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ECONOMIC ANALYSIS FROM EUROPEAN COMMISSION'S DIRECTORATE GENERAL FOR ECONOMIC AND FINANCIAL AFFAIRS

Fragmentation of wholesale funding markets – an empirical approach to measure country-specific risk premia in banks' bond spreads

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Summary

This brief presents empirical evidence that euro-area wholesale banking markets have become fragmented along national boundaries. The estimations identify a significant premium in the range 60-170 basis points on issued debt that banks have paid to investors if they are located in Spain, Ireland or Italy. Portuguese and Greek banks paid a premium up to 170 respectively 200 basis points due to the impact of sovereign risk on market fragmentation. The premium for banks in other core countries is in the ballpark of around 30 to 60 basis points.

The coefficients should be read as an average risk premium over the period mid-2010 to January 2014 that banks have to pay more than banks located in Germany. The range emerges from the results of estimates that differ in whether they exclude sovereign risk from the fragmentation premium (lower bound) or treat sovereign risk as part of the fragmentation premium (upper bound). For the pre-crisis period 2003-2010, coefficients were generally insignificant or much lower.

Introduction

In a monetary union, integrated financial markets play a central role for the smoothing of income shocks and the sharing of risks. The trend of increased integration in the EU banking sector that had prevailed up to 2007 has been revered since the global financial crisis and the euro area sovereign debt crisis. Especially the observation of diverging rates for bank lending to the private sector across euro-area Member States has given rise to a discussion on financial fragmentation against the background that diverging credit trends entail considerable consequences for the euro area's cyclical outlook.

This brief provides evidence of fragmentation on the market for bank funding through bonds. Fragmentation is measured by estimating whether the country of residence of euro-area banks has an impact on their costs of debt issuance.

The standard approach measures fragmentation through the rising dispersion in the interest rate on credit to non-banks. This measure is limited to indicating how the costs of fragmentation are passed through to customers. Moreover, the complication with this measure was that both credit risk and demand for credit have become more dispersed as evidenced by the trend in non-performing loans and cyclical developments. Attempts to disentangle the impact of risk and fragmentation on market prices has been inconclusive, with most of the analysis suggesting that credit risk factors have a non-negligible impact (see Battistini et al. (2013), IMF (2013), ECFIN (2012, 2013) and the references quoted therein).

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While market fragmentation should be visible in different coefficients of country-specific variables, a central question is whether sovereign risk is considered a sign of fragmentation or of credit risk. On integrated markets, there is little reason that the credit risk of healthy banks should be strongly correlated with that of the sovereign. Public support to ailing banks since 2008, however, revealed the importance that the implicit guarantee of the sovereign for banks can have. Consequently, credit rating agencies take sovereign risk into account when assessing the credit risk of banks. A number of banks were downgraded shortly after the sovereign they are located in had been downgraded.

The econometric approach used here has the advantage of allowing for different treatment of sovereign risk. When inserting the yield on public bonds as additional control variable, the fragmentation premium can be considered an add-on to sovereign risk. The coefficients in estimates with control for the sovereign yield define the lower range of the fragmentation premium. The upper range comprises that part of the risk premium that is caused by sovereign risk.

In a comparable approach, Gilchrist and Mojon (2014) compiled a measure of market fragmentation that also focuses on the yield of bonds issued by banks and corporates. They constructed national indices of bonds issued by banks and corporates for Germany, France, Italy and Netherlands from yields on secondary markets. The calculation of their credit spread is very similar to the measure used here. They arrive at much higher differences between yields that Italian and Spanish banks have to pay compared to French and German banks. It is however not clear to what extent this higher difference is due to factors unrelated to market fragmentation, for example because of differences in ratings or other characteristics of the bonds.

While data and methodological caveats suggest the approach is not be perfect, it delivers plausible results, based on much wider coverage than alternative data sources could provide. The data panel used here is based on bonds issued by more than 400 banks. Although the use of the data base requires some transformation of the data and yields an approach that could be considered being dependent on the estimation technique, alternative data sources, such as on interbank markets[1] or CDS markets[2], suffer from problems that are equally serious.

Description of the approach

The approach chosen is based on yields on primary markets, when dealer banks have to set a price to sell the bond and a number of variables control for changes to the market environment over time as well as for characteristics of the bonds. The advantage of the econometric approach is that it helps isolate the impact of other determinants of the bond yield, reflecting that the underlying bonds are very heterogeneous, differing along maturity, coupon, ratings, amounts and a host of other characteristics. The population of banks active on the market also varies over time while liquidity on secondary markets is thin.

The key idea of the exercise consists in testing whether the dummy for the county of origin of a bank is able to explain the price it has to pay when issuing a bond, when controlling for factors that reflect market conditions on the day of issuance, characteristics of the bond and the rating of the bank. The approach broadly follows the set up chosen in London Economics (2021) that analysed the impact of state guarantees on the yield of bank bonds. Bond data stems from Dealogic, market data from Global Data Insight. The dependent variable is the spread on the day of the pricing of the bond, calculated as the yield of the bond displayed by Dealogic in the data base minus the yield of the German government bond with same maturity on the same day.[3] For

[1] The interest rates that banks charge amongst each other in interbank lending operations are not public and Euribor quotes are poor proxies. They are based on indications of what banks understood the market rate was, but not on actual rates they charged or paid, and the sample of banks has dropped to currently 30 banks, implying that for some countries there are only 1 or 2 banks that quote rates. This would hardly be representative for a country index. Moreover, they have been subject to manipulation, which is consistent with the observed small actual variation of data across the panel.

[2] CDS quotes are more harmonised than bond yields and available as time series. They are, however, only available for about 40 large EU banks among and it is not evident whether transactions are taking place at the quoted prices.

[3] For a subset of bonds, the database provides a ready-made asset swap spread. These were used for robustness tests.

maturities of non-round years, the yield of the benchmark was interpolated.[4]

The main independent variable of interest to identify fragmentation is the origin of the issuing bank. Dealogic offers two options, the nationality of the issuer and the nationality of the underlying risk. For most bonds, these are identical. The notable outlier is Ireland, i.e. bonds issued by branches or subsidiaries of foreign banks in Ireland. Both were used as dummy variables. The nationality of the risk turned out to produce more consistent results in terms of lower standard deviation and higher R2.

In some estimates, sovereign risk was controlled for by the yield of the 10-year sovereign bond of the country of the underlying risk. This allows the fragmentation premium to be decomposed in a part that is dependent on the solvency of the sovereign and a part that is not, reflecting whether sovereign risk is considered part of the fragmentation premium. The estimates with control for sovereign risk describe the lower bound as a "pure" price of market segmentation. The upper bound includes sovereign risk, obtained through the estimate without control for sovereign risk, or, as control, the obtained elasticity times the observed yield spread difference. The range helps identify to what extent policy measures that address the sovereign-bank nexus may also reduce the costs of fragmentation. The coefficient for sovereign risk was assumed identical for all euro-area Member States in the standard specification. In a different specification, the coefficient was allowed to be different across countries. In this case, the 10 year sovereign yield of the country of the risk was used instead of the country dummy.

A host of control variables were added to isolate the influence of bond-, bank- and time-specific factors. As regards the characteristics of the bond, control variables were maturity, volume, squared volume and dummies for collateral/covered, guarantees, subordination, private placement, callable. Bank-specific controls were the rating and whether it was issued by a non-bank entity. The insertion of further bank-specific control variables, possibly balance sheet data, would be an avenue for further research. For the time being, credit ratings were used as "catch-all" variables.

Since all bonds were issued at a different point in time, the market situation on the day of the pricing is controlled by the 10-year swap rate on the day, the term premium (10 year German sovereign yield minus 3 month Libor) and the VIX. The latter is the implied volatility of the S&P 500, which has emerged as a custom measure of uncertainty on global markets. The choice of the interest rate variables was motivated by avoidance of multi-collinearity. The swap rate and the term structure have a much lower correlation (-0.18) than any other combination of interest rates (between 0.7 and 0.99).

The available data set was cleaned in order to arrive at a panel with meaningful observations. The initial data base consisted of more than 14000 bonds issued by 504 euro area banks between 2003 and January 2014. The cleaning of the data pool led to a reduction in the number of observations that could actually be used to 4364 bond issuances by 429 banks. The cleaning process followed three steps. In a first step, all bonds not issued by a bank located in DE, FR, IT, BE, AT, NL, PT, ES, FI or LU were deleted. For other countries, too few observations were available. In a second step, all bonds with variable coupons or maturity either below 2 or above 12 years were deleted in order to ensure the consistent calculation of the spread variable.[5] Furthermore, all bonds with a spread below 50 basis points were deleted from the sample in a third step[6].

The initial estimate was carried out with all control variables. Subsequently, the insignificant variables were eliminated and among the correlated variables, the best performing ones in terms of lower standard deviation were maintained. For the reduced-form estimate, the sample was split into

- a pre-crisis period from 2003 to June-2010 (pre-sovereign crisis ending with the EL programme, 2192 observations) and

[4] A superior alternative to this i-spread would be the z-spread used in London Economics (2012), which takes the curvature of the yield curve into account. This calculation would however require the use of sophisticated financial software not available in ECFIN.

[5] Yields of sovereign bonds with a maturity below 2 years would have to be taken from a different data source, which would have impaired the interpolation of the yields. For maturities above 12 years, interpolation would have to be done with 15, 20 or 25-year bonds, which reduces accuracy and could yield a material impact of the curvature of the yield curve.

[6] Many spreads were artificially low, often negative, due to a misleading coding in the original data base. The yield displayed was not adjusted for contractually agreed changes in the coupon, i.e. stepwise increases or declines over time, and differed therefore from the true yield. Since it was practically impossible to recalculate the yield for a few thousand bonds, these bonds were excluded from the usable sample.

- a crisis period from July 2010 to January 2014 (2172 observations).

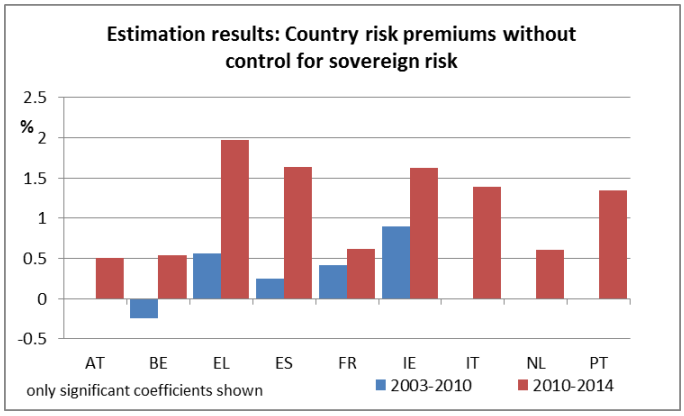
Additional splits of the sample were introduced with panels ranging from

- 2003 to mid-2007 (pre-crisis, 272 observations),
- mid-2007 to mid-2010 (banking crisis, 1920 obs.),
- mid-2010 to mid-2012 (sovereign crisis, 1532 obs.),
- mid-2012 to January 2014 (post OMT, 640 obs.).

For some countries there were very few observations in this more detailed breakdown, i.e. 5 Finnish, 3 Greek in the final period, 2 Irish in the pre-terminal period. Therefore, interpretation is based on the estimate for the breakdown in two periods.

Results

Most estimates of coefficients of country dummies are significantly different from zero for the period of the sovereign debt crisis. Most control variables have the expected signs and the ones kept are highly significant. R2 is reasonably high at 0.26 for the pre-sovereign crisis and 0.56 for the crisis period. Country dummies are around 1.7 for the crisis period for IE, IT and ES (see estimate 1 in the table) and 0.6 to 0.7 in estimates that control for sovereign risk (see estimate 3 in the table). That is, banks in these countries pay about 60 to 170 basis points more because of their location in a vulnerable Member State. As regards the effect of higher sovereign risk, the coefficient suggests that a 100 basis points increase in the sovereign yield increases the spread by 30 basis points (see estimate (3) in the table). When the estimate is re-run for the period 2003-mid 2010, country coefficients are much smaller or not significant (see chart below and estimate (2) in the table).



Coefficients for PT and EL are at 130 and 200 basis points if sovereign risk is not controlled for. When however controlling for sovereign risk, coefficients turn negative in estimate (3), which is at odds with expectations. Taken at face value, the estimates suggest that sovereign risk explains the fragmentation premium in these two countries whereas in the other countries there is a small share of the fragmentation premium that is unrelated to sovereign risk.

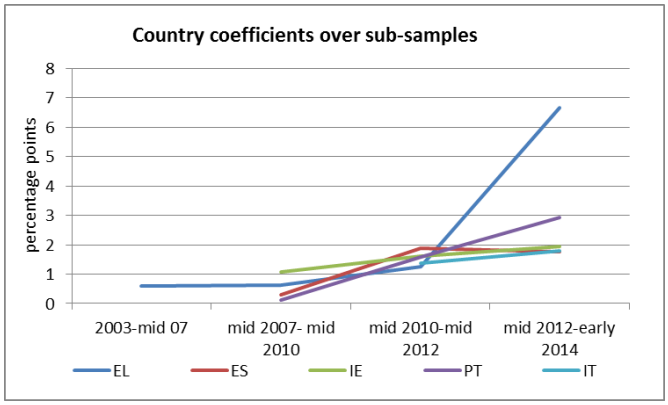
Since sovereign and banking risk are interrelated, other specifications where tested. The assumption in the preferred estimate that the coefficient of sovereign risk is the same across countries can be loosened. If the country dummies are replaced by country-specific coefficients for sovereign risks (i.e. the sovereign yield of the country instead of the dummy), it turns out that coefficients are around 0.5 for all countries, except EL and PT, where they are around 0.2 (see estimate (4) in the annexed table), yielding a fragmentation premium of 190 and 173 basis points, respectively. This could mean that either sovereign risk has a smaller impact on banking risk in these two countries or, more realistically, that the sovereign yield in these countries was particularly high. The latter would be consistent with the notion of an overshooting of sovereign risk in some vulnerable Member States. If both country dummies and country-specific sovereign risk are estimated simultaneously, one of the coefficients turns insignificant. There is, however, no regularity: for EL and IE the country dummies remain significant, for ES, IT and PT the sovereign risk coefficient.

Table: Estimation results, dependent variable spread of bonds issued by banks over same-maturity German bond on day of pricing of issuance

	(1) 2010H2-2014		(2) 2003-2010H1		(3) Like (1) with sovereign risk		(4) Like (1) with sovereign yield instead of country dummies		(5) Like 1 with swap spread as dependent variable	
	Coefficient	prob	Coefficient	prob	Coefficient	prob	Coefficient	prob	Coefficient	prob
C	2.40	0.00	1.40	0.00	2.44	0.00	2.20	0.00	1.77	0.00
AT *)	0.51	0.00	-0.01	0.92	0.35	0.00	0.51	0.00	0.39	0.00
BE *)	0.54	0.00	-0.25	0.00	0.17	0.34	0.46	0.00	0.63	0.00
EL *)	1.97	0.00	0.56	0.00	-1.33	0.00	0.17	0.00		
ES *)	1.64	0.00	0.25	0.00	0.77	0.00	0.52	0.00	1.83	0.00
FI *)	0.43	0.07	0.28	0.33	0.29	0.24	0.54	0.00	0.12	0.49
FR *)	0.62	0.00	0.41	0.00	0.38	0.00	0.55	0.00	0.46	0.00
IE *)	1.62	0.00	0.89	0.00	0.69	0.02	0.42	0.00	1.16	0.00
IT *)	1.39	0.00	0.04	0.54	0.61	0.00	0.51	0.00	1.49	0.00
NL *)	0.60	0.00	0.12	0.10	0.32	0.01	0.49	0.00	0.40	0.00
PT *)	1.35	0.00	0.14	0.11	-0.06	0.77	0.31	0.00	2.17	0.00
LU *)	1.18	0.00	0.28	0.01	1.10	0.00	0.83	0.00		
Swap rate	0.25	0.00	-0.17	0.00	-0.09	0.18	-0.21	0.00	0.50	0.00
Term premium	-0.87	0.00	-0.03	0.11	-0.72	0.00	-0.66	0.00	-0.98	0.00
VIX	0.00	0.66	0.01	0.00	0.00	0.55	0.01	0.16	-0.01	0.05
maturity	-0.05	0.00	0.02	0.00	-0.05	0.00	-0.05	0.00	0.03	0.02
volume	0.00	0.03	0.00	0.09	0.00	0.00	0.00	0.01	0.00	0.19
volume^2	0.00	0.13	0.00	0.03	0.00	0.05	0.00	0.11	0.00	0.11
Guarantee *)	0.88	0.00			0.72	0.00	0.66	0.00	-1.22	0.00
Collateralised *)	0.14	0.13	-0.36	0.00	0.04	0.69	0.01	0.93	-0.51	0.00
Private issuance *)	0.13	0.04	0.04	0.28	0.13	0.04	0.11	0.06	0.11	0.51
non-bank entity *)	-0.16	0.79	0.32	0.32	-0.24	0.68	-0.14	0.81	-0.97	0.01
subordinated *)	1.53	0.00	0.51	0.00	1.72	0.00	1.64	0.00	1.16	0.00
AAA *)	-1.17	0.00	0.03	0.59	-1.08	0.00	-0.94	0.00	-0.54	0.00
AA *)	-0.97	0.00	0.18	0.02	-0.95	0.00	-0.84	0.00	-0.60	0.00
AA+ *)	-0.95	0.00	0.09	0.37	-0.87	0.00	-0.71	0.00	-0.50	0.00
AA- *)	-0.86	0.00	0.28	0.00	-0.83	0.00	-0.69	0.00		
A *)	-0.11	0.22	0.23	0.01	-0.20	0.04	-0.04	0.67	-0.33	0.00
A+ *)	-0.50	0.00	0.20	0.01	-0.57	0.00	-0.45	0.00	-0.03	0.79
A- *)	-0.47	0.00	0.36	0.00	-0.50	0.00	-0.40	0.00		
BBB *)	0.19	0.20	0.74	0.00	-0.02	0.91	0.06	0.68	0.43	0.00
BBB+ *)	0.07	0.59	0.43	0.00	-0.14	0.28	-0.11	0.38	0.30	0.32
BBB- *)	4.60	0.00			-0.06	0.79	0.44	0.00	0.30	0.37
BB *)	0.31	0.36			0.32	0.35	2.20	0.00	1.77	0.00
Sovereign risk +)					0.30	0.00	0.51	0.00		
Adjusted R-squared	0.56		0.26		0.52		0.59		0.73	
Prob(F-statistic)	0		0		0		0		0	
observations	2171		2193		2171		2171		568	

*) Dummy equal to 1 if the condition applies to a bond, country dummies replaced by 10 year sovereign bond of the country in estimate (4) except for LU. Coefficients of country dummies are to be read as the cost of not being located in Germany.

+) Sovereign risk measured as 10 year yield of sovereign bond of the country of risk. German bond yield for bonds by German banks in estimate (4).



If the estimation is redone with the breakdown of four sub-periods, coefficients for vulnerable Member States increase over time and become significantly different from zero (see right chart above). Country dummies are generally not significantly different from zero in the pre-crisis period 2003-2007 for both vulnerable and non-vulnerable Member States. In the estimates with control for sovereign risk, non-vulnerable Member States' coefficients stay insignificant for most other periods. Moreover, they do not decline for the last sub-period, which covers the time after the announcement of OMT, when sovereign risk considerably moderated. One could therefore argue that the effect of OMT on banks' funding costs was limited to the indirect effect via lower sovereign risk. It should be noted however, that for these sub-periods, the above mentioned low number of bond issued in some countries questions the reliability of the results.

The robustness tests carried out do not undermine the general results. When the nationality of the bank is used rather than the country of the risk to construct the country dummy, coefficients remain stable except for IE. This is not surprising as both parameters are the same for most bonds in all countries. The exception is IE where 60 bonds were issued by Irish entities, but with only 44 bonds exposed to risks in Ireland. The issuers were mainly Irish subsidiaries of German and Italian banks.

Since rating agencies adjust bank ratings to the rating of the sovereign, an endogeneity bias emerges. To at least partially take account of it, additional estimates were run with ratings clustered in the preferred specification into A, B and other including not-rated bonds. Coefficients remained broadly constant. The country-risk premia of IE, ES and IT declined to about 60 basis points.

The elimination of bonds with artificially low spread, i.e. below 50 basis points, seems not to have a material impact on the significance of the estimates. The coefficients increase when observations with systematically lower dependent variable are added to the panel. Coefficients remain significant and the order of coefficients across countries remains unchanged, i.e. all shift up by about the same amount. A second robustness tests consisted in using an alternative cleaning technique[7] and a third in using the asset swap spread instead of the spread over the Bund yields leads to broadly similar results (see estimate 5 in the table).[8] Coefficients for the vulnerable Member States are comparable, being slightly higher for ES and PT at 180 and 220 basis points. The data panel is however substantially smaller with 568 observations for the period 2010H2 to 2014.

An interesting side-result was obtained for subordinated bonds. The coefficient rises over the sub-periods from insignificant in 2003-mid-2007 via 0.75 in the banking crisis and 1.3 during the sovereign crisis period to 2.4 in the OMT period. The implied increase in the costs of issuing subordinated bonds from zero to 240 basis points is consistent with the increased prominence given to bail-in of subordinated debt over time.

Discussion and caveats

The main result indicates that banks in vulnerable Member States are paying a significant premium for medium-term funding on bond markets. This country premium can be interpreted as measure of market fragmentation. In ES, IE and IT, part of the premium seems to be unrelated to sovereign risk. Such a part unrelated to sovereign risk is however not identifiable for PT and EL. This is consistent with the notion of sovereign risk being at the core of financial stability risks in these countries, whereas in ES and IE banking risk is widely seen to be at the core of sovereign risk.

Two relevant methodological caveats cast doubts on the robustness of the results. First, data quality is an issue and became evident in hundreds of bonds with a negative spread. Though these were eliminated from the panel, it is likely that the computation error leading to negative spreads

[7] For this test, the panel was not cleaned from spreads with implausibly low values. Instead, all bonds with special comments on the coupon were deleted, motivated by the observation that unusual time properties of the coupon are usually flagged in the coupon.
[8] The asset swap spread is available in Dealogic for a subset of bonds.

is also present in the yield of retained bonds. The underlying issue is that the yield in the data base is derived from issuing prices and coupons. Both components give scope to miscalculations. Many bonds or large parts of them were not completely sold to the market, but retained and have served mainly as collateral in central bank operations rather than as an investment vehicles. This may have led to distorted prices. As regards coupons, for many of the bonds with negative or low spreads the coupon was not constant over time, but followed a formula and it seems to be the case that the data provider did not fully embody changes to the coupon in the formula used to calculate the yield. The second caveat relates to the remaining correlation between dependent variable and error term. Bonds with large residuals tend to be those that are endowed with large spreads. The reason could be that the control for ratings is not sufficient to fully control for bank-specific risks. The high R2 gives some reassurance that the exogenous variables used are not marginal compared to the missing unobserved variables.

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