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**Working Paper**

## Leading indicator properties of corporate bond spreads, excess bond premia and lending spreads in the euro area

ECB Working Paper, No. 1911

**Provided in Cooperation with:**

European Central Bank (ECB)

*Suggested Citation:* Krylova, Elizaveta (2016) : Leading indicator properties of corporate bond spreads, excess bond premia and lending spreads in the euro area, ECB Working Paper, No. 1911, ISBN 978-92-899-2159-6, European Central Bank (ECB), Frankfurt a. M., <https://doi.org/10.2866/090796>

This Version is available at:

<https://hdl.handle.net/10419/154344>

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EUROPEAN CENTRAL BANK  
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## Working Paper Series

Elizaveta Krylova **Leading indicator properties of corporate bond spreads, excess bond premia and lending spreads in the euro area**

No 1911 / June 2016



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## Abstract

This paper analyses leading indicator properties of a broad set of credit spreads, compiled on the basis of information from both corporate bonds and bank loans for forecasting of real activity, unemployment, inflation and lending volumes in the euro area and in five major European economies. It also introduces a set of indicators for excess bond premia, adjusting corporate bond spreads for credit risk of the issuer and the term, coupon and liquidity premia. I find that the majority of macroeconomic indicators can be better predicted by the excess bond premia compared to non-adjusted indices; the rating-adjustment and time-varying parameter estimates seem to be particularly important. Although the predictive power of lending spreads is inferior to the predictive power of the excess bond premia, the forecasting performance of models which use the information from both lending and corporate bond spreads is always superior to models using only information from one source of external funding.

JEL classification: G12, C21, C22, E37, E44

Keywords: excess bond return, credit risk, forecasting

## Non-technical summary

Numerous empirical studies show that financial indicators, in particular corporate bond spreads, contain valuable information for future outcomes of macroeconomic indicators and lending volumes. Theoretical interpretations of this fact emphasize the impact of the external finance premium, which refers to financing conditions of corporations. Asymmetric information and financial markets imperfections are the most prevailing explications for why external finance is costly and why the availability of external finance may be time varying. Two major types of external funding opportunities for euro area corporations include bank loans and corporate bonds. However, contrarily to the US, funding through the issue of corporate bonds still plays a relatively minor role in the euro area.

In line with the theoretical considerations regarding the nature of the external finance premium, lower grade corporate bond spreads are supposed to contain more valuable information for future real activity as they represent financing conditions of firms typically considered being vulnerable to financial frictions. And the BBB-AAA corporate bond spread accounts for the differences in financing conditions of firms with different credit qualities. Similarly, lending rates on small loans together with rates on overdrafts reflect conditions of bank loans for firms and households considered being more vulnerable to financial frictions. And the spreads between lending rates on small and big loans account for the differences between bank loans for firms with different credit qualities. This paper empirically verifies these theoretical considerations and assesses which information regarding underlying bonds and loans is important for forecasting real activity, unemployment, inflation and volumes of lending in the euro area and in five major European economies.

From the dataset on individual corporate bonds, I construct various corporate bond spread indices based on different attribution (country, sector and rating) of underlying bonds. Rating attribution of corporate bonds appears to be especially important for forecasting, in particular, the BBB-AAA spread, which is traditionally used for forecasting of macroeconomic indicators, is performing better than alternative corporate spreads. Subsequently, I introduce a set of the excess bond premia, which captures the deviations of corporate bond pricing from the pricing of credit risk of an issuer, additionally adjusted for the term, coupon and liquidity premia. I find that most of the predictive power of corporate bond spread indices is related to the developments in the excess bond premia. The excess bond premia, which allow the variations in the pricing of credit risk and other factors always outperform alternative excess bond premia in terms of forecasting. These variations in the pricing of credit or other risks are most likely linked to the market participants' perceptions of risks and to prevailing risk-tolerance among investors, introducing the time-varying risk premia in corporate bond yields.

Finally, I demonstrate that the predictive power of models which use the information from both lending and corporate bond spreads is always superior to the predictive power of regressions using only information from one source of external funding. Thus, the information content of spreads, derived from both major sources of external financing for euro area corporations and households is complementary to each other and are both important for forecasting of macroeconomic indicators and volumes of lending.

## 1. INTRODUCTION AND LITERATURE OVERVIEW

This paper relates to the empirical literature on the forecasting power of financial indicators, in particular of corporate credit spreads, for macro-economic variables. A number of studies have examined this issue by means of small-scale models and dynamic factor models (see, e.g. Gilchrist et al, 2009, for references). The major conclusions of these studies vary substantially depending on the chosen set of financial indicators and on the time periods under investigation. Already Stock and Watson (2003) concluded that the forecast performance of a single financial variable is rather unstable over time<sup>2</sup>. Theoretical reasonings for why financial markets anticipate business cycle phases are two-fold. The first explanation relates to the intrinsic forward looking nature of financial markets: even in the absence of any causal links between financial conditions and future macroeconomic outcomes, asset prices capture expectations of market participants regarding the future rate of growth of the economy. The second explanation accounts for a more active role of financial markets, emphasizing the financial accelerator mechanism and the External Finance Premium (EFP), defined as the gap between the cost of external and the opportunity cost of internal finance (see, for example, Bernanke et al, 1999). Asymmetric information and financial markets imperfections are the most prevailing explications for why external finance is costly and why the availability of external finance may be time varying.

The purpose of the present paper is to complement the existing literature by designing refined proxies for the EFP, which are linked to the two major sources of external funding in the euro area, and by assessing the predictive power of these indicators for real activity, inflation and lending activity in the euro area and in five major European economies. In more detail, first, this paper constructs various volume-weighted maturity-matched corporate bond spread indices based on rating, country and industry attribution of underlying bonds on the basis of most representative individual euro-denominated investment grade bonds (see Section 2.1). Second, it introduces a broad set of volume-weighted indices of the Excess Bond Premia (EBPs) and excess bond returns on the basis of residual components, unexplained by bond-specific characteristics and available information regarding credit quality of underlying bonds (see Section 2.2). Third, it compiles several bank lending spread indices, distinguishing between different interest rate fixation periods as well as risk profiles of borrowers (as discussed in Section 2.3). And finally, this paper assesses the forecasting performance of the abovementioned proxies for the EFP and the combinations of credit spreads, based on the information contained in both corporate bonds and bank loans (see Section 3).

Recent studies, which focus on predictive content of financial variables for euro area real activity in the framework of large-scale and medium-scale models include, among others, Forni et al. (2009) and

<sup>2</sup> Evolution of financial markets is one of explanations of the time-varying predictive properties of financial indicators, the rapid pace of financial innovations over the past twenty years has affected the structure and design of financial instruments, thus, has changed their information content.

Espinoza, Fornari and Lombardi (2009). These studies provide mixed results<sup>3</sup>. Buchmann (2011) assesses the forecasting contribution of corporate bond indices published by Merrill Lynch for the euro area real activity and reports that medium-risk bond spreads with long maturities perform best. The current paper compliments this analysis by compiling the exactly maturity-matched corporate spreads, by constructing refined spread indices, distinguishing between different country and industry attributions of underlying bonds and by adjusting spreads for the impact of the credit risk, term and coupon premia. Moreover, as shown by Krylova (2016), the Merrill Lynch euro area corporate bond indices contain euro-denominated corporate bonds with the country-of-risk attribution outside the euro area and even outside Europe as well as bonds with embedded special features, prices of which are contaminated by different categories of risk.

Gilchrist and Mojon (2012) constructed volume-weighted corporate bond spread indices for financial and non-financial corporations for four major European countries<sup>4</sup> and found that these indicators improve upon the mismatched by maturity BBB-AAA corporate spreads in forecasting real economic activity, inflation and bank lending activity. The current paper compliments this study by considering a broader set of corporate spread indices, based on different rating, country and sector attributions of underlying bonds, and by constructing the EBPs<sup>5</sup>, which capture the deviations of corporate bond pricing from the pricing of credit risk of an issuer, additionally adjusted for the term, coupon and liquidity premia. Moreover, the corporate spreads in Gilchrist and Mojon (2012) are measured with respect to German government bond yields, and are, therefore, contaminated by the “flight-to-quality” and liquidity effects in pricing of German sovereigns, at least during the period of the sovereign debt crisis.

Most of the literature that analyses the predictive content of credit spreads focuses on the US data and considers credit spreads, derived from the prices of corporate bonds on primary or secondary markets. The euro area corporate bond market is relatively young, compared to the government bond market, and continues to be much smaller than in the US, both in terms of absolute value and relative to the size of the economy. Market-based debt financing remains a comparatively minor source of external funding for euro area firms. Therefore, proxies of the EFP for European companies should embrace the premium, which firms have to pay for borrowing funds from banks over the risk-free rate. These premia would account for frictions and asymmetric information in bank credit. To my knowledge, the only previous research assessing the forecasting contribution of bank lending rates is Nicoletti and Passaro (2012). They investigated how the predictive content of credit spreads, compiled on the basis of the information

<sup>3</sup> Forni et al (2009) showed that financial variables help in forecasting inflation, but not industrial production. Espinoza, Fornari and Lombardi (2009) argued that financial indicators do not improve short and medium-term GDP forecast in a traditional set up, however, when conditional predictive ability tests are considered, then financial variables play a role in the prediction of the euro area GDP, in particular between 1999 and 2002.

<sup>4</sup> Krylova (2016) showed that the volume-weighted spreads of financial and nonfinancial bonds in the euro area and major European economies are heavily driven by the rating decompositions and changes in ratings of underlying bonds, at least during the pre-crisis period.

<sup>5</sup> The predictive power of the EBPs was analysed by Gilchrist and Zakrajsek (2011), who computed one year-ahead distances to default for a big sample of US non-financial corporations and decomposed volume-weighted corporate credit spread indices into a predictable component that captures the available firm-specific information on expected defaults and a residual component – the EBP. Gilchrist and Zakrajsek (2011) show, that most of predictive power of their indices for future economic activity is accounted for the developments in the EBP. They argue that the EBP represents variation in the pricing of default risk, rather than in the risk of default itself, and that the shocks to the excess bond premium are linked to the deterioration in the profitability and creditworthiness of broker-dealers and investors in the corporate debt market.

gathered from both corporate bonds and bank loans<sup>6</sup>, with respect to the Italian GDP growth evolved over time. Results of Nicoletti and Passaro (2012) suggest that credit spreads both from corporate bond markets and bank loans play a relevant role in predicting the Italian GDP and that credit spreads have a more prominent role in GDP forecasting in periods of financial distress.

A broad set of financial indicators, designed in this paper to reflect the EFP related to the two major sources of external funding in the euro area, is subsequently tested for their predictive power for future outcomes of several macroeconomic indicators, such as real activity, unemployment rate, inflation and bank lending activity in five major European economies and in the euro area. I find that in general the country-specific corporate bond indices, based only on rating attribution, exhibit higher forecasting power than indices based only on industry attribution. Moreover, the BBB-AAA spread, which is traditionally used for forecasting of macroeconomic indicators, often outperforms alternative corporate spreads. Further, in the majority of cases, the EBP and excess bond returns provide the superior forecast to different corporate spread indices, non-adjusted for credit-risk of an issuer and bond-specific characteristics. Also, the EBPs allowing for the variations in the pricing of credit risk and other factors always outperform the constant parameters EBPs in terms of forecasting. These variations in the pricing of different types of risks introduce the time-varying risk premia in corporate bond yields and most likely reflect the prevailing perception of risk among market participants and prevailing risk-tolerance among investors. Finally, the combination of credit spreads, based on the information contained in both corporate bonds and bank loans, always provides the superior forecasting performance over the single measure of credit spreads. Thus, the information content of spreads, derived from both major sources of external financing for euro area corporations is complementary to each other and are both important for forecasting of macroeconomic indicators and volumes of lending.

## **2. CORPORATE BOND AND BANK LENDING SPREADS IN THE EURO AREA**

This section aims at designing financial indicators reflecting the EFP related to the two major sources of external funding in the euro area: intermediate bank-based and market-based debt financing. In this way, Section 2.1 discusses the construction of a broad set of volume-weighted maturity-matched corporate bond spread indices, based on different attributions of underlying bonds. Section 2.2 refines these indices through the adjustment of corporate bond spreads by bond-specific characteristics. Thus, Section 2.2 introduces a broad set of the EBPs and EBRs, encompassing the residual components in corporate bond pricing, not explained by credit risk of an issuer together with the term, coupon and liquidity premia. Section 2.3 continues with construction of spreads, based on information contained in bank lending rates.

<sup>6</sup> They used the BAA-AAA Merrill Lynch spread index for euro-denominated bonds of non-financial corporations as no corporate bond index for Italy was available. This index, however, is maturity-mismatched and includes euro-denominated bonds with the country-of-risk attribution outside Europe as well as securities with embedded special features, belonging to different categories of risk. For bank credit spreads they used the spread between the average rate on outstanding loans to non-financial firms and the prime rate (the rate applied to firms in the 10th percentile of credit rating as evaluated by banks). Thus, their bank credit spread measures the heterogeneity between the rates paid on less risky loans and an average over rates for the total stock of outstanding loans. This bank credit spread is constructed on the basis of granular information on individual loans, though it is maturity-mismatched, it is capable to sort corporate loans by risk profile.

When compiling the different financial indicators, reflecting the EFP, I pay attention to the theoretical consideration<sup>7</sup> that the predictive power of the EFP for macroeconomic indicators arises from the link between the borrowers' balance sheets and their access to external finance, which has an impact on growth through consumption and investment decisions of firms and households. Though, the EFP is unobservable, the literature highlights various, potentially highly correlated observable indicators. Several papers compare the estimates of the EFP, derived from DSGE models<sup>8</sup> with the presence of financial frictions, with observable proxies of it. For example, the US model of De Graeve (2008) solely based on non-financial macroeconomic data provides estimates of the EFP that are highly correlated with the high-yield corporate bond spread and to the BBB-AAA corporate bond spread. The high-yield corporate bond spread is an indicator of financing conditions of firms typically considered vulnerable to financial frictions and the BBB-AAA corporate bond spread accounts for the heterogeneity between the funding opportunities for firms with different credit qualities. These results are in line with the theoretical reasonings regarding the nature of the EFP, which emphasise that lower grade bond spreads are supposed to contain more valuable information for future real activity. However, a similar analysis performed by Gelain (2010) for the euro area provides counter-intuitive results; estimates of the EFP are highly correlated with corporate bond spreads for the AAA-rated bonds.

## 2.1 Corporate bond spread indices

The first set of financial indicators proxying the EFP is linked to market-based debt financing and is based on prices of corporate bonds without embedded special features.<sup>9</sup> I use the same dataset of individual euro-denominated investment grade corporate bonds as in Krylova (2016)<sup>10</sup>. To distinguish between credit risk and term premia, I compute exactly maturity-matched corporate credit spreads with respect to the euro area risk-free interest rate, namely the Overnight Indexed Swap (OIS) rate. As was already mentioned above, the euro area sovereign debt crisis has triggered large yield gaps between sovereign issues of distressed and non-distressed countries, together with high volatility and liquidity drawn. The yields of countries under stress suffered from low liquidity and high risk premia, leading in some cases to an overpricing of sovereign risk<sup>11</sup>. At the same time, “flight-to-quality” portfolio shifts to

<sup>7</sup> The predictive content of the EFP might be as well linked to the direct role of the financial sector in business cycle amplification: deterioration in the balance sheet positions of banks leads to a reduction of credit supply, which in turn causes an increase in costs of alternative sources of funding, which again has an impact on aggregate demand (see a Van den Heuvel, 2002, for a literature survey on the bank capital channel).

<sup>8</sup> Original Bernanke et al (1999) framework forces the EFP to be counter-cyclical. However, subsequent studies show that the models incorporating financial frictions in the presence of the large set of structural shocks can lead to different pro/counerycyclical properties of the EFP on the basis of the shocks, which dominate the others in the particular period (as in de Graeve (2008) for the US model and in Gelain (2010) for the euro area model).

<sup>9</sup> Special features, embedded in a bond (callable, puttable, floating rate, etc), influence bond pricing and, therefore, the information content of credit spreads. As only insignificant part of bonds in our sample has embedded special features, I choose to simply exclude them from further consideration. Alternatively, Gilchrist and Zakrajsek (2011) used option-adjusted corporate spreads as about two thirds of securities in their sample of US corporate bonds were callable.

<sup>10</sup> See Annex 1 in Krylova (2016) for the description of the dataset and Annexes 2, 3 and 4 and Section 2 for some stylised facts regarding the development in the corporate euro-denominated bond market.

<sup>11</sup> As shown in Krylova (2016), the euro area sovereign debt crisis had a significant impact not only on the divergence between bond yields of non-distressed and distressed euro area sovereigns and corporates, but also on the changes in sovereign versus corporate ratings as well, especially in countries under stress, leading to a counter-intuitive break-up of the existence of country ceiling for corporate bonds ratings. Moreover, sovereign ratings in some countries under stress sharply declined to the levels of the minimal investment grade corporate ratings in these countries.



“safe haven” government bonds of non-distressed countries resulted in “negative risk premia” in the latter, most notably German government bonds. Therefore, the measurement of corporate spreads with respect to government bond yields suffers from an extra effect as the pricing of sovereigns was contaminated by the sovereign debt crisis or, in the opposite, by “flight-to-quality” and liquidity effects.

I construct a broad set of corporate bond spread indices, based on different attribution of underlying bonds, namely:

- (1) Indices based only on country and on rating attributions;
- (2) Indices based only on country and on sector attributions;
- (3) Indices based on country, industry and rating attributions.

The detailed list of compiled corporate bond spread indices is presented in Annex 1. Chart A1 in Annex 1 depicts some of the computed corporate spreads, revealing pronounced cross-country and cross-sector differences, especially during the period of the sovereign debt crisis. As was shown in Krylova (2016), while the rating effect had the most pronounced impact on corporate bond pricing during the first episode of the financial crisis in 2009, the impacts of the country and sector effects were prevailing during the sovereign debt crisis. Moreover, the peak in corporate bond spreads during the sovereign debt crisis was more prominent compared to the peak during the first episode of the financial crisis for most of financial corporate spreads (excluding Germany and the Netherlands) as well as for non-financial and composite corporate spread indices for Italy and Spain. At the same time, this peak was less pronounced during the sovereign debt crisis compared to the first episode of the financial crisis for most of non-financial and composite corporate spread indices (excluding Italy and Spain) and for financial corporate spreads for Germany and the Netherlands.

## 2.2 Excess bond premia

The second group of financial indicators is designed as more refined measures of the EFP linked to the corporate debt market: corporate bond spreads are adjusted for the impact of several bond-specific characteristics. Though the corporate spread indices, defined in section 2.1, are already exactly maturity-matched, there are important individual bond characteristics affecting spreads, namely the remaining time-to-maturity<sup>12</sup>, a coupon rate<sup>13</sup>, liquidity, ratings<sup>14</sup> and country-of-risk and industry. To disentangle

<sup>12</sup> The term structure of credit spreads is less pronounced than the term structure of yields. The upward sloping term structure of credit spreads is more common for highly-rated issues; their long-term bonds can more likely get downgraded, rather than upgraded to even higher ratings. Contrarily, the long-term very low-rated corporate bonds can more likely get upgraded, what implies the downward sloping term structure of corporate spreads. Moreover, time to maturity and credit risk are not independent, less risky firms tend to issue longer rated bonds as more risky firms, belonging to the same rating category.

<sup>13</sup> The level of a coupon paid by a bond influences its yield through duration and convexity effects. Moreover, a coupon rate of a bond might impact its credit spread through the tax effect.

<sup>14</sup> Ratings are the only available proxies for firms’ financial health for our sample of euro-denominated corporate bonds. Notwithstanding that other measures of credit risk (distances to default, expected default frequencies, etc) are more accurate predictors of default than ratings, Loeffler (2007) illustrates that ratings embody the judgemental assessments of long-term credit quality of an issue and capture different aspects of credit quality as market-based measures of credit risk.

the changes in corporate bond spreads due to differences in systematic risk factors I use the same cross-sectional regression as in Krylova (2016) and its variation without liquidity<sup>15</sup>.

$$Spread_{c,r,s,\tau}^i(t) = \alpha_t + \sum_{r=1}^{10} \beta_{r,t} R_{i,t}^r + \sum_{c=1}^{14} \gamma_{c,t} C_i^c + \sum_{s=1}^2 \sigma_{s,t} S_i^s + \varphi_t \tau_{i,t} + \rho_t coupon_i + \lambda_t liq_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Spread_{c,r,s,\tau}^i(t) = \alpha_t + \sum_{r=1}^{10} \beta_{r,t} R_{i,t}^r + \sum_{c=1}^{14} \gamma_{c,t} C_i^c + \sum_{s=1}^2 \sigma_{s,t} S_i^s + \varphi_t \tau_{i,t} + \rho_t coupon_i + \varepsilon_{i,t} \quad (2)$$

Here  $Spread_{c,r,s,\tau}^i(t)$  is a spread of a corporate bond  $i$  at time  $t$  with respect to the OIS rate with exactly the same time-to-maturity;  $\tau_{i,t}$  is remaining time to maturity for a corporate bond  $i$  at time  $t$ ;  $R_{i,t}^r$ ,  $C_i^c$  and  $S_i^s$  are rating, country and sector dummies for a corporate bond  $i$  at time  $t$ , I distinguish between 10 rating segments, 14 countries and financial and non-financial categories;  $liq_{i,t}$  is a proxy of liquidity for a corporate bond  $i$  at time  $t$  and  $coup_i$  is a coupon rate, paid by a corporate bond  $i$ .

To avoid multicollinearity, the constraint<sup>16</sup> for coefficients on rating, country and sector dummies is imposed, it requires the weighted coefficients to sum up to zero:

$$\sum_{r=1}^{10} \omega_{r,t} \beta_{r,t} = 0, \quad \sum_{c=1}^{14} v_{c,t} \gamma_{c,t} = 0, \quad \sum_{s=1}^2 \eta_{s,t} \sigma_{s,t} = 0 \quad (1a)$$

here  $\omega_{r,t}$ ,  $v_{c,t}$ ,  $\eta_{s,t}$  are the weights of rating  $r$ , country  $c$  and sector  $s$  in the total outstanding volume of bonds in our sample at time  $t$ .

Parameter estimates of a reduced cross-sectional regression (2), presented in Annex 2, are very close to the parameter estimates of regression (1), presented in Krylova (2016). The estimates reveal that the coefficients on rating dummies are close to each other in the middle of a rating scale and become more distinct for high-rated and low-rated bonds. Therefore, I introduce another version of a cross-sectional regression, which uses a single rating variable in place of the ten rating dummies, This rating variable  $R_{i,t}$  is created from a *logit* transformation<sup>17</sup>, which “stretches out” the values of a variable at the tails of the distribution and is close to a linear function for the values of a variable in the middle of the distribution.  $R_{i,t}$  is scaled from -3 to +3 (or from 0 to 6). The cross-sectional regression then takes the following form:

$$S_{c,r,s,\tau}^i(t) = \alpha_t + \beta_t R_{i,t} + \sum_{c=1}^{14} \gamma_{c,t} C_i^c + \sum_{s=1}^2 \sigma_{s,t} S_i^s + \varphi_t \tau_{i,t} + \rho_t c_i + \varepsilon_{i,t} \quad (3)$$

<sup>15</sup> Though I use a refined proxy of liquidity, computed as the bid-ask spread, scaled by the mid-yield, it is based on available market quotes, which might be only “indicative” quotes of market makers and not linked to real trades.

<sup>16</sup> The economic interpretation of this constraint implies that the weighted average rating, country or sector components is equal to zero at each time  $t$  and, therefore, the spread of the weighted market portfolio is equal to the common factor (a constant in regression (1)), affecting all corporate spreads identically plus the weighted average maturity, coupon and liquidity effects. Thus, this constraint has advantages in economic interpretation of results due to the direct comparison with the weighted market portfolio. Moreover, it stabilises the coefficients on country, rating and sector dummies through assigning higher weights to bonds with bigger volumes of issuances, which have higher probability to be traded on the market, thus, to have real prices and not just indicative quotes.

<sup>17</sup> The original ratings, scaled from 1 (AAA) to 10 (BBB minus), are converted to the variable ranging from 0.05 to 0.95. Afterwards, I apply the *logit transformation*  $\ln(p/(1-p))$  and create the variable ranging between -3 to +3. Additionally, I consider the extra shift of the obtained rating variable by 3, what implies that the rating variable takes only positive values.

I estimate (3) both separately for each period  $t$  (thus, letting parameters to be time-varying) and pooling observations across periods (thus, implying constant parameters). In both cases estimates satisfy the constraint (3a), which requires the weighted coefficients on country and sector dummies to sum up to zero:

$$\sum_{c=1}^{14} \nu_{c,t} \gamma_{c,t} = 0, \quad \sum_{s=1}^2 \eta_{s,t} \sigma_{s,t} = 0 \quad (3a)$$

The constant parameter estimates imply a constant over time non-zero mean level of corporate spreads, from which the actual corporate spreads deviate due to individual bond characteristics. The time-varying parameter estimates allow the magnitudes of the various effects and the common factor  $\alpha_t$  to fluctuate in time, permitting it to capture, for example, the high degree of comovements in corporate spreads during the crises periods and the heterogeneous impact of the rating versus the country effects during the two episodes of the financial crisis.

Annex 2 presents summary statistics on the time-varying parameter estimates including the average size and significance levels for the full sample<sup>18</sup> and for two sub-samples (starting from 2007 and from 2010). In addition, Annex 2 presents the constant parameter estimates (when all observations are pooled together in one regression). The rating effect and the common factor are always statistically significant and have positive values, indicating that lower-rated bonds have higher spreads. Contrary to the estimates of regressions (1) and (2), the maturity term is on average close to significance for the full sample and becomes significant after 2007, whereas the coupon effect becomes significant only after 2010. The coefficient of the maturity term also shows an increasing trend starting from almost zero values in 1999 and reaching 5 in 2014, justifying the upward-sloping corporate spreads curve with a 5 basis points increase per year of remaining maturity in 2014. The corporate spreads curve is also supposed to steepen continuously during the whole time period starting from the almost flat curve in 1999. At the same time, both the weighted average maturity and the weighted average coupon at country levels and at the composite euro area level decline with time, thus, the weighted average maturity of bonds, attributed to the euro area, decreases from 5.9 years in 1999 to 5.1 years in 2014, whereas the weighted average coupon declines from 6.0% to 3.7% during the same time. Similarly to the estimation results of regressions (1) and (2), the level and significance of coefficients on sector dummies confirm that the sector effect was not important for the corporate bond pricing until 2007. Starting from 2007, financial corporations have higher spreads than non-financials. The parameters, related to country dummies are not significant for the whole sample, but become significant from 2010 onwards for Germany, Italy, Spain and Sweden.

<sup>18</sup> For this exercise I use the extended datasample, covering 192 monthly intervals from January 1999 till December 2014.

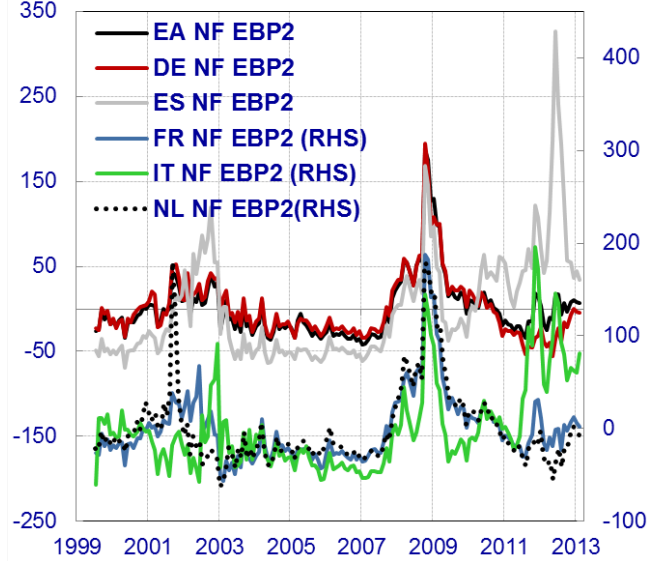
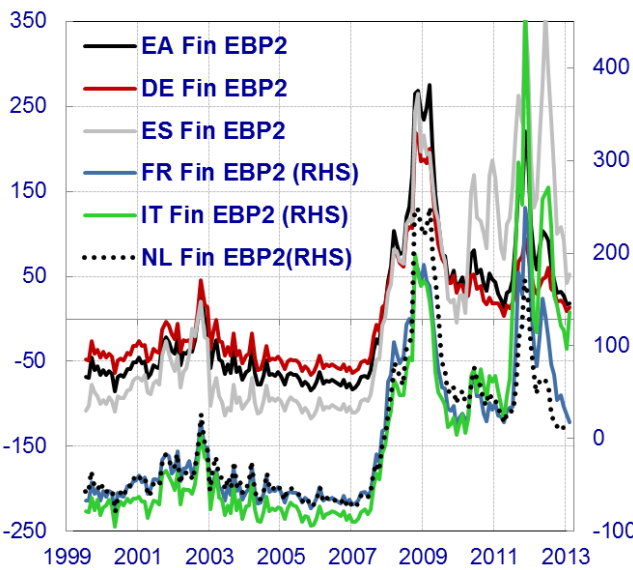
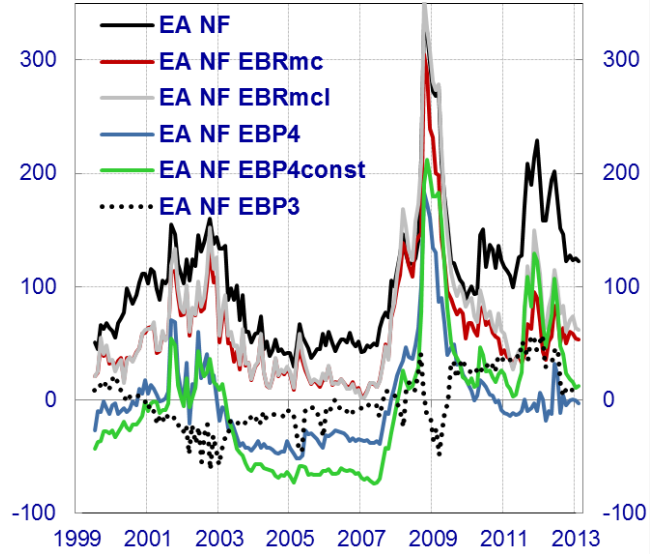
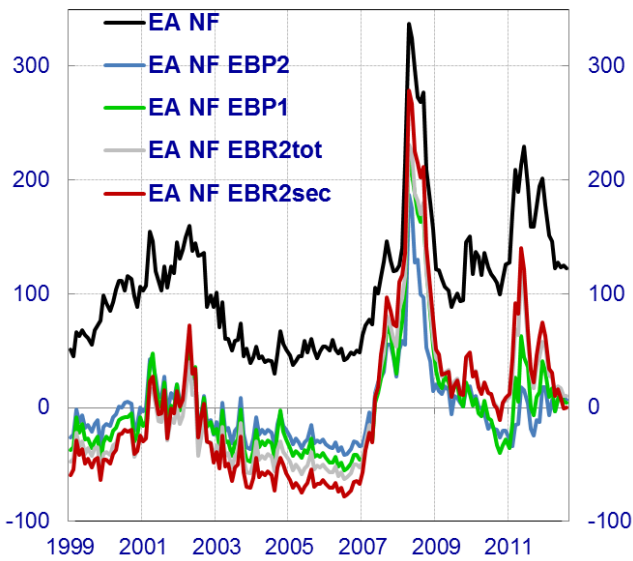
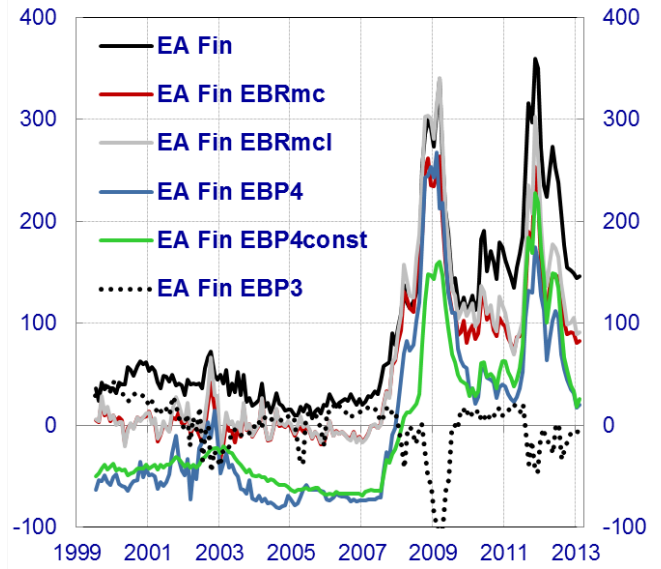
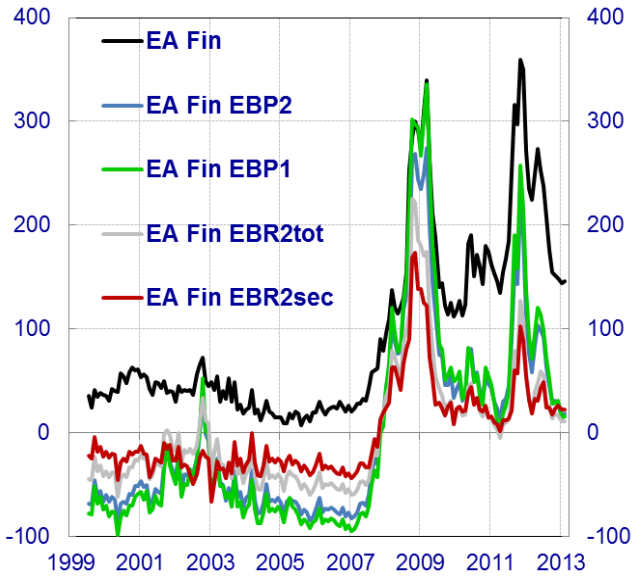
The EBP represents the residual component<sup>19</sup> in corporate bond pricing, not explained by individual bond-specific characteristics and credit risk of an issuer. Driessen (2005) refers to the unexplained part of variance in corporate spreads as a large risk premia possibly caused by a tendency for firms to default in waves. Gilchrist and Zakrajsek (2011) argue that the EBP represents variation in the pricing of default risk, rather than in the risk of default itself, and that the shocks to the excess bond premium are linked to the deterioration in the profitability and creditworthiness of broker-dealers and investors in the corporate debt market. They also show that most of the predictive power of corporate credit spread indices is accounted for the developments in the EBP. Based on the constant and time-varying parameter estimates of cross-sectional regressions (1), (2) and (3), I introduce a broad set of the EBPs and Excess Bond Returns (EBRs)<sup>20</sup> for individual bonds (see Annex 3 for the details). Afterwards, based on the EBPs for individual bonds, I design the various volume-weighted corporate EBP indices for the euro area and five major European economies, weighting the individual EBPs with the outstanding volumes of issuances of individual securities. The aforementioned set of the EBPs is constructed separately for financial and non-financial sector corporate bonds in the sample. EBPs, computed on the based on the single rating variable  $R_{i,t}$  are also constructed for all bonds (both financial and non-financial), attributed to a country or to the euro area as a whole.

Chart 2 depicts the demeaned EBPs and EBRs for financial and non-financial corporations and the euro area and country levels. They exhibit broadly similar patterns; differences stem from the inclusion of additional factors into regressions and from allowing the parameters to be time-varying or fixing them constant. For financial corporations, the degree of easing from the peak of spreads due to the sovereign debt crisis is stronger for the EBPs with the constant parameter estimates, reflecting that the model-implied impact of credit risk did not change from the crisis period. The time-varying parameter estimates assign a very high impact of credit risk during the first episode of the financial crisis, a lower impact of credit risk during the sovereign debt crisis and a reduced magnitude of credit risk effect at the end of the sample. Therefore the EBP with the time-varying parameter estimates is closer to the original index. For NFCs, the peak of corporate spreads during the sovereign debt crisis is more pronounced in the EBPs with the constant parameter estimates and is smoothed by the EBP with the time-varying parameters, indicating that latter estimates attribute the big bulk of volatility in corporate spreads to the credit risk factor, thus, filter them out from the original index while composing the EBP.

<sup>19</sup> Numerous empirical studies confirm that only some fraction of variance in corporate bond spreads, normally amounting to less than 50% of total variance in spreads, can be explained by systematic movements in default risk of individual firms. Even models, accounting for default loss, tax effects, liquidity premia, business cycle conditions and bond specific characteristic can not explain all variation in corporate bond spreads. For example, Driessen (2005) leaves about one third of variation unexplained after carefully considering default risk factor, two credit risk factors common for all firms in his sample, liquidity risk and tax effect. Gilchrist and Zakrajsek (2011) computed the year-ahead distances to default for a big sample of US non-financial corporations and found that distances to default together with other bond-specific characteristics could explain only 65% of variance in credit spreads. This fact led to the emergence of the “credit spread puzzle” concept in corporate finance (see literature overview in Christensen (2008)).

<sup>20</sup> As the EBP has a developed connotation of a deviation of corporate spreads relative to credit risk of an issuer, we will use the term EBR in other cases, denoting a deviation of corporate spreads relative to other factors.

Charts 2 – Excess bond returns and excess bond (credit) premia (basis points)



Source: ECB calculations, Merrill Lynch and Bloomberg.

Note: Outstanding volumes of issuances are used to weight corporate spreads of different securities. The details of construction of different EBP2s and EBRs are presented in Annex 3.

## 2.3 Bank lending spread indices

As intermediated bank-based financing remains the most important source of external funding in the euro area, this section presents the construction of proxies for the EFP based on available information related to bank loans. These premia should account for frictions and asymmetric information in bank credit and embrace the premium over the risk-free rate, which firms with different risk profiles have to pay for borrowing funds from banks. When one wants to construct the equivalents of the exactly maturity-matched corporate spreads for lending rates, the periods of initial rate fixation<sup>21</sup> and not the durations of credit contracts should be seen as an analogue of maturity for corporate bonds. Explicitly, lending rates on loans with floating rates or with initial rate fixation periods less than 1-year can be compared with money-market rates, whereas lending rates on loans with long periods of initial rate fixation mirror the developments in interest rates on capital markets instruments.

Additional distinction between corporate small loans<sup>22</sup> (up to €1 million) and big loans (over €1 million) permit to account for heterogeneity between the lending rates paid on less risky loans and more risky loans. In line with the theoretical considerations regarding the nature of the EFP, we assume that lending rates on small loans together with rates on overdrafts will reflect the bank-based funding conditions of economic agents (firms and households) typically considered being more vulnerable to financial frictions. Thus, they are supposed to contain more valuable information for future real activity. The spreads between lending rates on small and big loans will account for the heterogeneity between the bank-based funding opportunities for firms with different credit qualities, and therefore, is also supposed to have the predictive power for macroeconomic indicators. The construction of lending spreads is discussed in Annex 4; Table A4 reports the detailed list of computed lending spreads indicating the euro area risk free rate used to compile spreads (if applicable) and Chart A4 depicts some of these lending spreads (spreads between lending rates on small and big loans for NFCs are smoothed by means of the 3-month moving averages due to high volatility).

Though most of lending spreads also exhibit peaks during two episodes of the financial crisis in 2009 and in 2012, they do not commove with corporate bond spreads. Several lending spreads do not decline or decline only very slightly after the first episode of the financial crisis and start again an increasing trend in 2012. In many cases, in particular, in case of small loans, the dispersion of spreads increased significantly in 2011 and continued to stay at elevated levels with lending spreads for Italy and Spain exceeding significantly their counterparts in other major European countries and the euro area aggregates. Arnold and van Ewijk (2014) explored the impact of the crisis on bank retail and deposit interest rates in the euro area and found that the heterogeneity in sovereign risks across member states accounts for a sizable part of the increase in the dispersion of various lending and deposit rates. By contrast, the impact

<sup>21</sup> Unfortunately, the granular information on the interest rate fixation periods and the volumes of individual loans, which would be necessary to compile the exactly maturity-matched spreads is not available, but the dataset on lending rates is broken down by four maturity buckets.

<sup>22</sup> Lending rates on small loans typically proxy the lending rates for Small and Medium Enterprises (SMEs), however, the size of a loan may also be related, to some extent, to its purpose (e.g. inventory financing, working capital, etc) and its duration. SMEs are considered to have higher probabilities of default. Also, SMEs are more dependent on banks financing as large corporations have an option of alternative sources of funding.

of the increased heterogeneity in credit risks on bank retail rates was less pronounced. Darracq et al. (2014) documented that the traditional policy transmission mechanism, which assumed that policy rates and market interest reference rates were the most direct determinants of retail bank lending rates, was ill-equipped to explain an increasing level of heterogeneity in bank retail lending rates during the crisis. They also highlighted the importance of the quantity and quality of bank capital, credit risk and perception of risk and the fragmentation of banks funding conditions owing to tensions on the government bond market for retail bank interest rate pass-through.

Boucinha and Krylova (2015) describe the impact of banks funding conditions into retail lending rates; they underline that increases in funding costs influence rates for small loans to a higher extent as they influence lending rates for large corporations and that this disparity is more pronounced in stressed economies. In particular, banks in distressed countries are more likely to penalise their clients in case of an increase in funding costs, whereas banks in non-distressed countries may partially absorb the shocks to funding costs. The so called “bank-sovereign nexus” (a tight link between sovereign and bank creditworthiness, which can be illustrated by the high degree of correlation between sovereign CDS premia and bank CDS premia in the euro area countries) is a factor potentially playing a role in the challenges of banks in distressed countries to absorb the shock to funding costs. Banks at the retail level have to compete with high yields on government bonds in countries with stressed sovereigns. Additionally, high domestic base of banks’ sovereign bond holdings accentuates the self-reinforcing loop between bank and sovereign risks. Thus, lending spreads contain additional information about funding conditions, which is not covered by corporate bond spreads. These two sides of information regarding the EFP obtained from two sources of external financing for European corporations could be complementary to each other and both of them could have the predictive power for real activity, other macroeconomic indicators and lending volumes. These assumptions will be empirically assessed in the next section.

### 3. EMPIRICAL ANALYSIS

This section assesses the predictive power of different proxies of the EFP linked to bank-based and market-based debt financing in the euro-area. It employs a univariate forecasting equation as used in previous studies (Gilchrist and Mojon, 2012, and Gilchrist and Zakrajsek, 2011):

$$\Delta^h \log Y_{t+h} = \alpha_0 + \alpha_1^1 r_t + \alpha_1^2 r_{t-1} + \alpha_2^1 t_t + \alpha_2^2 t_{t-1} + \log Y_t + \beta_1 s_t + \beta_2 s_{t-1} \quad (4)$$

against the baseline regression

$$\Delta^h \log Y_{t+h} = \alpha_0 + \alpha_1^1 r_t + \alpha_1^2 r_{t-1} + \alpha_2^1 t_t + \alpha_2^2 t_{t-1} + \log Y_t \quad (4a)$$

Here,  $\Delta^h \log Y_{t+h} = \frac{1200}{h+1} \ln \left( \frac{Y_{t+h}}{Y_t} \right)$  is the measure of the h-months ahead change in the variable of interest (macroeconomic or lending activity indicator ( $Y_t$ ));  $r_t$  is the real short-term interest rate in the euro area, proxied by the 3-months Euribor deflated with HICP;  $t_t$  is the slope of the default-free yield curve, proxied by the difference between the 10-year euro area swap rate and the 3-months Euribor and

$s_t$  is a credit spread (corporate bond spread, the EBP or lending spread) of interest. Thus, the baseline regression includes an autoregressive term, the real interest rate and the slope of the risk-free yield curve<sup>23</sup>. Afterwards, I separately add different credit spread indices to the baseline regression. These indices include: the volume-weighted maturity-matched corporate bond spread indices, based on different attribution (country, sector and rating) of underlying bonds as described in Section 2.1; the various EBP and EBR indices for countries and the euro area composites as described in Section 2.2 and the lending spread indices covered in Section 2.3.

Finally, I investigate whether the proxies for the EFP, reflecting intermediated bank-based financing and market-based debt financing conditions, contain complementary information, i.e. whether the forecasting performance of regression (4) improves when both lending and corporate bond spreads are included. The forecasting equation, therefore, takes the form:

$$\Delta^h \log Y_{t+h} = \alpha_0 + \alpha_1^I r_t + \alpha_1^2 r_{t-1} + \alpha_2^I t_t + \alpha_2^2 t_{t-1} + \log Y_t + \beta_1 s_t^{bonds} + \beta_2 s_{t-1}^{bonds} + \beta_3 s_t^{loans} + \beta_4 s_{t-1}^{loans} \quad (5)$$

Here  $s_t^{bonds}$  is a corporate bond spread index or the EBP (EBR) and  $s_t^{loans}$  is a lending spread index.

I consider the forecasts of lending activity and the major monthly indicators of real activity and of inflation, namely: Industrial Production (IP); Purchasing Managers' Index (PMI); Unemployment rate and Harmonised Index of Consumer Prices (HICP). Lending activity is represented by the indices of notional stocks,<sup>24</sup> to NFCs at various maturities, i.e. short-term (less than 1-year), medium-term (1- to 5-years) and long-term (more than 5-years). Further, I inspect loans to households for housing purposes and loans for households for consumer purposes.

I evaluate forecasts based on equations (4) and (5) at horizons of, 3, 6, 9, and 12 months. Our data sample for this exercise covers only the period of January 2003 – February 2012 because of limitations of statistics for lending spreads. The quality of the forecast is assessed by the adjusted  $R^2$  statistics<sup>25</sup>.

The tables in this section present only qualitative results of the econometric exercise, indicating which corporate bond spread index, the EBP (EBR) or lending spread provides the highest adjusted  $R^2$  statistics of the forecast. Thus, Table 1 summarises qualitative results only for different corporate bond spread indices; Table 2 summarises information about the predictive power of the different EBRs and EBPs and Table 3 provides condensed information about the forecasting performance of lending spreads. More detailed estimation output is reported in Annex 5.

<sup>23</sup> As was shown in several studies, real interest rates and slopes of the sovereign yield curves together with corporate bond credit spreads of different maturities and credit risk contain valuable information about the future development of economic activity and inflation, see, for example, Stock and Watson (2003) for references.

<sup>24</sup> Indices of notional stocks are constructed by setting the series equal to 1 or 100 in the base month, and then extending forward the series with the growth rates constructed as flows of current month over the stock of previous month. This allows us to correct the series for the effects of reclassifications, exchange rate variations and other revaluations. I use indices of notional stocks in case of Germany, France, Spain, and the Netherlands and use stocks for Italy. To approximate the euro area loans I construct the composites from the individual statistics of the five abovementioned countries.

<sup>25</sup> The improvement in the forecasting accuracy assessed this way might be only marginal and not statistically significant. Statistical significance of the superiority of the forecast accuracy can be evaluated, for example, by Diebold-Mariano test.



**Table 1. Corporate bond spread indices in the best performing forecasting regressions**

*a) forecasts of real economic activity and inflation*

<b>Germany</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	NF BBB-AAA	NF BBB-AAA	NF BBB-AAA	NF BBB-AAA
PMI	NF BBB-AAA	NF BBB-AAA	low-rated	Fin
Unemployment rate	NF BBB-AAA	NF BBB-AAA	BBB-AAA	BBB-AAA
HICP	NF BBB-AAA	NF BBB-AAA	BBB-AAA	NF BBB-AAA
<b>France</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	low-rated	low-rated	all bonds	high-rated Fin
PMI	NF	Fin	Fin	Fin
Unemployment rate	BBB-AAA	BBB-AAA	BBB-AAA	low-rated
HICP	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
<b>Spain</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	low-rated NF	medium-rated Fin	medium-rated Fin	medium-rated Fin
PMI	Fin BBB-AAA	Fin BBB-AAA	Fin BBB-AAA	Fin BBB-AAA
Unemployment rate	Fin BBB-AAA	Fin BBB-AAA	Fin BBB-AAA	Fin BBB-AAA
HICP	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
<b>Italy</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	low-rated NF	low-rated NF	NF BBB-AAA	NF BBB-AAA
PMI	low-rated NF	NF BBB-AAA	NF BBB-AAA	high-rated Fin
Unemployment rate	high-rated Fin	high-rated Fin	Fin	Fin
HICP	BBB-AAA	BBB-AAA	BBB-AAA	Fin BBB-AAA
<b>Netherlands</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	BBB-AAA	NF	NF	BBB-AAA
PMI	NF	NF	NF BBB-AAA	high-rated Fin
Unemployment rate	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
HICP	NF BBB-AAA	high-rated NF	BBB-AAA	NF
<b>Euro-area</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Industrial production	NF BBB-AAA	low-rated NF	low-rated Fin	low-rated Fin
PMI	low-rated NF	low-rated Fin	low-rated Fin	low-rated Fin
Unemployment rate	BBB-AAA	low-rated	low-rated Fin	Fin
HICP	BBB-AAA	BBB-AAA	low-rated Fin	low-rated Fin

*b) forecasts of volumes of lending*

<b>Germany</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	NF BBB-AAA
Medium-term lending to NFCs	basic regr	NF BBB-AAA	medium-rated NF	NF BBB-AAA
Long-term lending to NFCs	NF BBB-AAA	low-rated NF	low-rated NF	low-rated NF
Loans to households for housing	NF BBB-AAA	NF BBB-AAA	high-rated	BBB-AAA
Consumer credits	high-rated	high-rated	NF	NF
<b>France</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
Medium-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	NF
Long-term lending to NFCs	high-rated	all bonds	all bonds	all bonds
Loans to households for housing	low-rated	high-rated Fin	Fin	Fin
Consumer credits	NF BBB-AAA	NF	all bonds	all bonds
<b>Spain</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	medium-rated Fin	medium-rated Fin	all bonds	all bonds
Medium-term lending to NFCs	medium-rated Fin	all bonds	all bonds	all bonds
Long-term lending to NFCs	BBB-AAA	medium-rated Fin	Fin	Fin
Loans to households for housing	medium-rated Fin	medium-rated Fin	Fin	all bonds
Consumer credits	medium-rated Fin	Fin	medium-rated Fin	all bonds
<b>Italy</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
Long-term lending to NFCs	BBB-AAA	high-rated Fin	low rated	low rated
Loans to households for housing	BBB-AAA	high-rated Fin	NF	NF
Consumer credits	high-rated Fin	NF	NF	NF
<b>Netherlands</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	NF	BBB-AAA	BBB-AAA	BBB-AAA
Medium-term lending to NFCs	high-rated Fin	NF BBB-AAA	NF BBB-AAA	BBB-AAA
Long-term lending to NFCs	low-rated	NF	NF	NF
Loans to households for housing	all bonds	BBB-AAA	BBB-AAA	NF BBB-AAA
Consumer credits	NF BBB-AAA	Fin	Fin	Fin
<b>Euro-area</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	BBB-AAA
Medium-term lending to NFCs	BBB-AAA	low-rated Fin	all bonds	low-rated NF
Long-term lending to NFCs	BBB-AAA	BBB-AAA	BBB-AAA	Fin
Loans to households for housing	low-rated NF	low-rated Fin	low-rated Fin	low-rated Fin
Consumer credits	all bonds	low-rated Fin	low-rated Fin	low-rated Fin

Note: Table reports qualitative results for forecasting equation (4). It indicates the corporate bond spread indices providing the highest adjusted  $R^2$  statistics. See Annex 5 for more detailed estimation output.

Table 1, which summarises the results for different corporate bond spread indices in qualitative terms<sup>26</sup>, confirms that indices, which are based only on rating attribution, exhibit higher forecasting power than indices based only on industry attribution. Moreover, often the BBB-AAA spread, which is traditionally used for forecasting of macroeconomic indicators, is performing better than alternative corporate spreads. In general, only the rating attribution of the underlying bonds is important for forecasting of macroeconomic outcomes and lending volumes in case of Germany and France and for forecasting of lending volumes in case of the Netherlands and the euro area. However, in several cases both rating and sector attributions of underlying bonds were found to be important; for example, in the case of Spain the macroeconomic indicators for all, except one forecasting horizons, are better predicted from the volume-weighted index of medium-rated financial corporations. Overall, the information about only industry attribution of underlying bonds is not sufficient for forecasting of macroeconomic indicators and lending volumes; i.e. simple corporate spread indices for financial and non-financial bonds underperform alternative corporate spread indices, which take into account also the information regarding credit quality of issuances. In several cases, the combination of both rating and sector attributions improves the predictive power of the volume-weighted maturity-matched corporate bond spread indices.

**Table 2. EBP4s and EBRs in the best performing forecasting regressions**

*a) forecasts of real economic activity and inflation*

<b>Germany</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	-	EU NF EBP4	DE NF EBP2	DE NF EBP2
<b>PMI</b>	DE Fin EBP4	DE Fin EBP4	DE Fin EBRmc	DE Fin EBRmc
<b>Unemployment rate</b>	-	-	-	-
<b>HICP</b>	-	DE NF EBP4	DE Fin EBP4	DE Fin EBP4
<b>France</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	EU NF EBP4	EU Fin EBP4	FR Fin EBP4	FR Fin EBRmc
<b>PMI</b>	FR NF EBP4	FR Fin EBP2	FR Fin EBRmc	-
<b>Unemployment rate</b>	-	EU NF EBRmc1	EU NF EBRmc1	EU NF EBRmc1
<b>HICP</b>	EU NF EBP4	EU NF EBP4	EU NF EBP4	FR NF EBP4
<b>Spain</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	EU Fin EBP4	EU Fin EBP3	EU Fin EBP4	EU Fin EBP2
<b>PMI</b>	EU NF EBP3	-	-	-
<b>Unemployment rate</b>	EU NF EBP4	EU Fin EBP3	-	-
<b>HICP</b>	EU NF EBP3	EU NF EBP4	EU NF EBP4	EU NF EBP4
<b>Italy</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	EU NF EBP4	EU NF EBP4	EU Fin EBP2	EU Fin EBP2
<b>PMI</b>	EU NF EBRmc1	EU Fin EBP3	EU Fin EBP2	EU Fin EBP2
<b>Unemployment rate</b>	-	-	-	IT Fin EBP4
<b>HICP</b>	EU NF EBP4	EU NF EBP4	EU NF EBP4	EU NF EBP1
<b>Netherlands</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	-	EU NF EBRmc	NL NF EBRmc	NL NF EBRmc
<b>PMI</b>	EU NF EBP4	EU Fin EBP3	EU Fin EBR2 tot	NL Finin EBRmc
<b>Unemployment rate</b>	NL NF EBP3	NL NF EBP3	NL NF EBP3	NL NF EBP3
<b>HICP</b>	NL NF EBP2	EU NF EBP4	NL NF EBRmc1	EU NF EBP4
<b>Euro-area</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
<b>Industrial production</b>	EU NF EBRmc	EU NF EBRmc	EU NF EBRmc1	EU NF EBR2 Sec
<b>PMI</b>	EU EBP3	EU Fin EBP3	-	-
<b>Unemployment rate</b>	EU NF EBRmc1	EU NF EBR2 Sec	-	-
<b>HICP</b>	EU NF EBP4	EU NF EBP4	EU NF EBP4	EU NF EBP4

<sup>26</sup> Annex 5 reports separately the parameter estimates for the best performing regressions among regressions, which include volume-weighted corporate bond spread indices (in the second column) and the baseline regression (in the first column).

b) forecasts of volumes of lending

<b>Germany</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	EU EBP3	DE Fin EBP3	DE NF EBP1	EU NF EBP1
Medium-term lending to NFCs	DE Fin EBRmc	-	-	-
Long-term lending to NFCs	EU NF EBRmc	-	EU NF EBP4	EU NF EBR2 tot
Loans to households Finor housing	EU Fin EBP3	EU Fin EBP4	EU Fin EBP3	EU EBP3
Consumer credits	-	EU Fin EBRmc1	EU Fin EBP3	EU Fin EBP3
<b>France</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	EU NF EBRmc1	FR NF EBP4	EU NF EBRmc1
Medium-term lending to NFCs	EU EBP3	-	-	-
Long-term lending to NFCs	-	-	-	-
Loans to households Finor housing	EU NF EBRmc1	-	FR Fin EBP4	FR Fin EBP2
Consumer credits	-	-	FR Fin EBP4	FR Fin EBP4
<b>Spain</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	-	ES Fin EBP4	ES Fin EBP4
Medium-term lending to NFCs	-	ES NF EBRmc	ES NF EBRmc	ES NF EBRmc
Long-term lending to NFCs	-	-	-	-
Loans to households Finor housing	-	ES Fin EBRmc	-	-
Consumer credits	-	ES Fin EBP4	ES Fin EBP4	ES Fin EBP4
<b>Italy</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	IT NF EBRmc1	IT NF EBRmc1	IT NF EBRmc1
Long-term lending to NFCs	EU EBP3	IT NF EBP1	IT Fin EBRmc1	IT Fin EBP2
Loans to households Finor housing	-	-	IT EBP3	IT EBP3
Consumer credits	IT EBP3	IT EBP3	IT EBP3	IT EBP3
<b>Netherlands</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	NL NF EBRmc	NL NF EBRmc	NL NF EBRmc	NL NF EBRmc
Medium-term lending to NFCs	NL NF EBRmc	EU EBP3	NL EBP3	-
Long-term lending to NFCs	-	EU Fin EBR2 tot	NL NF EBRmc	EU NF EBP2
Loans to households Finor housing	EU NF EBP3	EU NF EBP3	NL Fin EBP4	-
Consumer credits	NL EBP3	NL NF EBP3	-	-
<b>Euro-area</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	-	EU NF EBRmc1	EU NF EBRmc1
Medium-term lending to NFCs	-	-	-	-
Long-term lending to NFCs	-	-	-	-
Loans to households Finor housing	-	EU NF EBR2 Sec	-	-
Consumer credits	-	-	-	-

Note: Table reports qualitative results for forecasting equation (4). It indicates the EBP/ EBR providing the highest adjusted  $R^2$  statistics. The cells are left blank in case the highest adjusted  $R^2$  statistics for the regressions with the EBRs (EBPs) was lower than for corresponding regressions using the corporate bond spread indices (presented in Table 1). See Annex 5 for more detailed estimation output.

Table 2, which summarises information<sup>27</sup> about the predictive power of the different EBRs and EBPs, shows that most of the predictive power of corporate bond spread indices is related to developments in the EBP, which captures the deviations of corporate bond pricing from the pricing of credit risk of an issuer, additionally adjusted for the term, coupon and liquidity premia. Moreover, the variations in pricing of credit and other risks obtained from the time-varying parameter estimates are important. Specifically, compared to non-adjusted corporate spread indices, the use of EBPs and EBRs in general results in improved predictions of macroeconomic indicators at all forecasting horizons. The same holds for lending volumes in Germany, Italy and the Netherlands, but not in France, Spain and the euro area aggregate.

Among the various adjustments of corporate bond spreads for individual bond-specific characteristics, the rating adjustment plays an important role for improving the forecasts. Regressions including the EBPs (which require the rating-adjustment together with the coupon, maturity and, if applicable, liquidity

<sup>27</sup> The cells in Table 2 are left blank in case the highest adjusted  $R^2$  statistics for regressions with the EBRs (EBPs) was lower than for corresponding regression using the corporate bond spread indices or the baseline regression (presented in Table 1). Note, that Annex 5 reports separately the parameter estimates for the best performing regressions among regressions, which include EBRs (in the third column), which include the EBPs based on rating dummies (EBP1 and EBP2) (in the fourth column) and which include the EBPs based on a rating variable (replacing rating dummies) with the time-varying and the constant parameter estimates (EBP3 and EBP4) (in the fifth column).

adjustments) exhibit higher adjusted  $R^2$  statistics than regressions including the EBRs. Replacing the rating dummies with a single rating variable in many cases improves the forecasting performance: regressions using EBP3 and EBP4 often provide higher  $R^2$  statistics than regressions using EBP1 and EBP2. Besides, the EBPs obtained with the time-varying parameter estimates have always higher predictive power compared to EBPs obtained with the constant parameter estimates (when all observations are pooled together). The time-varying parameter estimates allow the magnitudes of the common factor, the rating, country, etc. effects fluctuate in time, permitting to capture the high degree of comovements in corporate spreads during the crisis periods and the heterogeneous impact of the rating versus the country effects during the two episodes of the financial crisis. This finding highlights the importance of variations in the pricing of credit risk and other factors for forecasting purposes, in particular, during the episodes of the financial crisis. Asset prices consider the macroeconomic, political and other factors through the lenses of market participants' perceptions, thus, riskiness of corporate bonds and their exposure to systemic euro area risks differs among countries and also across time and constitutes the time-varying risk premia of corporate bond yields.

**Table 3. Lending spreads in the best performing forecasting regressions**

*a) forecasts of real economic activity and inflation*

<b>Germany</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	-	-	NFC small <1y	-
PMI	-	NFC small <1y	Spread S-B >5y	-
Unemployment rate	HH 1-5y	-	-	-
HICP	-	-	-	-
<b>France</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	-	-	-	-
PMI	-	-	-	-
Unemployment rate	-	-	-	-
HICP	-	-	-	-
<b>Spain</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	-	-	-	-
PMI	-	-	-	-
Unemployment rate	-	-	-	-
HICP	-	-	-	-
<b>Italy</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	-	-	-	-
PMI	HH overdr	HH overdr	HH overdr	HH overdr
Unemployment rate	HH 1-5y	-	-	-
HICP	-	-	-	-
<b>Netherlands</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	NFC overdr	NFC overdr	-	-
PMI	-	-	-	-
Unemployment rate	-	NFC overdr	NFC overdr	NFC overdr
HICP	-	-	-	-
<b>Euro-area</b>	3-months ahead	6-months ahead	9-months ahead	12-months ahead
Industrial production	-	-	-	-
PMI	HH overdr	-	-	-
Unemployment rate	-	-	-	-
HICP	-	-	-	-

b) forecasts of volumes of lending

<b>Germany</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	HH >5y	NFC small >5y	-	-
Medium-term lending to NFCs	Spread S-B >5y	Spread S-B >5y	Spread S-B >5y	-
Long-term lending to NFCs	NFC small >5y	HH 1-5y	-	-
Loans to households for housing	-	-	NFC small <1y	Spread S-B 1-5y
Consumer credits	-	Spread S-B 1-5y	-	-
<b>France</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	-	-	-
Medium-term lending to NFCs	Spread S-B 1-5y	Spread S-B 1-5y	-	-
Long-term lending to NFCs	NFC small >5y	NFC small >5y	-	-
Loans to households for housing	HH 1-5y	-	-	-
Consumer credits	NFC overdr	-	-	-
<b>Spain</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	-	-	-
Medium-term lending to NFCs	-	-	-	-
Long-term lending to NFCs	Spread S-B <1y	Spread S-B <1y	NFC small <1y	NFC small <1y
Loans to households for housing	-	-	-	-
Consumer credits	-	-	-	-
<b>Italy</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	NFC overdr	NFC overdr	NFC overdr	-
Long-term lending to NFCs	-	HH overdr	HH overdr	-
Loans to households for housing	HH 1-5y	HH >5y	-	-
Consumer credits	HH 1-5y	HH 1-5y	-	-
<b>Netherlands</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	NFC small <1y	NFC small <1y	NFC small <1y	NFC small <1y
Medium-term lending to NFCs	-	-	NFC overdr	NFC overdr
Long-term lending to NFCs	NFC overdr	-	-	-
Loans to households for housing	NFC overdr	-	HH > 5y	HH 1-5y
Consumer credits	NFC small <1y	NFC small <1y	NFC small <1y	NFC small <1y
<b>Euro-area</b>	<b>3-months ahead</b>	<b>6-months ahead</b>	<b>9-months ahead</b>	<b>12-months ahead</b>
Short-term lending to NFCs	-	-	-	-
Medium-term lending to NFCs	-	-	-	-
Long-term lending to NFCs	NFC small 1-5y	-	-	-
Loans to households for housing	-	-	-	-
Consumer credits	NFC overdr	-	-	-

Note: The table reports qualitative results for forecasting equation (4). It indicates the lending spread index providing the highest adjusted  $R^2$  statistics. The cells are left blank in case the highest adjusted  $R^2$  statistics for the regressions with the lending spread indices was lower than for corresponding regressions using the corporate bond spread indices and the EBPs/EBRs (presented in Table 1 and Table 2). See Annex 5 for more detailed estimation output.

Table 3 provides qualitative information<sup>28</sup> about the forecasting performance of lending spreads. It documents an inferior forecasting performance compared to indicators based on the corporate bond spreads. Only in case of lending volumes for Germany and the Netherlands, the inclusion of lending spreads improves forecasting performance compared to corporate bond spreads and the EBPs (EBRs). This poor performance may be partially related to the fact that our lending spreads are not as refined<sup>29</sup> as corporate bond spreads. Often lending spreads for overdrafts for NFCs and households, which reflect funding conditions of economic agents being very vulnerable to financial frictions, are performing better than alternative lending spreads.

Finally, I find that the forecasting performance of regressions, which use the information from both lending and corporate bond spreads, always improves upon regressions using only information from one source of external funding for European companies. To assess it, I estimate regression (5) using the best

<sup>28</sup> The cells in Table 3 are left blank if the highest adjusted  $R^2$  statistics for the regressions with lending spreads was lower than for corresponding regressions with the EBPs (EBRs) (presented in Table 2) or regressions using corporate bond spread indices or baseline regression (presented in Table 1). Sixth column of Annex 5 reports more detailed parameter estimates for the best performing regressions among regressions, which include lending spreads.

<sup>29</sup> The granular information on the interest rate fixation periods and the volumes of individual loans, which would be necessary to construct the equivalents of the exactly maturity-matched spreads, is not available.

performing corporate spread index or the best performing EBP (EBR) and a set of lending spreads. Annex 5 indicates that in the vast majority of cases, regression (5) provides higher adjusted  $R^2$  statistics than regression (4), confirming that the information from both major sources of external financing for euro area corporations contain important information for future developments in macroeconomic indicators and lending volumes and these two sources of information are complementary to each other.

#### 4. CONCLUSIONS

This paper investigates the leading indicator properties of a broad set of financial indicators, reflecting the EFP, based on information from two major sources of external financing for euro area corporations: intermediated bank-based funding and market-based debt funding. I assess which information regarding underlying bonds or loans and which adjustment of bond prices are important for forecasting of real activity, unemployment, inflation and lending volumes in the euro area and in five major European economies to improve the forecasting power of the baseline model, which controls for the autoregressive component and the predictive power of the real interest rate and the slope of the risk-free yield curve.

First, from the dataset on individual euro-denominated investment-grade corporate bonds, I construct a broad set of exactly maturity-matched volume-weighted corporate bond spread indices based on different attributions of underlying bonds, including country, sector and rating attributions. In general, the country-specific corporate bond indices, based only on rating attribution, exhibit a better forecasting performance than indices based only on industry attribution. Moreover, often the BBB-AAA spread, which is traditionally used for forecasting of macroeconomic indicators, is performing better than alternative corporate spreads. However, in several cases a combination of both rating and sector attributions is important for the forecasting of country-specific and the euro area aggregate macroeconomic indicators and volumes of lending.

Second, I introduce a set of volume-weighted indices of the EBPs and EBRs, capturing the deviations of corporate spreads relative to the credit risk of issuers and other bond-specific characteristics. Most of the predictive power of corporate bond spread indices is related to the developments in the EBPs, namely, the majority of macroeconomic indicators can be better predicted by the EBPs (or the EBRs) compared to non-adjusted corporate bond spread indices. In case of lending volumes – it is valid only for Germany, Italy and the Netherlands. The rating-adjustment seems to be particularly important, resulting in higher adjusted  $R^2$  statistics using the EBPs, compared to regressions using the EBRs. Moreover, the EBPs obtained with the time-varying parameter estimates always have a superior forecasting performance compared with the performance of EBPs with the constant parameter estimates, highlighting the importance of variations in the pricing of credit risk and other factors, in particular, during the episodes of the financial crisis. These variations in the pricing of credit or other risks are most likely linked to the market participants' perceptions of risks and to prevailing risk-tolerance among investors, introducing the time-varying risk premia in corporate bond yields.

Third, in general, lending spreads perform worse in terms of forecasting compared to both volume-weighted corporate bond spread indices and the EBPs (or the EBRs). And fourth, the forecasting performance of regressions which use the information from both lending and corporate bond spreads are always superior compared to regressions using only information from one source of external funding. Thus, the information content of spreads, derived from both major sources of external financing for euro area corporations and households is complementary to each other and are both important for forecasting of macroeconomic indicators and volumes of lending.

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## Annex 1. Construction of corporate bond spread indices

For the subsequent forecasting exercise I construct a broad set of corporate bond spread indices for Germany, France, Spain, Italy and the Netherlands and for the euro area on the basis of corporate bonds without embedded special features<sup>30</sup> with the country-of-risk<sup>31</sup> attribution to five major European economies. To distinguish properly between credit risk and term premia, the exactly maturity-matched corporate credit spreads are computed with respect to the euro area risk-free interest rates, namely the Overnight Indexed Swap (OIS)<sup>32</sup> curve. To obtain the corporate bond spread index, corporate bond spreads for individual bonds are weighted with the outstanding volumes of issuances of individual securities. Although our sample of corporate bonds<sup>33</sup> includes bonds of other euro area countries, the number of bonds for each month is insufficient to construct meaningful indices for other countries, except for the selected ones. Moreover, I try to construct all specified indices for each country adding the neighbouring rating categories in case there is insufficient number of bonds for each month, but some of these indices will be missing in case of Spain and Italy. Table A1 reports the constructed set of the volume-weighted corporate bond spread indices.

**Table A1. Constructed set of the volume-weighted corporate bond spread indices**

Description	Analogue of traditional spread	Denoted further as
spreads for all bonds, attributed to a given country	country spread	<i>all bonds</i>
spreads of high rated bonds	AAA spread	<i>high-rated</i>
spreads of low rated bonds	BBB spread	<i>low-rated</i>
spreads of high-rated bonds minus spreads of low-rated bonds	BBB-AAA spread	<i>BBB-AAA</i>
spreads of financials corporations	Financials spread	<i>Fin</i>
spreads of non-financials corporations	Non-financials spread	<i>NF</i>
spreads of high-rated financial corporations	AAA financials spread	<i>high-rated Fin</i>
spreads of low-rated financial corporations	BBB financials spread	<i>low-rated Fin</i>
spreads of medium-rated financial corporations (*)	A financials spread	<i>medium-rated Fin</i>
spread of high-rated minus spread of low-rated financial bonds	BBB-AAA for financials	<i>Fin BBB-AAA</i>
spreads of high-rated non-financial corporations	AAA non-financials spread	<i>high-rated NF</i>
spreads of low-rated non-financial corporations	BBB non-financials spread	<i>low-rated NF</i>
spreads of medium-rated non-financial corporations (**)	A non-financials spread	<i>medium-rated NF</i>
spreads of high-rated minus spread of low-rated non-fin bonds	BBB-AAA non-financials	<i>NF BBB-AAA</i>

Note: (\*) Computed only for Spain.

(\*\*) Computed only for France.

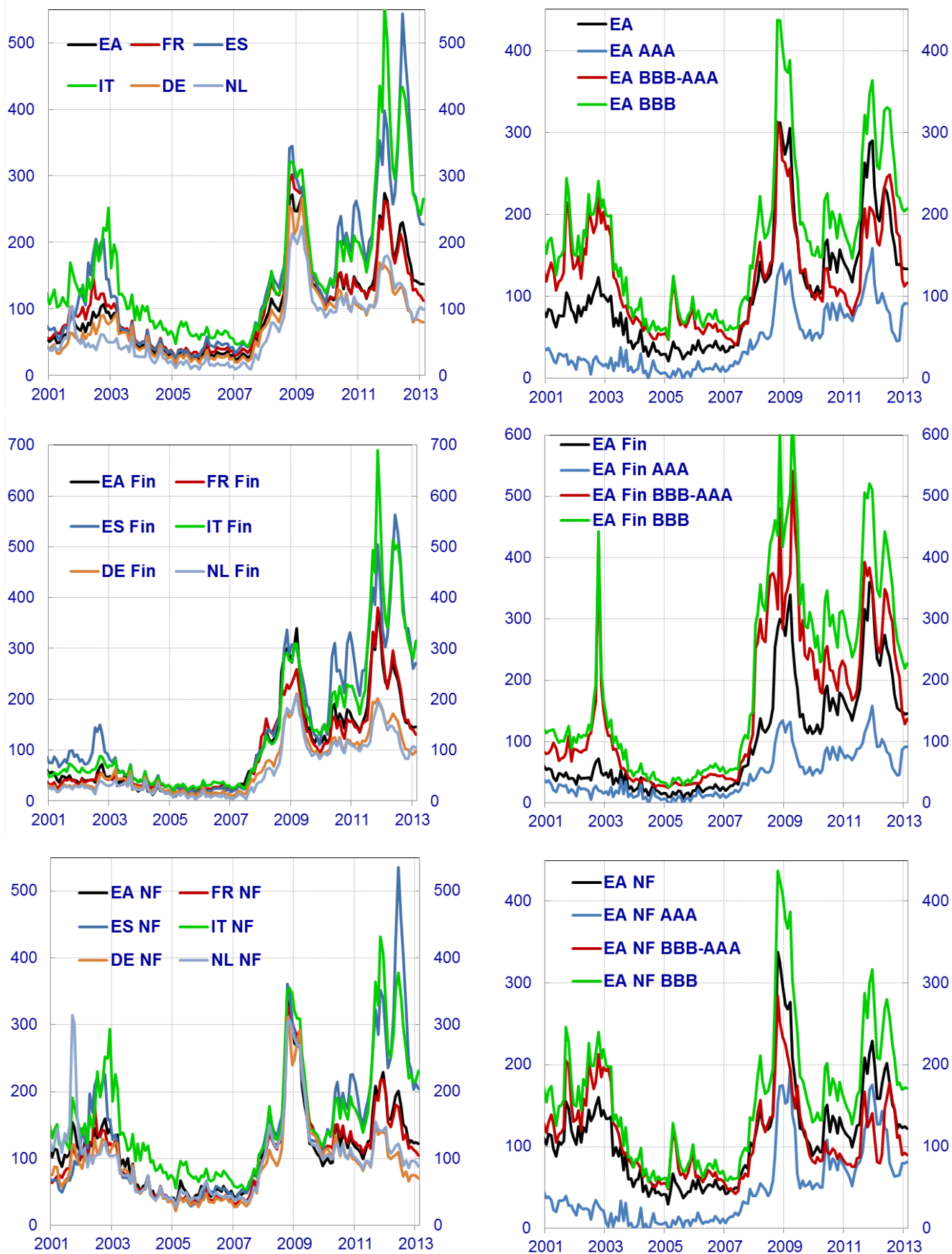
<sup>30</sup> Special features, embedded in a bond (callable, puttable, floating rate, etc), influence bond pricing and, therefore, the information content of credit spreads. As only insignificant part of bonds in our sample has embedded special features, I choose to simply exclude them from further consideration. Alternatively, Gilchrist and Zakrajsek (2011) used option-adjusted corporate spreads as about two thirds of securities in their sample of US corporate bonds were callable.

<sup>31</sup> Country-of-risk attribution of a corporate bond might not coincide with country-of-residence and/ or country-of-issuance attributions. Several reasons, including differences in legislative and tax systems are causing the issuances of corporate bonds in foreign countries, thus, 34% of Belgian bonds, 28% of German bonds, 24% of Spanish bonds, 49% of Portuguese bonds in our sample were issued in the Netherlands. Moreover, 83% of Greek bonds were issued in Great Britain.

<sup>32</sup> The OIS rates are available for the certain grid of maturities. I use linear spline interpolations to obtain the OIS rates to the exact time-to-maturity of corporate bonds in our sample.

<sup>33</sup> See Annex 1 in Krylova (2016) for the description of the dataset and Annexes 2, 3, and 4 and Section 2 for some stylised facts regarding the development in the corporate euro-denominated bond market.

Charts A1 – Corporate bond spread indices (basis points)



Source: ECB calculations, Merrill Lynch and Bloomberg.

Note: Outstanding volumes of issuances are used to weight corporate bond spreads of different securities.

## Annex 2. Parameter estimates of alternative cross-sectional regressions

**Table A2.1. Average parameter estimates and significance of coefficients<sup>34</sup> in regression (2).**

a) Average through July 1999 – February 2013

Country effect				Rating effect				Sector effect						
coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value					
AT	1	0.47	FR	-8	0.38	AAA	-66	0.00	BBB1	48	0.00	Financials	24	0.33
AU	-3	0.52	GB	1	0.35	AA1	-50	0.00	BBB2	77	0.00	Non-financials	-22	0.34
BE	0	0.47	IT	12	0.21	AA2	-35	0.00	BBB3	131	0.00			
CH	-4	0.41	JP	16	0.46	AA3	-32	0.00					coeff	p-value
DE	-14	0.46	NL	-9	0.50	A1	-15	0.16				<b>Common effect</b>	56	0.11
DK	-9	0.33	SE	-8	0.39	A2	6	0.24				<b>Maturity</b>	4	0.01
ES	26	0.38	US	23	0.40	A3	19	0.15				<b>Coupon</b>	5	0.04

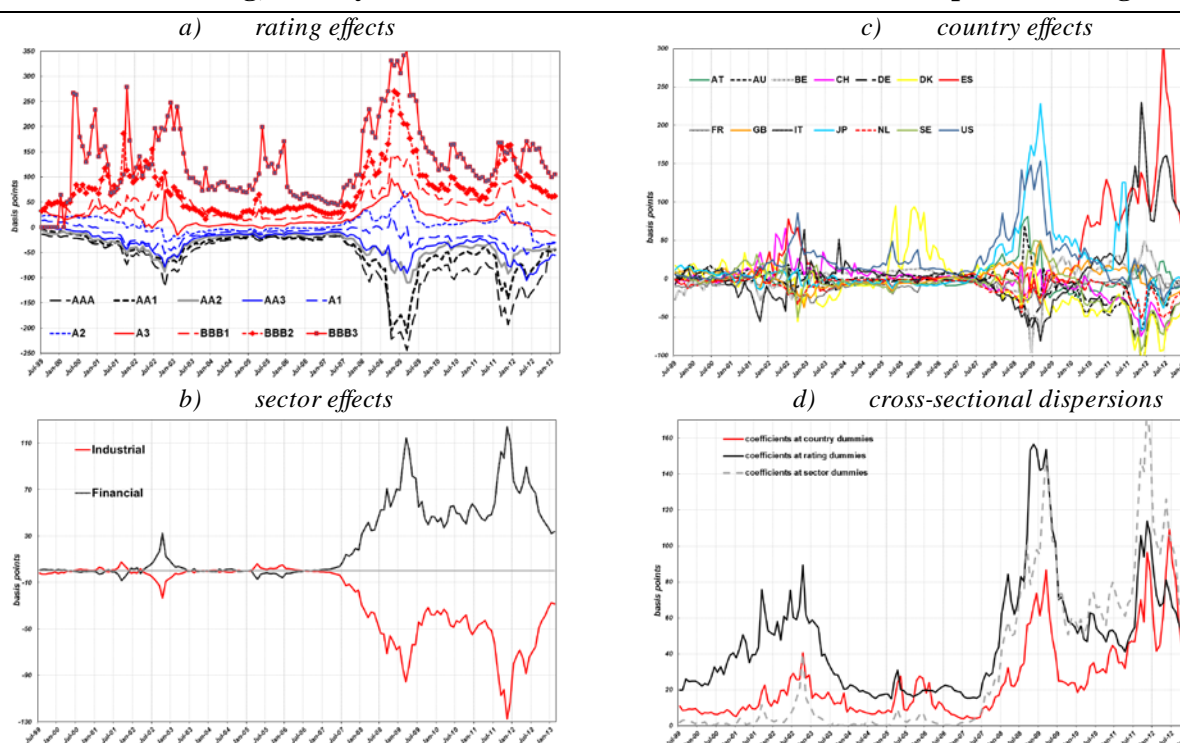
b) Average through January 2007 – February 2013

Country effect				Rating effect				Sector effect						
coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value					
AT	3	0.36	FR	-6	0.51	AAA	-103	0.00	BBB1	61	0.00	Financials	51	0.01
AU	-12	0.41	GB	7	0.34	AA1	-75	0.00	BBB2	101	0.00	Non-financials	-48	0.01
BE	1	0.42	IT	25	0.14	AA2	-48	0.00	BBB3	155	0.00			
CH	-19	0.33	JP	36	0.30	AA3	-45	0.00					coeff	p-value
DE	-30	0.14	NL	-15	0.32	A1	-19	0.17				<b>Common effect</b>	97	0.03
DK	-32	0.24	SE	-17	0.33	A2	12	0.23				<b>Maturity</b>	5	0.01
ES	53	0.30	US	31	0.36	A3	24	0.08				<b>Coupon</b>	6	0.06

c) Average through January 2010 – February 2013

Country effect				Rating effect				Sector effect						
coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value					
AT	-4	0.47	FR	-3	0.59	AAA	-103	0.00	BBB1	52	0.00	Financials	60	0.00
AU	-27	0.21	GB	1	0.25	AA1	-68	0.00	BBB2	89	0.00	Non-financials	-58	0.00
BE	11	0.41	IT	72	0.07	AA2	-46	0.00	BBB3	130	0.00			
CH	-33	0.10	JP	11	0.41	AA3	-51	0.00					coeff	p-value
DE	-40	0.03	NL	-18	0.29	A1	-29	0.06				<b>Common effect</b>	86	0.00
DK	-48	0.03	SE	-40	0.07	A2	3	0.23				<b>Maturity</b>	7	0.00
ES	105	0.01	US	5	0.40	A3	10	0.16				<b>Coupon</b>	10	0.00

**Charts A2.1 – Rating, country and sector effects and their cross-sectional dispersions. Regression (2).**



Source: ECB calculations, Merrill Lynch and Bloomberg.

<sup>34</sup> Due to parameter constraints we eliminate 3 dummies (1 country, 1 rating and 1 sector dummy) from the set of explanatory variables in order to calculate standard errors and corresponding t-statistic for parameter estimates. Afterwards we recalculate standard errors eliminating 3 other dummies from regressors and report the average of two estimates (when applicable).

**Table A2.2. Average parameter estimates and significance of coefficients in regression (equation 3) with the rating variable scaled from -3 to +3 with the time-varying and the constant parameter estimates in the presence of parameter constraint (3a).**

*a) Average through January 1999 – December 2014*

Country effect			Country effect			Sector effect		
coeff		p-value	coeff		p-value	coeff		p-value
AT	-1	0.30	FR	-9	0.32	Financials	21	0.14
AU	-6	0.53	GB	0	0.31	Non-financials	-21	0.17
BE	-4	0.50	IT	17	0.20		coeff	p-value
CH	1	0.37	JP	11	0.40	<b>Common effect</b>	65	0.02
DE	-16	0.36	NL	-4	0.49	<b>Rating effect</b>	32	0.00
DK	-15	0.36	SE	-14	0.31	<b>Maturity</b>	3	0.08
ES	19	0.30	US	21	0.16	<b>Coupon</b>	5	0.12

*b) Average through January 2007 – December 2014*

Country effect			Country effect			Sector effect		
coeff		p-value	coeff		p-value	coeff		p-value
AT	5	0.29	FR	-11	0.35	Financials	41	0.02
AU	-7	0.41	GB	3	0.37	Non-financials	-42	0.02
BE	-5	0.48	IT	30	0.09		coeff	p-value
CH	-10	0.30	JP	25	0.34	<b>Common effect</b>	100	0.00
DE	-31	0.08	NL	-5	0.46	<b>Rating effect</b>	44	0.00
DK	-37	0.19	SE	-24	0.24	<b>Maturity</b>	4	0.02
ES	44	0.25	US	26	0.20	<b>Coupon</b>	6	0.13

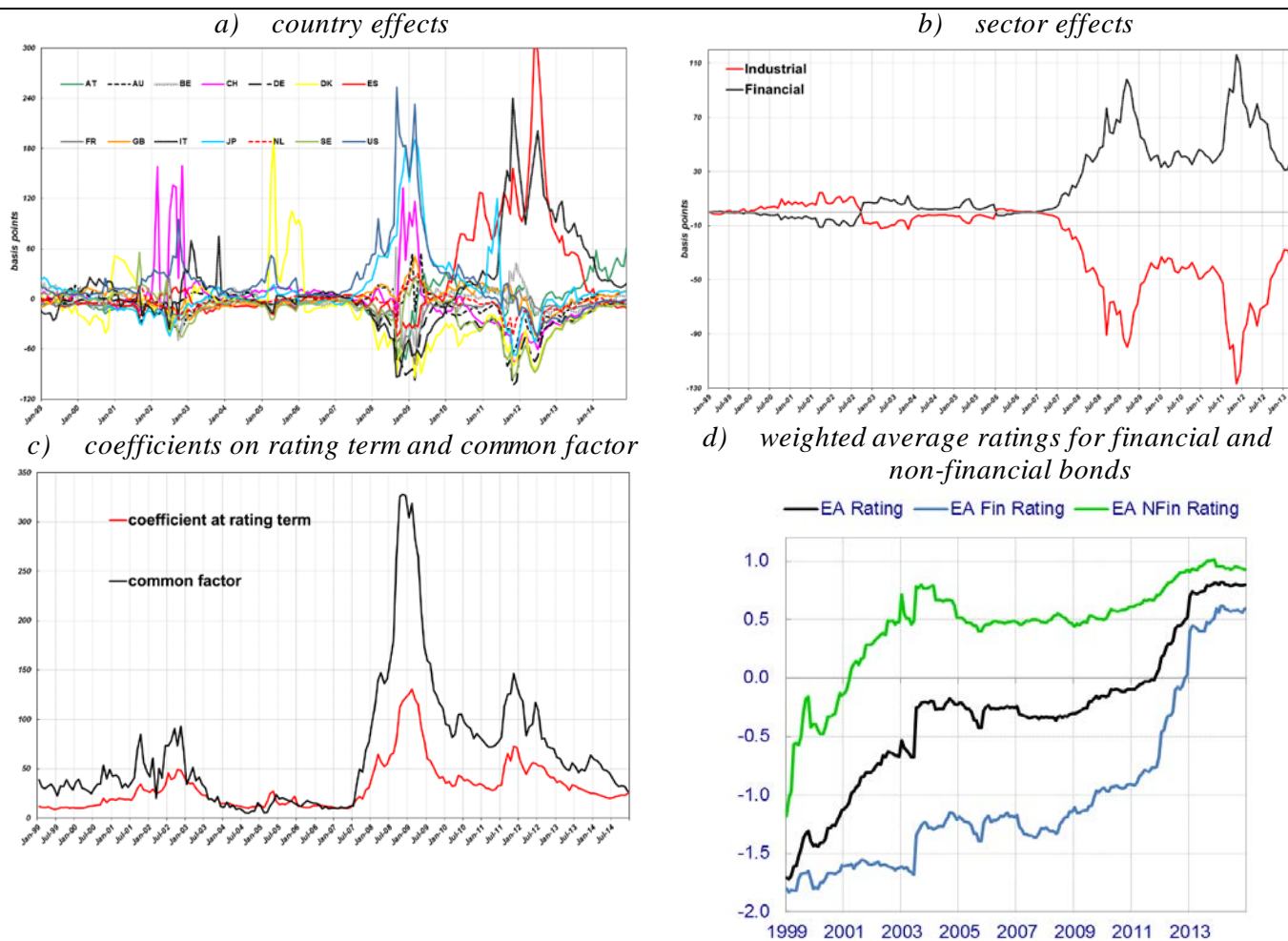
*c) Average through January 2010 – December 2014*

Country effect			Country effect			Sector effect		
coeff		p-value	coeff		p-value	coeff		p-value
AT	15	0.29	FR	-6	0.39	Financials	42	0.00
AU	-15	0.30	GB	0	0.31	Non-financials	-43	0.00
BE	-1	0.48	IT	68	0.05		coeff	p-value
CH	-24	0.17	JP	4	0.44	<b>Common effect</b>	76	0.00
DE	-32	0.03	NL	-10	0.41	<b>Rating effect</b>	37	0.00
DK	-35	0.11	SE	-34	0.08	<b>Maturity</b>	5	0.00
ES	75	0.07	US	-4	0.31	<b>Coupon</b>	8	0.00

*d) Constant parameters, estimated pooling all observations through January 1999 – December 2014*

Country effect			Country effect			Sector effect		
coeff		p-value	coeff		p-value	coeff		p-value
AT	-15	0.00	FR	-9	0.00	Financials	27	0.00
AU	8	0.00	GB	-5	0.00	Non-financials	-22	0.00
BE	-1	0.54	IT	45	0.00		coeff	p-value
CH	9	0.00	JP	10	0.00	<b>Common effect</b>	101	0.00
DE	-20	0.00	NL	-16	0.00	<b>Rating effect</b>	37	0.00
DK	-25	0.00	SE	-21	0.00	<b>Maturity</b>	2	0.00
ES	23	0.00	US	15	0.00	<b>Coupon</b>	0	0.01

**Charts A2.2 – Time-varying estimates of coefficients of regression (3) with the presence of parameter constraint (3a) and weighted average ratings for financial and non-financial bonds.**

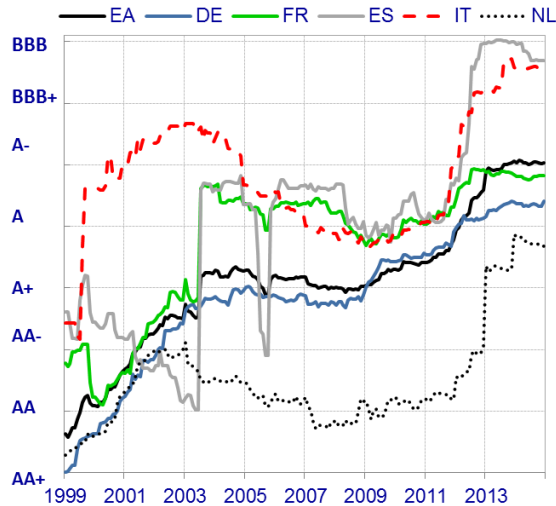


Source: ECB calculations, Merrill Lynch and Bloomberg.

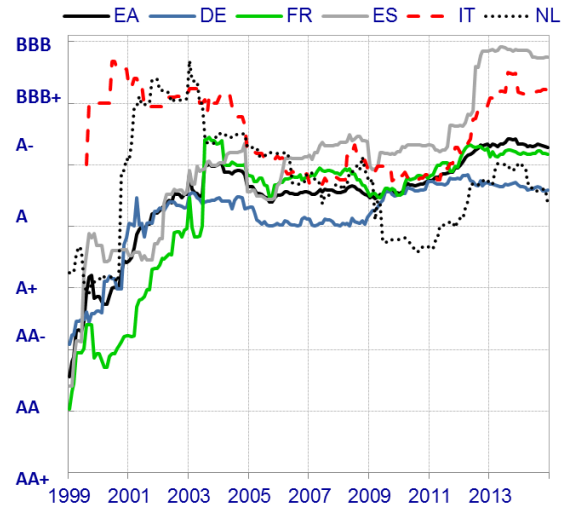
Note: Rating variable is scaled from -3 to +3 and is obtained by the means of logit transformation.

## Charts A2.3 – Weighted average rating, maturity and coupons

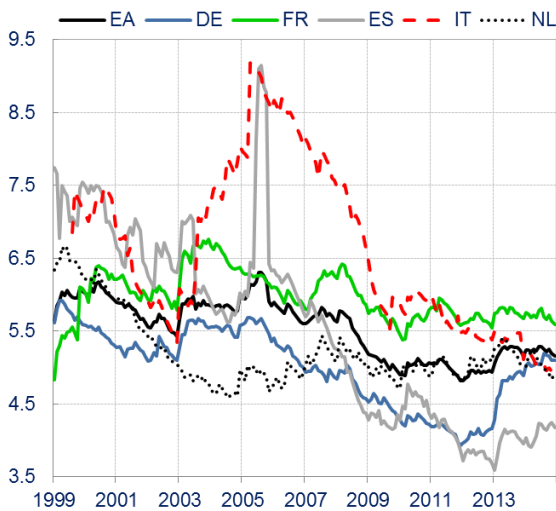
a) weighted average ratings (all bonds)



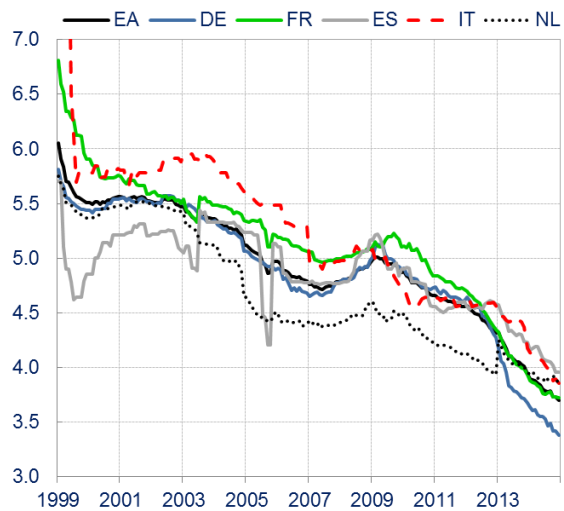
a) weighted average ratings (NFCs)



c) weighted average maturity (years)



d) weighted average coupon (percentages)



Source: ECB calculations, Merrill Lynch and Bloomberg.

Note: We distinguished between 10 rating notches (AAA, AA+ (AA1), AA (AA2), AA- (AA3), A+ (A1), A (A2), A- (A3), BBB+ (BBB1), BBB (BBB2) and BBB- (BBB3)- rated bonds).

### Annex 3. Construction of EBPs and EBRs

Based on the constant and time-varying parameter estimates of cross-sectional regressions (1), (2) and (3), I construct the following set of the Excess Bond Premia (EBPs) and Excess Bond Returns (EBRs)<sup>35</sup> for individual bonds. To obtain the aggregated indices at a country or industry level, the EBPs or EBRs for individual bonds are weighted with the outstanding volumes of issuances of individual securities.

- The maturity, coupon and liquidity-adjusted individual EBR for a bond  $i$  at time  $t$ , calculated using coefficients of equation (1) with the presence of constraint (1a) ( $EBR_{mcl}^i(t)$ ):

$$EBR_{mcl}^i(t) = Spread_{c,r,s,t}^i - \tau_{i,t} - \rho_t coupon_i - \lambda_t liq_{i,t}$$

- The maturity and coupon-adjusted individual EBR for a bond  $i$  at time  $t$ , calculated using coefficients of regression without liquidity term (2) with the presence of constraint (1a) ( $EBR_{mc}^i(t)$ ):

<sup>35</sup> As the EBP has a developed connotation of a deviation of corporate spreads relative to credit risk of an issuer, we will use the term EBR in other cases, denoting a deviation of corporate spreads relative to other factors.

$$EBR_{mc}^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i$$

- The maturity, coupon, liquidity and rating-adjusted individual EBP for a bond  $i$  at time  $t$ , calculated using coefficients of equation (1) with the presence of constraint (1a) ( $EBP1^i(t)$ ):

$$EBP_1^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \lambda_t liq_{it} - \beta_{r,t}$$

- The maturity, coupon and rating-adjusted individual EBP for a bond  $i$  at time  $t$ , calculated using coefficients of equation (2) (cross-sectional regression without liquidity term) with the presence of constraint (1a) ( $EBP2^i(t)$ ):  $EBP_2^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t}$

- Total residuals of regression (2) or the completely-adjusted (maturity, coupon, sector, country and rating-adjusted) individual EBP for a bond  $i$  with rating  $R_{it}^r$ , country  $C_i^c$  and sector  $S_i^s$  at time  $t$ . This individual EBP will be used to construct only the euro area composites ( $EBP2tot^i(t)$ ):

$$EBR_{2tot}^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t} - \gamma_{c,t} - \sigma_{s,t}$$

- The maturity, coupon and sector-adjusted individual EBR for a bond  $i$  at time  $t$ , calculated using coefficients of regression without liquidity term (2). This individual EBR will be used to construct only the euro area composites ( $EBR2sec^i(t)$ ):  $EBR_{2sec}^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \sigma_{s,t}$

- The maturity, coupon and rating-adjusted individual EBP for a bond  $i$  with rating  $\tilde{R}_{it}$  at time  $t$ , calculated using coefficients of equation (3) with the presence of constraint (3a) with the time-varying parameters (regression with a rating variable replacing 10 rating dummies. It is scaled from 0 to 6 and is obtained by a logit transformation) ( $EBP3^i(t)$ ):  $EBP_3^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t} \tilde{R}_{it}$

- The maturity, coupon and rating-adjusted individual EBP for a bond  $i$  with rating  $\tilde{R}_{it}$  at time  $t$ , calculated using coefficients of equation (3) with the presence of constraint (3a) with the constant parameter estimates (cross-sectional regression with a rating variable replacing 10 rating dummies. It is scaled from 0 to 6 and is obtained by a logit transformation) ( $EBP3const^i(t)$ ):

$$EBP_3^i const(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t} \tilde{R}_{it}$$

- The maturity, coupon and rating-adjusted individual EBP for a bond  $i$  with rating  $R_{it}$  at time  $t$ , calculated using coefficients of equation (3) with the time-varying parameters (cross-sectional regression with a rating variable replacing 10 rating dummies. It is scaled from -3 to +3 and is obtained by a logit transformation) ( $EBP4^i(t)$ ):

$$EBP_4^i(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t} R_{it}$$

- The maturity, coupon and rating-adjusted individual EBP for a bond  $i$  with rating  $R_{it}$  at time  $t$ , calculated using coefficients of (3) with the constant parameter estimates (regression with a rating variable replacing 10 rating dummies. It is scaled from -3 to +3 and is obtained a logit transformation) ( $EBP4const^i(t)$ ):  $EBP_4^i const(t) = Spread_{c,r,s,\tau}^i(t) - {}_t\tau_{it} - \rho_t coupon_i - \beta_{r,t} R_{it}$

Thus, EBPs, based on rating dummies, are denoted as EBP1 and EBP2 (where EBP1 corresponds to the estimates of regression (1) including the liquidity term and EBP2 – to the estimates of regression (2) without the liquidity term). EBPs, based on a rating variable (replacing rating dummies) are denoted as EBP3 and EBP4 (where EBP3 corresponds to the estimates of regression (3) with a rating variable scaled from 0 to 6 and EBP4 – to the estimates with a rating variable scaled from –3 to +3).

#### Annex 4. Construction of lending spreads

Our lending spreads indices are based on available detailed interest rate statistics, provided by Monetary Financial Institutions (MFIs) and compiled by the ECB since the beginning of 2003 (see, for example, ECB (2005)). Unfortunately, the granular information on the interest rate fixation periods and the volumes of individual loans, which would be necessary to construct the exactly maturity-matched spreads is not available, but the dataset is broken down by four buckets: overdrafts<sup>36</sup>, loans with floating rates or less than 1-year initial rate fixation periods, loans with initial rate fixation periods over 1-year and less than 5-years and loans with initial rate fixation periods over 5-years. Additional distinction between corporate small loans (up to € 1 million) and big loans (over € 1 million) permit to account for heterogeneity between the lending rates paid on less risky loans and more risky loans. Table A4 reports the computed set of lending spreads with respect to the euro area risk-free interest rates (if applicable). Some of these lending spreads are presented in Chart A4; due to high volatility spreads between lending rates on small and big loans for NFCs are smoothed by means of the 3-month moving averages.

**Table A4. Constructed set of lending spread indices**

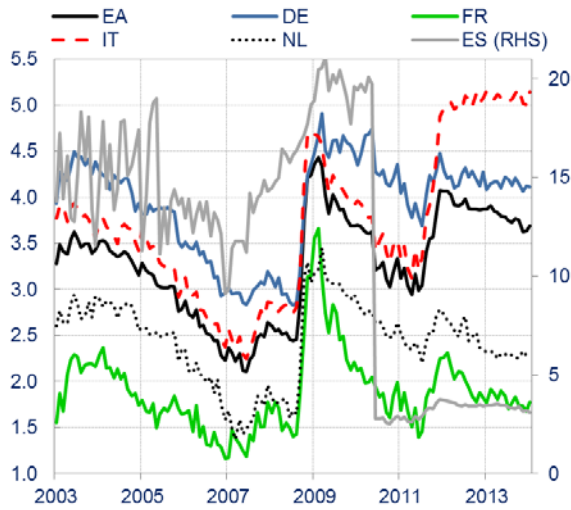
Lending spread	Lending rate used to compute spread	Versus euro-area risk-free rate	Denoted further as
Spread for NFC overdrafts	Overdrafts for NFCs	1-month Euribor	<i>NFC overdr</i>
Spread for NFC short-term small loans	Rates on small loans for NFCs with less than 1-year initial rate fixation periods	3-month Euribor	<i>NFC small &lt;1y</i>
Spread for NFC medium-term small loans	Rates on small loans for NFCs with 1-5-years initial rate fixation periods	2-year swap rate	<i>NFC small 1-5y</i>
Spread for NFC long-term small loans	Rates on small loans for NFCs with over 5-years initial rate fixation periods	5-year swap rate	<i>NFC small &gt;5y</i>
Spread between lending rates on NFC short-term small and big loans	Spreads between lending rates on small and big loans for NFCs with less than 1-year initial rate fixation periods		<i>Spread S-B &lt;1y</i>
Spread between lending rates on NFC medium-term small and big loans	Spreads between lending rates on small and big loans for NFCs with 1-5 years initial rate fixation periods		<i>Spread S-B 1-5y</i>
Spread between lending rates on NFC long-term small and big loans	Spreads between lending rates on small and big loans for NFCs with over 5-years initial rate fixation periods		<i>Spread S-B &gt;5y</i>
Spread for overdrafts for households	Rates on overdrafts for households	1-month Euribor	<i>HH overdr</i>
Spread for short-term mortgage loans	Rates on loans to households for house purchase with less than 1-year initial rate fixation periods	3-month Euribor	<i>HH &lt; 1y</i>
Spread for medium-term mortgage loans	Rates on loans to households for house purchase with 1-5 years initial rate fixation periods	2-year swap rate	<i>HH 1-5y</i>

<sup>36</sup> Overdrafts comprise a big share of NFC's financing in some euro area countries (for example, in Italy) and constitute only a minor source of financing in other countries (for example, in Spain).

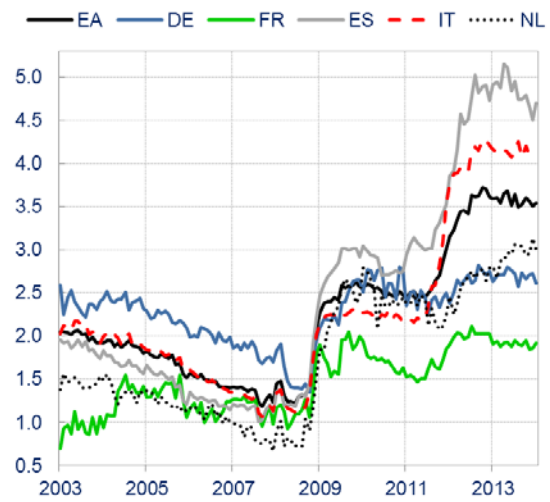


**Charts A4 – Bank lending spreads (percentages)**

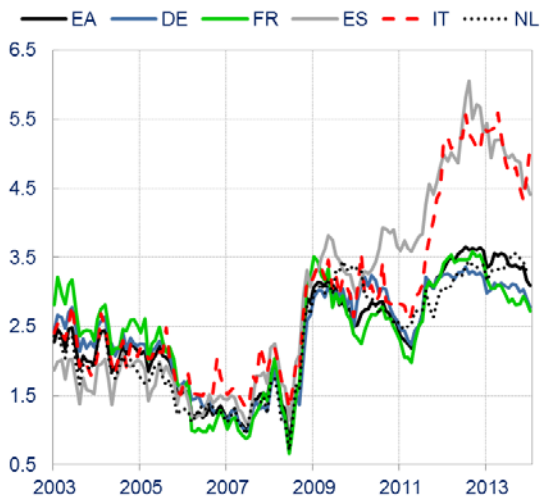
a) *overdraft NFCs*



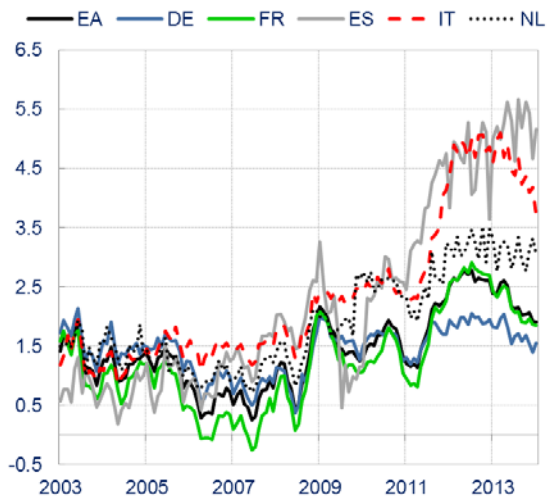
b) *Loans to SME with less than 1 –year fixation*



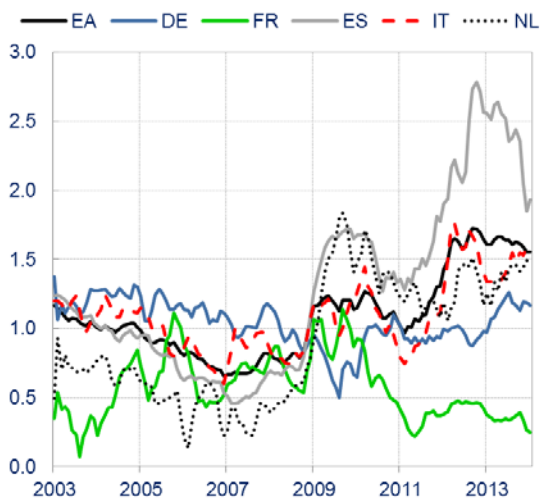
c) *Loans to SME with fixation 1-5 years*



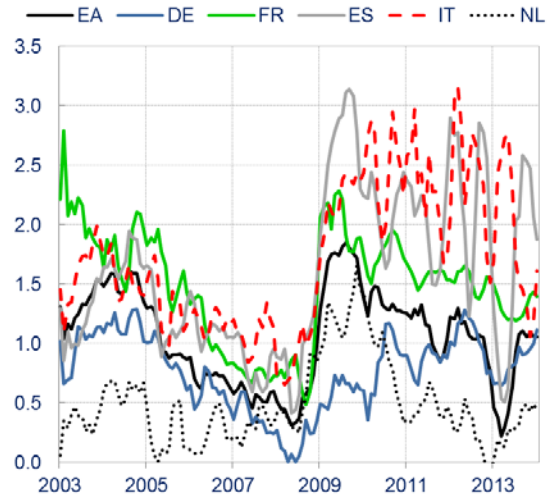
d) *Loans to SME with fixation over-5 years*



e) *Spread between lending rates on small and big loans with fixation less than 1-year (smoothed by 3-months averages)*



f) *Spread between lending rates on small and big loans with fixation 1-5 years (smoothed by 3-months averages)*



Source: ECB calculations

## **Annex 5. Predictive content of corporate spreads for macroeconomic and lending indicators**

Each table in Annex 5 presents selected parameter estimates of:

1. *(in the first column)*: the baseline regression (4a), which includes only the autoregressive term, real interest rate and the slope of risk-free rate (term spread);
2. *(in the second column)*: the best performing regression (4) among regressions, including the weighted corporate bond spread indices, based on different attributions (country, sector and rating) of the underlying bonds;
3. *(in the third column)*: the best performing regression (4) among regressions, including EBRs (i.e. corporate bond spreads, adjusted for the term, coupon and liquidity premia) for financial and non-financial corporations for corresponding country and the euro area composites;
4. *(in the fourth column)*: the best performing regression (4) among regressions, including the EBPs based on 10 rating dummies (EBP1 and EBP2);
5. *(in the fifth column)*: the best performing regression (4) among regressions, including the EBPs based on a rating variable with the time-varying and the constant parameter estimates (EBP3 and EBP4);
6. *(in the sixth column)*: the best performing regression (4) among regressions, including the bank lending spreads;
7. *(in the seventh column)*: the best performing regression (5), including the lending spread indices and the best performing corporate bond spread index or the EBP or the EBR as was found by steps 1.-5.



























### Acknowledgements

The views expressed in this paper are those of the author and are not necessarily shared by the European Central Bank. I thank Matthieu Darracq Paries and Gerhard Rünstler for their very helpful comments.

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ISSN 1725-2806 (online)  
ISBN 978-92-899-2159-6  
DOI 10.2866/090796  
EU catalogue No QB-AR-16-028-EN-N