DOCUMENTS DE TREBALL
DE LA FACULTAT DE CIÈNCIES
ECONÒMIQUES I EMPRESARIALS

Col·lecció d'Economia

The Impact of Monetary Union on EU-15 Sovereign Debt Yield Spreads

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* The backbone of this paper was written while I was a Visiting Scholar at the Economics Department of the Massachusetts Institute of Technology (September 2000-August 2002). I would like to thank MIT Economics Department for their hospitality, the Spanish Ministry of Education for their financial support, and both Campe Goodman and Analistas Financieros Internacionales S.A. who kindly provided part of the data used in the empirical analysis. I am grateful to Rudi Dornbusch, Roberto Rigobon, and all the participants at the International Breakfast Workshop at MIT for their useful comments on a very preliminary draft. Special thanks to Jordi Galí and Jaume Ventura, for their insightful comments. I alone am responsible for any errors remaining in the final version.

Abstract

With European Monetary Union (EMU), there was an increase in the adjusted spreads (corrected from the foreign exchange risk) of euro participating countries' sovereign securities over Germany and a decrease in those of non-euro countries. The objective of this paper is to study the reasons for this result, and in particular, whether the change in the price assigned by markets was due to domestic factors such as credit risk and/or market liquidity, or to international risk factors. The empirical evidence suggests that market size scale economies have increased since EMU for all European markets, so the effect of the various risk factors, even though it differs between euro and non-euro countries, is always dependent on the size of the market.

JEL Classification Numbers: E44, F36, G15.

Keywords: Monetary integration, sovereign securities markets, international and domestic credit risk, and market liquidity.

Introduction.

Before the introduction of the euro, yield differentials between European sovereign borrowers were mostly determined by four factors: expectations of exchange rate fluctuations, differences in domestic tax-regimes, differences in credit risk, and differences in market liquidity. The introduction of a common currency in twelve countries in January 1999 and the elimination (or reduction to insignificant levels) of differences in tax treatment during the 1990s eliminated two of these factors in euro-participating countries, and paved the way for a much more integrated and competitive public debt market. As a result, euro-area government bond markets began to be considered as a single market, comparable in terms of size to the US or Japan. Nevertheless, segmentation did not disappear completely. In 2005, public debt management is still decentralised under the responsibility of 12 sovereign issuers with differences in rating and a variety of issuing techniques (see Favero, Missale and Piga, 1999). These are features that distinguish the euro-area debt market from its US and Japanese counterparts. One example of this segmentation is the persistence of yield differentials. This paper sets out to examine this persistence and to explore what happened to both euro and non-euro countries' yield spreads on government bonds after the introduction of the euro.

Therefore, we extend the analysis presented in Gómez-Puig (2004) and Gómez-Puig (2005) to the European Union countries that did not participate in the EMU- Denmark Sweden, and the United Kingdom - in order to compare the results with those we obtained for the participant countries. We will see that, interestingly, the differences in yield spreads behaviour between periods are much more accentuated for non-participating countries. Since Currency Union, outside the increased substitutability and competition between euro-area markets, non-euro countries seem to have benefited from both a lower assessment of their risk premium by market participants and a higher assessment of their particular "idiosyncrasies" (compared to euro-area countries). This has attracted to their markets investors who wished to reduce their portfolio risk through the diversification of their investments. As a result, these countries present lower than expected borrowing costs.

In our earlier papers, a first point that was assessed was whether EMU had 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 whether, conversely, the maximum threshold that countries had for both their budget deficit and their level of public indebtedness (resulting in broad improvements in budgetary balances) and the possibility that markets do not regard the "no-bail-out" clause as credible, especially in the case of large markets (i.e. that the theory "too big to fail" holds), had actually resulted in a decrease in perceived credit risk. Secondly, the introduction of the euro reduced segmentation between euro-area government bond markets. The removal of the exchange rate risk brought down an important barrier that fostered captive domestic markets and had gone some way to explaining the home bias that existed in cross-border investments in the European Union. Adjaouté et al. (2000) traced the extent of the home bias, in both the bond and equities markets, for the major European countries – the UK, France, Germany, Spain, the Netherlands, and Italy – during the period 1980-1999[1]. The increased substitutability of sovereign securities after EMU intensified the rivalry between sovereign issuers to attract investors, since they were competing directly for the same pool of funding. In this new scenario, market liquidity differences may have become a more significant component of yield spreads. This was the second point that we assessed in our earlier studies. Nevertheless, as the literature on this topic is limited, our analysis also built on findings in the empirical literature regarding sovereign bond yield spreads on emerging markets, which suggested that spreads

[1] They report that the United Kingdom held the highest share of foreign assets as a function of total financial wealth (24%); Spain had the smallest (5%), and the Netherlands, Germany and Italy had shares around 17%. Moreover, as expected, for bills 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 period. At the beginning of the 1990s, the UK led this sample in international portfolio diversification, with foreign security holdings of 32% (compared with 10% in Germany).

were also sensitive to international risk factors, mainly US risk factors and interest rates (see Codogno, Favero and Missale, 2003).

Therefore, the analysis in this paper will also be threefold: first, we break down non-euro yield spreads into their two main domestic components (market liquidity and credit risk differences) not related to exchange risk (we need to make this adjustment in order to have homogeneous series for non-euro and euro participating countries in which exchange risk was removed in 1999). Second, we examine whether there was a change in the price assigned to them by markets after the introduction of the euro which might explain the observed yield spread behaviour. Third, we will examine the effects of international risk factors on yield differentials. The main goal of the analysis will be to identify the possible factors behind the average decrease of 14.20 basis points (compared to the average increase of 11.98 basis points observed in EMU-countries) in yield spreads during the first three years of Monetary Union, once they are corrected from the exchange rate factor (following Favero, Giavazzi and Spaventa (1997) we will correct pre-EMU spreads by estimating the foreign exchange factor as the differential between the 10 year swap rate in the currency of denomination of the bond and the 10 year swap rate in Deutsche marks)

The sample is composed of daily data from January 1996 to December 2001 (therefore, the same time interval - three years - will be considered for both pre-

EMU and EMU periods) and includes the three EU-15 countries that preferred to stay out of the European Monetary Union: Denmark, Sweden and the United Kingdom.

We will present the results of two different specifications which are the ones that presented the highest explanatory power in our previous studies, as one important goal of this paper is to compare the results of the analysis with those obtained for euro-countries (Gómez-Puig, 2004 and 2005). Therefore we will first implement (I) a static panel regression[2], and (II) a static regression for each individual country with the same explanatory variables as in the panel estimation. The relative debt-to-GDP ratio will be used to identify differences in default risk, while two different variables will be used to capture market liquidity: the bid/ask spread (a proxy of market tightness) and on-the-run/off-the-run differentials (a complementary measure of market liquidity). Finally, the spread between 10-year fixed interest rates on US swaps and the yield on 10-year Moody's Seasoned AAA US corporate bonds is introduced in the model as a proxy of international risk factors. To the best of our knowledge, no empirical analysis to date has used a daily dataset for two of the most important measures of liquidity, the bid/ask

[2] In our earlier papers, we estimated a dynamic model but the introduction of a lag of the dependent variable did not improve the results.

spreads and the on-the run/off-the run yield differentials, corresponding to the trading activity in the whole of the EU-15 securities market.

The empirical evidence shows that the relevance of international risk factors in explaining the observed change in adjusted spreads is larger in non-euro participating countries than in euro-area countries. The fact that these countries kept their Monetary Autonomy might explain this greater vulnerability to external risk factors. However, the results of all the specifications are highly consistent, providing evidence that in all European markets (both euro and non-euro participants) market size scale economies increased with Currency Union and that the rise was higher in smaller debt markets. Hence, they suggest that the removal of the exchange rate barrier might have penalised EMU small markets twice. First, within the euro-area, the German market could have concentrated the majority of the trading activity, and in the current context of increased competition between these markets, their relative success might be dependent on their size. And, second, outside the euro-area, the Currency Union has enhanced the "singularity" of the debt markets because their securities are still denominated in their own currency. In particular, the British market, which before EMU not only was one of the most important European debt markets, but also was the European market that held the highest share of foreign assets as a function of total financial wealth (See Adjaouté et al. 2001 or Tesar and Werner 2005), is surely the one that has capitalised most on this new advantage and has attracted a significant volume of funds.

The rest of the paper is organised as follows: Section 2 explains the foreign exchange correction applied in the pre-EMU period. Section 3 outlines evidence concerning Monetary Integration in Europe and the evolution of the relative cost of borrowing in EU-15 countries. Section 4 focuses on the various domestic and international factors to which adjusted spreads might be sensitive, and describes the data. Section 5 explains the models and estimation methodology. Section 6 reports the results. Lastly, section 7 draws conclusions.

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

As discussed by Favero et al. (1997) a direct measure of the component of yield differentials not related to exchange rate factors can be obtained by comparing the yields of assets issued by two different states in two different currencies (say, one in Spanish pesetas, the other in D-marks) and the yield spreads in the same currencies and with the same life to maturity issued by the same (non-government) subject, or by two otherwise comparable issuers (in the second case, apart from the exchange rate risk, other factors influencing yield spreads can then be ignored when differences are taken). 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.

However, on balance, the drawbacks of the interest differential on supranational issues or corporate issues seem to be greater. So though not a perfect measure, the spread on fixed interest rate swap contracts can 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 a popular vehicle used 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 (which is denominated in the same currency), meaning that the default risk of the underlying asset is not translated 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 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 the first at the same intervals a floating amount of interest on the notional principal calculated according to a floating-rate index[3]. IRS are liquidated by differences, "cash-flow

[3] In this paper, the 6-month money Libor rate (in the respective currency) in non-euro participating countries, and Libor rate before the EMU and the Euribor after its implementation in euro-participating countries.

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[4]. IRS usually present a spread over the on-the-run government bond yield at the same maturity, and their price basically accounts for the counterparty credit risk, the 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[5]. Hence, the swap rate differential is an appropriate measure for capturing the exchange-rate change component of yield spreads.

[4] I.e. if a 10-year Spanish Peseta IRS is 11.50-11.60, this means that one should pay a fixed interest rate of 11.60% in exchange for the six-month Spanish Peseta Libor in the euro-market, or the six-month Libor in order to receive a fixed rate of 11.50%.

[5] With regard to the counterparty credit risk, not only are most of the participants present in the different currency segments of the underlying swap market (the euro-deposit market) the same, but also the counterparty credit risk associated with 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 with the floating leg of the swap contract (the six-month Libor rate). However, because market risk is usually highly correlated within euro-currency 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 that 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 biased downward. However, the data (see table 1) show an increase in the yield spread in the EMU period for some euro-countries in which the swap differential was not significant in the pre-EMU period. This is the case of Austria, Belgium, France and the Netherlands. This finding 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 use of the swap rate differential as an appropriate measure for capturing the exchange-rate change component of yield spreads.

So we denominate:

$I_{i,10}$ = 10-year Yield on sovereign bonds of country *i*
$IRS_{i,10}$= 10-year 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 1990s:

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

$DR_{i,10}$ = 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:

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

Then, approximating:

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

and building up the variable "*$ADJUSTED\ SPREAD_{it}$*", as the difference between the total yield differential and the swap rate differential,

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

it can be inferred that the variable $ASPREAD_{it}$, which will be used as the dependent variable, will mainly account for credit risk and market liquidity differences[6]of country *i*'s sovereign securities over Germany. So, this variable could be considered an appropriate indicator of yield differential components not related to exchange rate factors.

3. Monetary integration and the relative cost of borrowing in EU-15: Some evidence.

The aforementioned elimination of two of the main components of yield differentials prompted a substantial convergence in total yield differentials over 10-year German bond yields during the period January 1999-December 2001 in EMU-participating countries. This is shown in table 1: the average spread over German yields decreased from 58.22 to 25.24 basis points. Nevertheless, convergence only implied a sizeable reduction in the relative borrowing costs for the countries that presented wider spreads, lower rating and higher foreign exchange risk: that is, Italy, Spain, Portugal, and to a lesser extent 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

[6] We are not considering the effect of international risk factors in this breakdown

16.92 basis points, on average, respectively, see table 2). To sum up, while average gross yield spreads (relative to Germany) declined after EMU, they rose in 4 of the 9 countries[7]. Moreover, what is really puzzling is that once adjusted for the swap differential, spreads rose for all 9 countries with Currency Union. The average value is 25.21 basis points in the EMU period compared with 13.23 basis points before EMU (see tables 1 and 2).

However, if we analyse the spread behaviour of non-EMU participating countries in the first three years since the introduction of the euro we observe huge differences. Figure 1 shows that, for non-euro participating countries as well, total yield differentials have converged since Monetary Union. Therefore, on average, non-euro countries have experienced a decrease in their borrowing costs since the euro. However, the spread reduction is more than twice that registered by euro-countries (32.99 basis points on average). In particular, the average spread over German yields decreased by 73.06 basis points, from 100.81 in the pre-EMU period to 27.75 in the EMU period (see table 1) in the three non-euro countries as a whole. On the other hand, the swap differential behaviour clearly differs. The different pattern that it already showed before the euro (see figure 2) has been accentuated after Currency Union and the close convergence to zero of swap differentials among euro-countries. Hence, the temporal evolution of the adjusted

[7] The previous analysis for EMU-participating countries did not include Greece and Luxembourg

spread presents a completely different picture for non-euro countries after January 1999 (see figure 3) and its average value has also decreased: 14.20 basis points on average between the two periods. Actually, it decreases in Sweden (12.20 basis points) and the United Kingdom (30.70) while it experiences a slight increase in Denmark (0.31 basis points), the non-euro country with the smallest debt-market (see table 3).

Therefore, in a context of higher integration between European markets, the countries that did not join Monetary Union, and thus did not experience an increase in their degree of substitutability and competition with the German securities, seem to have benefited from that fact in terms of an important decrease in their risk premium over Germany (not related to exchange rate factors), which has resulted in lower borrowing costs. The main goal of this paper will be to find an explanation for these decreasing yield spreads.

One possible explanation, which is supported by the beliefs of both market participants and member state debt managers, could be that in the current context of increased competition between euro-area government securities markets their success might be limited by the extent of their liquidity and market size. Specifically, on the one hand, as the German sovereign debt market is the second largest 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 into higher adjusted spreads in EMU-participating countries[8]. Nevertheless, on the other hand, the British sovereign debt market not only is the fourth largest in the European Union-15 area (see table 3) but, since Monetary Integration, has also benefited from a new advantage over euro-area debt markets because its debt is still denominated in a different currency which allows portfolio diversification and risk reduction. Therefore, since EMU the British market might have capitalised on its role as the main competitor to the German market, and might have attracted funds from those investors who wished to reduce their risk by investing in a market that still permits portfolio diversification. Consequently, with the euro the small-size euro-area debt markets might have been twice penalised. First, within the euro-area, the German market could have concentrated the majority of the trading activity. And, second, outside the euro-area, the enhanced British market might have attracted a significant volume of funds due to its "renewed" singularity.

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, meaning 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

[8] The existence of a very liquid futures bond market in Germany also represents an additional advantage of holding German bonds.

market effect in the new trade and geography literatures (Helpman and Krugman, 1985). As in the trade literature, these effects come from the combination of imperfect substitution and transaction costs. McCauley and Remolona (2000) note that if substantial fixed costs are involved in the production of information about the future path of interest rates, the size of the whole debt market matters. They calculate that there may be a size threshold around $100-200 billions; below this level, they state that sustaining a liquid government market may not be easy. Table 3 shows that while in the euro-area only five countries (Italy, Germany, France, Spain and Belgium) surpassed that threshold, in the non-euro-area two countries did (Sweden and the United Kingdom) and the third (Denmark) came close[9]. Economides and Siow (1988) point out that there may be a trade-off between liquidity and market size: the smaller the market, the lower the outstanding volume traded in it. Therefore, the more difficult it will 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 (which will present lower price volatility, bigger scale economies and higher probability of a favourable match) to small and illiquid markets.

[9] Within the euro-area: 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. Outside the euro-area: only Denmark presents an amount slightly below the $100 billion level.

Consequently, liquidity will be "self-reinforcing": since traders prefer to participate in liquid markets, more traders will participate in them, and more liquid they will be. This self-fulfilling nature of liquidity is also outlined by Plantin (2003)

On the other hand, in a scenario in which EMU denies governments the emergency exit of money creation and forbids both the ECB and the EU to bail out troubled governments, another possible explanation for the observed rise in adjusted spreads in euro-area countries could be a high degree of credibility for the "no-bail-out" clause. Consequently, it is vital to assess whether the too big to fail theory (TBTF), taken from the banking system[10], might also hold in sovereign debt markets; if it does apply, the removal of the exchange rate barrier would have punished smaller countries by making them pay both a higher liquidity and higher default risk premium than large ones. In this regard, in the banking system, as Kaufman (2002) and Goodhart and Huang (2005) point out, the TBTF theory

[10] Too big to fail (TBTF) is a term frequently used in banking to describe how bank regulators may deal with severely financially troubled banks. The term came into common usage in 1984, when the regulators were faced with the economically insolvent Continental Illinois National in Chicago, which was both the seventh largest bank in the country at the time and the largest correspondent bank having interbank deposit and Fed funds relationships with more than 2,200 other banks. The federal regulators did not legally close the bank and protected all uninsured depositors and creditors against loss. In addition, at least initially, the old shareholders were not ousted. The Continental case was resolved in this way, in part, because the regulators believed that, particularly because of its large size and broad interconnections with other banks, allowing the bank and/or its parent bank holding company to fail and imposing losses on its uninsured depositors and creditors would have serious, adverse effects on other banks, financial markets, and the macroeconomy (see Kaufman, 2002).

states that adverse shocks from bank failures are perceived to be more strongly and widely felt (the existence of serious contagion and systemic risk makes regulators perceive that widespread devastation could result from a large bank failing) than similar shocks from the failure of non-bank firms of equal size; the larger the bank, the more serious and widespread the damage. Analogously, because adverse macroeconomic shocks and contagion consequences to neighbouring countries are much greater the larger the country's debt market, agents might expect that, beyond a certain threshold size, governments will receive financial support in case of fiscal distress in the form of a bail-out. Consequently, while big countries (both euro and non-euro participating) default risk premium should not change (or may even decrease) with EMU, for small countries (whose public debt market does not reach the threshold size), agents might expect the "no-bail-out" rule to hold. So, their default risk should increase with their membership of Monetary Union, since they lose monetary authority.

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

Now that we have defined the dependent variable ($ASPREAD_{it}$) which allows separation of the liquidity and credit risk components from expected exchange-rate depreciation, a decomposition between the liquidity premium and the credit-risk component is attempted by modelling their behaviour to a number of factors that potentially affect only one of them.

With regard to domestic risk factors, a crucial issue in this paper (and one that is vital for policymaking) is the identification of the two main domestic sources of risk that have made up yield spreads in euro-participating countries since the start of Monetary Integration: (1) differences in credit risk and (2) differences in market liquidity, in order to assess whether their impact over yield spreads has changed with the common currency in the whole European Union-15 countries. With this goal in mind, the relative debt-to-GDP ratio will be used as a proxy to measure differences in credit risk. This variable has been widely used in the literature by other authors (Bayoumi, Goldstein and Woglom (1995) among them)[11] and presents the advantage over other measures such as the rating differential that it cannot be considered an ex-post measure of fiscal sustainability. Because market liquidity is an elusive concept, we use the definition provided by the Bank for International Settlements (1999): "a liquid market as a market where participants can rapidly execute a large volume of transactions with a small impact on prices[12]". In this paper, two different proxy variables will be used to

[11] 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 irresponsible borrowers 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.

[12] 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

measure this effect: (i) the bid/ask spread and (ii) the on-the run/off-the run spread.

(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 in unwinding 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. Note that as market dealers reduce their liquidity risk, the bid/ask spread should narrow with trading activity.

ii) 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

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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 others.

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-flow 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 an insight into the value of liquidity that other measures do not offer.

To sum up, the two variables described will be used in our models to control for market liquidity. However, for the sake of fairness, it has to be noted that measuring the liquidity premium remains a difficult issue because market liquidity and credit risk interact with each other. The lack of liquidity increases 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[13].

Lastly, a third point that will be assessed in this paper is the influence of international risk factors on yield spreads. Hence, the analysis will also build on

[13] See Vayanos (2004) among others.

the findings of recent work that suggest that yields spreads on government securities are sensitive to international risk factors.

As 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 comprises daily data spanning the period 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 it 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 5 presents the starting benchmark dates used by Datastream as well as the characteristics of the different benchmarks that compose the yield and swap series for non-EMU participating countries.

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 in time, using the same benchmarks and starting dates that Datastream uses to create the 10-year yields and swap rates series (see table 5). For all the different issues Bloomberg provides daily quoted prices calculated as the average bid and ask quotations at the close.

A similar methodology is used to build the on-the-run/off-the-run spread daily time-series. These series were 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 5).

The overall outstanding amounts of public debt data have been drawn from the Bank for International Settlements (BIS; see table 3) and the GDP from Eurostat. However, as these series are only provided with quarterly frequency, for the construction of the relative level of indebtedness and the relative debt-to-GDP ratio daily time-series (see table 4), the rest of the data have been extrapolated assuming a daily constant rate of increase of those volumes, which in fact present very slight differences within countries over the period studied. For this reason, it can be assumed that the extrapolation will not produce important biases in the data and can be applied in this case.

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

All the variables included in the estimation that capture domestic risk factors are in relative terms to the German ones, as our dependent variable ($ASPREAD_{it}$) is the difference between the total yield differential and the swap differential of country *i* over Germany. Thus, $BIDASKDIF_{it}$ 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 and $LNDEBTGDP_{it}$ is the (log) deviation of country *i* debt-to-GDP ratio from Germany's debt-to-GDP ratio.

5. Modelling adjusted yield spread behaviour.

5.1. Static Panel models with both domestic and international factors.

The first specification is a panel regression that includes three groups or countries. In this specification, in addition to the variables already mentioned ($LNDEBTGDP_{it}$, $BIDASKDIF_{it}$,, $ONOFFDIF_{it}$,, and $USSPREAD_{it}$), country and monthly dummy variables will be introduced, as well as a dummy (*DPRE*) that takes the value 1 in the pre-EMU period (and 0, otherwise). 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 liquidity variables and the yield $ASPREADS_{it}$ (if liquidity is self-fulfilling, the proxies of market liquidity might present a non-linear relationship, i.e. a liquid/illiquid market might lead to an increasingly lower/higher liquidity premium) a quadratic specification for the variables $BIDASKDIF_{it}$, and $ONOFFDIF_{it}$ will be formulated. So, with the following defined previously:

$$BIDASKDIF2_{it} = (BIDASKDIF)^2_{it}$$

$$ONOFFDIF2_{it} = (ONOFFDIF)^2_{it}$$

the domestic risk variables (DRV_{it}) will be:

$$DRV_{it}=(LNDEBTGDP_{it}, BIDASKDIF_{it}, BIDASKDIF2_{it}, ONOFFDIF_{it}, ONOFFDIF2_{it}) \qquad (5)$$

While the international risk variables (IRV_{it}) will be:

$$IRV_{it} = USSPREAD_{it} \qquad (6)$$

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) will appear in the regression both linearly and interacting with the domestic risk variables. This captures the idea that international risk affects adjusted yield differentials because European government bonds are imperfect substitutes due to differences in either market liquidity or 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. Hence, the independent effect of domestic risk variables on adjusted spreads is also controlled by entering these variables linearly in the regressions.

Therefore, the first specification will be a panel model with both domestic and international risk variables:

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

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

The vector of independent variables will be:

$$X_{it} = (IRV_{it}, DRV_{it}, DRV_{it} * IRV_{it}) \quad (7)$$

In addition

$$\beta = \beta_1 + \beta_2 DPRE_{it}$$

5.2.. Regressions for each individual country.

In the panel regression above, all country dummies turn out to be significant at the 5 percent confidence level, meaning that specific factors in each different country are relevant and suggesting that a separate estimation for each of them will provide wider information. We will do this in the second set of regressions where, using the same independent variables as in the panel regression, a static estimation will be implemented separately for each of the three non-euro countries in the sample. Therefore, the following empirical model on daily data will be implemented separately for each individual country:

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

Hence, three regressions will be calculated, where the vector of independent variables will be:

$X_{it} = (IRV_{it}, DRV_{it}, DRV_{it} * IRV_{it})$

Obviously, as in the panel regressions, in model II:

$\beta = \beta_1 + \beta_2 DPRE_{it}$

6. Results.

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

Tables 6 and 7 present respectively the values and standard errors of the estimated coefficients corresponding to the first and second specifications, while table 8 presents the results obtained from the second specification when it was estimated for the euro-area countries. For each exogenous variable, these tables allow calculation of the corresponding marginal effects for the EMU period (β_1) and the pre-EMU ($\beta_1 + \beta_2$), from the estimated coefficient values.

In particular, table 6 presents the results for the static panel regression which includes both domestic and international risk factors and, in order to compare the results, also introduces the results obtained from the same panel regression when it was applied to the euro-participating countries. Because of their length, the coefficients of the monthly and the country dummy variables are not presented, although monthly dummies are significant in the majority of the periods. As for the country dummies, all of them are significant. Therefore, specific factors in each different country are relevant, which means that a separate estimation for each of them (as in the second specification) might provide wider information. Specifically, the panel regression for non-euro countries shows that not only does the default risk premium not increase with Currency Union but its marginal impact becomes negative with the euro. Even so, the increase in the EMU period of the marginal impact of the interaction of the default risk proxy with the international risk factor qualifies to some extent the previous results. Actually, what seems to be relevant is the increase in the marginal effect of the international factor which, in addition, is higher than the one we obtained for euro-countries. Finally, with regard to the variables that capture liquidity risk, we should note that the on-the-run/ off-the-run differential not only increases its marginal impact with the euro, but also shows a non-linear behaviour that supports the self-fulfilling behaviour of liquidity.

Conversely, the panel estimation for EMU-countries not only showed that government securities adjusted yield differentials carried a credit risk premium to compensate investors for bearing default risk, but it also registered an increase with Monetary Integration. So, at least for all EMU countries as a whole, the results suggested that the "no-bail-out" was credible: that is, markets expected the EU Commission or the ECB to support financially distressed countries (table 8 will show that this results, however, were less conclusive in the country-specific regressions, where the marginal impact of the default risk variable in the EMU period differed within countries according to the size of their markets) On the other hand, with respect to the variables that were used as proxies of market liquidity, both the bid/ ask spread and the on-the-run/ off-the run marginal impact rose in the EMU period. As mentioned, the international risk factor marginal effect registered a slight increase with the euro, but lower than the one experienced by non-euro participating countries.

Tables 7 and 8 present the results of the country-specific estimations for the non-euro and euro-participating countries respectively, using the same dependent variables as those used in the panel regressions. Consequently, they give more precise information for each specific country and, in fact suggest very interesting results. Table 7 presents the results for non-euro countries: the United Kingdom, Sweden and Denmark. In the case of the British market we should point out that all the explanatory variables used in the regression lose their significance in the EMU period. Therefore, variables other than those used as proxies of domestic risk (default and market liquidity) or international risk must explain the decrease of the 10-year adjusted spread over Germany (30.70 basis points on average) in the EMU period. In our opinion, one possible explanation could be a flight of funds from small euro-area debt markets to the enhanced British debt market which not only is big enough to be liquid by itself, but, since the introduction of the common currency, presents an additional advantage in terms of allowing portfolio diversification, since its securities are not denominated in euros. In the Swedish market we should also mention the decrease in the marginal impact of the default risk variable in the EMU period, in spite of its very high debt-to-GDP ratio (see table 4). Hence, it seems that the default risk might be compensated by its increased liquidity, both because it has a “relevant” size (which could reduce the importance of default risk as long as agents believe that it is “too big to fail”) and because its singularity has increased since Monetary Union. The increase in the significance of the non-linear term of the bid-ask spread since EMU supports the self-fulfilling nature of liquidity (that is, that it increases the more liquid the market is) and is in concordance with the rest of the results. Finally, Denmark, the only non-euro participating country that, even very slightly, has experienced an increase of its adjusted spread over Germany with the euro (0.31 basis points on average) is the one with the smallest debt-market. This seems to support the theory that big markets are the ones that have experienced the most benefits from Monetary Integration. Actually, the marginal impact of the non-linear term of both the bid/ask and the on-the-run/ off-the-run spreads registers an increase in the EMU period when it is interacted with the international risk proxy. This result supports the increasingly nature of illiquidity in the case of a small-debt market such as the Danish market. So, as Economides and Siow (1988) point out, since traders prefer to participate in liquid markets, their transactions will flee from illiquid to more liquid markets, fostering a liquidity trade-off from the small to larger debt markets.

Table 8 presents the results of the same regressions applied to euro-countries. There are some notable differences. First, the variation in the marginal impact of the default risk variable in the EMU period differs, within the euro-area, according to the size of the market. Therefore, while in small markets the marginal effect increases (as in the Netherlands) or remains positive in spite of falling (as in Austria and Finland), in larger and more indebted countries[14] the impact either remains negative (as in Belgium) or becomes negative (as in Italy, Spain and Portugal). These results clearly suggest that the FBTF theory holds in euro-area sovereign debt markets, since they reinforce the relevance of market size in the degree of explanatory power of credit risk variables. In addition, the majority of the countries that present an increase in the marginal effect of one of the market liquidity proxies in the EMU period have either very small or very large government debt markets. For instance, with EMU, the non-linear behaviour of one of the market liquidity variables included in the model (the on-the-run/off-the-run spreads) is particularly notable in two of the smallest (Austria and Finland) and two of the largest markets (France and Spain). Analogously, for the smallest and the biggest debt markets (Ireland and Italy, respectively) the non-linear term of the bid/ask spread has risen since EMU. This non-linear behaviour of market liquidity variables (if they increase/decrease, liquidity premium rises/drops at an increasing rate), especially in small and large debt markets, again supports the idea that liquidity is self-fulfilling. On the other hand, the

[14] During the period 1996-2001 the five EU-15 countries with the larger ratio debt-to-GDP: were Belgium (102.28%), Italy (95.07%), Sweden (54.55%, Denmark (52.80%) and Spain (48.81%) (see table 4).

international risk variable marginal impact (unlike in the panel regression) in the few cases where it is significant becomes negative with the euro. However, when the variable that captures international risk is interacted with the linear term of some market liquidity proxies the marginal impact over adjusted spreads registers a change in the EMU period for some small markets.

7. Conclusions

Non-euro participating countries' adjusted spreads experienced an average decrease of 14.20 basis points with Currency Union. Conversely, euro-area countries' adjusted spreads over 10-year German securities registered an average rise of 11.98 basis points in the first three years of EMU, resulting in a lower than expected decrease in the costs of borrowing (which actually increased in the case of Austria, Belgium, France and the Netherlands). Therefore, in a context of higher integration between European markets, the countries that did not join Monetary Union, and thus did not experience an increase in their degree of substitutability and competition with German securities, seem to have benefited from that fact, in the shape of an important decrease in their risk premium that has resulted in lower borrowing costs. However, while in euro-area markets a change in the market assessment of domestic (both liquidity and default risk) rather than international factors (which would only play a smaller role) might be behind the increase observed in adjusted spreads with Monetary Integration, even though the effect differs according to the size of the market[15]; as mentioned, in non-euro participating countries, the importance of international risk factors in explaining adjusted spread changes increases. The fact that these countries do not share a common Monetary Policy might explain this greater vulnerability to external risk factors.

However the results of all specifications are highly consistent. They provide evidence that market size scale economies seem to have increased with Currency Union and that the smaller the debt market, the higher the rise. Actually, since January 1999 the adjusted spread over 10-year German bonds has increased in all euro-area countries and in the smallest non-euro participating country (Denmark, which experienced an average rise of 0.31 basis points), and table 3 shows that with an average market share of 22.05%, the German market is the second biggest in the euro-area, only surpassed by the Italian. Hence, on the one side, an improvement of relative German market liquidity might be behind the adjusted spread changes. In fact, within the euro-area, 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 spreads with the introduction of the euro (see table 2). Indeed, other authors as Bernoth, von Hagen and Schuknecht

[15] These results seem consistent, they point out that, since EMU, market assessment of both liquidity and default risk (whose measurement, see section 4, is difficult because the two variables interact with each other) is closely related within countries as it depends on the size of their debt market.

(2004) also state that since EMU the German government bond yields have still been below those of bonds issued by governments with much better debt positions. In their view, 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[16], an opinion that seems to support our conclusions. On the other hand, outside the euro-area, the enhanced British market might also have attracted an significant volume of funds due to its "renewed" singularity which still allowed investors to reduce their risk investing in a market where debt is denominated in a different currency. Hence, the British market might have capitalised on its role as the German market's main competitor.

Therefore, the removal of the exchange rate barrier seems to have punished euro-area smaller markets twice (they are forced to compete in terms of liquidity with larger countries for the same pool of funding, only being able to offer smaller bond issues), by making them pay both higher liquidity and a higher default risk premium than larger ones. This empirical evidence is also in concordance with the fact that the three countries that account for around 59% of the euro-area government securities markets (Italy, France and Spain) are precisely the ones

[16] 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.

with the lowest adjusted spread rise since Monetary Integration (see tables 1 and 2). Moreover, in the two samples, default risk only seems to be relevant when it is accompanied by a small market size. These results then show that the theory “too big to fail” holds: it is expected that large countries will be bailed out in case of fiscal distress. This explains why the default risk premium has decreased for some big countries since EMU. In small countries, on the other hand, markets expect that the “no-bail-out” clause will hold, and membership of the monetary union has increased the default risk since these countries have lost monetary authority. In both Italy and Sweden, for instance, in spite of their very high debt-to-GDP ratio, the associated default risk might be compensated by both the increased liquidity characteristic of a big market and the lack of credibility of the no-bail-out clause.

Finally, these results reinforce the self-fulfilling nature of market liquidity. In the case of both the smallest and the largest debt markets, illiquidity or liquidity presents a non-linear behaviour that supports the idea that traders’ transactions flee from illiquid to liquid debt markets. So, the more liquid (illiquid) a market is, the more traders want (do not want) to participate in it, resulting in an increase (decrease) in the liquidity of the market. In particular, both the German and the British market might have benefited from an increase in their trading activity which has penalised small European debt markets that registered increases in their adjusted spreads.

To conclude, with the introduction of a common currency and in the current context of higher competition between euro-area government securities markets, the success of these sovereign securities debt markets may be highly dependent on their market size, while non-euro participating countries, which did not suffer the increase in their degree of substitutability and competition mentioned above, seem to have benefited from the fact that market participants consider their risk premium to be low and the investment advantages to be high.

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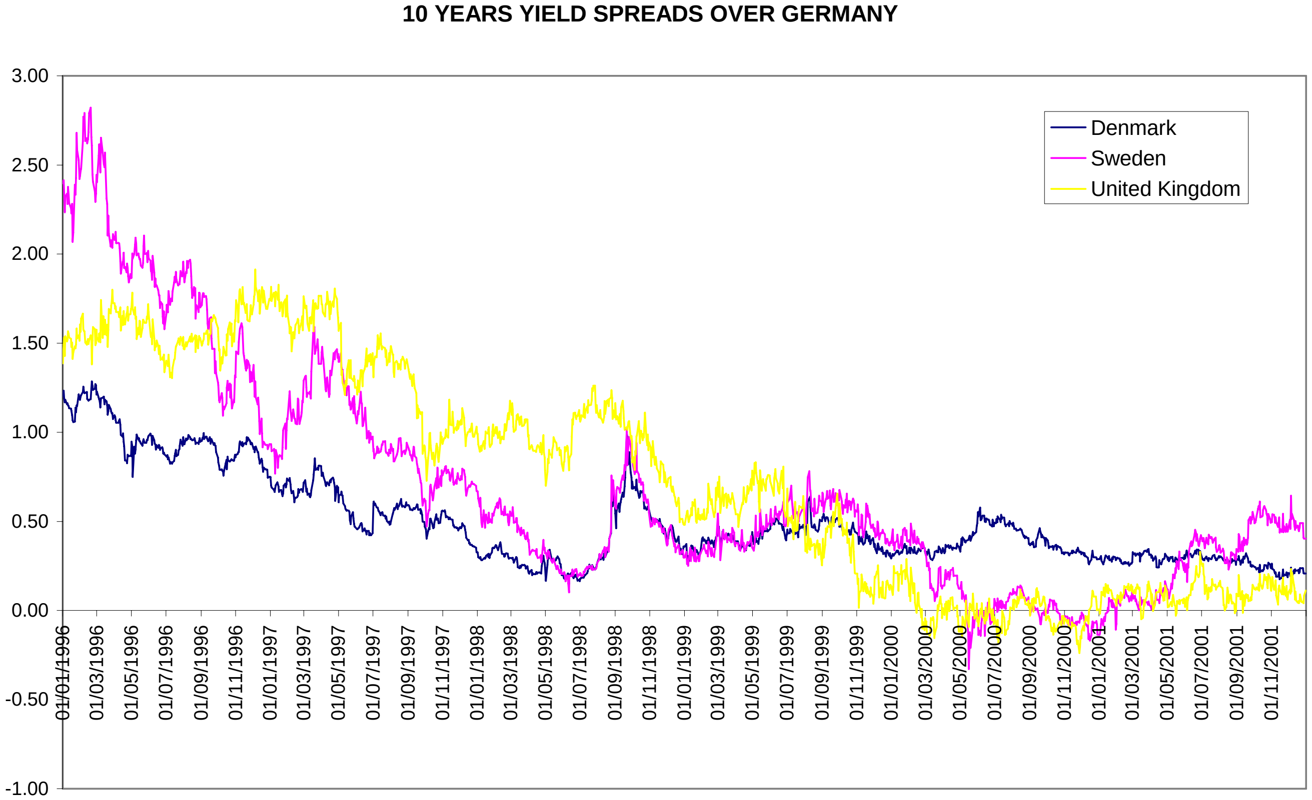
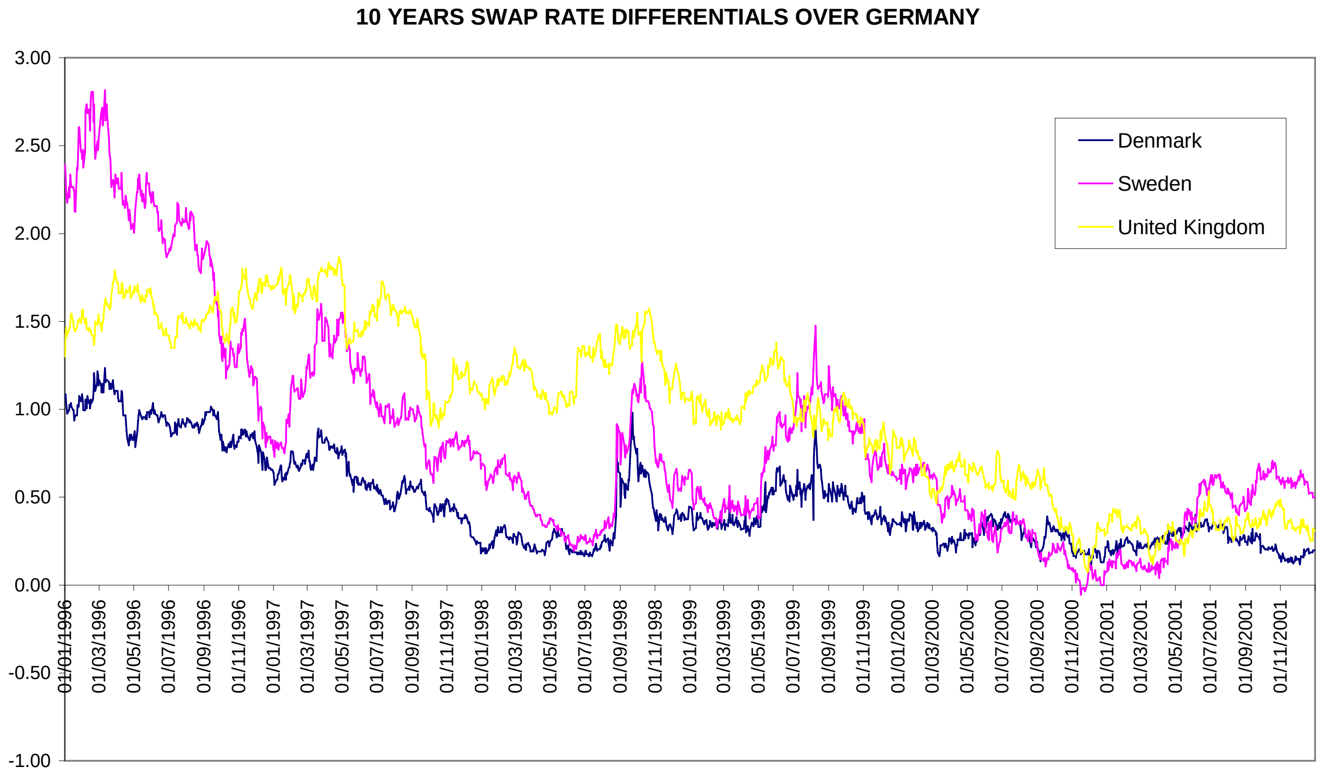
FIGURE 1



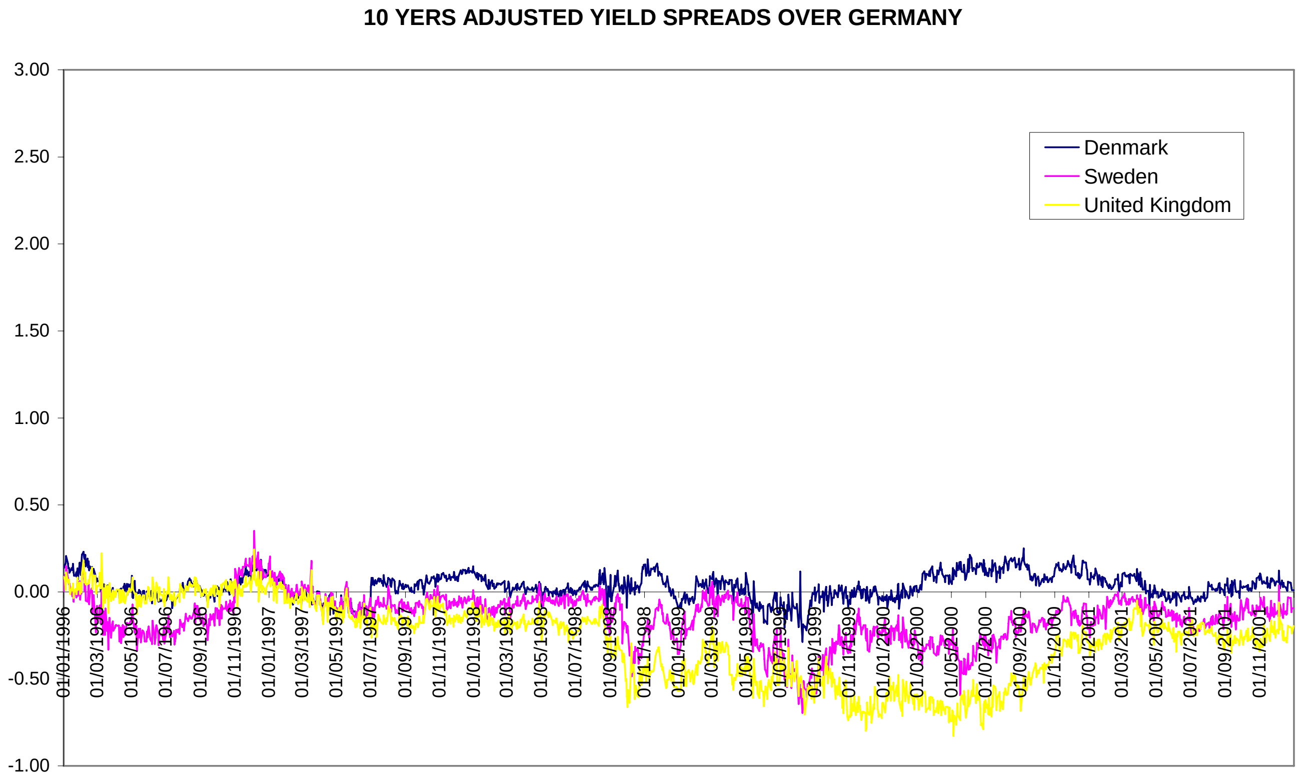
NOTE: Yield differential = ($I_i - I_{DM}$), where I_i is the 10-year yield on country i government bonds and I_{DM} is the 10-year yield on Germany government bonds.
Source : Datastream

FIGURE 2



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



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

TABLE 1

	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)**
EURO						
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
Average	**58.22**	**44.99**	**13.23**	**25.24**	**0.03**	**25.21**
St.dev.	57.48	51.37	10.33	10.66	0.08	10.64
NON-EURO						
DK	64.01	61.09	2.92	35.83	32.61	3.23
SW	108.48	117.15	-8.67	28.14	49.01	-20.87
UK	129.95	142.05	-12.10	19.27	62.07	-42.80
Average	**100.81**	**106.77**	**-5.95**	**27.75**	**47.90**	**-20.15**
St.dev.	33.63	41.46	7.87	8.29	14.76	23.02

NOTE: AT: Austria, BE: Belgium, FI: Finland, FR: France, IE: Ireland, IT: Italy, NL: The Netherlands, PT: Portugal, SP: Spain, DK: Denmark, SW: Sweden and UK: United Kingdom. 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

Differences between EMU and PRE-EMU		
	$(I_i\text{-}I_{DM})$	$ASPREAD_i$
	(4)-(1)	(6)-(3)
EURO		
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
Average	**-32.99**	**11.98**
St.dev.	53.77	4.69
NON-EURO		
DK	-28.18	0.31
SW	-80.33	-12.20
UK	-110.68	-30.70
Average	**-73.06**	**-14.20**
St.dev.	41.73	15.60

NOTE: AT: Austria, BE: Belgium, FI: Finland, FR: France, IE: Ireland, IT: Italy, NL: The Netherlands, PT: Portugal, SP: Spain, DK: Denmark, SW: Sweden and UK: United Kingdom. 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 3

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**	**% over EU-15**
Ireland	19.93	23.20	23.12	21.93	24.73	24.07	19.95	23.15	0.69	0.59
Portugal	35.19	36.47	32.84	34.04	37.49	42.35	45.61	37.67	1.13	0.95
Finland	33.20	38.15	41.56	44.28	45.60	47.70	46.28	43.39	1.30	1.10
Austria	57.04	58.95	63.87	69.28	86.05	99.74	100.52	76.80	2.30	1.94
Greece	64.10	79.58	84.47	84.80	88.43	96.73	102.20	87.23	2.62	2.21
Netherlands	155.64	159.89	159.68	170.12	178.14	180.98	177.50	171.44	5.14	4.34
Belgium	228.86	230.59	228.41	229.67	231.85	246.18	248.66	236.75	7.10	5.99
Spain	211.07	241.63	259.63	272.41	287.34	311.04	299.43	269.56	8.09	6.82
France	497.35	536.05	565.50	623.91	639.85	708.45	709.23	614.79	18.45	15.56
Germany	676.53	682.74	699.45	738.75	767.35	816.77	790.81	734.97	22.05	18.60
Italy	896.49	1022.19	1011.08	1037.09	1042.62	1088.36	1056.96	1036.69	31.11	26.23
EMU	2875.40	3109.45	3169.63	3326.27	3429.43	3662.37	3597.15	3332.43	100.00	84.33
Denmark	89.78	90.22	87.89	87.70	86.74	86.93	82.03	88.63	-	2.24
Sweden	111.09	114.30	110.02	111.34	123.04	117.24	91.22	111.83	-	2.83
U.Kingdom	316.49	373.76	418.68	396.12	456.97	475.31	460.79	418.69	-	10.60

Source: Bank for International Settlements.

TABLE 4

DEBT-TO-GDP average value 1996-01(%)	
Belgium	102.276
Italy	95.065
Sweden	**54.559**
Denmark	**52.799**
Spain	48.810
Netherlands	46.624
France	46.092
Austria	39.357
Germany	37.593
Finland	36.838
Portugal	35.895
United Kingdom	**35.708**
Ireland	26.594

Source: BIS and Eurostat.

TABLE 5

	Starting date as a benchmark	Name	Coupon	Maturity date
DENMARK				
	Jan-96	DANSKE STAT	1994 8%	15/03/06
	Jul-97	DANSKE STAT	1996 7%	15/11/07
	Feb-99	DANSKE STAT	1998 6%	15/11/09
	Mar-01	DANSKE STAT	2000 6%	15/11/11
SWEDEN				
	Nov-96	SVENSKA	1996 6.5%	
	Feb-97	SVENSKA	1996 8%	15/08/07
	Feb-98	SVENSKA	1997 6.5%	05/05/08
	Jul-98	SVENSKA	1993 9%	20/04/09
	Feb-01	SVENSKA	2000 5 1/4%	15/03/11
UNITED KINGDOM				
	Mar-96	TREASURY	7.50%	07/12/06
	May-97	TREASURY	7.25%	07/12/07
	Oct-98	TREASURY	9%	13/10/08
	Apr-99	TREASURY	5.75%	07/12/09
	Apr-01	TREASURY	6.25%	25/11/10
	Aug-01	TREASURY	5%	07/03/12

Source: Datastream

TABLE 6

Cross-Sectional Time-Serie FGLS Regression.
Sample: Pre-EMU: 1996:01-1998:12
EMU: 1999:01-2001:12

dependent variable: ***ASPREAD***	SPECIFICATION I (non-euro countries)		SPECIFICATION I (euro countries) (Gómez-Puig, 2005)	
X_{it}	$\beta_1\ (X_{it})$	$\beta_2\ (DPRE_{it} * X_{it})$	$\beta_1\ (X_{it})$	$\beta_2\ (DPRE_{it} * X_{it})$
***LNDEBTGDP** it*	-0.316** (0.060)	0.563** (0.080)	0.181** (0.008)	-0.017** (0.002)
***ONOFFDIF** it*	1.162** (0.087)	-3.193** (0.202)	1.782** (0.104)	-1.082** (0.118)
***ONOFFDIF2** it*	3.968** (0.516)	-2.888** (0.681)	-10.686** (0.608)	5.133** (0.616)
***BIDASKDIF** it*	-	1.307** (0.475)	0.557** (0.050)	-0.386** (0.075)
***BIDASKDIF2** it*	-	-	-	-2.670** (0.742)
***USSPREAD** it*	0.109** (0.021)	-0.198** (0.041)	0.034** (0.007)	-0.018** (0.009)
***LNDEBTGDP*USSPREAD** it*	0.254** (0.051)	-0.845** (0.113)	0.050** (0.003)	-0.082** (0.003)
***ONOFFDIF*USSPREAD** it*	-0.802** (0.109)	4.287** (0.371)	-1.860** (0.106)	0.899** (0.145)
***ONOFFDIF2*USSPREAD** it*	-5.700** (0.815)	-	15.425** (0.720)	-6.340** (0.726)
***BIDASKDIF*USSPREAD** it*	-0.822* (0.430)	-	-0.401** (0.059)	-
***BIDASKDIF2*USSPREAD** it*	-	16.744** (8.372)	-	4.301** (0.731)
	γ		γ	
***DPRE** it*	0.129** (0.032)		0.038** (0.009)	
	α		α	
CONSTANT	-		0.160** (0.005)	
Number of observations =	3402		12139	
Number of groups =	3		9	
Avg obs per group =	1195.5		1406	
Log likelihood =	6734.189		23893.12	
Wald chi2 =	17824		53337.41	
Prob > chi2 =	0.00		0.00	

**Significant at 5 percent confidence level.
*Significant at 10 percent confidence level.
Standard Errors within parentheses

TABLE 7

SPECIFICATION II (non-euro countries)

Regression with Newey-West Standard Errors
Sample: Pre-EMU: 1996:01-1998:12
EMU: 1999:01-2001:12

dependent variable: *ASPREAD*

	DENMARK		SWEDEN		UNITED KINGDOM	
X_t	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$
LNDEBTGDP $_t$	-	-	-3.331**	3.284**		
			(0.898)	(0.963)		
ONOFFDIF $_t$	-1.191**	-	7.185**	-6.143**		1.561**
	(0.442)		(2.568)	(2.644)		(0.463)
ONOFFDIF2 $_t$	-6.539**	11.493**	-129.52**	124.94**		11.679**
	(2.856)	(3.450)	(56.664)	(56.651)		(1.830)
BIDASKDIF $_t$	2.317**	3.129**	-4.665**	-		-3.492**
	(0.981)	(1.573)	(0.917)			(1.071)
BIDASKDIF2 $_t$	(-47.777)	-41.845*	36.244**	-		28.100*
	(21.132)	(23.430)	(13.142)			(15.825)
USSPREAD $_t$	-	-	-	-		0.124
						0.053
*LNDEBTGDP*USSPREAD* $_t$	-	-	-	-		
*ONOFFDIF*USSPREAD* $_t$	-	3.032*	-10.986**	9.755**		
		(1.638)	(4.441)	(4.590)		
*ONOFFDIF2*USSPREAD* $_t$	10.160**	-18.984**	283.37**	-279.22**		-16.634**
	(4.590)	(5.842)	(94.909)	(94.959)		(3.344)
*BIDASKDIF*USSPREAD* $_t$	-3.358**	-	8.779**	-		7.353**
	(1.608)		(2.086)			(1.635)
*BIDASKDIF2*USSPREAD* $_t$	71.586**	75.251**	-85.035**	79.203**	-20.543**	-51.382**
	(36.179)	(39.973)	(25.838)	(33.831)	(9.071)	(23.851)
	γ		γ		γ	
DPRE	-		-		0.125*	
					(0.075)	
	α		α		α	
CONSTANT	0.283**		0.556**		-0.286**	
	(0.063)		(0.279)		(0.074)	
Number of obs	1485		1069		848	
F (23, 1461)	98.59		135.93		200.56	
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 8

SPECIFICATION II (euro countries), Gómez-Puig (2005)

Regression with Newey-West Standard Errors
Sample: Pre-EMU: 1996:01-1998:12
EMU: 1999:01-2001:12
dependent variable: *ASPREAD*

	AUSTRIA		BELGIUM		FINLAND		FRANCE		IRELAND		ITALY		THE NETHERLANDS		PORTUGAL		SPAIN	
X_t	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$	$\beta_1 (X_t)$	$\beta_2 (DPRE*X_t)$
LNDEBTGDP $_t$	0.916**	1.638**	-1.517**	-	0.533**	5.500**	-	-	-	-	-2.373**	5.703**	0.500**	-0.298**	-1.283**	1.011**	-2.071**	5.689**
	(0.132)	(0.646)	(0.324)		(0.115)	(2.260)					(0.165)	(0.665)	(0.115)	(0.117)	(0.189)	(0.239)	(0.251)	(0.689)
ONOFFDIF $_t$	-2.141**	3.744**	-1.365**	-2.290**	-1.631**	4.524**	-1.271**	4.018**	-	-	-1.358**	1.913**	-	-	-	1.594**	-	-
	(0.432)	(0.566)	(0.577)	(0.971)	(0.247)	(0.924)	(0.417)	(1.062)			(0.390)	(0.545)				(0.284)		
ONOFFDIF2 $_t$	17.615**	-15.591*	-	18.141**	10.813**	-17.480**	23.925**	-61.363**	4.766**	-	-	-	-	-	-	-7.161**	11.072**	-17.219**
	(4.855)	(8.433)		(7.735)	(1.750)	(2.934)	(6.518)	(13.129)	(2.171)							(1.797)	(3.385)	(5.609)
BIDASKDIF $_t$	0.399**	4.733**	-0.320**	-3.901**	-	-	-0.578**	4.019**	-	-	-	-	-	-1.344**	-	-0.348*	-	1.236*
	(0.186)	(1.080)	(0.134)	(0.914)			(0.189)	(1.535)						(0.239)		(0.180)		(0.754)
BIDASKDIF2 $_t$	-2.041**	-93.305**	-	84.921**	-	-	-	146.486**	191.559**	-281.101**	10.017**	-11.053**	-	6.816*	6.043**	-	17.571**	-
	(0.948)	(30.215)		(32.750)				(72.806)	(95.043)	(115.133)	(4.474)	(4.959)		(3.807)	(1.015)		(2.972)	
USSPREAD $_t$	-	-	-	-	-0.051**	1.262**	-	0.629**	-	-0.450**	-1.735**	4.359**	-0.659**	0.220**	-	0.395**	-0.395**	2.494**
					(0.018)	(0.249)		(0.211)		(0.227)	(0.149)	(1.265)	(0.162)	(0.032)		(0.026)	(0.056)	(0.344)
LNDEBTGDP*USSPREAD $_t$	-0.533**	-2.561**	-	-	-0.525**	-9.975**	-	-	-	-	2.079**	-4.394**	-	-0.613**	3.695**	-2.920**	2.307**	-9.159**
	(0.155)	(1.222)			(0.156)	(4.363)					(0.170)	(1.270)		(1.133)	(0.277)	(0.373)	(0.276)	(1.154)
ONOFFDIF*USSPREAD $_t$	2.181**	-4.813**	-	4.377**	1.815**	-7.608**	-	-4.412**	1.413**	-	1.773**	-	-	-	-2.938**	-	-	1.561*
	(0.648)	(0.957)		(1.475)	(0.312)	(1.542)		(1.604)	(0.619)		(0.663)				(0.493)			(0.863)
ONOFFDIF2*USSPREAD $_t$	-22.792**	-	-	-31.968**	-12.218**	27.089**	-26.901**	95.507**	-11.707**	-	-	24.480*	-	-	-	12.515**	-13.033**	21.534**
	(7.524)			(10.655)	(2.041)	(4.846)	(9.914)	(21.334)	(3.366)			(12.518)				(2.087)	(5.661)	(8.477)
BIDASKDIF*USSPREAD $_t$	-	-9.074**	0.534**	8.753**	-	-17.471**	-	-6.193**	11.310*	-	-	-	-	1.291**	1.055**	-	-0.296*	-
		(2.057)	(0.126)	(1.590)		(7.304)		(2.962)	(6.047)					(0.321)	(0.279)		(0.165)	
BIDASKDIF2*USSPREAD $_t$	-	207.74**	-	-140.378**	-	69.629*	-14.353*	-256.990*	-326.538**	503.828**	-17.142**	20.207**	-	-	-	-7.152**	-26.030**	-
		(58.660)		(60.130)		(37.129)	(8.074)	(144.199)	(152.508)	(202.411)	(4.646)	(6.013)				(1.548)	(5.093)	
	γ		γ		γ		γ		γ		γ		γ		γ		γ	
DPRE	-		-		-0.619**		-0.299		-		-5.576**		-		-		-1.590**	
					(0.136)		(0.142)				(0.663)						(0.201)	
	α		α		α		α		α		α		α		α		α	
CONSTANT	0.194**		1.782**		0.267**		-		-		2.361**		0.744**		0.134**		0.655**	
	(0.022)		(0.300)		(0.012)						(0.146)		(0.141)		(0.022)		(0.054)	
Number of obs	1481		1492		310		1478		582		1489		1490		1323		1494	
F =	F(23,1457) = 621.77		F(23,1468) = 429.29		F(23,1286) = 183.71		F(23,1454) = 107.29		F(23,558) = 75.52		F(23,1465) = 308.20		F(22,1467) = 364.47		F(13,1308) = 143.58		F(23,1470) = 148.17	
Prob > F =	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00	

**Significant at 5 percent confidence level.
*Significant at 10 percent confidence level.
Standard Errors within parentheses