



## **WORKING PAPER NO. 126**

### *The European Bond Markets under EMU*

**Marco Pagano and Ernst-Ludwig von Thadden**

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#### **Abstract**

In this paper, we document how in the wake of monetary unification the markets for Euro-area sovereign and private-sector bonds have become increasingly integrated. Issuers and investors alike have come to regard the Euro-area bond market as a single one. Primary and secondary bond markets have become increasingly integrated on a pan-European scale. Issuance of corporate bonds has taken off on an unprecedented scale in continental Europe. In the process, both investors and issuers have reaped the considerable benefits afforded by greater competition in the underwriting of private bonds and auctioning of public ones, and by the greater liquidity of secondary markets. Bond yields have converged dramatically in the transition to EMU. The persistence of small and variable yield differentials for sovereign debt under EMU indicates that Euro-area bonds are still not perfect substitutes. However, to a large extent this does not reflect persistent market segmentation but rather small differentials in fundamental risk. Liquidity differences play at most a minor role, and this role appears to arise partly from their interaction with fundamental risk. The challenges still lying ahead are numerous. They include the unbalance between the German-dominated futures and the underlying cash market; the vulnerability of the cash markets' prices to free-riding and manipulation by large financial institutions; the possibility of joint bond issuance by Euro-area countries; the integration of clearing and settlement systems in the Euro-area bond market, and the participation of new accession countries' issuers to this market.

**JEL classification numbers:** G15, G32.

**Keywords:** Euro, bond market, financial integration, bond yield differential.

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## **1. Introduction**

The European Monetary Union (EMU) has probably been the single most important policy-induced innovation in the international financial system since the collapse of the Bretton-Woods system. It has opened the possibility for the creation of a new, fully integrated continental financial market, of the same scale as that of the United States. By eliminating exchange rate risk, EMU has eliminated a key obstacle to financial integration. Before EMU, otherwise identical financial claims issued in different Euro-area currencies were imperfect substitutes and traded at different prices. EMU has eliminated this source of market segmentation.

While a single currency is a necessary condition for the emergence of pan-European capital markets, it is not a sufficient one. Other frictions may still stand in the way of full integration: even after the removal of exchange rate risk, persistent differences in tax treatment, standard contractual clauses and business conventions, issuance policy, security trading systems, settlement systems, availability of information, and judicial enforcement may still segment financial markets along national borders.

In the European bond market, however, monetary unification triggered a sequence of policy actions and private sector responses that swept aside most of the other obstacles to integration. This was facilitated by the intrinsically standardized nature of bonds and by the limited number of issuers in the sovereign bond market. The issuers coincided with the policy-makers who had promoted EMU, and were determined to gain in terms of reduced funding cost from a broader and more liquid market.

While the push towards integration arose in the public bond market, it had a powerful spillover effect on the private bond market, where it generated a dramatic growth in issuance, secondary market trading and competition among underwriters. In this paper, we describe the emergence of an integrated market for public as well as private Euro-area bonds, highlighting both the impressive changes already occurred and the reasons why these bonds are still imperfect substitutes.<sup>1</sup>

We start by illustrating, in Section 2, the chain reaction of policy actions and private sector responses that reshaped the institutional framework of the sovereign bond market, leading to more homogeneous issuance and trading arrangements, and illustrate how their effects spilled over into the market for private-sector bonds. In Section 3, we document how these changes fostered convergence in government bonds yields in the transition to EMU. In Section 4, we highlight that, in spite of all these achievements, Euro-area bonds are still imperfect substitutes, and investigate the reasons and implications of the remaining yield differentials and of their changes over time. Section 5 concludes, by summarizing and taking a look at possible future developments in this market.

## **2. Emergence of integrated bond markets in Europe**

While the introduction of the Euro sparked off bond market integration, its effects were magnified by its concomitance of a worldwide expansion in private bond issuance, which outweighed the stagnant public debt issuance of the 1990s. Indeed, it is private sector issuance that nurtured the growth of the Euro-area bond market in the wake of EMU, and transformed the Euro into a leading

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<sup>1</sup> Danthine, Giavazzi, and von Thadden (2001), Galati and Tsatsaronis (2001) and Hartmann, Maddaloni and Manganelli (2003) provide broader overviews, including other sectors of the financial market.

currency of denomination for international bond issues. Therefore, it seems appropriate to start our account by setting European developments in their global context. Our next step is to document how the introduction of the Euro changed both the behavior of Euro-area issuers and that of investors. It prodded the former to compete in the supply of more homogeneous securities to a much larger potential market, and the latter to shift their portfolio selection away from home issuers. At the same time, it opened up great opportunities to trading platforms with pan-European capabilities, and to intermediaries willing to compete for underwriting business on a pan-European basis. As we shall see, the response of markets and intermediaries to this challenge contributed to the integration of the market, by compounding the responses of issuers and investors.

### 2.1. The European market in global perspective

Before EMU, European bond markets were largely domestic and significantly smaller than their US counterparts. Table 1 gives an overview of the size of international bond markets in 1998: in that year, the value of total bonds outstanding in the Euro area was still 56 percent of the value in the US. This size differential existed for both the private and the public bond market. However, the Euro-area public and private bond markets taken together already accounted for 25 percent of the world total, and were significantly bigger than their Japanese counterparts.

**Table 1: Size of international bond markets in 1998**

|                   | Total bonds outstanding* | Of which: government bonds |
|-------------------|--------------------------|----------------------------|
| US                | 11, 656.45               | 7, 031.77                  |
| Euro zone         | 6, 526.42                | 3, 577.49                  |
| Japan             | 3, 958.94                | 2, 824.40                  |
| Rest of the world | 4, 369.43                | 2, 229.01                  |
| World total       | 26, 511.24               | 15, 662.67                 |

\* By country of origin of issuer, in \$ billion, end of third quarter 1998. *Source:* BIS, own calculations

Segmentation along national boundaries was a major feature of bond markets in Europe. At the start of the 1990s, almost all public debt was still issued domestically, while for private sector issues the ratio of domestic to international debt securities in Europe was about 4:1. Except for a few public or semi-public benchmark bonds such as the 10-year Bund or the German Pfandbriefe, also secondary market activity in Europe remained largely domestic until the late 1990s.

**Table 2: Global net issuance of debt securities**

| Currency/year        | 1994   | 1995   | 1996   | 1997   | 1998   | 1999   | 2000   | 2001   | 2002   |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| US dollar            | 664.3  | 796.9  | 1125.4 | 1255.5 | 1726.4 | 1511.9 | 1053.5 | 1302.1 | 1443.6 |
| Euro                 |        |        |        |        |        | 876.4  | 626.3  | 562.9  | 714    |
| Euro area currencies | 425.3  | 366.3  | 528.7  | 326.9  | 435.3  |        |        |        |        |
| Yen                  | 336.7  | 434.6  | 458.7  | 237.9  | 185.8  | 496.1  | 450.6  | 570.6  | 280.6  |
| Other currencies     | 578.3  | 544.1  | 392.6  | 362.4  | 438.9  | 470.7  | 375.9  | 450.6  | 494.3  |
| Total                | 2004.6 | 2141.9 | 2505.4 | 2182.7 | 2786.4 | 3355.1 | 2506.3 | 2886.2 | 2932.5 |

*Source:* BIS, own calculations.

All this changed drastically in the late 1990s. There was sustained growth in issuance of bonds worldwide, and Europe shared in this growth of the market especially with much increased corporate bond issuance and international debt issuance. Table 2 shows that global net debt issues increased by 65 percent between 1994 and 1999, and Figure 1.A indicates that this was mostly driven by the growth in bond issuance by the private sector. This growth occurred on both sides of the Atlantic, though with slightly different timing.

In the United States, the economic boom of the mid-1990s was accompanied by a strong expansion of private sector debt issues, with volumes rising from \$280 billion in 1994 to \$1,061 billion in 1998, as shown by Figure 1B. Yet, in the aftermath of the LTCM and Russian debt crises, private sector issues in the US declined sharply in 1999 and 2000, before issuing activity picked up again.

In the Euro area, the private-sector debt expansion was more modest than in the United States in the mid-1990s: it rose from \$124 billion to \$273 billion between 1994 and 1998. But, after the introduction of the Euro, private issuance more than doubled to \$657 in 1999, as illustrated by Figure 1C. Despite the subsequent reduction, Euro-area private-sector issuance later remained much higher than in the first part of the decade. That the 1999 boom is associated with the Euro is underscored also by the different pattern of private bond issuance observed for European countries outside the euro area (Figure 1.D), where the growth occurred gradually since 1994, as in the US.

In Japan, instead, private sector issues were almost flat in the 1990s, due to the prolonged recession. In contrast, public debt issuance increased drastically after 1998. This pattern is the opposite to that observed in the US and Europe, where net government borrowing decreased for most of the period. The spike of public debt issues in the US in 1998-99 was exclusively due to strong issuing activity of local governments and the housing finance agencies.

Hence, global bond issuance expanded dramatically in the 1990s, in three different areas: first, US private-sector issues in the mid-90s; second, Euro-area private-sector issues after the introduction of the Euro; and third, Japanese public borrowing after 1998. As of 2004, all these three features seemed to be persistent: between 1999 and 2003, average private bond issuance in the US was about \$900 billion, up from \$280 billion in 1994, that in the Euro-area was about \$550 billion, more than 4 times the 1994 level, and Japanese government borrowing averaged roughly \$450 billion, up from an average of \$250 billion in 1994-1998.

The strong expansion of the Euro-area bond market is reflected in an increase in the importance of the Euro as international issuing currency. Table 2 shows no increase in the relative importance of the Euro (or its precursor currencies) with respect to the dollar, but these numbers aggregate domestic and international debt issues. Unfortunately, the empirical classification of bond issues in these categories is controversial. According to the international statistics of the BIS, the Euro overtook the US dollar in 1999 as the most heavily used currency for international debt issues, and has traded the lead in this category with the dollar since then. International issues according to the BIS include all issues except the domestic-currency bonds issued by residents and targeted to domestic investors. However, Detken and Hartmann (2000) have rightly pointed out that these numbers understate the international use of the dollar, because of the global importance of the US market. They present data on announced debt issues that take this bias into account and find that the dollar has remained the most important international issuing currency, although the Euro has doubled its share in international debt issues between 1994 and 2003.<sup>2</sup>

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<sup>2</sup> We are grateful to Philipp Hartmann for sharing his updated data with us.

### Figure 1: Global bond issuance

Figure 1.A: Total net bond issues, worldwide

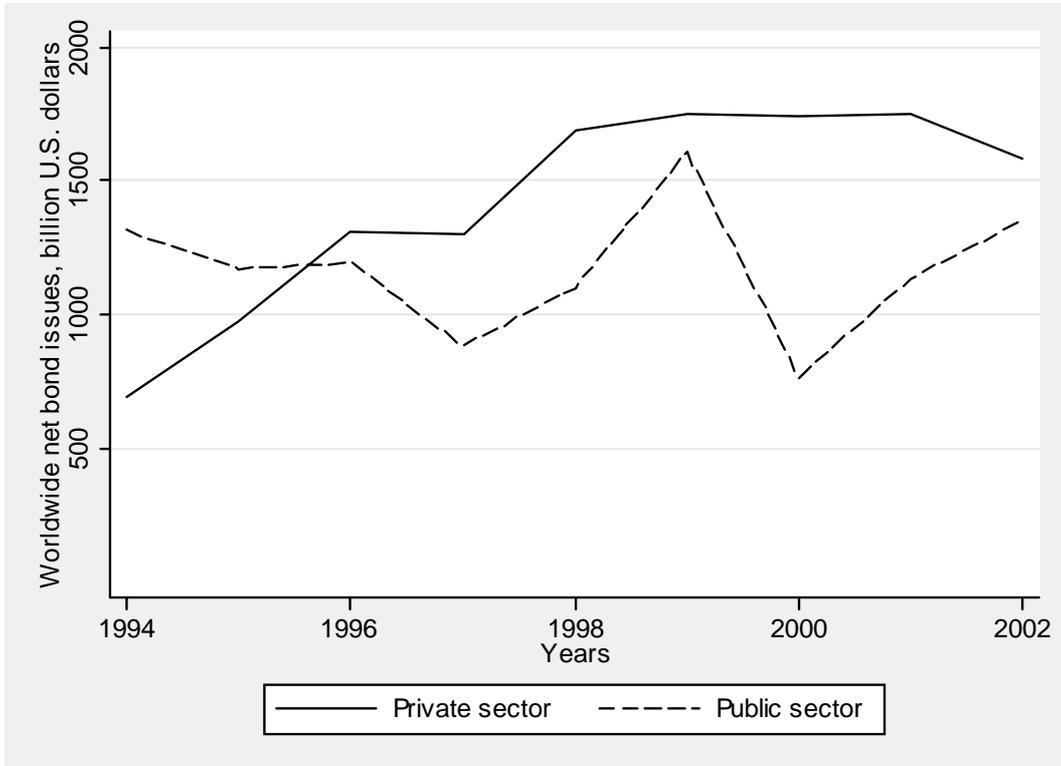


Figure 1.B: Total net bond issues, USA



Figure 1.C: Total net bond issues, Euro area

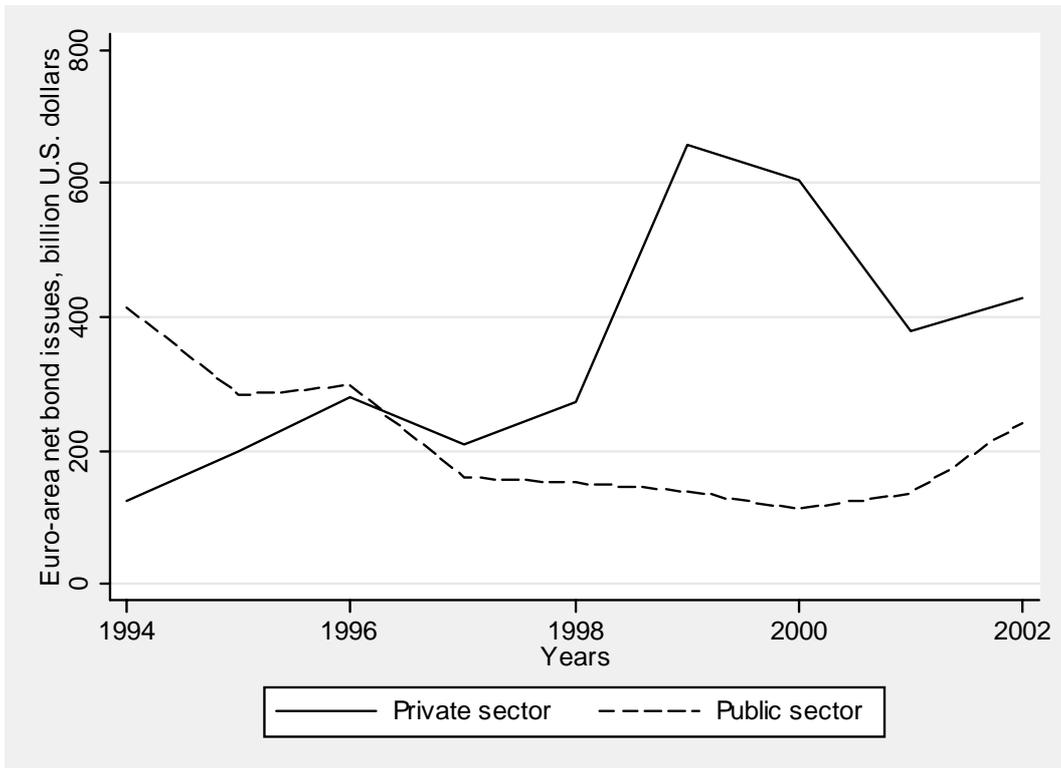


Figure 1.D: Total net bond issues, rest of Europe

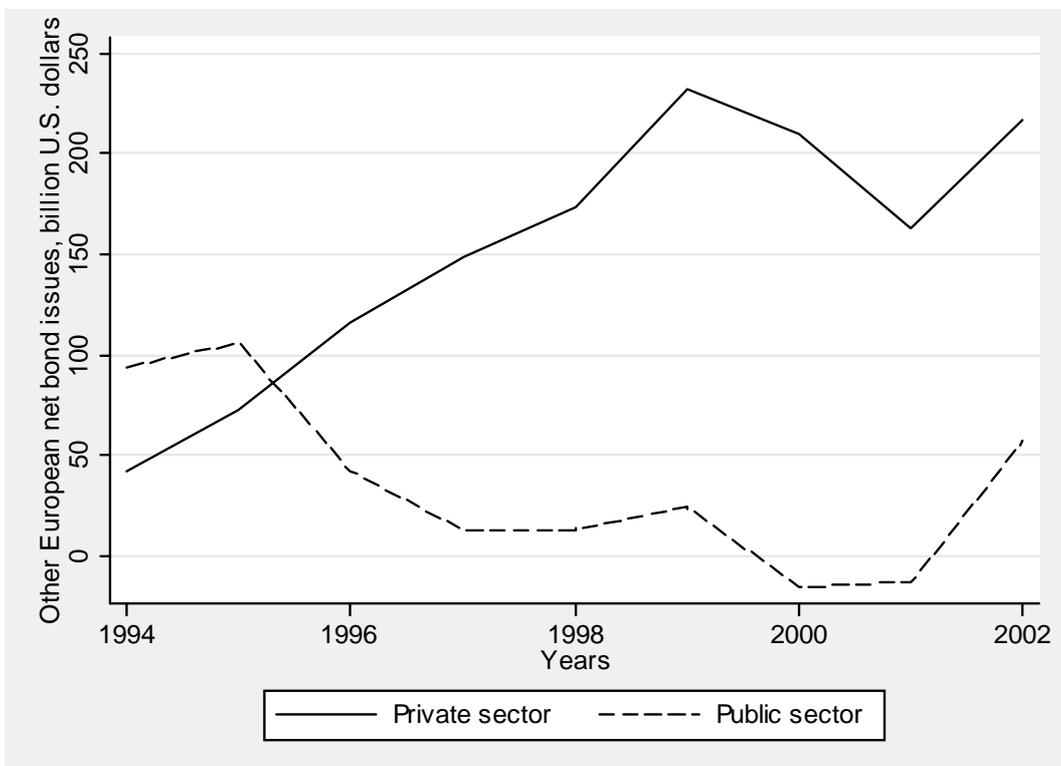
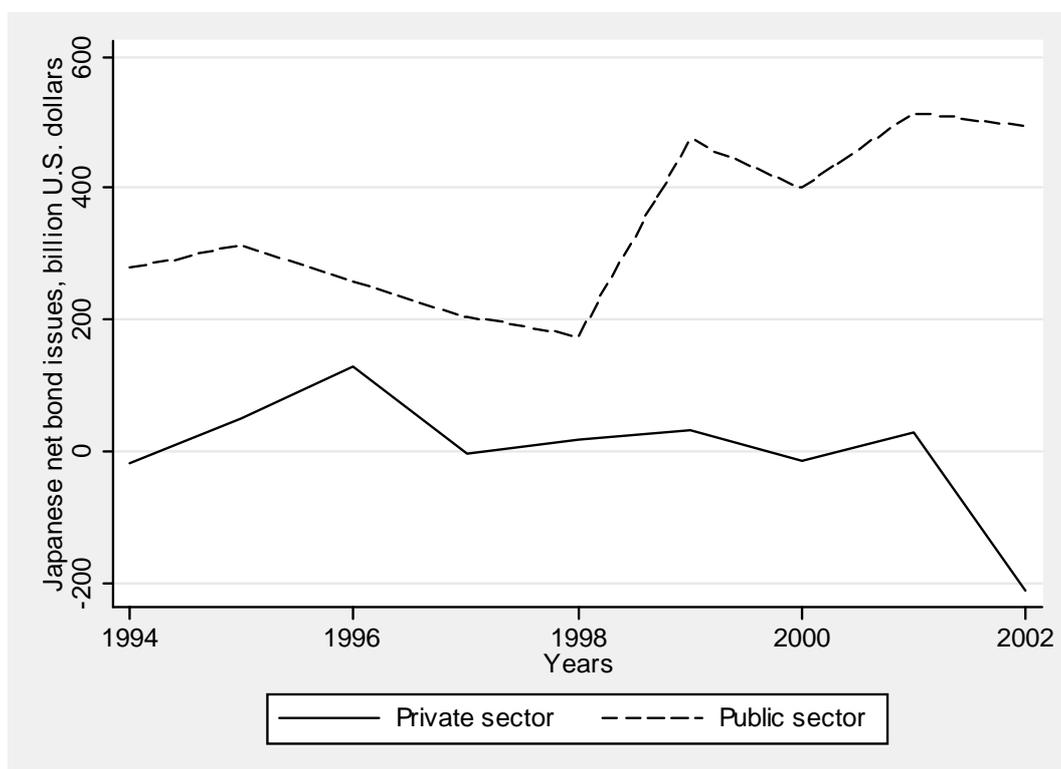


Figure 1.E: Total net bond issues, Japan



Note: Net issues in billions of US dollars. Private sector comprises financial institutions and non-financial corporations, public sector comprises central governments, local governments, public-sector firms and international organizations. Source: BIS, own calculations.

## 2.2. The supply side

### 2.2.1. Public issues

The fiscal discipline stemming from the Maastricht Treaty criteria has restrained the total volume of sovereign bonds issued in the Euro area. As shown in Figure 1.C, total public sector debt issues in the Euro area fell from \$414 billion in 1994 to \$111 billion in 2000. Recently this process has been partially reversed, but despite the de facto scrapping of the “Stability and Growth Pact” in 2003 its remnants can still be expected to curb the expansion of public debt in the foreseeable future.

Yet, despite this overall restraint on the size of the public debt market, the introduction of the euro has deeply changed the way in which public debt is issued in Europe. In fact, the changes in issuing policy by sovereign issuers went far beyond a simple currency conversion.

In 1995, EU governments decided that as of January 1999 all new fungible public debt by EMU member states should be issued in euro. This was a direct consequence of the introduction of the euro and in itself would have already created relatively large Euro markets for long-term public debt. Yet, governments were undecided at the time whether to redenominate their outstanding debt into euros with the inception of EMU. Redenomination would not only have added large volumes to the long end of the yield curve, but also created Euro markets for shorter maturities. This potentially beneficial effect needed to be balanced against the costs and technical difficulties of such a switch. The French and the Belgian governments opted very early in favor of redenomination, whereas the

German government for a long time seemed to be undecided. However, mostly for fear of a loss of competitiveness of the Frankfurt bond market, the German “Euro Introduction Law” of June 1998 stipulated the full conversion of existing German fungible federal debt by January 1, 1999.<sup>3</sup> In the wake of these decisions, all other EMU countries followed suit soon afterwards.<sup>4</sup>

The debate about debt conversion was driven by the concern about the benchmark status of national debt. As in the private debt market, benchmark status confers substantial benefits on the country that enjoys it, but a large market size obviously is a key requirement for this status. Therefore, the “race to the benchmark yield curve” was probably the most important factor in the decisions of governments to redenominate their outstanding public debt.

The competition behind the race for benchmark status was complemented by important cooperative elements in the development of the European public bond market. In fact, once the debt conversion decision was made, governments decided to go one step further and homogenize bond conventions. Shortly after the introduction of the Euro, all member countries switched the day-count of their outstanding and new issues to a common standard, and most of them switched to using the operating days of the TARGET settlement system as official business days for the service of their public debt. Many private bond issuers adopted similar reconventioning plans.<sup>5</sup> These changes made public bonds more easily comparable and substitutable. While not logical consequences of the introduction of the euro, they show that unification in one area brought about by the euro – the redenomination of bonds – entailed a further element of unification – the reconventioning.

Subsequently, Euro-area governments took several even farther-reaching decisions concerning the harmonization of issuing practices, the coordination of issuing dates, the optimal choice of issuing formats, and similar issues.<sup>6</sup> Although more progress is still possible on these fronts, issuing practices, in particular of smaller Euro countries, have changed considerably since the 1990s. Pre-announced auction calendars have become standard, re-openings and clusterings of issues in different parts of the maturity spectrum have become widely used tools of public management. In general, issue sizes have increased, with treasuries buying back old illiquid and/or short-dated bonds and exchanging them against new issues and concentrating new issues in fewer benchmark securities. Some smaller issuers introduced syndicated procedures instead of auctions to attract more investors. Moreover, the competition between national treasuries pushed them to innovate the menu of bonds offered: Spain and France have issued constant-maturity bonds; France, followed by other issuers, has introduced inflation-indexed bonds. Initially these were indexed to national price indices, but more recently some issues have been indexed to a European price index.

Interestingly, the euro has reached out even into the non-euro area. For example, the Bank of England has issued euro-denominated Treasury Bills already since 1999. This broadening of the euro-denominated public debt market has partly compensated the reduction of issuing volumes in most of the Euro-area countries until the early 2000s.

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<sup>3</sup> Except for some short-term obligations, which comprise less than 3 per cent of the fungible federal debt.

<sup>4</sup> With some minor exceptions such as Austria, which redenominated only the most liquid portion of its tradable debt (34 percent).

<sup>5</sup> For details, see Bank of England (1998).

<sup>6</sup> For a discussion, see Favero, Missale, and Piga (1999).

### 2.2.2. Private-sector issues

As documented by Figure 1.C, the private bond market in Europe experienced a major change in 1999, when issuing volumes more than doubled from \$273 billion to \$657 billion. While the 1998 issuing volume in the Euro area was less than 26% of that in the US, the 1999 volume was more than 74% of the US level. Part of this surge probably reflects exceptional and transient factors. First, the financial crisis of late 1998 resulted in catch-up issuing activity in early 1999 (which, however, was equally relevant for the US as for Europe). Second, the desire to set benchmarks with Euro issues pushed issuers to go to the market earlier and in more concentrated volumes than they might have chosen otherwise. But Figures 1.B and 1.C show that a significant part of this change was longer-lived.

The relatively small corporate bond market in Europe until the late 1990s is mirrored by the correspondingly greater importance of bank lending. While in the US bank loans play a negligible role in the financing of large companies and face strong competition from the bond market even for medium-size companies, they have been traditionally the dominant source of debt financing for almost all European companies, even the largest ones, as shown by Table 3.

**Table 3: Bank debt of non-financial firms**

|                | All non-financial firms,<br>1993 | 239 largest manufacturing<br>firms, 1996 |
|----------------|----------------------------------|--|
| Benelux        | 83.2                             | 48.1                                     |
| France         | 80.2                             | 44.3                                     |
| Germany        | 85.1                             | 63.2                                     |
| Italy          | 94.6                             | 73.9                                     |
| Spain          | 77.3                             | -  |
| United Kingdom | 49.4                             | 34.1                                     |
| United States  | 32.4                             | 9.4                                      |
| Japan          | -                                | 56.4                                     |

*Note:* Numbers are shares of bank debt in total debt. *Source:* Danthine, Giavazzi and von Thadden (2001).

This feature of European corporate finance began to erode in the second half of the 1990s. It is difficult to tell whether the change towards a stronger reliance on bonds has been driven mainly by firms or by the banks themselves. Part of the explanation is certainly the increasing reluctance of European banks to provide traditional loans, which inflate the asset side of balance sheets and thus depress key earnings ratios and require higher regulatory capital. But the introduction of the Euro has clearly been a crucial event also for the other side of the market: companies have seen the opportunity of accessing a larger pool of investors and diversifying their liabilities, so as to provide some competition to their bank financiers and decrease their vulnerability to credit crunches.

As in the public sector, bond issuance policy in the private sector changed fundamentally in Europe in the late 1990s. For example, the size of the largest issues increased substantially. While in 1998 there were just three bond issues in Euro legacy currencies above the equivalent of €1 billion, the three issues by Tecnost, the financing vehicle for Olivetti's takeover of Telecom Italia, in June and July 1999 alone raised €15.65 billion. Although these issues were widely perceived as exceptional, issue sizes in general in Europe increased significantly since 1999, with issues above €1 billion becoming more and more frequent.

Furthermore, the quality range of bond issues expanded significantly. In particular, the average credit rating of issuing companies fell significantly since EMU. While European bond markets used to be dominated by AAA and AA issues, almost 50% of all corporate bonds issued in 1999 had a single A credit rating. Further down the spectrum, even the first signs of a European junk bond market exist, although this segment is still underdeveloped.

Interestingly, Rajan and Zingales (2003) show that the boom of the corporate bond market after the introduction of the Euro indeed was stronger in the Euro area than outside. They conduct a simple panel data analysis for a sample of European countries since 1990 and find that net private debt issues became significantly larger for countries that adopted the Euro. This suggests that the introduction of the euro had a causal impact on the development of the corporate bond market in Europe.

Much of this supply-side development is undoubtedly due to the boom of some industries such as telecommunication, which were liberalized and deregulated in the late 1990s in many Western European countries. The resulting restructuring and consolidation fuelled a wave of mergers and acquisitions (M&A) that were largely financed by bonds. After the collapse of the equity market in 2000 and the worsening of the commercial paper market in the early 2000s, the bond market gained particular importance as a source of long-term funding. Figures 2.A and 2.B show that debt issuance was closely correlated with M&A activity both in the Euro area and in other European countries (chiefly the UK, which accounts for most M&A activity in the second group). The correlation is actually greater in the Euro area (94.3 percent) than in other European countries (66.3 percent), but the total value of M&A deals is much larger in the second group of countries.

Finally, Table 4 shows that the lion's share of private sector international debt securities in Europe keeps being issued by financial institutions.<sup>7</sup> This feature was weakened in 1998-2001, when the share of non-financial corporate issues began exceeding 20 percent, but was reasserted in 2002-03 when it declined to traditional levels of 10% and lower. However, the current breakdown is not dissimilar from that in the US.

**Table 4: Issuance of private-sector international debt securities by area and type of issuer**

| Area/issuer            | 1994 | 1995 | 1996 | 1997  | 1998  | 1999  | 2000  | 2001  | 2002  | 2003  |
|------------------------|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| <i>United States</i>   |      |      |      |       |       |       |       |       |       |       |
| Financial Institutions | 19.3 | 32.9 | 84   | 98.1  | 138.5 | 182.8 | 230.4 | 191.8 | 302.2 | 246.6 |
| Corporate Issuers      | 18.9 | 24.4 | 32   | 64.7  | 61.6  | 155.6 | 47.3  | 72.4  | 28.6  | 27.8  |
| <i>Euro Area</i>       |      |      |      |       |       |       |       |       |       |       |
| Financial Institutions | 68.6 | 87.5 | 154  | 147.2 | 163.8 | 356.5 | 430.3 | 325.2 | 385.6 | 591.4 |
| Corporate Issuers      | 7.2  | 8.1  | 4.4  | 17.1  | 32    | 120.5 | 96.1  | 82.7  | 10.6  | 56.8  |

*Note:* Net issues in US \$ billion. *Source:* BIS, own calculations.

<sup>7</sup> The break-down of domestic private issues is not available for the whole 1994-2003 interval. However, from available data show European non-financial corporations appear more active domestically than internationally, which counteracts the finding in Table 4.

## Figure 2: Bond issuance and M&A activity in Europe

Figure 2.A: Private net bond issues and value of M&A deals, Euro-area

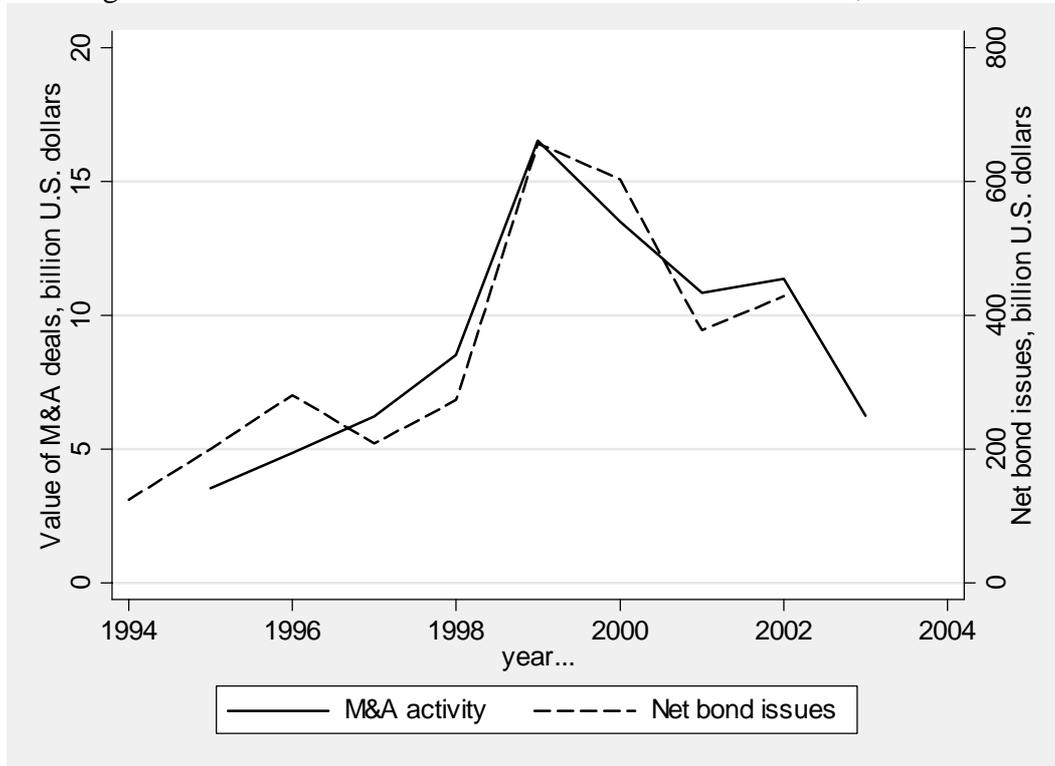
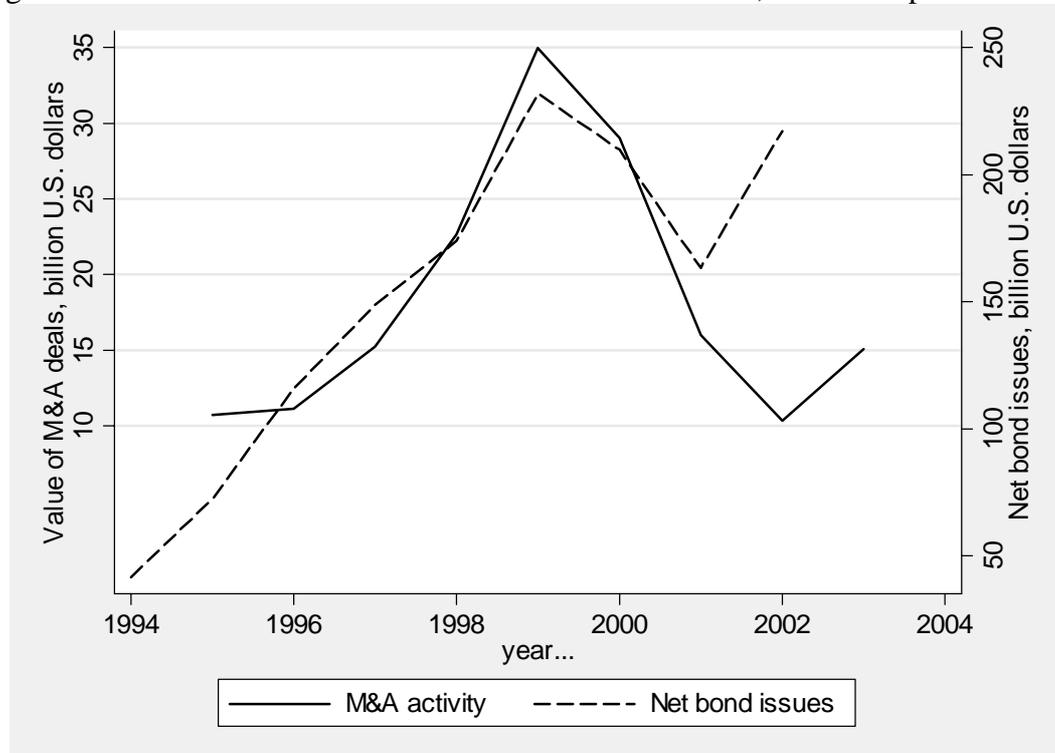


Figure 2.B: Private net bond issues and value of M&A deals, other European countries



Note: M&A activity is the total value of all M&A deals whose value is reported in the SDC Platinum database (US \$ billion). Net bond issues are private sector issues (US \$ billion). Sources: Thomson Financial Securities Data and BIS, respectively.

### 2.3. *The demand side*

At the same time as the supply of euro-area bonds increased and issuance policies converged, geographical diversification increased strongly in euro-area bond portfolios on the demand side.

This change was felt most dramatically with private issues. While until 1998 bond distribution in the euro zone for all but the very few largest firms was almost exclusively domestic, the larger bond issues already in 1999 were sold on a truly European scale that even surprised most market participants. A typical example was the €1 billion issue of Alcatel, the French telecom firm, in February 1999, 28 per cent of which was placed with Italian and more than 20 per cent with German investors. Alcatel's surprised CFO remarked after the issue "that a French corporate can sell its bonds primarily to Italy is something new". A similar example was the 1999 issue by Principal Life, a US insurer, where the head of the syndicate at CSFB for the European issue noted that "we sold 30 per cent of this deal in France. In the past we might have sold 3 per cent there".<sup>8</sup>

A similar evolution happened in the public bond market. According to ECB data quoted by Blanco (2001, Table 3), the share of euro-area government securities held by non-residents increased steadily from 16 percent in 1991 to 26.8 percent in 1998 and up to 33.5 percent in 2000. As shown by Adam, Jappelli, Menichini, Padula and Pagano (2002), much of this increase is due to institutional investors. Their study looks at the share of assets managed by money and bond funds that invest with a Europe-wide investment strategy between 1997 and 2001, based on data provided by the Fédération Européenne des Fonds et Sociétés d'Investissement (FEFSI).<sup>9</sup> The figures by Adam et al. (2001) have been recalculated and updated to 2003 by Baele, Ferrando, Hordhal, Krylova and Monnet ((2004). Both studies indicate that the adoption of the Euro is associated with a large increase in the asset share of internationally investing bond funds in Austria, Finland, France and Germany, with most of the change occurring at the time of the introduction of the Euro. The euro-area unweighted average of the share of assets invested in bond funds with a Europe-wide strategy rose from 17 percent in 1998 to 60 percent in 2002 (Baele et al. (2004), Chart 21).

Incidentally, a similar shift occurred also in the investment policies of pension funds and life-insurance companies, since EMU relaxed a number of regulatory restrictions on the currency matching of assets and liabilities, such as a 20-percent ceiling on the permissible mismatch in their denomination and other restrictions on the purchase of foreign assets.

Table 5 (column 1) shows that by 2003 more than half of the assets of bond funds were invested with an Europe-wide strategy in each euro-area country except Spain (the latter being likely due to misclassification of Spanish funds in the FEFSI data base). The countries where bond funds are more diversified are Belgium, Italy and Portugal. The greater appetite for diversification by investors based in these countries may reflect their greater concern with the solvency risk of their respective home issuers: Belgium, Italy and Portugal have the lowest-rated debt among those for which these data are available.<sup>10</sup>

Interestingly, this shift in portfolio allocation strategy is limited to the euro area, in two senses. First, it is peculiar to bond funds based in the euro area: in Denmark, Sweden and the UK the share

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<sup>8</sup> See Euromoney, August and September 1999.

<sup>9</sup> However, the FEFSI classification of funds according to their investment strategy (domestic, European or global) and type (money market, bond or equity) seems not entirely consistent across countries, being based on national schemes.

<sup>10</sup> These figures are a lower bound on the diversification attainable by individual investors since, even if all funds in a given country completely specialise in domestic investments, individual investors can diversify internationally by holding a mix of funds offered by foreign funds, if they have access to the investment products of other countries.

of bond funds with a European-wide investment strategy remained low and rather stable between 1998 and 2001 (Adam et al., 2001). Second, euro-area funds did not extend their diversification strategy also to bonds issued outside the euro area itself: the share of bond funds with a global bond investment strategy actually declined from 30 percent in 1998 to 20 percent in 1999 and stood roughly constant at that level until 2003. Apparently, euro-area investors now view the euro-area bond market as their home market, so that the traditional home bias “may have been replaced with a ‘euro area home bias’” (Baele et al., 2004, p. 54).

Rather than asking how diversified euro-area bond portfolios are, one can look at the weight of foreign investors in each of the euro-area bond markets. The answer to the latter question is only to a certain extent related to the former. For example, the investors from a given country can have diversified portfolios and still absorb most of the domestically issued bonds. Moreover, foreign investors include also those based outside the euro area.

But it turns out that also along this dimension the euro-area bond market has become highly integrated. Euro-area public debt bought by international investors is currently 61.2 percent of the total (unweighted average, excluding Germany), according to data collected by national treasuries and reported by MTS Group (2004). As shown in column 2 of Table 5, the investor base is more international in Euro-area countries with a smaller absolute amount of outstanding debt, such as Austria, Finland, Ireland, the Netherlands and Portugal, possibly because foreign institutional investors loom relatively larger in these small markets.

**Table 5: International diversification of bond portfolios in the Euro area**

| Country     | Share of assets invested in bond market funds with Europe-wide investment strategy, percent in 2003<br>(1) | International investor base as fraction of total investor base, percent in 2004<br>(2) |
|-------------|--|--|
| Austria     | 55   | 90-99  |
| Belgium     | 88   | 48.4   |
| Finland     | 61   | 62   |
| France      | 60   | 37   |
| Germany     | 52   | -  |
| Greece      | -  | 55   |
| Ireland     | -  | 75   |
| Italy       | 81   | 42   |
| Netherlands | -  | 81   |
| Portugal    | 98   | 80   |
| Spain       | 0  | 37   |
| Average     | 62   | 61.2   |

*Source:* The numbers in column 1 are from Baele et al. (2004), p. 53. The numbers in column 2 are from MTS Group (2004), p. 13.

## 2.4. *The response of intermediaries*

While Euro-area governments laid the institutional framework for an integrated bond market, financial intermediaries supported this integration by providing increasingly homogeneous secondary trading facilities and by competing on the primary market for government debt and corporate issues. This response by financial intermediaries was obviously triggered by the considerable business opportunities stemming from a pan-European bond market, but in turn it reinforced the process of integration, by feeding back onto the behavior of other market participants. For instance, trading platforms set homogeneous and more demanding requirements on issuers' policies and on dealers' market-making activity, and at the same time allowed investors to access an increasingly large menu of bonds with standardized trading procedures.<sup>11</sup> Similarly, investment banks' more aggressive competition for underwriting business reduced and homogenized the fees they charged to corporate customers, increasing companies' inducement to issue bonds even in the low-grade segment.

### 2.4.1. Public debt trading platforms

The emergence of pan-European trading platforms has been an important force in the process of integrating the secondary market for European government bonds. The most important among them are MTS in the cash market, and EUREX in the futures market.

MTS is a quote-driven, electronic trading platform that emerged from a public institution created in 1988 by the Italian Treasury and the Bank of Italy in collaboration with Italian primary dealers, to improve the liquidity of the Italian government bond market. The success of its trading model led to its privatization in 1997 and to the expansion in 1999 into the Netherlands, Belgium and France, establishing similar trading platforms – a first set of domestic MTS markets.

Currently, MTS is the parent company that partially owns subsidiaries in all the euro-area countries and in Denmark,<sup>12</sup> and trades government bonds in several Eastern European countries through its division "New EuroMTS" (since November 2003). MTS S.p.A. is owned by financial intermediaries: 55 percent of its capital belongs to non-Italian banks, and 45-percent to Italian ones.

The breakthrough in MTS's business model was the creation of EuroMTS, a pan-European inter-dealer platform that offered trading facilities for the largest and most liquid European government bonds and subsequently became the standard setter for European benchmark bonds, that is, the newly issued bonds at the 5- and 10-year maturities. The key to the success of this trading platform is to be found not only in its technical capabilities but also in MTS' ability to bring together issuers and dealers and to induce them to commit to a few simple rules so as to foster secondary market liquidity – a mutual commitment that MTS labels a "liquidity pact". Dealers commit to quote continuously two-way firm prices with a maximum spread, and issuers commit to an issue listing size at least equal to €5 billion for benchmark bonds and to a random allocation of bonds amongst bond dealers for quoting obligations. Moreover, MTS volumes contribute to the total trading volume that treasuries require of all dealers for admission to the primary market. In this way, the

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<sup>11</sup> While the contribution of electronic trading platforms to Euro-area bond market activity appears to be substantial, we are not aware of any formal econometric analysis that attempts to quantify such contribution.

<sup>12</sup> MTS created subsidiaries or divisions in the Netherlands in September 1999, Belgium in May 2000, France and Portugal in July 2000, Finland in April 2002, Spain in May 2002, Ireland in June 2002, Austria in June 2003, and Denmark, Greece and Germany in November 2003 (but traded German bonds since April 2001 through a division of EuroMTS).

MTS-sponsored “liquidity pact” has promoted the homogenization of the Euro-area sovereign bond market around minimum standards of size and liquidity.<sup>13</sup> For its part, MTS guarantees high pre-trade transparency, feeding real-time price and quantity data to final investors via 20 data distributors, and thereby encouraging competition in quote-setting.

Table 6 illustrates the impressive liquidity of the 10-year and 5-year benchmark bonds traded on EuroMTS. The bid-ask spread statistics in the table are based on daily data for 2002 and 2003 and refer to the best bid and ask prices quoted at 11 a.m. during all business days across all the cash markets. The data show that the average bid-ask spreads are tiny, ranging between 2 basis points in the most liquid market (Italy) to almost 5 in the least liquid (Finland). Interestingly, the German cash market is not the most liquid one, even in the 10-year maturity bucket for which the Bund is considered the benchmark. This is because most of the trading for 10-year German bonds occurs on the futures market, which is more liquid and far deeper than the corresponding cash one. Table 6 also shows that the bid-ask spread does vary over time: for instance, for Italy it ranges between a minimum of 1.2 and a maximum of 15 basis points. As we shall see, the time variation of liquidity is important in the empirical analysis of yield differentials.

Liquidity is lower for issues that are no longer benchmark bonds. These are traded in the domestic MTS markets, where the liquidity and size requirements established on EuroMTS for benchmark bonds are not enforced. However, the benchmark requirements tend to extend automatically also to these bonds, as older issues are gradually replaced with new ones, which formerly were benchmark issues.

**Table 6: Liquidity of the EuroMTS market**

| Country     | 10-year benchmark bonds, daily bid-ask spread data, 2002-2003 |         |         | 5-year benchmark bonds, daily bid-ask spread data, 2002-2003 |         |         |
|-------------|---|---------|---------|--|---------|---------|
|             | Average   | Minimum | Maximum | Average  | Minimum | Maximum |
| Austria     | 4.6   | 2.8     | 9.8     | 4.1  | 2.8     | 6.5     |
| Belgium     | 3.5   | 2.4     | 6.6     | 2.7  | 2.0     | 3.6     |
| Finland     | 4.9   | 2.8     | 8.4     | 4.1  | 2.8     | 6.2     |
| France      | 2.9   | 1.6     | 5.0     | 2.5  | 1.8     | 3.4     |
| Germany     | 3.2   | 2.0     | 7.0     | 3.2  | 1.8     | 5.0     |
| Italy       | 2.5   | 1.2     | 15.0    | 2.1  | 1.0     | 3.7     |
| Netherlands | 3.5   | 2.6     | 5.6     | 3.7  | 2.4     | 5.0     |
| Portugal    | 4.3   | 2.7     | 8.4     | 3.2  | 2.2     | 4.6     |
| Spain       | 3.5   | 2.0     | 6.4     | 2.9  | 1.6     | 4.6     |
| Average     | 3.66  | 2.23    | 8.02    | 3.17   | 2.04    | 4.73    |

*Note:* The bid-ask spread are expressed in basis points and are computed as the difference between the best bid and ask prices (divided by the mid-quote) quoted at 11 a.m. during all business days in EuroMTS cash markets. *Source:* MTS Group.

While the market discipline imposed by the “liquidity pact” on dealers creates obvious benefits to all market participants, the discipline is not perfect and the “pact”, like most other multilateral arrangements, is prone to moral hazard. The problem is that individual market participants can benefit from the liquidity provided by everybody else even at the expense of others, in which case

<sup>13</sup> More recent innovations by Euro MTS include a real-time index of European government bonds (since 2003), the vertical integration into clearing and settlement, and the expansion into the corporate bond market through its BondVision subsidiary. At the time of this writing it is too early to evaluate these developments.

the discipline can become a liability for the complying market-makers. This has indeed happened on 2 August 2004, when Citigroup flooded MTS (and other trading platforms) with sales of almost €12 billion across more than 200 bonds within seconds, pushing down prices by about 15 cents. As banks tried to hedge on the Bund future market, the future price dropped 47 cents. At that point, Citigroup bought back €4 billion of bonds at lower prices on the MTS trading system.<sup>14</sup> The price drop was quickly reversed, and Citigroup earned an estimated €15 million at the expense of other market makers.<sup>15</sup> In effect, Citigroup was able to earn this sum because it had a fleeting informational advantage over the rest of the market: the information about its own future trading strategy, which is price-relevant because of the sheer size of the orders that it can place. Normally, when they suspect that they may be receiving orders from an informed trader, market makers protect themselves by widening their quotes or refusing to trade. But the MTS market-makers were committed to quote firm prices for large amounts and keep tight spreads, and this allowed Citigroup to trade such a large amount before they could react.

Besides exposing the market's vulnerability to manipulation by large traders, this episode may be a deliberate attempt to break the "liquidity pact" by a large market maker. That Citigroup shows little concern for the liquidity of MTS may partly stem from its inherent conflict of interest vis-à-vis this trading platform – a situation common to several other large market players. It is at the same time a market participant and dealer in all 11 MTS sovereign bond markets, a shareholder of MTS, and a potential competitor of the trading platform owing to its in-house trading capabilities and its participation in competing platforms. This episode indicates that, for all their benefits to issuers, the implicit rules that guarantee the impressive liquidity of MTS are not unchallenged.<sup>16</sup> Accordingly, it has raised concerns by government officials that disruptions to market liquidity may increase the cost of issuing debt, and prompted investigations by security regulators for the possible breach of trading rules.

While MTS is by far the largest trading platform in the Euro-area cash market (especially in the Italian market), it has a low profile in the German bond market, where trading concentrates in the derivatives market, especially in the futures market managed by EUREX. The volume of trade on EUREX has increased almost tenfold between 1996 and mid-2001, from € 172.4 billion to € 1,639.1 billion (see Blanco, 2001, Table 4).<sup>17</sup> In the process it killed off Bund futures trading on London's LIFFE. Also futures trading in French, Italian, and Spanish bonds dwindled into disappearance by 2001.

The trading activity in the futures based on German bonds is so large that the open interest of the Bund futures contracts often exceeds the stock of deliverable bonds. This occasionally generates "squeezes", which are situations where few market participants buy a large fraction of the deliverable bonds before the maturity of the future contract. If successful, they profit at the expense of the holders of short positions in the futures contract, who must borrow deliverable bonds and lend money at below-market rates in the repo market. Squeezes generate sudden increases in the price of bonds, which spill over to the corresponding cash and the repo markets. The problem is

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<sup>14</sup> This account is based on a number of news reports in August 2004 and MTS sources.

<sup>15</sup> Citigroup's profit could have been even larger if eventually a few dealers had not stopped trading as the US bank kept buying back bonds at lower prices, as reported by Munter and van Duyn (2004).

<sup>16</sup> It should be noticed that the formal rules of MTS do not prescribe spreads as tight as those actually quoted: the actual spreads are 5 times tighter than the required ones. But issuers informally require banks to quote the tightest possible spreads, and this induces them to take such positions with so little reward and, as this episode highlighted, so much risk.

<sup>17</sup> Between 1999 and 2003, the number of contracts for Bund, Bobl and Schatz traded yearly on EUREX increased by 126,6%; by comparison, over the same interval the value of yearly trading volume on the MTS cash platform increased by 46.7% (data kindly provided by Philippe Rakotovoao).

amplified by the relative lack of depth of the German cash market, coupled with the fact that other Euro-area bonds are still less than perfect substitutes of German Bunds, as we shall see in Section 3.

#### 2.4.2. Corporate bond underwriters

The successful integration of secondary government bond markets in the Euro zone is not paralleled in the corporate bond market, which is more fragmented. Most of this fragmentation is due to the fragmentation of clearing and settlements systems in Europe. Although the problem has been well known since the late 1990s (see, e.g., Padoa-Schioppa (1999)), progress has been slow. Securities settlement in the Euro area is still dominated by national players, whose number has only come down from 23 to 14 until 2003 (compared to 2 in the US), and hampered by national rules that restrict cross-border activities of settlement houses.<sup>18</sup>

Yet, as highlighted in Section 2.2, the true explosion of bond issuance associated with EMU occurred in the corporate bond market, not in the sovereign bond segment. An important reason for this success was the corporate bond underwriters' response to EMU. As the barriers that segmented the European market for corporate bond underwriting began to erode, investment banks started to benefit from the scale economies in the provision of underwriting services and from the lower entry barriers in the industry. Santos and Tsatsaronis (2002) show that as a result underwriting fees in the euro-denominated market converged rapidly to the corresponding fees in the dollar-denominated segment of the industry. They show that, while total underwriter proceeds quadrupled between 1998 and 1999 (and remained around the new level until 2001), the average gross fees in the euro-denominated segment of the bond market halved in the year of introduction of the euro, dropping from 1.7 percent in 1998 to 0.8 percent in 1999, and remained at the average level of 0.6 percent in the 1999-2001 interval – exactly the same figure as in the US-denominated segment (Santos and Tsatsaronis (2002), Table 5). By multivariate regression analysis of a sample of 3,110 bonds they highlight the key role of EMU in the reduction of fees.

Melnik and Nissim (2004) confirm the convergence of underwriting characteristics (extent of underpricing, underwriter compensation, bond maturity, syndicate size) in the Euro area and the U.S. after EMU, but point out that the reduction of fees alone does not mean that EMU has reduced underwriter compensation. In a careful analysis of the pricing of Eurobond issues around 1999, they show that the strong reduction in underwriter fees after 1998 was almost fully compensated by an increase in the underwriter spread (i.e., the difference between the price charged to the public and the price guaranteed to the issuer). Thus total underwriter compensation remained largely stable with the introduction of EMU. The real impact of EMU, according to Melnik and Nissim (2004), was the almost complete elimination of the significant bond underpricing that had prevailed until 1998.

At the same time, the degree of concentration in the industry dropped, especially as a result of the entry of US investment banks into this market: the Herfindhal index more than halved, from 971.2 in 1998 to 400 in 1999, and the share of the top 5 banks dropped from 57.1 to 33.4 percent (Santos and Tsatsaronis (2002)). The increased competition was felt particularly in the smaller currency segments, where before EMU the share of the top 5 bookrunners was higher than 75 percent. Interestingly, borrowers appear to have switched away from their home-currency underwriters for their euro-denominated issues compared to those in legacy currencies (59.5 percent versus 80.5 percent before EMU). Essentially, European corporate issuers moved away from their home bankers, generally towards the larger US investment houses.

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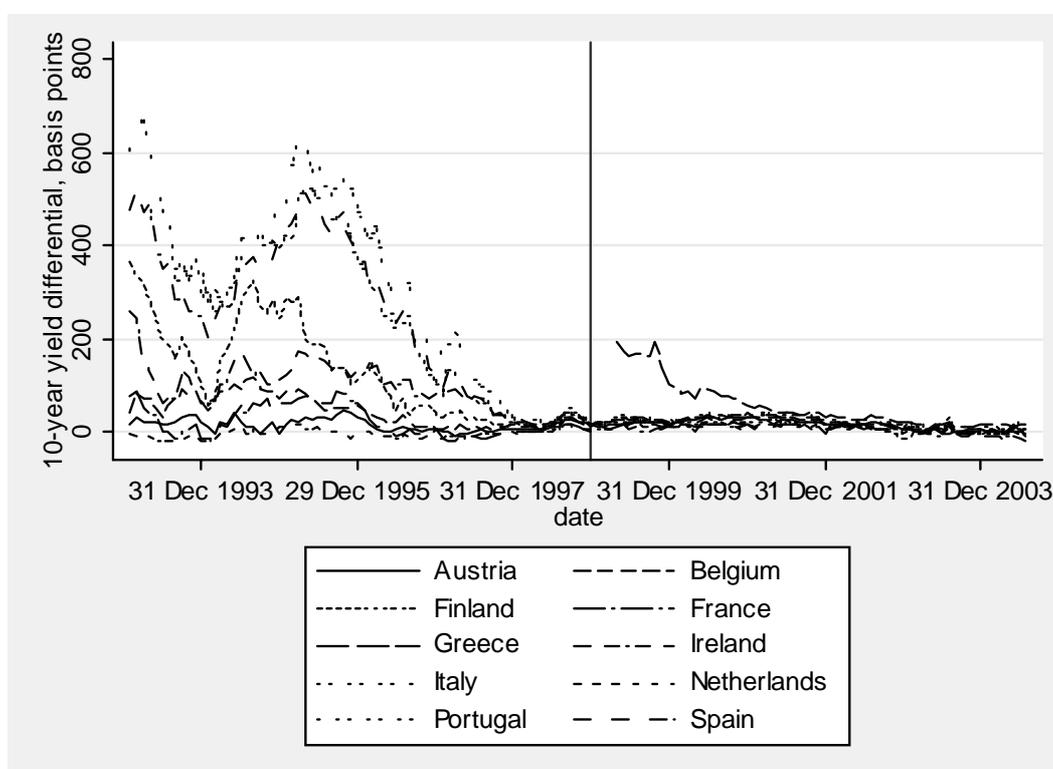
<sup>18</sup> The report by the Giovannini Group (2003) provides an assessment of the situation and proposes various policy reactions.

### 3. Convergence of yields in the transition to EMU

The combined effect of EMU, concomitant institutional changes and private-sector responses illustrated so far translated into a dramatic convergence of the yields on public debt of the same maturity on the eve of monetary unification. This is illustrated in Figure 3 with reference to the 10-year benchmark bonds (but qualitatively similar pictures are obtained for other maturities).

The figure shows end-of-month yield spreads for euro-area benchmark government bonds relative to Germany from January 1993 to July 2004. The convergence of the spreads toward zero is dramatic. Considering all EMU initial participants (and thus excluding Greece), the mean yield spread over the German yield fell from 218 basis points in 1995 to 111 in 1996, 39 in 1997, 19 in 1998 and 20 in 1999. It rebounded slightly in 2000-01, before resuming its downward trend.

**Figure 3: 10-years benchmark bond yield spreads, January 1993 – July 2004**



*Note:* Yield differentials are computed as the difference relative to the yield on German 10-year benchmark bonds, based on monthly data (end-of-month observations). *Source:* Datastream.

Most of the action in these years derives from the convergence of the non-core EMU participants: Finland, Ireland, Italy, Portugal and Spain, and later Greece, which joined the euro area at the beginning of 2001. The bonds issued by Austria, Belgium, France and the Netherlands already featured low spreads relative to German bonds since 1996. This is because before EMU the probability of depreciation relative to the D-Mark was considerable in the first set of countries, but not in the second. Indeed, for the non-core EU countries the drop of the 10-year yield spreads is overwhelmingly due to the elimination of this possibility, as shown by Blanco (2001). He measures this risk factor by the spread between the 10-year swap rate of the currency and the German swap rate, and finds that the foreign exchange factor accounts for 41 of the 46 basis points of the 1996-98 yield differential for Finland, 37 out of 45 for Ireland, 132 out of 154 for Italy, and 96 out of 115 for

Spain. In contrast, it accounts for a negligible fraction of the differentials for Austria, Belgium, France and the Netherlands.

The convergence associated with the transition to the euro is confirmed also by formal indicators proposed by Adam et al. (2001) using panel data techniques. The idea behind these indicators is that markets are integrated if price differentials are not *persistent*, i.e. if price discrepancies are rapidly eliminated by arbitrage, and if price *dispersion* for these products is small or absent. Applied to bond yields,  $\beta$ -convergence measures if they converge to the same steady-state value, by regressing their changes on their past levels;  $\sigma$ -convergence measures bond market integration at a point in time, by assessing if the cross-sectional dispersion of yields decreases over time.

Adam et al. (2001) measure  $\beta$ -convergence of bond yields on data from January 1995 to September 2001 for euro-area countries (plus Denmark). They regress the changes in bond yield spreads relative to Germany on their past levels (allowing for different coefficients in the pre- and post-EMU regimes), controlling for fixed country effects and lagged interest rate changes. The coefficients of the lagged interest rate level – if negative – measure the speed of convergence before and after the transition to the single currency. The estimated coefficients are respectively -0.041 and -0.079, both significantly different from zero, though not significantly different from each other. So  $\beta$ -convergence appears to be consistent with the data for the whole interval.

However, measuring  $\sigma$ -convergence can be of independent value to assess financial integration, since  $\beta$ -convergence does not necessarily imply  $\sigma$ -convergence: mean reversion does not require the cross-sectional variance to decrease, and it could even be associated with  $\sigma$ -divergence.<sup>19</sup> Adam et al. (2001) report that in the 10-year government bond market the standard deviation of yield differentials relative to the German yield in 1999 declined to ¼ of its 1995 value. They also regress the cross-sectional standard deviation on a broken linear time trend, the breakpoint being January 1999. In the regression for euro-area countries only, the estimated coefficients of the two time trends indicate that  $\sigma$ -convergence took place until the launch of the euro, but not afterwards: only the coefficient that applies to the pre-EMU interval is negative and statistically different from zero. This evidence adds an important element relative to that on  $\beta$ -convergence: the convergence in the euro-area government bond market occurred before 1999, not later. This already points to the persistence of residual segmentation under EMU – consistently with the evidence that will be reviewed in the next section.

Baele et al. (2004) propose yet another method to measure the changing degree of bond market integration, based on the idea that in an integrated market local yields changes are driven by common rather than local shocks. To measure the relative role of these shocks, they estimate a regression of the changes in each country's 10-year government bond yield on a constant and the change in the German yield. They estimate the regression over a moving window of 18 months, so as to obtain a time-series of constant and slope estimates for each country, and find that the slope coefficients start to converge towards 1 after 1998. So local bond markets have become less affected by idiosyncratic local news. Accordingly, the fraction of the total variance in local yield changes explained by changes in the German yield has increased from less than 50 per cent to over 97 per cent between 1997 and 2002 in Finland, Greece, Italy, Portugal and Spain.

The same authors analyze also the degree of integration of the corporate bond market under EMU. They wish to estimate if corporate yields embody country effects, after controlling for all the other measurable characteristics associated with the time-profile of the bond's cash flow, with the likelihood of default and with liquidity. To this purpose, they collect the yields of 1,256 corporate

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<sup>19</sup> See Quah (1993) for further details on this issue.

bonds from Austria, France, Germany, Ireland, the Netherlands and Spain) for the EMU period, and estimate cross-sectional regressions of yield differentials (relative to an equally-weighted corporate bond portfolio) on a constant and a set of bond characteristics: coupon, liquidity, time to maturity, rating, sector and country. The estimation produces a time series of coefficients for each explanatory variable. Among these, the country dummies' coefficients may be seen as a measure of the respective country-specific risk factors. For all countries except Germany, these country coefficients are significantly different from zero at the 5 percent level, but are extremely small: 4, 6 and 2 basis points for Spanish, Irish and Austrian bonds, -8 basis points for French ones, and close to zero for German and Dutch bonds. They typically account for no more of 2 percent of the cross-sectional variance of yield differentials. This suggests that also the corporate bond market has achieved a remarkable degree of integration.<sup>20</sup>

This study of the corporate bond market is a useful reminder that bond market integration does not require complete convergence of bond yields. Even in an integrated market, differentials may persist to the extent that they are a reflection of the various bonds' different risk, maturity or cash-flow characteristics, rather than stemming from trading costs, taxes, clearing and settlement costs, or other institutional barriers to trade. Due to their highly standardized nature and low idiosyncratic risk, government bonds are well suited for an assessment of such differentials. This is the objective of the following section.

#### 4. Bond yield differentials under EMU

Despite the dramatic convergence documented in the previous section, yield differentials have not disappeared completely under EMU, so that euro-area sovereign bonds are still not perfect substitutes. This can be seen in Figure 4, which is based on the same data as Figure 3 except for the time interval, which includes only the EMU period, and for the omission of Greece, whose yield differential would dwarf all the others. Table 7 reports descriptive statistics by country and by year based on the same data. Taken together, Figure 4 and Table 7 shows four important facts.

First, yield differentials vary considerably *across countries*, from 8 basis points for Irish debt to 26 basis points for Italian one. This begs the question of what explains these cross-country differences.

Second, for each give country the yield differential varies considerably *over time*. Therefore, yield spreads are a source of additional risk that must be taken into account and priced by investors and traders. This is especially important for traders who go long in the cash market on higher-yield bonds while hedging their interest rate exposure by shorting the very liquid German Bund on the future market: these positions are risky, since they are exposed to yield spread risk. In fact, there are traded derivatives, such as spread options, that explicitly refer to observed yield spreads.

Third, the yield spreads have a clear tendency to co-move. This is evident from Figure 4, but it is formally confirmed by the statistical evidence reported in Codogno, Favero and Missale (2003), and Geyer, Kossmeyer and Pichler (2004). This comovement implies that yield spread risk cannot be fully hedged by holding a diversified portfolio of euro-area bonds, and begs the question of what generates such comovement. As we shall see later in this section, the empirical studies just quoted have made considerable progress in this direction

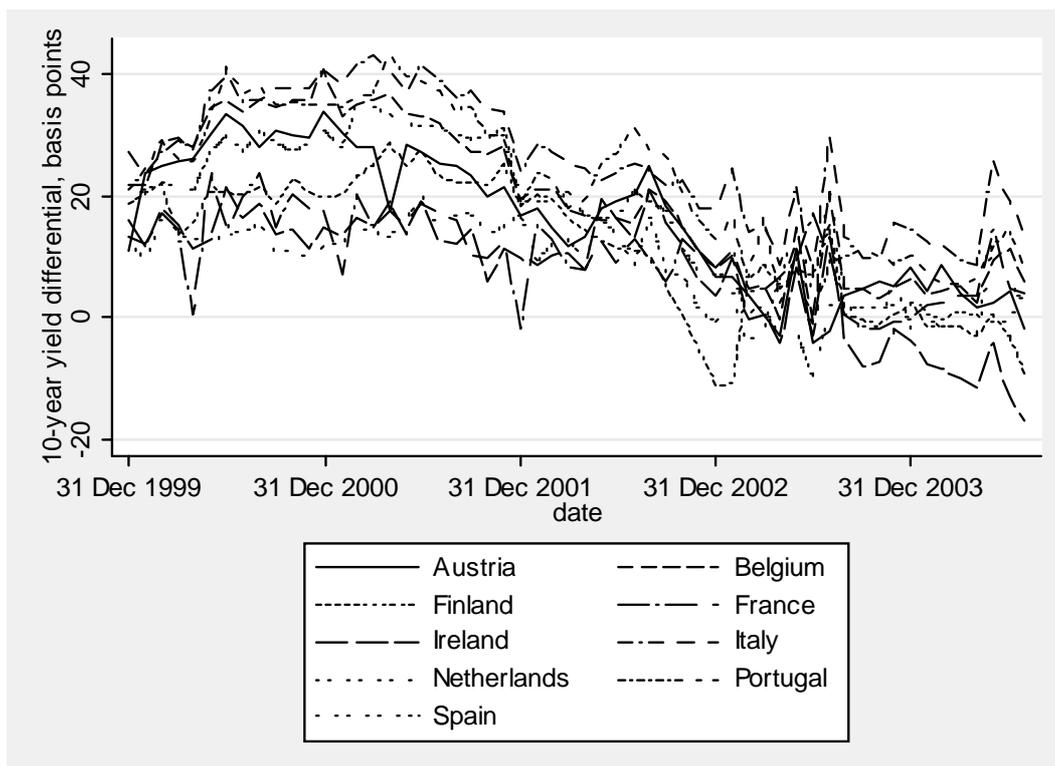
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<sup>20</sup> An interesting attempt to estimate the determinants of yield spreads of individual corporate issues in the Euro zone is Driessen (2002), who uses a three factor model for corporate bonds of various rating classes and distinguishes between global factors, rating class specific factors, and issuer-specific factors.

Finally, in the figure there is a distinct trend reduction in yield differentials relative to the Bund. One may be tempted to conclude that convergence has continued also after the inception of EMU, so that euro-area yield differentials will soon be a thing of the past. This would be a mistake, however. The *level* of most yield differentials features a trend decline because the yield on the Bund has been rising relative to most other euro-area public debt, possibly in connection with the deteriorating position of the German budget. But in absolute value the yield differentials are not declining or disappearing. To see that, it is sufficient to consider that their cross-sectional *dispersion* has remained rather stable around the value of 7 in the period 1999-2004, as shown by the lower panel of Table 7. Also the difference between the maximum and the minimum has not changed much (about 25 basis points) over this time period, even while both the minimum and the maximum declined gradually.

Therefore, since yield differentials cannot be yet written off in the Euro-area government bond market, we now analyze the determinants behind their variation across countries and over time, and review the available evidence.

**Figure 4: 10-years benchmark bond yield spreads under EMU**



*Note:* Yield differentials are computed as the difference relative to the yield on German 10-year benchmark bonds, based on monthly data (end-of-month observations). *Source:* Datastream.

**Table 7: 10-year benchmark bond yield differentials under EMU, descriptive statistics by country and by year**

| Time-series statistics by country | Average | Standard deviation | Minimum | Maximum |
|-----------------------------------|---------|--------------------|---------|---------|
| Austria                           | 16.2    | 11.1               | -4.1    | 33.8    |
| Belgium                           | 19.8    | 12.3               | -0.6    | 40.9    |
| Finland                           | 11.9    | 11.0               | -11.1   | 28.8    |
| France                            | 10.5    | 6.8                | -1.9    | 23.9    |
| Ireland                           | 7.7     | 10.0               | -17.1   | 21.4    |
| Italy                             | 26.0    | 10.6               | 6.5     | 43.1    |
| Netherlands                       | 9.4     | 6.7                | -4.4    | 20.4    |
| Portugal                          | 22.7    | 12.0               | -1.0    | 43.3    |
| Spain                             | 16.2    | 12.9               | -9.5    | 35.2    |
| Cross-country statistics by year  | Average | Standard deviation | Minimum | Maximum |
| 1999                              | 20.0    | 7.0                | 6.7     | 29.4    |
| 2000                              | 24.4    | 8.3                | 11.5    | 34.9    |
| 2001                              | 26.8    | 9.0                | 11.0    | 37.8    |
| 2002                              | 15.3    | 6.0                | 5.3     | 25.2    |
| 2003                              | 5.3     | 6.1                | -4.9    | 16.5    |
| 2004 (January-July)               | 3.0     | 7.0                | -10.3   | 14.5    |

*Note:* Yield differentials are computed as the difference relative to the yield on German 10-year benchmark bonds. The statistics are based on monthly data (end-of-month observations). The standard deviation, minimum and maximum by year shown in the lower panel of the table are the yearly averages of the respective monthly cross-sectional statistics. *Source:* Datastream.

#### 4.1. Possible determinants

The reasons why yield spreads may continue to be non-zero under EMU fall in two groups: (fundamental) risk factors and residual market frictions.

As already noticed in our discussion of the corporate bond market, yield spreads due to risk differences are not inconsistent with market integration. They may arise from either (i) intrinsic differences in country-specific default risk (due for instance to different debt-GDP ratios of different countries) or (ii) different sensitivities of the bonds' future payoffs to common shocks. As an example of the latter, consider the scenario in which EMU eventually collapses and euro-area countries revert to national currencies. In such a scenario, the convergence process analyzed in the previous section would most likely operate in reverse, with countries such as Italy, Greece, Portugal and Finland experiencing large increases in yield differentials due to the resurgence of their currency risk. In this scenario, the holders of these bonds would suffer larger losses than those of other sovereign bonds. Ex ante, a revision of the estimated probability of a future EMU collapse (a common shock) has greater effects for the prices of these euro-area bonds, which should therefore be considered as riskier.

The other possible explanation for the persistence of Euro-area yield differentials – market frictions – is instead synonymous with segmentation. Frictions include (i) trading costs, arising from bid-ask spreads, brokerage commissions or transaction fees; (ii) clearing and settlement fees, and (iii) taxes. From the perspective of market participants, some trading costs (such as the cost of market presence, clearing and settlement fees, and taxes) are exogenous, while other trading costs (such as

search costs and bid-ask spreads) are endogenous in the sense that they result from strategic responses by market participants to the structure of the market and the information available. Practitioners generally refer to all these factors related to the ease and cost of trading under the common label of “liquidity”, and in fact often argue that the residual euro-area yield differentials are due to differential liquidity.

Interestingly, illiquidity can itself generate a particular type of risk – liquidity risk. One may have to liquidate an asset at an unexpected time of need or buy at an unexpected time of affluence. Risk-neutral investors would value a euro of transaction costs identically in all contingencies. Instead a risk-averse investor would value it differently in different states of the world, since his marginal utility of wealth differs across different states of nature. In this sense, transaction costs not only have a welfare cost for investors in terms of their income effect (as they reduce lifetime resources) but also because of their risk-bearing implications. If the size of the transaction cost can vary, this creates a further source of risk.

In addition, fundamental risk and liquidity may interact with each other in nontrivial manners, which are potentially quite important for empirical work as we shall see in Section 4.2. Favero, Pagano and von Thadden (2004) make this point in the context of a general equilibrium model where idiosyncratic liquidity shocks may force investors to sell their bonds before maturity. They show that the interaction between liquidity and fundamental risk has different effects on yields depending on whether one refers to *current* or to *future* liquidity.

If a bond has high *current* transaction costs, this *softens* the negative price impact of an increase in fundamental risk. Here the intuition is similar to the logic of trading distortions resulting from taxation in public economics. Suppose that on an asset the buyer and seller must pay a proportional transaction tax. Then the larger is the transaction tax, the lower the after-tax price faced by either one. If the asset becomes riskier, the effect on the price will be smaller the larger is the tax, since the initial after-tax price is correspondingly lower. The tax effectively reduces the variance of the price arising from news about the future.

The opposite is the case if a bond is expected to have a high *future* transaction cost, that is, when the bond may have to be liquidated. In this case, illiquidity tends to *amplify* the price effect of an increase in risk. To understand why, consider that an asset with risky fundamentals is one whose future cash flow is likely to be low in “bad times”. If such an asset is also relatively illiquid, the investor who sells it in “bad times” not only is likely to get a low price because of poor fundamentals, but will also pay a high transaction cost. So liquidity risk exacerbates the effects of fundamental risk. By the same token, future liquidity may compensate for fundamental risk: when the price of risk increases, for instance because of an increase in aggregate fundamental risk, investors may prefer a more liquid bond even if it is more sensitive to fundamental risk.

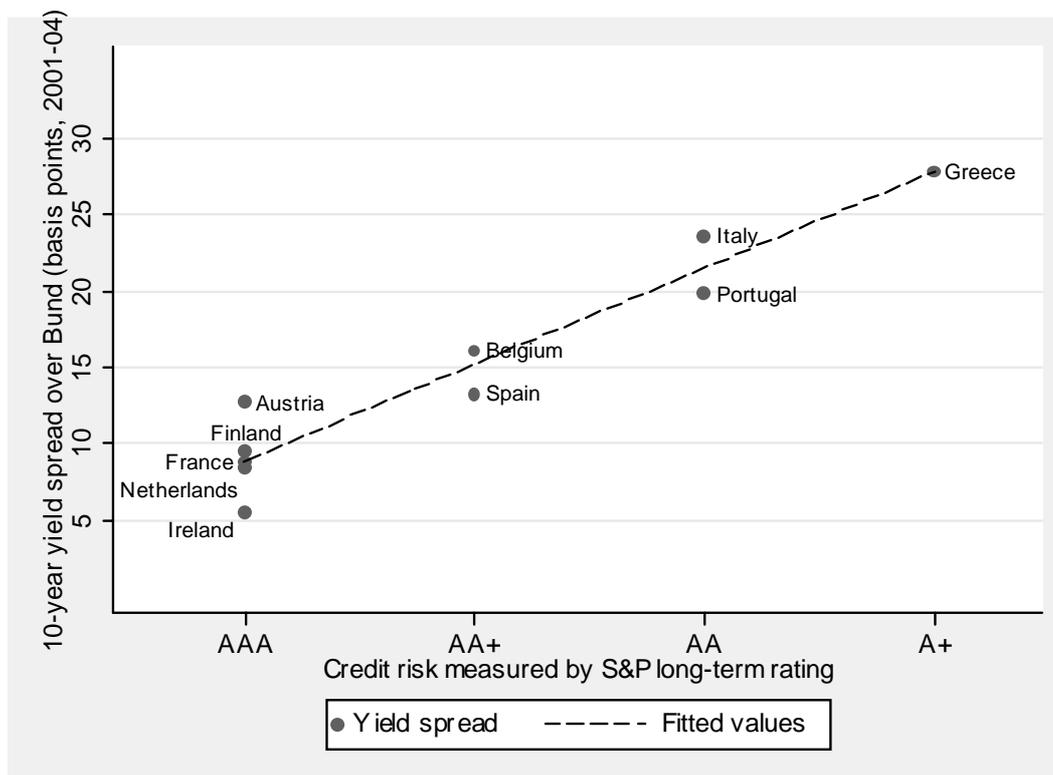
All this suggests that, to identify at the empirical level the factors that explain euro-area yield spreads, one has not only to account for differences in fundamental risk, and for differences in liquidity, but also for their interactions.

#### 4.2. *The evidence*

Figure 5 shows that fundamental risk clearly plays a role in Euro-area yield spreads. It plots average 10-year bond yield differentials relative to the German yield against the respective S&P long-term ratings, which presumably are a summary measure of credit risk. The points are clearly scattered

along a regression line with positive slope, with Greece, Italy and Portugal at the top of the range, Spain and Portugal in the middle, and Austria, Finland, France, Ireland and the Netherlands, all with AAA rating, closely clustered in a range from 5.5 to 12.7 basis points.

**Figure 5: 10-years average yield differentials and credit risk**



*Note:* Yield differentials are averages of the difference relative to the yield on German 10-year benchmark bonds, based on monthly data from January 2001 to July 2004. *Source:* Yields are from Datastream, S&P long-term ratings are from MTS Group (2004), p. 11.

Despite the paucity of the data points, this suggests that credit risk can indeed explain a considerable portion of cross-country differences in yields. This already is striking, as a sovereign default of any of these countries within 10 years seems far-fetched, given their economic history since World War 2.<sup>21</sup> But ratings may also reflect the different currency risk of these bonds in the event of a collapse of the EMU and a re-introduction of national currencies.

Even though they are closely correlated with the cross-country variation in yield spreads, ratings explain very little of their variation over time, which creates “yield spread risk”. Explaining this time variation is quite challenging, mainly because its two possible determinants – liquidity and fundamental risk – are detectable on very different time scales. Liquidity is best captured in relatively high-frequency data, where a precise measurement of transaction costs is possible.

<sup>21</sup> The relevance of sovereign default risk is further supported by credit default swap (CDS) data, available for most EMU countries since 2001. As documented by Codogno, Favero, and Missale (2003) for 2002, CDSs were priced between close to 0 basis points (for France) to more than 12 basis points (for Italy) relative to Germany, suggesting that markets perceived and priced the possibility of a default for at least some Euro zone countries (this evidence should not be overstated, as the market for CDSs is fairly thin and market prices therefore are noisy).

Fundamental risk determined by macroeconomic variables, instead, is better measured at lower frequencies, or by evaluating the impact of macroeconomic news over a long time-horizon.<sup>22</sup> Existing studies place themselves at different points in this difficult tradeoff to identify the two potential determinants of yield spreads.

Geyer, Kossmeier and Pichler (2004) estimate a multi-issuer state-space version of the Cox-Ingersoll-Roll (1985) model of the evolution of bond yield spreads (over Germany) for four EMU countries (Austria, Belgium, Italy, and Spain). They work with weekly yield spreads for the full maturity spectrum of 2 to 10 years from January 1999 to May 2002. Their approach allows to leave the factors driving the process of yield spreads unspecified and to identify the number and type of relevant factors. Their main findings are that (i) one single (“global”) factor explains a large part of the movement of all four processes, (ii) idiosyncratic country factors have almost no explanatory power, and (iii) the variation in the single global factor can to a limited extent be explained by EMU corporate bond risk (as measured by the spread of EMU corporate bonds over the Bund yield), but by nothing else (in particular not by measures of liquidity), and thus remains largely mysterious.<sup>23</sup>

The most striking finding by Geyer, Kossmeier and Pichler (2004) is the virtual absence of country-specific yield-spread risk. In fact, when they estimate a version of their model restricted to one common factor and one country-specific factor for each country, the four country-specific factors still have an average correlation of 0.76, almost as high as the correlation among common factors in individual country models. Therefore they focus on a model with two common factors for all issuers and no country-specific factors. In this estimation, all country-specific factor weights are highly significant and standard errors of residuals small. They conclude that “there is no ... issuer specific structure in EMU government bond spreads” and that “country-specific variation in spreads is best modeled by country-specific Gaussian errors” (p. 188).

Therefore, it is no surprise that these authors find no role for their liquidity variables, which are typically related to local market features and frictions. Their measurement of liquidity variables is, however, not very satisfactory, as they do not use data on bid-ask spreads, which are commonly considered to be the best measures of liquidity,<sup>24</sup> but rather indirect measures of liquidity, such as the yield differential between on-the-run and off-the-run bonds and the issue size.

The studies by Codogno, Favero and Missale (2003) and Favero, Pagano and von Thadden (2004) address this problem, by using richer data to measure liquidity, including data on bid-ask spreads in the EMU government bond market. Furthermore, these studies are more explicit in the search for relevant risk factors, by including specific international and domestic factors in their regressions.

Using monthly data, Codogno, Favero and Missale (2003) proxy the country-specific risk factor by national debt to GDP ratios (noting that other variables do not add explanatory power) and international risk factors by US bond yield spreads.<sup>25</sup> Similarly to Geyer, Kossmeier and Pichler (2004), they find that the domestic risk factor is irrelevant, except for the case of Austria, Italy and Spain. Interestingly, for the latter two countries the ratio of debt to GDP is insignificant as a single variable, but significant when interacted with one of the US risk factors. This non-linearity points to

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<sup>22</sup> For such analyses using US data see Balduzzi, Elton, and Green (2001) and Green (2004).

<sup>23</sup> The same applies to the result by Collin-Dufresne, Goldstein, and Martin (2001), who analyze US corporate bond spreads.

<sup>24</sup> See, e.g., Fleming (2001).

<sup>25</sup> More precisely, the two variables considered are (i) the spread between fixed interest rates on US swaps and US government bond yields and (ii) the spread between the yields on US AAA corporate bonds and government bonds (all for 10 years). The variables proxy the risk of the banking and the corporate sector, respectively.

a possible interaction between international market conditions and domestic fundamental risk. In particular, it suggests that, at least for Italy and Spain, international investors take domestic risk into account when reacting to changing world market risk (as proxied by US market conditions).

In a second approach, Codogno, Favero and Missale (2003) combine the daily data on US bond prices with daily data on bid-ask spreads and market activity for European government bonds in 2002. With daily data, of course, macroeconomic variables move too slowly to allow estimation of the impact of the domestic risk factor, and thus are not included. In this estimation, the international factor is statistically significantly different from zero for all countries except for Finland, France, and Ireland, while liquidity (as measured by the trading volume on EuroMTS) plays a statistically significant and correctly signed role for France, Greece, the Netherlands, and Spain. When compared to the first set of results in the same paper, the fact that international risk remains significant for several countries once liquidity is controlled for may imply that “differences in default risk are the main propagation mechanism” (p. 524). But as the authors admit, this conclusion is not very strong. In particular, most countries in the sample display very similar debt to GDP ratios, with only Belgium and Italy clearly above, and Ireland clearly below the median. Hence, it seems difficult to attribute observed market segmentation directly to these national differences.

Favero, Pagano and von Thadden (2004) analyze the possible causes and consequences of liquidity in more detail. In particular, they point out that transactions costs should affect yield differentials in two ways: directly with a positive sign (as investor require higher returns to compensate them for transaction costs), and indirectly through the interaction of liquidity with fundamental risk. The sign of the coefficient of this interaction term depends on whether the liquidity variable reflects current or future trading costs, as explained in Section 4.1 above. Depending on which component is more prominent, the impact of changing international (common) risk factors may be different. The main insight of the theory for the econometric specification is that liquidity effects should enter both linearly and via their interaction with the risk factor.

The empirical analysis by Favero, Pagano and von Thadden (2004) uses two years of daily transactions data from EuroMTS and bid-ask spreads carefully synchronized with return data. First, they confirm the previous two studies’ finding that the international risk factor is highly significant for all countries.<sup>26</sup> Second, they find a greater role for liquidity variables, provided they are interacted with risk variables in the specification, as suggested by their model. Focusing for brevity on their results for the 10-year maturity, the coefficient of the bid-ask spread is positive for all countries except Finland, but significantly different from zero only for Austria, Belgium, the Netherlands and Portugal. So, as predicted by the theory, for these four countries a higher bid-ask spread is associated with a higher yield spread. Importantly, in all four cases, the positive effect of the bid-ask spread on yield differentials is paired with a significantly negative coefficient of the interaction term between the liquidity measure and the international risk factor. This illustrates the importance of non-linearities in the effect of liquidity indicators on yield differentials. In fact, the coefficient of the liquidity differential is significant only when this interaction term is included.

In conclusion, despite their considerable differences in the methodology and data used, all three studies agree on the finding that yield differentials under EMU are driven mainly by a common risk (default) factor, related to the spread of corporate debt over government debt. They also agree on the conclusion that liquidity differences have at best a minor direct role in the time-series behavior of yield spreads, and – according to the last of the three studies – an indirect role, in that they modify the impact of the risk factor on yield spreads.

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<sup>26</sup> In this study, the international risk factor is measured as the spread between the fixed interest rates on US swaps and the yield on US government bonds of the same maturity.

An open question remains about why the common international risk factor is best measured by the differential between corporate and public bond yields in Europe and in the US: does this capture events in the US that impact European bond markets directly? Or is there a common latent variable that makes European and US data comove? And if there is such a common factor, is its impact on European spreads mainly a direct one or is it mediated by liquidity or macroeconomic variables?

A possible approach towards answering the first two questions is to study the dynamic linkages between the time series of bond returns explicitly. This is done by Skintzi and Refenes (2004) who estimate an extended GARCH model of European and US weekly bond returns and (time-varying) volatilities.<sup>27</sup> They find stronger evidence for spillovers between the volatilities of the return series than for the returns themselves. In particular, they find return spillovers from an Euro area index into the series of 4 out of 8 EMU countries (Belgium, France, Netherlands, and Spain), and volatility spillovers for 6 out of the 8 countries (Austria, Belgium, France, Germany, Italy, Spain). These spillovers have intensified after the start of EMU. For the four European non-EMU countries in the sample, they find no spillovers for returns, but volatility spillovers into the series for Denmark, Sweden, and the UK.

Concerning the impact of the US series (modeled as an exogenous factor), Skintzi and Refenes (2004) find an impact on returns within EMU only for Austria, Belgium, and Spain (and the three Scandinavian countries), but a clear impact on the volatilities of all 8 EMU countries. The first of these two results is surprising in the light of the findings discussed earlier in this section, and the second suggests that further studies should pay more attention to volatilities, and not only returns.

## 5. Conclusions

The years since monetary unification have witnessed the emergence of an integrated Euro-area bond market. Issuers and investors alike have come to regard the Euro-area bond market as a single one. Primary and secondary bond markets have become increasingly integrated on a pan-European scale. Issuance of corporate bonds has taken off on an unprecedented scale in continental Europe. In the process, both investors and issuers have reaped the considerable benefits afforded by greater competition in the underwriting of private bonds and in the auctioning of public ones, and by the greater breadth and liquidity of secondary markets.

These benefits have been particularly valuable for Euro-area governments, many of whom must service a large stock of public debt: for them, even shaving a few basis points off the cost of debt servicing makes a considerable difference in terms of reduced taxes to be raised in the future. But the benefits have been no less important for European companies, which have acquired cheaper access to a market that can disenfranchise them from banks for the provision of debt finance. The effect on company financing and the attendant effects on credit markets are likely to be the most pervasive legacy of European bond market integration.

Bond yields have converged dramatically in the transition to EMU. The persistence of small and variable yield differentials for sovereign debt under EMU indicates that Euro-area bonds are still not perfect substitutes. However, to a large extent this is not the reflection of persistent market segmentation but of small differentials in fundamental risk – either in default risk or in vulnerability to the risk of eventual EMU collapse. Liquidity differences appear to play at most a minor direct role, but a more significant role through their interaction with changes in fundamental risk.

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<sup>27</sup> The EMU countries in their study are Austria, Belgium, France, Germany, Ireland, Italy, the Netherlands, and Spain, the European non-EMU countries Denmark, Norway, Sweden, and the UK. They rely on the national Datastream Benchmark Bond Indices (total returns) with 5 years average maturity for the period 1/2/1991 – 31/12/2002.

The challenges and opportunities still lying ahead are numerous. First, there is a striking unbalance between futures and cash markets. Euro-area futures refer almost entirely to German bonds, while the cash market for German bonds is far less developed, which periodically determines squeezes and inefficient price volatility. In contrast, other large cash markets, such as the Italian one, are very liquid but lack a corresponding future market.

Second, the impressive liquidity of the cash markets is due to the market-makers' collective commitment to quote bid and ask prices for very large amounts at very tight spreads, but this commitment is vulnerable to free-riding and manipulation by large financial institutions, as the August 2004 Citigroup episode demonstrates. It is still unclear whether such opportunistic behavior is a serious threat to the persistence of the current liquidity levels.

Third, the possibility of joint bond issuance by Euro-area countries has been repeatedly considered because of its ability to fully exploit the liquidity benefits of a completely unified market. However, issuers have so far discarded it because it would generate an implicit debt guarantee by some countries in favor of others, with potentially serious incentive effects on fiscal discipline. The challenge here is to design a scheme capable of reaping the liquidity benefits of joint issuance, while minimizing its adverse effects. For instance, joint issuance could be allowed only to EU countries that respect certain standards of fiscal discipline and/or could be limited to short maturity bonds.

Another challenge is to overcome the persistent fragmentation of clearing and settlement systems in the Euro-area bond market, which prevents a full integration of the market for private-sector bonds.

Last, but not least, the Euro-area bond market will expand further as new EU member countries gradually join EMU. In fact, in anticipation of this outcome, their bonds are already being actively traded on the same platforms that cater to the bonds of existing EMU members.

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