, which seems to support our conclusions.

On the other hand, with regard to the dynamic specification including both international and domestic risk variables, the results presented in table 6 show that the introduction of global risk variables in the model do not change the leading role of market liquidity in explaining adjusted spreads changes. It is important to note though that, default risk marginal impact (both in the linear form or when it is interacted with international risk) increases in some countries in the EMU period. However, it is puzzling that the rise occurs in countries that do not have a specially high debt-to GDP ratio but that do have a small-size debt market (the Netherlands, Ireland and Portugal).

In particular, the main conclusions of the second specification are a general higher significance of the different variables in the countries with a smaller debt market size. This would be consistent with the results of the previous specification according to which the increase in market size scale economies with the Monetary Union are bigger the smaller the debt market is. Besides, it would also be in concordance with the fact that the three countries that account for around the 70% of the euro-area government securities markets (Italy, France and Spain) are precisely the ones that have experienced the lowest adjusted spread rise with the Monetary Integration. In this sense, the removal of the exchange rate barrier would have penalised small countries, which have been forced to compete with major in terms of liquidity, having to offer only bond issues of a smallest size. On the other hand, even though they are relevant, international risk factors appear less significant than local risk factors in explaining adjusted spreads changes. In addition, default risk only seems to be relevant when it is accompanied by a small market size. In this sense, in Italy, although its very high debt-to-GDP ratio, the associated default risk might be compensated by the increased liquidity that a big market supposes. Therefore, the relevance of market liquidity indicators and, in particular, the importance of market size in the explanatory power degree of the different risk variables is reinforced with these results. All the countries that present an

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<sup>19</sup> According to these results market liquidity rather than relative supply might be the force that drives the relationship between relative indebtedness levels and adjusted spreads in the euro-area countries.

<sup>20</sup> In addition, these authors also conclude that countries whose national debt has a larger share in total EU debt pay lower interest rates than EU countries with smaller shares.

increase in the marginal impact of one of the market liquidity proxies in the EMU period have small-size government debt markets. It is the case of the Netherlands or Ireland where the marginal effect of the bid/ ask spread (the most straight measure of liquidity) has increased, or of Austria and Finland (where the on the run/off the run spread marginal impact has risen with the Currency Union).

In particular, from the second specification the following facts are worthy of remark. Firstly, a substantial decrease in the significance of the lag dependent variable (which captures the structural aspects of both credit risk and market liquidity) in the EMU period, except in countries that present a high debt-to-GDP ratio relative to Germany. Actually, the effect remains unchanged in the case of Belgium and Ireland, while it rises for Spain and Italy. Therefore, with the Currency Union, adjusted spreads are, in general, less sensitive to structural differences in market liquidity or credit risk, except in the countries (but Ireland<sup>21</sup>) where there are more chances that debt sustainability becomes a problem. With regard to the international risk variable, it turns out to be significant only in the case of the smallest debt markets (the potentially more illiquid markets, see McCauley and Remolona, 2000): Austria, Finland, Ireland and the Netherlands. Moreover, in the case of the smallest market, Ireland, the significance has increased. In the three other countries, even though still significant, its significance has decreased with the Currency Union. These facts might imply that the smaller the market the more sensitive it is to global risk factors, even though, in general, the explanatory power of international risk factors has decreased with the Monetary Integration. We should then look at domestic risk variables in order to find the reasons behind the adjusted spreads rise observed with the EMU.

Hence, secondly, with regard to the relative debt-to-GDP variable (a proxy of default risk), it is not significant in the EMU period for the countries with the higher relative debt ratio: Belgium, Italy, France, Austria and Spain. These markets (but Austria) also have a big market size relative to Germany. For the four other countries, the significance has remained unchanged in the case of Finland, whereas it has decreased in the case of Ireland and the Netherlands. Only in the case of Portugal the marginal effect increases with the EMU (with a 10 percent confidence level though). For the variables that control for market liquidity, the following results have been obtained. The relative spread between the on-the run and the off-the run yields only presents a positive marginal effect on adjusted spreads in the EMU period in the case of Finland and Austria (both of them are small-size debt markets), which has also increased compared to the pre-EMU. Finally, in the case of the bid-ask spread, it presents a positive marginal effect in the EMU period for Austria, Belgium, Ireland, the Netherlands and Portugal. Again, except in the case of Belgium, all of them are small-size debt

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<sup>21</sup> It is important to remark that the results obtained for Ireland must be taken with prudence because for this country the number of available observations is substantially smaller than for the rest of the countries.

markets. Moreover the significance of this variable has increased with the Currency Union in Ireland and the Netherlands.

Thirdly, with regard to the interaction between the international risk variable and the domestic ones (which should identify changes in adjusted yield spreads entirely attributed to differences in default risk or market liquidity), in the case of the interaction with the default risk variable, the marginal effect is significantly positive in the EMU period for Austria, Finland, Ireland and the Netherlands (at the 10 percent confidence level it is also significant for France). Besides, in Ireland and the Netherlands the effect has risen compared with the pre-EMU period. Nevertheless, with respect to the interaction with the market liquidity variables, the marginal effect is significant in some countries, even though always with the wrong sign.

To conclude, the constant (that should capture other factors affecting adjusted yield spreads fluctuations) is only significant at the 5 percent confidence level in the case of Finland, Ireland, the Netherlands and Portugal. Again, the four countries (but the Netherlands) present a debt-to-GDP ratio lower than Germany and a small-size debt market.

## **8. Conclusions.**

Euro-area countries' adjusted spreads over 10-yr German securities experienced an average rise of 11.98 basis points in the first three years after the beginning of the Monetary Union. This fact resulted in a decrease lower than the expected in the costs of borrowing (they actually increased in the case of Austria, Belgium, France and the Netherlands). Therefore, either a change in domestic (market liquidity and/or credit risk) or international risk factors or in the market pricing of them might have occurred with the EMU.

The results of both specifications are highly consistent and provide evidence that market size scale economies seem to have increased with the Currency Union and that this rise is higher the smaller (and potentially more illiquid) the debt market is. In the first specification, the evidence supports the idea that a change in the market assessment of liquidity measured by both the bid/ask spreads and the relative market size levels, rather than credit risk, could be the factor behind the adjusted spreads increase in the EMU period. In particular, the results support the existence of a positive relationship in the case of the bid/ask spreads and a negative non-linear relationship between relative debt levels and adjusted spreads. In both cases, the marginal effect has been accentuated with the EMU.

In the second specification, the empirical evidence also shows, in general, a higher significance of the different variables in the EMU period for the countries with a smaller debt market size. For instance, default risk marginal impact increases in some countries in the EMU period, but which is puzzling is that the rise occurs in countries that do not have a specially high debt-to GDP ratio but that do have a small-size debt market: Portugal, the Netherlands and Ireland. The latter two countries are precisely the ones that also experience a rise in the marginal effect of the bid/ask spread with the EMU, whereas in the case of the other variable that controls for market liquidity, the on-the run/ off-the run spread, its marginal impact only increases in another two small-size debt markets: Austria and Finland. In this same vein, international risk factors are only significant for the smaller debt markets, although their marginal effect do not increase with the common currency (but for Ireland).

Then, even with this necessary caution taken into account the difficulty in measuring liquidity premium because its interaction with credit risk, this empirical evidence, which, on the other hand, is supported by both market participants and member state debt managers beliefs, allows us to claim that the removal of the exchange rate barrier might have implied a change in the market assessment of liquidity rather than default or international risk factors (which only seem to play a smaller role). These facts might be behind the observed increase in adjusted spreads with Monetary Integration. Although the rise differs according to the size of the market. In particular, as the German sovereign debt market is the second-biggest market in the euro-area (only surpassed by the Italian), a concentration of trading activity in the German market might have occurred and, consequently, wider liquidity differences vis-à-vis German bonds might have been translated in higher adjusted spreads. Actually, the countries with a larger debt market relative to Germany (Italy, France and Spain) are the ones that have experienced the lowest increase in their adjusted spread with the introduction of the euro (see table 1b). To conclude, in the actual context of higher competition among euro-area government securities' markets, small-size markets might have been penalised as they now compete much more closely with major markets for the same pool of funding. Therefore, with the introduction of a common currency, euro-area sovereign securities' debt markets success might be limited by the extent of their liquidity and market size.

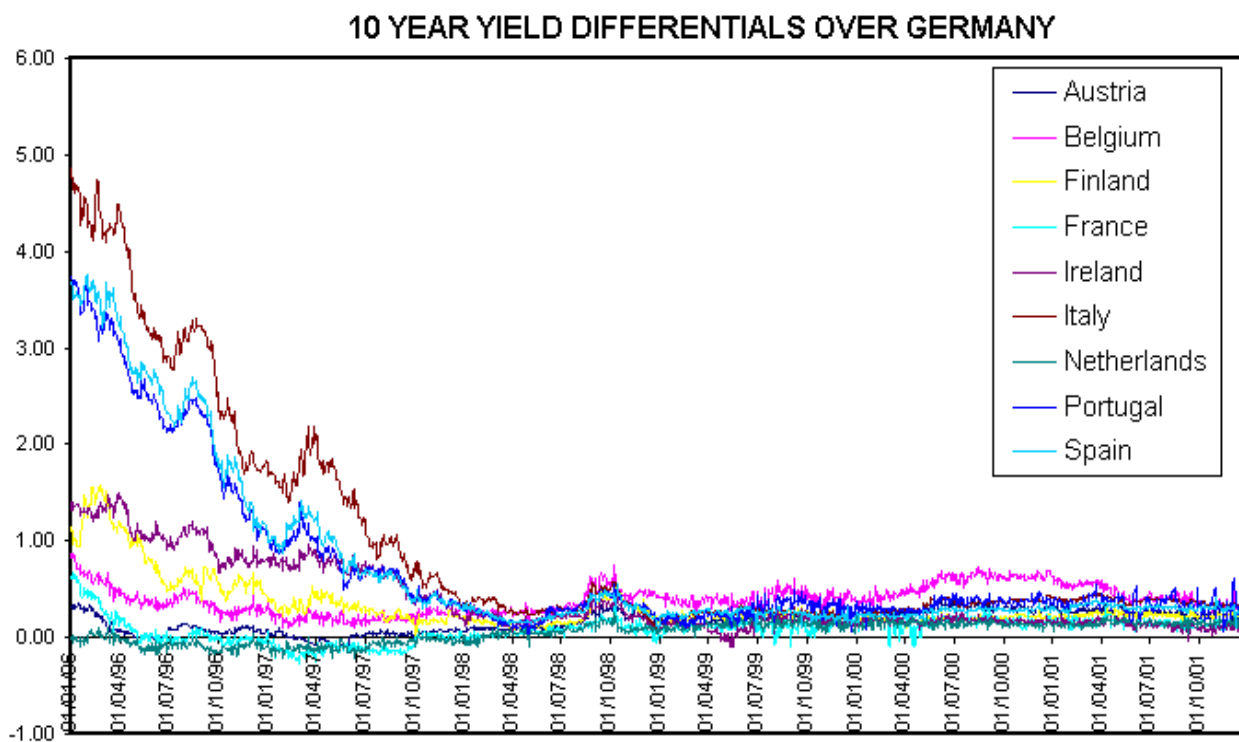
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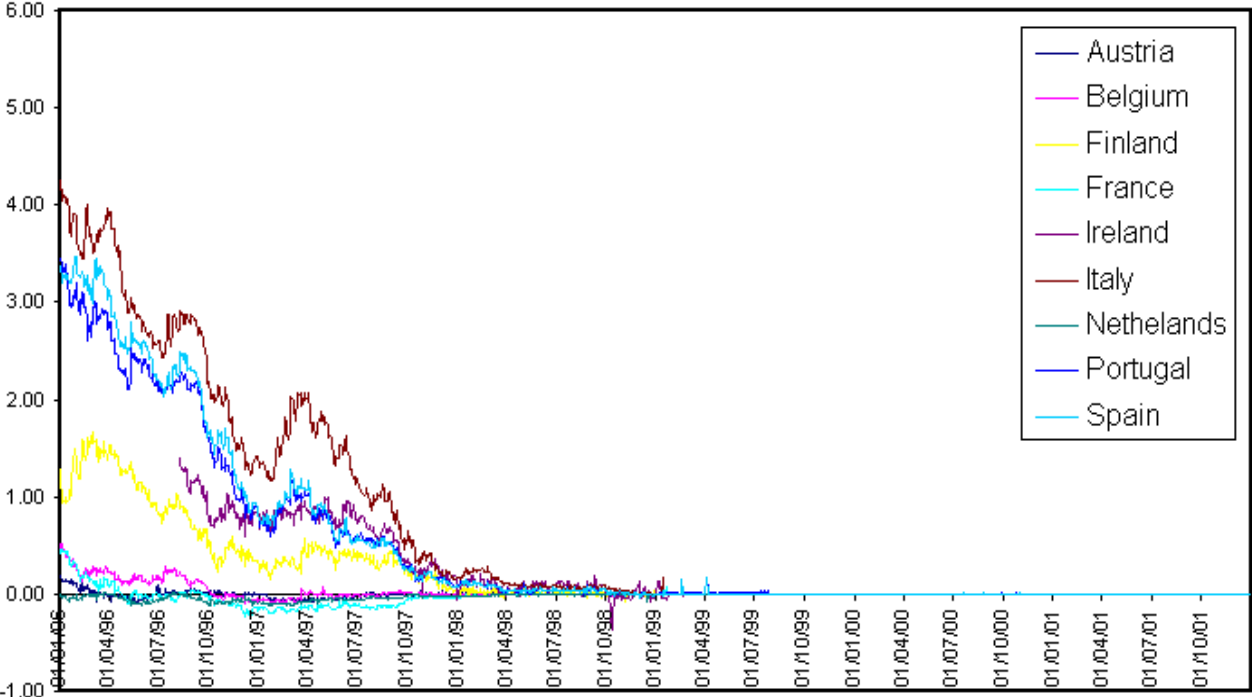
FIGURE 1



NOTE: Yield differential =  $(I_i - I_{DM})$ , where  $I_i$  is the 10-year yield on country  $i$  government bonds and  $I_{DM}$  is the 10-year yield on Germany government bonds.  
Source : Datastream

FIGURE 2

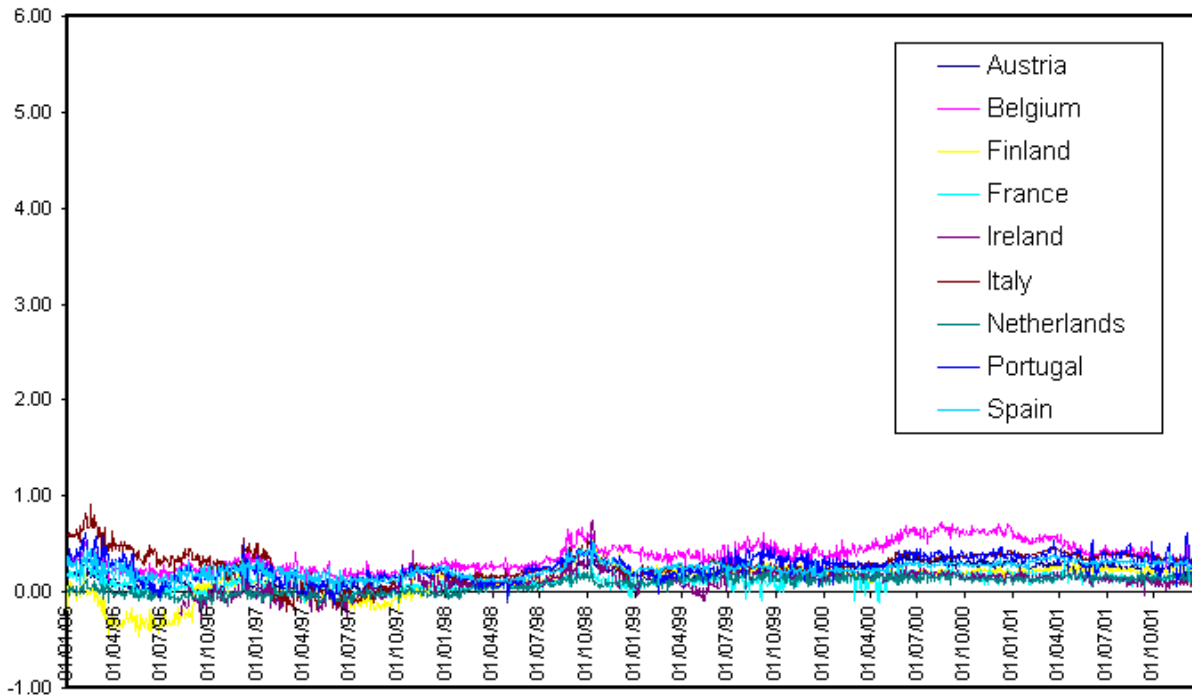
10 YEARS SWAP RATE DIFFERENTIALS OVER GERMANY



NOTE: Swap differential =  $(IRS_i - IRS_{DM})$ , where  $IRS_i$  is the 10-year interest rate swap of currency  $i$  and  $IRS_{DM}$  is the 10-year interest rate swap of the D-mark.  
Source :Datastream

FIGURE 3

10 YEARS ADJUSTED YIELD SPREADS OVER GERMANY



NOTE: Adjusted yield spread = Yield differential – Swap differential =  $(I_i - I_{DM}) - (IRS_i - IRS_{DM})$ . Source: Datastream.

TABLE 1a

	PRE-EMU (1996-1998)			EMU (1999-2001)		
	$(I_i - I_{DM})$	$(IRS_i - IRS_{DM})$	$ASPREAD_i$	$(I_i - I_{DM})$	$(IRS_i - IRS_{DM})$	$ASPREAD_i$
	(1)	(2)	(3)=(1)-(2)	(4)	(5)	(6)=(4)-(5)
AT	9.07	-0.33	9.40	24.42	-0.01	24.43
BE	33.06	4.29	28.77	46.30	-0.01	46.31
FI	43.56	41.31	2.25	21.95	-0.01	21.96
FR	2.97	-3.10	6.07	14.05	0.00	14.05
IE	50.52	43.84	6.68	14.78	0.00	14.78
IT	157.73	133.04	24.69	32.32	0.05	32.27
NL	-2.70	-3.52	0.83	14.22	-0.01	14.23
PT	111.73	91.42	20.31	31.85	0.22	31.63
SP	118.06	97.99	20.07	27.24	0.04	27.20
<b>Average</b>	<b>58.22</b>	<b>44.99</b>	<b>13.23</b>	<b>25.24</b>	<b>0.03</b>	<b>25.21</b>
St.dev.	57.48	51.37	10.33	10.66	0.08	10.64

TABLE 1b

Differences between EMU and pre-EMU		
	$(I_i - I_{DM})$	$ASPREAD_i$
	(4)-(1)	(6)-(3)
AT	15.34	15.03
BE	13.24	17.53
FI	-21.61	19.71
FR	11.08	7.98
IE	-35.74	8.10
IT	-125.40	7.58
NL	16.92	13.40
PT	-79.88	11.31
SP	-90.82	7.13
<b>Average</b>	<b>-32.99</b>	<b>11.98</b>
St.dev.	53.77	4.69

NOTE: AT: Austria, BE: Belgium, FI: Finland, FR: France, IE: Ireland, IT: Italy, NL: The Netherlands, PT: Portugal, SP: Spain. Source: Datastream.

$(I_i - I_{DM})$  = 10-year yield difference over Germany

$(IRS_i - IRS_{DM})$  = 10-year interest rate swap difference over Germany

$ASPREAD_i = (I_i - I_{DM}) - (IRS_i - IRS_{DM})$

TABLE 2

DOMESTIC DEBT SECURITIES PUBLIC SECTOR AMOUNTS OUTSTANDING (Billions of euros)									
	1995-12	1996-12	1997-12	1998-12	1999-12	2000-12	2001-12	average	% over EMU
Ireland	19.93	23.20	23.12	21.93	24.73	24.07	19.95	23.15	0.69
Portugal	35.19	36.47	32.84	34.04	37.49	42.35	45.61	37.67	1.13
Finland	33.20	38.15	41.56	44.28	45.60	47.70	46.28	43.39	1.30
Austria	57.04	58.95	63.87	69.28	86.05	99.74	100.52	76.80	2.30
Greece	64.10	79.58	84.47	84.80	88.43	96.73	102.20	87.23	2.62
Netherlands	155.64	159.89	159.68	170.12	178.14	180.98	177.50	171.44	5.14
Belgium	228.86	230.59	228.41	229.67	231.85	246.18	248.66	236.75	7.10
Spain	211.07	241.63	259.63	272.41	287.34	311.04	299.43	269.56	8.09
France	497.35	536.05	565.50	623.91	639.85	708.45	709.23	614.79	18.45
Germany	676.53	682.74	699.45	738.75	767.35	816.77	790.81	734.97	22.05
Italy	896.49	1022.19	1011.08	1037.09	1042.62	1088.36	1056.96	1036.69	31.11
EMU	2875.40	3109.45	3169.63	3326.27	3429.43	3662.37	3597.15	3332.43	100.00

Source: Bank for International Settlements.

TABLE 3

S&P	Moody's	Rating Scale
AAA	Aaa	1
AAA	Aa1	2
AA+	Aaa	2
AAA	Aa2	3
AA+	Aa1	3
AA	Aaa	3
AA+	Aa2	4
AA	Aa1	4
AA+	Aa3	5
AA	Aa2	5
AA-	Aa1	5
AA	Aa3	6
AA-	Aa2	6
AA	A1	7
AA-	Aa3	7
A+	Aa2	7
AA-	A1	8
A+	Aa3	8
AA-	A2	9
A+	A1	9
A	Aa3	9

NOTE: AT: Austria, BE: Belgium, FI: Finland, FR: France, GE: German, IE: Ireland, IT: Italy, NL: The Netherlands, PT: Portugal, SP: Spain. Source: Bloomberg for S&P and Moody's Ratings. Rating scale inspired in Blanco (2001).

TABLE 4

	Starting date as a benchmark	Name	Coupon	Maturity date
<b>AUSTRIA</b>				
	Dec-95	OESTERREICH	1995 6.5%	17/11/05
	Mar-96	OESTERREICH	1996 6.125%	09/02/06
	Jul-96	OESTERREICH	1996 6.25%	31/05/06
	Nov-96	OESTERREICH	1996 5.875%	15/07/06
	Feb-97	OESTERREICH	1997 5.625%	17/01/07
	Jun-97	OESTERREICH	1997 5 3/4%	11/04/07
	Sep-97	OESTERREICH	1997 5 5/8%	15/07/07
	Feb-98	OESTERREICH	1998 5%	15/01/08
	Apr-99	OESTERREICH	1999 4%	15/07/09
	Dec-99	OESTERREICH	1999 5 1/2%	15/01/10
	May-01	OESTERREICH	2001 5 1/4%	04/01/11
<b>BELGIUM</b>				
	Feb-95	BELGIUM OLO	1994 6.5%	31/03/05
	Mar-96	BELGIUM OLO	1995 7%	15/05/06
	Jan-97	BELGIUM OLO	1996 6 1/4%	28/03/07
	Dec-97	BELGIUM OLO	1997 5 3/4%	28/03/08
	Feb-99	BELGIUM OLO	1999 3 3/4%	28/03/09
	Feb-00	BELGIUM OLO	2000 5 3/4%	28/09/10
	May-01	BELGIUM OLO	2001 5%	28/09/11
<b>FINLAND</b>				
	Jul-93	FINLAND	1993 9 1/2%	15/03/04
	Sep-96	FINLAND	1996 7 1/4%	18/04/06
	Dec-97	FINLAND	1997 6%	25/04/08
	Dec-98	FINLAND	1998 5%	25/04/09
	Feb-00	FINLAND	2000 5 3/4%	23/02/11
<b>FRANCE</b>				
	Aug-95	OAT FRANCE	1995 7 3/4%	25/10/05
	Feb-96	OAT FRANCE	1995 7.25%	25/04/06
	Oct-96	OAT FRANCE	1995 6.50%	25/10/06
	Apr-97	OAT FRANCE	1996 5.5%	25/04/07
	Oct-97	OAT FRANCE	1997 5.5%	25/10/07
	Mar-98	OAT FRANCE	1998 5.25%	25/04/08
	Nov-98	OAT FRANCE	1998 8.5%	25/10/08
	Jan-99	OAT FRANCE	1998 4%	25/04/09
	Jul-99	OAT FRANCE	1999 4%	25/10/09
	Mar-00	OAT FRANCE	2000 5.5%	25/04/10
	Sep-00	OAT FRANCE	2000 5.5%	25/10/10
	Jun-01	OAT FRANCE	2001 6.5%	25/04/01
<b>GERMANY</b>				
	Nov-95	BUNDESREPUB.DTL	1995 6 1/2%	14/10/05
	Feb-96	BUNDESREPUB.DTL	1996 6%	05/01/06
	Mar-96	BUNDESREPUB.DTL	1996 6%	16/02/06
	Jun-96	BUNDESREPUB.DTL	1996 6 1/4%	26/04/06
	Feb-97	BUNDESREPUB.DTL	1997 6%	04/01/07
	May-97	BUNDESREPUB.DTL	1997 6%	04/07/07
	Feb-98	BUNDESREPUB.DTL	1998 5 1/4%	04/01/08
	Aug-98	BUNDESREPUB.DTL	1998 4 3/4%	04/07/08
	Feb-99	BUNDESREPUB.DTL	1999 3 3/4%	04/01/09
	Apr-99	BUNDESREPUB.DTL	1999 4%	04/07/09
	Aug-99	BUNDESREPUB.DTL	1999 4 1/2%	04/07/09
	Nov-99	BUNDESREPUB.DTL	1999 5 3/8%	04/01/10
	Jun-00	BUNDESREPUB.DTL	2000 5 1/4%	04/07/10
	Dec-00	BUNDESREPUB.DTL	2000 5 1/4%	04/01/11
	Jun-01	BUNDESREPUB.DTL	2001 5%	04/07/11

TABLE 4 (Continuation)

<b>IRELAND</b>				
	Jun-95	IRISH TRSY.	8%	18/08/06
	Oct-97	IRISH TRSY.	6%	18/08/08
	Jul-99	IRISH TRSY.	4%	18/04/10
<b>ITALY</b>				
	Sep-95	BTP ITALY	1996 10 1/2%	01/09/05
	Jun-96	BTP ITALY	1996 9 1/2%	01/02/06
	Nov-96	BTP ITALY	1996 8 3/4%	01/07/06
	Feb-97	BTP ITALY	1997 6 3/4%	01/02/07
	Oct-97	BTP ITALY	1997 6 3/4%	01/07/07
	Feb-98	BTP ITALY	1997 6%	01/11/07
	Jul-98	BTP ITALY	1998 5%	01/05/08
	Jan-99	BTP ITALY	1998 4 1/2%	01/05/09
	Oct-99	BTP ITALY	1999 4 1/4%	01/11/09
	Jul-00	BTP ITALY	2000 5 1/2%	01/11/10
	Jun-01	BTP ITALY	2001 5 1/4%	01/08/11
<b>NETHERLANDS</b>				
	Dec-95	NEDERLAND	1995 6 3/4%	15/11/05
	Feb-96	NEDERLAND	1995 6%	15/01/06
	Feb-97	NEDERLAND	1997 5 3/4%	15/02/07
	Feb-98	NEDERLAND	1998 5 1/4%	15/07/08
	Feb-99	NEDERLAND	1999 3 3/4%	15/07/09
	Feb-00	NEDERLAND	2000 5 1/2%	15/07/10
	Apr-01	NEDERLAND	2001 5%	15/07/11
<b>PORTUGAL</b>				
	Mar-95	PORTUGAL OT	1995 11 7/8%	23/02/05
	Jul-96	PORTUGAL OT	1996 9.5%	23/02/06
	Mar-97	PORTUGAL OT	1997 6.625%	23/02/07
	Jun-98	PORTUGAL OT	1998 5 3/8%	23/06/08
	Jul-99	PORTUGAL OT	1999 3.95%	15/07/09
	Jun-00	PORTUGAL OT	2000 5.85%	20/05/10
	Apr-01	PORTUGAL OT	2001 5.15%	15/06/11
<b>SPAIN</b>				
	Dec-95	OBLIGACION ESTADO	1995 10.15%	31/01/06
	Oct-96	OBLIGACION ESTADO	1996 8.8%	30/04/06
	Feb-97	OBLIGACION ESTADO	1996 7.35%	31/03/07
	Nov-97	OBLIGACION ESTADO	1997 6%	31/01/08
	Jan-99	OBLIGACION ESTADO	1998 5.15%	30/07/09
	Jan-00	OBLIGACION ESTADO	1999 4.0%	31/01/10
	Feb-01	OBLIGACION ESTADO	2000 5.4%	30/07/11
	Oct-01	OBLIGACION ESTADO	2001 5.35%	31/10/11

Source: Datastream



TABLE 5

Cross-Sectional Time-Serie FGLS Regression, with country dummies			
Sample: Pre-EMU: 1996:01-1998:12			
EMU: 1999:01-2001:12			
dependent variable: <i>ASPREAD</i>			
	EMU COUNTRIES		
$X_{it}$	$B_1 (X_{it})$	$B_2 (DPRE_{it} * X_{it})$	$B_1 + B_2$
	$B(EMU)$		$B(preEMU)$
<i>BIDASKDIF<sub>it</sub></i>	0.167** (0.020)	-0.064** (0.024)	0.103**
<i>OUTDEBTRAT<sub>it</sub></i>	-0.320** (0.059)	0.096** (0.012)	-0.225**
<i>OUTDEBTRAT2<sub>it</sub></i>	-0.130** (0.038)	-0.024** (0.009)	-0.154**
<i>RATINGDIF<sub>it</sub></i>	0.014** (0.002)	0.005** (0.001)	0.019**
	$\lambda_i$		
<i>DAUSTRIA</i>	0.014* (0.008)		
<i>DBELGIUM</i>	0.109** (0.014)		
<i>DFINLAND</i>	-0.065** (0.005)		
<i>DFRANCE</i>	0.246** (0.026)		
<i>DIRELAND</i>	-0.107** (0.006)		
<i>DITALY</i>	0.688** (0.037)		
<i>DNETHERLANDS</i>	-0.037** (0.012)		
<i>DSPAIN</i>	0.110** (0.015)		
	$\gamma$		
<i>DPRE<sub>it</sub></i>	-0.045** (0.006)		
	$\alpha$		
<i>CONSTANT</i>	0.230** (0.009)		
Number of observations =	12928		
Number of groups =	9		
Avg obs per group =	1440.56		
Log likelihood =	25386.52		
Wald chi2 =	50894.2		
Prob > chi2 =	0.00		

\*\*Significant at 5 percent confidence level.

\*Significant at 10 percent confidence level.

Standard Errors within parentheses

TABLE 6

Regression with Newey-West Standard Errors									
Sample: Pre-EMU: 1996:01-1998:12									
EMU: 1999:01-2001:12									
dependent variable: <i>ASPREAD</i>									
	AUSTRIA			BELGIUM			FINLAND		
$X_t$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$
	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$
<i>ASPREAD</i> <sub>t-1</sub>	0.620** (0.043)	0.208** (0.054)	0.828**	0.713** (0.029)	-0.050 (0.053)	0.713**	0.508** (0.039)	0.292** (0.050)	0.800**
<i>USSPREAD</i> <sub>t</sub>	0.060** (0.025)	0.110** (0.048)	0.170**	0.137 (0.371)	0.770 (0.624)	-	0.040** (0.019)	0.173** (0.081)	0.213**
<i>LNDEBTGDP</i> <sub>t</sub>	-0.103 (0.109)	-0.693** (0.274)	-0.693**	-0.068 (0.363)	0.299 (0.437)	-	-0.471** (0.168)	0.398 (1.326)	-0.471**
<i>ONOFFDIF</i> <sub>t</sub>	0.407* (0.221)	-0.424* (0.262)	-0.017*	-0.145 (0.209)	0.101 (0.251)	-	0.475** (0.162)	-0.399** (0.183)	0.076**
<i>BIDASKDIF</i> <sub>t</sub>	0.485* (0.268)	-0.430 (0.401)	0.485*	0.540** (0.198)	0.324 (0.500)	0.540**	0.261 (0.170)	0.261 (0.170)	-
<i>LNDEBTGDP</i> <sub>t</sub> * <i>USSPREAD</i> <sub>t</sub>	0.293** (0.132)	1.244** (0.529)	1.538**	-0.087 (0.399)	-0.714 (0.641)	-	0.614** (0.203)	0.234 (3.023)	0.614**
<i>ONOFFDIF</i> <sub>t</sub> * <i>USSPREAD</i> <sub>t</sub>	-0.543** (0.236)	0.733* (0.440)	0.190*	0.026 (0.229)	-0.410 (0.375)	-	-0.702** (0.184)	0.234 (3.022)	-0.702**
<i>BIDASKDIF</i> <sub>t</sub> * <i>USSPREAD</i> <sub>t</sub>	-0.596** (0.297)	0.420 (0.761)	-0.596**	-0.695** (0.229)	-0.678 (1.063)	-0.695**	-0.287* (0.160)	0.641** (0.269)	0.354*
	$\gamma$			$\gamma$			$\gamma$		
<i>DPRE</i> <sub>t</sub>	-0.094** (0.029)			-0.324 (0.418)			-0.166** (0.040)		
	$\alpha$			$\alpha$			$\alpha$		
CONSTANT	0.018 (0.019)			0.108 (0.339)			0.083** (0.020)		
Number of obs	1481			1491			1311		
F =	F(17,1463) = 1813.43			F(17,1473) = 1333.43			F(17,1293) = 422.05		
Prob > F =	0.00			0.00			0.00		

\*\*Significant at 5 percent confidence level.

\*Significant at 10 percent confidence level.

Standard Errors within parentheses

TABLE 6 (Continuation)

$X_t$	FRANCE			IRELAND			ITALY		
	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$
	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$
$ASPREAD_{t-1}$	0.453** (0.045)	0.205** (0.056)	0.658**	0.615** (0.073)	-0.119 (0.087)	0.615**	0.919** (0.028)	-0.083* (0.045)	0.836*
$USSPREAD_t$	-0.188 (0.138)	-0.050 (0.261)	-	0.840** (0.307)	-1.140** (0.358)	-0.300**	0.160 (0.156)	1.418* (0.861)	1.418*
$LNDEBTGDP_t$	-0.914 (0.572)	-0.317 (0.756)	-	-1.103** (0.438)	1.036** (0.462)	-0.068**	0.083 (0.151)	0.891** (0.394)	0.891**
$ONOFFDIF_t$	0.150 (0.430)	-0.194 (0.499)	-	0.320 (0.414)	-1.573** (0.478)	-1.573**	-0.044 (0.232)	0.179 (0.256)	-
$BIDASKDIF_t$	-0.533* (0.312)	1.851** (0.477)	1.318*	3.488** (1.168)	-3.493** (1.302)	-0.004**	0.091 (0.158)	-0.136 (0.184)	-
$LNDEBTGDP_t * USSPREAD_t$	1.224* (0.641)	-0.004 (1.282)	1.224*	1.224** (0.500)	-1.187** (0.594)	0.037**	-0.178 (0.180)	-1.413 (0.905)	-
$ONOFFDIF_t * USSPREAD_t$	-0.277 (0.492)	0.864 (0.703)	-	-0.276 (0.378)	2.824** (0.648)	2.824**	0.061 (0.219)	0.148 (0.375)	-
$BIDASKDIF_t * USSPREAD_t$	0.264 (0.317)	-3.155** (0.849)	-3.155**	-0.416** (0.126)	4.883** (1.537)	4.467**	-0.086 (0.171)	0.293 (0.287)	-
	$\gamma$			$\gamma$			$\gamma$		
$DPRE_t$	0.029 (0.159)			0.889** (0.282)			-0.874** (0.371)		
	$\alpha$			$\alpha$			$\alpha$		
<b>CONSTANT</b>	0.211* (0.128)			-0.690** (0.270)			-0.049 (0.130)		
<b>Number of obs</b>	1478			582			1489		
<b>F =</b>	F(17,1460) = 260.39			F(17,564) = 106.83			F(17,1471) = 1191.19		
<b>Prob &gt; F =</b>	0.00			0.00			0.00		

\*\*Significant at 5 percent confidence level.

\*Significant at 10 percent confidence level.

Standard Errors within parentheses

TABLE 6 (Continuation)

$X_t$	NETHERLANDS			PORTUGAL			SPAIN		
	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$	$\beta_1(X_t)$	$\beta_2(DPRE_t * X_t)$	$\beta_1 + \beta_2$
	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$	$\beta(EMU)$		$\beta(pre-EMU)$
$ASPREAD_{t-1}$	0.217** (0.040)	0.270** (0.059)	0.487**	0.563** (0.043)	0.259 (0.054)	0.822**	0.771** (0.043)	-0.199** (0.059)	0.571**
$USSPREAD_t$	-0.171** (0.030)	0.311** (0.154)	0.140**	0.021 (0.067)	0.070 (0.113)	-	-0.035 (0.110)	-0.365 (0.264)	-
$LNDEBTGDP_t$	-0.855** (0.174)	1.141** (0.349)	0.286**	1.264** (0.507)	-1.055* (0.550)	0.209*	-0.326 (0.438)	-0.502 (0.626)	-
$ONOFFDIF_t$	-0.182 (0.336)	-0.443 (0.417)	-	0.329 (0.213)	-0.416 (0.307)	-	0.094 (0.194)	-0.711** (0.312)	-0.711**
$BIDASKDIF_t$	0.520** (0.254)	-0.443** (0.268)	0.077**	0.435** (0.158)	0.830 (1.170)	0.435**	0.007 (0.139)	0.200 (0.274)	-
$LNDEBTGDP_t * USSPREAD_t$	0.988** (0.196)	-1.302** (0.622)	-0.315**	-0.890 (0.572)	0.743 (0.766)	-	0.188 (0.520)	1.215 (1.026)	-
$ONOFFDIF_t * USSPREAD_t$	0.053 (0.363)	1.553** (0.650)	1.553**	-0.678** (0.236)	0.876 (0.553)	-0.678**	0.011 (0.211)	1.247** (0.507)	1.247**
$BIDASKDIF_t * USSPREAD_t$	-0.423* (0.257)	0.076 (0.346)	-0.423*	-0.364** (0.147)	-3.046 (2.728)	-0.364**	-0.007 (0.130)	0.000 (0.000)	-
	$\gamma$			$\gamma$			$\gamma$		
$DPRE_t$	-0.374** (0.089)			-0.180** (0.070)			0.187 (0.154)		
	$\alpha$			$\alpha$			$\alpha$		
CONSTANT	0.265** (0.029)			0.172** (0.058)			0.126 (0.096)		
Number of obs	1490			1323			1494		
F =	F(17,1472) = 507.92			F(17,1305) = 384.66			F(17,1476) = 326.17		
Prob > F =	0.00			0.00			0.00		

\*\*Significant at 5 percent confidence level.

\*Significant at 10 percent confidence level.

Standard Errors within parentheses