THE ECONOMIC JOURNAL

The Economic Journal, **128** (*February*), 118–158. Doi: 10.1111/ecoj.12427 © 2016 Royal Economic Society. Published by John Wiley & Sons, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

CREDIT RISK IN THE EURO AREA*

Simon Gilchrist and Benoit Mojon

We construct credit risk indicators for euro area banks and non-financial corporations. These indicators reveal that the financial crisis of 2008 dramatically increased the cost of market funding for both banks and non-financial firms. In contrast, the prior recession following the 2000 US dot-com bust led to widening credit spreads of non-financial firms but had no effect on the credit spreads of financial firms. The 2008 financial crisis also led to a systematic divergence in credit spreads for financial firms across national boundaries. Credit spreads provide substantial predictive content for real activity and lending measures for the euro area as a whole and for individual countries.

The euro area has become the epicentre of world financial stress since the post-Lehman recession escalated into a sovereign debt crisis that began in 2010. The fear of a sovereign default and the possible break up of the euro has resulted in diverging financial conditions for debt issuers across countries within the euro area. This divergence of financial conditions within the Eurosystem has been among the main motivations for a series of non-conventional monetary policy measures taken by the ECB since May 2010. In particular, the launch of the outright monetary transactions (OMT) in the late summer of 2012 was motivated by the need to 'restore' the transmission mechanism, i.e. the uniqueness of financial conditions within the euro area.

Although policy makers remain concerned about the fragmentation of the European financial system, gauging the extent of financial distress for countries within the euro area remains a considerable challenge. There are very few reliable indicators of credit risk in the euro area and across euro area countries. Most statistics on euro area interest rates are either sovereign interest rates or bank retail interest rates. In principle, the latter reflect the effective cost of external finance for a large proportion of the population of euro area firms and for households. In practice, retail bank interest rates are based on surveys rather than market-based indicators. In addition, bank retail interest rates reflect compositional changes among borrowers as well as the varying degree of competition between banks.

Market interest rates arguably provide better indicators of credit risk as they reflect, in real time, the beliefs of many investors. Although market-based indices of an average of corporate bond yields are commercially available, these are frequently constructed from arbitrary samples of firms whose characteristics evolve over time in a non-transparent manner. Furthermore, the lack of information regarding the underlying structure of the portfolio leads to a maturity mismatch when constructing credit

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We are particularly grateful to Beatrice Saes-Escorbiac, Jocelyne Tanguy and Aurélie Touchais for their excellent research assistance. We thank Viral Acharya, Marcus Brunnermeier, Christina Romer, David Romer, Richard Portes, Pierre Sicsic, Morten Ravn, two anonymous referees and participants to Banque de France, Banco de Espagna and LBS seminars and the NBER Summer Institute. The opinions expressed in this article are those of the authors and do not reflect the views of the Banque de France.

spreads as the difference in yields between corporate bonds and sovereign bonds. This maturity mismatch confounds measurement by not properly distinguishing between credit risk and term premia.

This article introduces new indices of credit risk in the euro area. These indices aggregate the information obtained from thousands of corporate bonds and hundreds of thousands of monthly observations on the yield to maturity of such bonds since the launch of the euro in January 1999. Following Gilchrist *et al.* (2009) and Gilchrist and Zakrajsek (2012*b*), we construct a credit spread at the bond level as the difference between the corporate bond yield and the yield of a German bund zero coupon bond of the same maturity. By constructing credit spreads at the bond-issuance level, we thus avoid confounding credit risk premia with term premia. We then aggregate bond-level credit spreads to obtain indices of credit risk for two sectors, banks and non-financial corporations (NFC hereafter) for the four largest euro area countries: Germany, France, Italy and Spain. By aggregating this information across countries, we are also able to construct credit spreads for the euro area as a whole.

Our credit spreads reveal that the financial crisis of 2008 dramatically increased the cost of market funding for both financial and non-financial firms in the euro area. Furthermore, since the summer of 2010, there has been a strong divergence in corporate credit spreads across countries similar to the one observed for sovereign spreads. The credit spreads of both financial and non-financial corporations in Italy and Spain widened dramatically during this time period. Although not as pronounced, we further document a deterioration in the credit spreads of financial institutions in France and Germany during the post-2010 period. In contrast, the credit spreads of non-financial firms in France and Germany remain below their 2009 peak.

In addition to documenting the evolution of credit spreads across countries within the euro area, we also analyse the information content of these credit spreads by examining their ability to predict commonly used indicators of economic activity, inflation and bank lending. These results imply that, for the euro area as a whole, both financial and non-financial credit spread indices are highly robust leading indicators for economic activity and growth in bank lending. In terms of aggregate spending components, we find that both bank and NFC credit spreads are particularly informative about the future growth in non-residential investment. In contrast, only bank credit spreads are found to be robust predictors of the future growth in consumption spending.

We also consider the ability of country-specific financial and non-financial credit spreads to predict country level economic activity. When conducting this exercise, we examine the forecasting power of corporate bond spreads defined as the difference between the corporate bond yield and the country-specific sovereign bond yield. We find a clear pattern across countries. For the two-core European countries in our sample, France and Germany, bank credit spreads and non-financial credit spreads provide the same information content in terms of forecasting economic activity. For the two periphery countries, Italy and Spain, we find that bank credit spreads provide substantial forecasting power for economic activity but that non-financial corporate credit spreads provide no incremental forecasting power for such activity variables. This finding implies that credit risk indices that are specific to the financial sector are highly robust predictors of economic activity across all countries and provide

particularly valuable information to environments where sovereign risks spill over into risk in the financial sector.

In order to characterise the response of economic activity to disruptions in credit markets we also estimate a factor-augmented vector autoregression (FAVAR) and study the impulse response of euro area and country-specific measures of economic activity to shocks to credit spreads that are orthogonal to information contained in both real activity series and other asset prices. Consistent with the findings that credit spreads predict future economic activity, the FAVAR results imply that disruptions in credit markets lead to a sharp reduction in stock returns, significant declines in output and inflation, and increases in unemployment across the euro area and within each of the four countries.

The FAVAR exercise takes a specific albeit conservative stand on the identification of credit shocks. As a robustness exercise, we also adopt the external instruments approach of Stock and Watson (2012) and Mertens and Ravn (2013) and examine the response of economic activity variables to movements in credit spreads that are due to changes in liquidity conditions in the German bund market as measured by Monfort and Renne (2014). The external instrument identification procedure delivers very similar qualitative as well as quantitative impulse responses of euro area macroeconomic variables to credit spreads as those that we obtain under the identified VAR approach. This finding provides additional support for a causal interpretation of the FAVAR finding that disruptions in credit supply as measured by a widening of credit spreads lead to widespread and persistent contractions in economic activity.

There is a long tradition of building credit risk indicators from bond prices and assessing their predictive content for economic indicators over the business cycle.[1] Our approach replicates the one developed in Gilchrist and Zakrajsek (2012*b*) for US data. Bleaney *et al.* (2016) have implemented a similar approach for corporate bonds from Austria, Belgium, France, Germany, Italy, the Netherlands, Spain and the UK, yet they focus exclusively on NFC credit spreads, while we highlight the unique role of corporate credit risk for banks.

The role of banks in the transmission of monetary policy has been analysed in a number of research papers, including nine euro area country case studies that consistently analysed individual balance sheet data in the context of the Eurosystem Monetary Transmission Network. Angeloni *et al.* (2003) and Ehrmann *et al.* (2003) provide an overview of these results. More recently, many papers have focused on the spillover of the euro area sovereign debt crisis to credit markets, including Albertazzi *et al.* (2012), Battistini *et al.* (2013), Del Giovane *et al.* (2013), Neri and Ropele (2013) and references therein.[2]

Several papers have also gathered evidence on the importance of banks for the euro area business cycle. Among these, Lacroix and Montornès (2009), de Bondt *et al.* (2010), Ciccarelli *et al.* (2010), Hempell and Kok Sorensen (2010) and Del Giovane *et al.* (2011), show in particular that the diffusion indices constructed from the ECB

[1] See in particular Estrella and Hardouvelis (1991), Friedman and Kuttner (1992, 1993), Estrella and Mishkin (1998) and Gertler and Lown (1999).

[2] See also Panetta and Signoretti (2010) for an earlier study of the effects of financial stress on banks' activity.

Bank Lending Survey contain predictive power for economic indicators in the euro area.[3]

The rest of the article is organised as follows. Section 1 describes the data used to construct credit indices at the country level for both banks and non-financial firms and documents the evolution of these indices over the available sample period, 1999–2013. Section 2 assesses the ability of credit spreads to predict economic activity, inflation and lending aggregates. Section 3 uses a factor-augmented VAR framework to explore the distinct role of credit spreads in the business cycle. Section 4 concludes.

1. Credit Risk Indices for the Euro Area

Following the methodology of Gilchrist and Zakrajsek (2012*b*), we use individual security level data to construct security-specific credit spreads. We then average these credit spreads to obtain credit spread indices at the aggregate level. This methodology allows us to construct credit spread indices that reflect the two key characteristics of the European financial system: the importance of banks, and the extent of national fragmentation of financial markets within the euro area.

It is well known that the European financial system is dominated by banking institutions. That such financial firms account for a disproportionate share of the corporate bond market is perhaps less widely recognised. Bonds issued by euro-area banks account for over 5 trillion euro as of 2012. This compares to 800 hundred billion euro issued by non-financial corporations and 6.2 trillion euro issued by sovereigns.[4] Thus to a large extent, the bond market overwhelmingly reflects a combination of debt issued by financial institutions and sovereigns with only a small fraction of issuance accounted for by non-financial corporations.[5] The latter rely instead on bank loans, which amount to nearly 4.4 trillion euro, i.e. more than five times the debt they issue as corporate bonds.[6]

The importance of individual countries in the European financial system reflects the national fragmentation of the euro-area financial market that has re-emerged since the Lehman bankruptcy in 2008. In this environment, credit conditions in sovereign debt markets may easily spill over into country-specific financial markets. In turn, a deterioration in balance sheets of the financial sector at the country level may lead to an increase in sovereign risk.

Given these concerns we build two indicators, one for banks and one for non-financial corporations, for each of the four largest euro area countries: France, Germany, Italy and Spain. These countries account for 80% of the euro area

[3] In addition to providing an analysis of the evolution of euro area and country-specific corporate credit spreads, an important goal of this research project is to construct credit risk indicators in a uniform and hence comparable manner for the euro area and within the four largest euro area countries. Importantly, our data collection methods, which rely on publicly available information, allow us to provide consistent monthly updates to all aggregate credit indices.

[4] The total debt of the euro area public sector exceeds 8 trillion euro, once bank loans, primarily granted to cities and regions, are included.

[5] The euro area corporate bond market is relatively liquid. Biais *et al.* (2006) report for instance that each security is subject to approximately three trades per day on average

[6] See also ECB (2013) for a recent review of the relative role of banks and markets in financing non-financial corporations in the Euro area.

population, economic activity and financial markets. Although in principle it is possible to extend the analysis to countries beyond Spain, in practice, the corporate debt market becomes too shallow and provides a cross-section of issuers that is too narrow to build reliable macroeconomic indicators for smaller countries.

1.1. *Data Sources and Methods*

Our indices are based on a comprehensive list of corporate debt securities issued by corporations in the euro area big four as reported in Bloomberg and Datastream. For each security, we use the Datastream month end 'effective yield' and subtract from it the interest rate of a zero coupon sovereign bond of matched duration.[7] In the case of France, Italy and Spain, we compute two spreads, one defined with respect to a German bund and one with respect to their domestic sovereign bond. Our choice of the German bund as the benchmark risk-free asset is motivated by the increased and more volatile sovereign spreads between Italian, Spanish and to a lesser extent French treasury yields with respect to the German bund interest rate as the European debt crisis has unfolded. To match duration, we obtain an estimate of the zero-coupon German bund yield at a specific maturity using standard yield-curve fitting techniques. Our euro area spreads are aggregates of the national spreads defined with respect to the German bund.

To construct credit indicators, we focus on fixed-coupon, euro-denominated, non-callable, non-guaranteed securities. We provide details of the sample selection including names of all issuers in Appendix A. The resulting database includes over 90,000 monthly observations from nearly 2,300 corporate bonds. Of these, about 50,000 observations are effective yields on bonds issued by banks. The remaining 40,000 observations are issued by non-financial corporations.

Table 1 provides descriptive statistics of the underlying bond market data by type of issuer and by country. The number of securities available varies significantly across countries and over time. The cross-country variation is in part due to the depth of the market as measured by country size in economic terms. It also reflects institutional characteristics specific to each country. In particular, German banks have a noticeably large number of securities outstanding in comparison to banks in the other three countries. The number of issuers is therefore a more informative statistic of data coverage. This varies from 66 banks and 112 non-financial companies in Germany to 26 banks and 22 non-financial companies in Spain. Table 1 also highlights considerable variation in data availability over time. Notably, data coverage is somewhat limited for the first years of the sample and grows over time as the European bond market deepens.[8]

Table 1 also provides summary statistics on the characteristics of individual bonds, including size of issuance, maturity and duration. Banks tend to issue smaller amounts than non-financial companies, especially in Germany where the median issuance of banks amount to $121 million. The median issuance for non-financial companies ranges

[7] For a subset of securities, we independently verified that the effective yield provided by Datastream matches the effective yield computed from the bond price and the sequence of coupons.

[8] The limited sample size in the earlier yields is partially due to limited availability of data on securities that have expired and for which our source does not maintain records.

Table 1

Descriptive Statistics of the Micro Data Used to Build the Indices

	Banks											
	Germany			France			Italy			Spain		
Number of observations	27,860			11,573			8,889			2,774		
Number of securities	867			241			296			69		
Number of securities in May 2012	561			122			166			35		
Number of securities in June 2005	191			67			32			16		
Number of securities in January 1999	34			30			22			10		
Total number of issuers	66			40			47			26		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Mkt value of issue ($ thousands)	333,881	120,875	587,179	498,888	279,601	578,111	570,700	307,093	653,037	342,691	200,000	423,537
Maturity at issue (years)	6.6	5	3.9	9.5	10	3.3	7.7	8	3.5	9.8	10	6.5
Remaining maturity	4.1	3.5	2.9	4.8	5	6.7	4.4	3.4	3.2	3.3	2.5	2.5
Duration (years)	3.4	2.9	2.1	4.4	4.3	2.4	3.7	3.3	2.3	5	3.9	3.7
Domestic sovereign ZCY	2.3	2.4	1.4	3.1	3.2	1.2	3.6	3.5	1.2	3.7	3.8	1.1
German sovereign ZCY	2.3	2.4	1.4	3	3.2	1.4	2.3	2.2	1.5	2.2	2.2	1.7
Spread/German sovereign ZCY	1.6	1.3	1.9	1.4	0.9	1.6	2.4	1.7	2.8	2.5	2.5	2.4

Table 1
(Continued)

Non-financial corporations												
	Germany			France			Italy			Spain		
Number of observations	15,471			13,696			6,702			2,695		
Number of securities	333			283			139			39		
Number of securities in May 2012	188			142			62			22		
Number of securities in June 2005	98			98			44			19		
Number of securities in January 1999	14			16			4			4		
Total number of issuers	112			88			62			22		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Mkt value of issue ($ thousands)	907,783	672,495	767,060	798,285	708,968	561,291	891,480	753,742	736,147	517,025	494,007	411,515
Maturity at issue (years)	7.8	7	4.5	8.5	7	3.7	9.2	7	6	11.8	10	7
Remaining maturity (years)	4.4	4	5.9	5.2	4.5	3.4	5	4.3	10.2	5.5	5.3	3.1
Duration (years)	4	3.5	2.6	4.3	4	2.4	5.1	4	3.7	5.4	5	3.2
Domestic sovereign ZCY	2.6	2.7	1.3	3	3.1	1.1	3.8	3.8	1.1	3.7	3.8	0.9
German sovereign ZCY	2.6	2.7	1.3	2.9	3	1.2	3.1	3.2	1.2	3.1	3.3	1.2
Spread/German sovereign ZCY	1.4	1.1	1.3	1.4	1	1.7	2.2	1.6	2.4	2	1.5	2.1

from \$494 million in Spain to \$753 million in Italy. The initial maturity of the securities is close to 10 years and the remaining maturity ranges from 3 to 5 years across portfolios.

For each security, the spread S_{it}, on corporate bond i, is constructed by subtracting from the effective yield R_{it} the German bund zero coupon interest rate of a similar duration $ZCR_t^{DE}[\mathrm{Dur}(i,t)]$:

$$S_{it} = R_{it} - ZCR_t^{DE}[\mathrm{Dur}(i,t)].$$

For France, Italy and Spain, we also compute a spread defined with respect to their domestic sovereign (DS):

$$S_{it}^{DS} = R_{it} - ZCR_t^{DS}[\mathrm{Dur}(i,t)].$$

As shown in Table 1, the mean and median credit spreads for the entire sample period appear to be relatively homogenous across sectors and countries. For banks, the median credit spread ranges from 0.9% for French banks to 2.1% for Spanish banks. Non-financial corporations have median spreads with respect to the German bund that range from 1.0% in France to 1.6% in Italy.[9]

Country-specific credit risk indicators defined with respect to the German bund S_t^k, or with respect to domestic sovereign bonds $S_t^{DS,k}$, are constructed as a weighted average of credit spreads on individual securities:

$$S_t^k = \sum_i w_{it} S_{it},$$

and

$$S_t^{DS,k} = \sum_i w_{it} S_{it}^{DS},$$

where the weight

$$w_{i,t} = \frac{MVAI_{it}}{\sum_i MVAI_{i,t}},$$

is defined as the ratio of the market value at issue of the security relative to the total market value at issue of all bonds in the sample during a point in time. In addition to constructing country-specific credit spread indices, we also use the same methodology to construct a value-weighted credit spread index for the euro area as a whole.[10]

When conducting forecasting exercises for euro area aggregates we analyse the forecasting content of the euro area weighted average credit spreads defined relative to the German bund. In contrast, to analyse the predictive power of bank and NFC credit

[9] Similar descriptive statistics for spreads defined with respect to domestic sovereign bonds, not reported here for the sake of space, are available upon request to the authors.

[10] We have compared these spreads to unweighted averages as well as to trimmed means that exclude the first and the ninety-ninth percentiles and the fifth and the ninety-fifth percentiles of the spread distributions. These comparisons, which are available upon request to the authors, reveal that these alternative approaches produce highly correlated indices. The only notable exception pertains to German bank spreads during the 2002–3 slowdown. In this episode, the unweighted credit spread index is significantly higher than the weighted index presented in this article, implying that the cost of market funding for small German banks increased at that time.

spreads at the country level, we focus on the information content of country-specific credit spreads defined relative to their own sovereign counterparts.

1.2. *The Time-series Evolution of Credit Spreads*

Figures 1 and 2 display the time-series evolution of the credit risk indicators for banks and the NCFs for each country and for the euro area. We plot the spreads defined with respect to the Bund in the top panel and the ones with respect to the domestic sovereign in the bottom panel. We compute euro area aggregate credit spreads only with respect to the Bund which has become the benchmark risk free asset for fixed income assets denominated in euro. The time series behaviour of these credit spreads

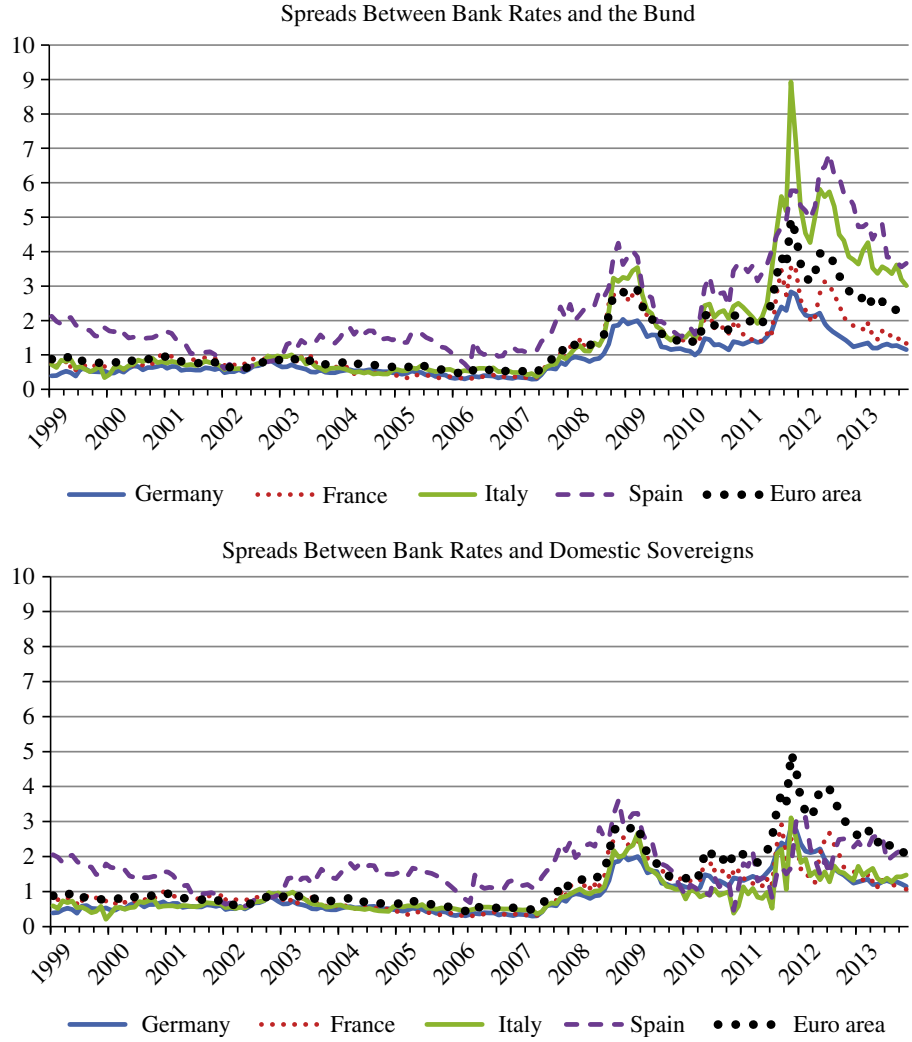

Fig. 1. *Euro Area Corporate Credit Spreads for Banks*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

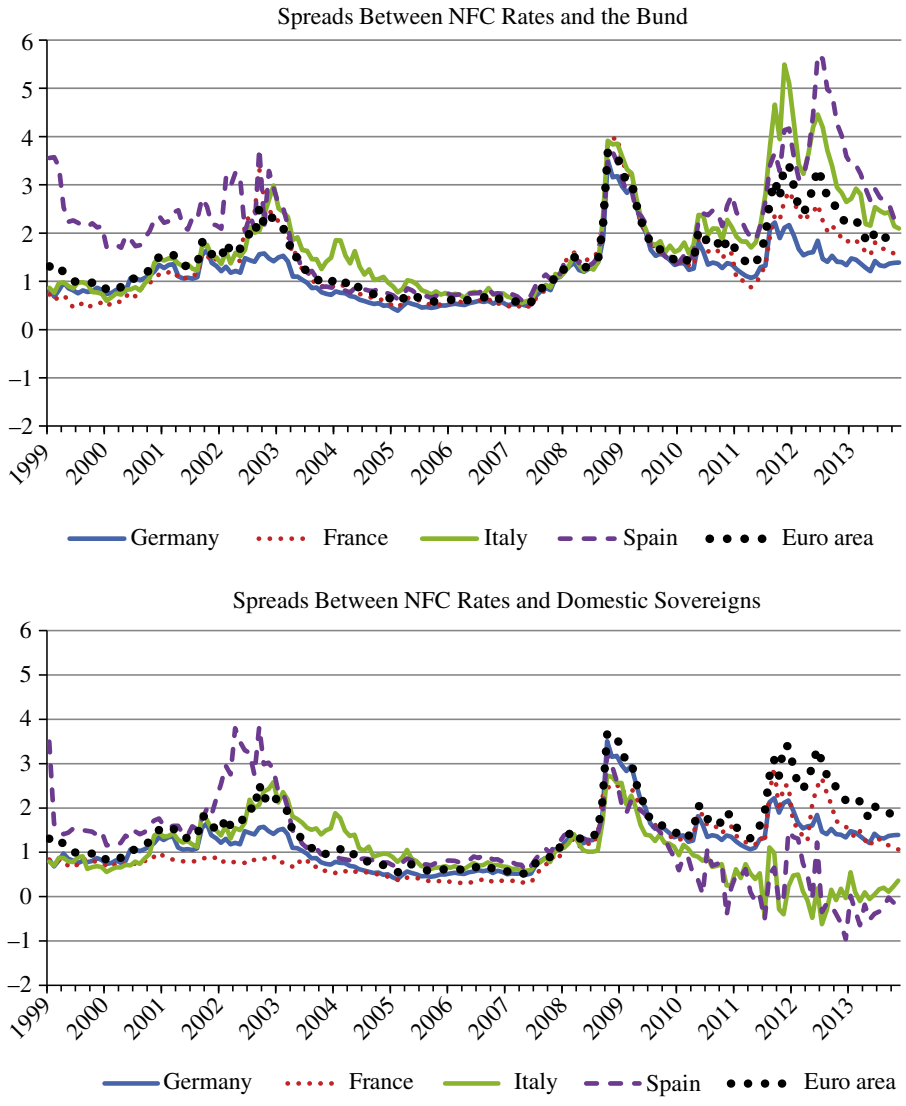

Fig. 2. *Euro Area Corporate Credit Spreads for NFCs*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

show a number of striking patterns that reflect financial developments in the euro area over the 1999–2013 sample period.

Prior to the global financial crisis that began in mid-2007, credit spreads for banks in Germany, France and Italy were both low and exhibited a strong common co-movement. In the 1999–2002 period, these credit spreads were roughly on the order of 80–100 basis points. These credit spreads fell to roughly 50 basis points during the 2003–7 period of strong growth in housing prices in the US, the UK, Spain and other European countries. This drop in credit spreads to historic lows is consistent with the low credit spreads and credit risk premiums observed in the US financial markets as

documented by Gilchrist and Zakrajsek (2012*b*). During this period, credit spreads for Spanish banks are somewhat elevated and do not exhibit strong co-movement with other countries however.

Credit spreads of European non-financial corporations show much more variation over this time period. In particular, credit spreads for non-financial firms rose substantially during the slowdown in global economic activity that followed the bursting of the US dot-com bubble. In contrast, bank credit spreads appear largely unaffected by the 2001–2 global slowdown.

As can be seen in Figure 1, the financial crisis of 2008 dramatically increased the cost of market funding for banks. This is especially true in Germany, Italy and France where, prior to mid-2007, bank credit spreads were on the order of 50 basis points, but subsequently rose sharply in response to the deterioration in global financial conditions that occurred in late 2008 and throughout 2009. Credit spreads on Spanish banks, although already elevated relative to the spreads in other countries, also widened during this period.

Credit spreads for non-financial firms also rose sharply during the 2008 financial crisis. Strikingly, there is very little divergence in financial conditions for non-financial firms across European countries during this period. In contrast, one can see a distinct divergence in country-specific credit spreads for the banking sector during the 2008–9 episode. In effect, the on-going national fragmentation of European financial markets was seeded in the 2008 financial crisis.

The final distinct episode of interest is the post-2010 period during which the risk of sovereign default became a growing concern within European financial markets, as shown by the much larger level reached by the Italian and Spanish spreads defined with respect to the Bund. Such concerns led to a widening of credit spreads on Italian, Spanish and, to a lesser extent, French banks in the second quarter of 2010. Although credit spreads fell somewhat in early 2011, they again increased sharply in 2011Q4 at which point the average credit spread on Italian banks peaked at 9%. During this episode, credit spreads on Spanish banks jumped three percentage points (from 2.5% to 5.5%). Credit spreads for German and French banks also increased sharply during this period. Although credit spreads on Italian banks fell relative to their 9% peak, credit spreads on Spanish banks continued to rise, reaching an all-time high of 8% in 2012Q2. Subsequent to this spike, bank credit risk fell continuously across all four countries and in the euro area as a whole, a fact that is likely attributable to the more activist stance of the ECB as of mid-2012.

In contrast to the 2008–9 episode in which credit spreads of non-financial companies exhibited a very strong co-movement, it appears that country-specific risks spilled over into the non-financial sector with the onset of the European debt crisis. Figure 2 clearly shows the same cross-country divergence in credit spreads of non-financial corporations that one sees in the credit spreads of financial companies from 2010 onwards. By this measure, country-specific sovereign risk factors caused a sharp rise in funding costs for banks and a coincident rise in funding costs for non-financial firms during the post-2010 period. However, since 2012, credit spreads for non-financial issuers from Italy and Spain have fallen below sovereign spreads in these countries. In contrast, in France and Germany, credit spreads for both NFCs and banks always exceed the spreads on sovereign bonds.

The lower panels of Figures 1 and 2 display the time series evolution of country-specific bank and NFC credit spreads relative to domestic sovereign spreads. As shown in the lower panel of Figure 1, owing to increased sovereign risk, bank credit spreads widen less relative to domestic sovereign bonds than they do relative to the German bund in the wake of the US financial crisis and the increased turmoil in euro area sovereign debt markets. As shown in the lower panel of Figure 2, defining NFC credit spreads relative to their domestic sovereign counterpart further highlights the divergence between the experience of the two core countries, Germany and France, relative to those in the periphery, Italy and Spain. Defined in this manner, non-financial credit spreads in Italy and Spain narrow considerably and occasionally turn negative during the post-2010 period, implying that non-financial corporations in the periphery face lower borrowing costs than their sovereign counterparts. This suggests that disruptions in sovereign debt markets matter primarily to the extent that they lead to a widening of spreads in the financial sector which may then be transmitted to the real economy through subsequent curtailments in bank lending and real economic activity.

1.3. *Comparison to Alternative Series*

In Figures 3 and 4, we compare the Gilchrist-Mojon (GM thereafter) euro area credit spreads to alternative measures of credit risk. For banks, we compare the euro area credit spread to the 6-month EURIBOR-EONIA SWAP (BOR-OIS hereafter), a widely used measure of counterparty and credit risk in the interbank market. These spreads are shown in Figure 3. Both the GM and the BOR-OIS spread show negligible credit/counterparty risk in August 2007 but rise sharply thereafter, indicating peak financial stress in late 2008, after Lehman filed for bankruptcy. These risk indicators

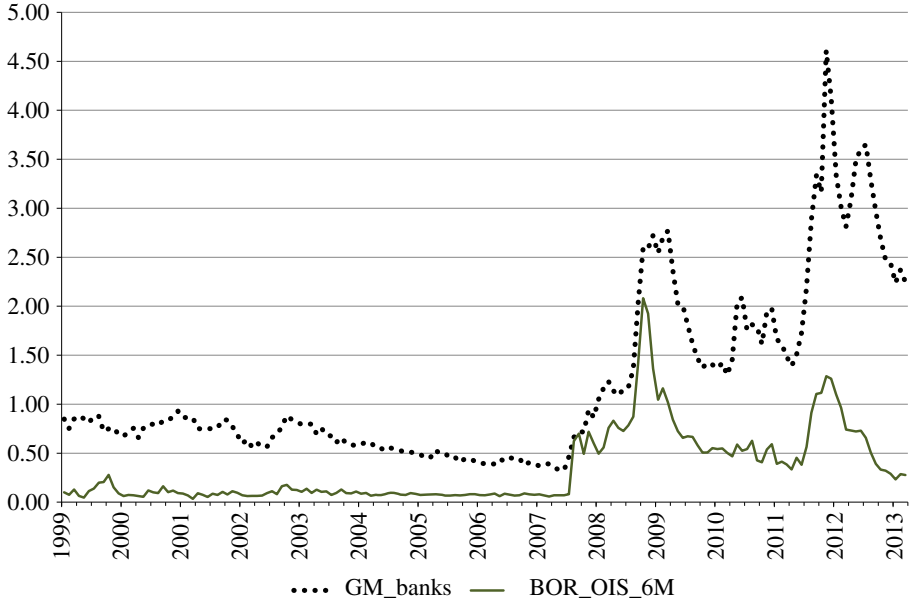

Fig. 3. *Credit Spreads for Euro Area Banks Compared to BOR-OIS Spread*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

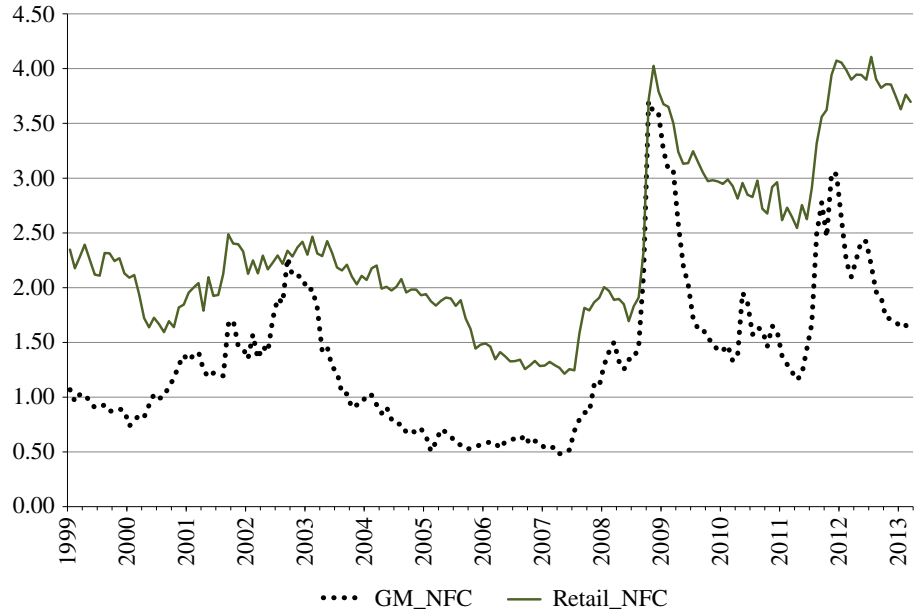

Fig. 4. *Credit Spreads for Euro Area NFCs Compared to Retail Lending Rates*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

clearly diverge in the post-2010 period however. This divergence may in part be due to compositional changes in the Euribor-OIS market whereby, over time, riskier banks are excluded from transacting. Such compositional bias is much less likely to influence the GM euro area credit spread which is constructed from longer term securities that include all financial institutions that have issued such securities, not just those that still transact in the Euribor-OIS market. These results suggest that credit spreads constructed from secondary bond prices may provide a more informative measure of overall financial distress than the BOR-OIS spread.

Figure 4 compares the GM euro area credit spread for non-financial firms to the credit spread obtained from retail interest rates on bank loans.[11] To construct a retail credit spread, we subtract the 6-month EONIA SWAP rate from the retail interest rate. This is a reasonable benchmark because bank loans still overwhelmingly dominate the external financing of euro area NFCs and such loans are typically granted at a variable interest rate that is indexed to short-term money market interest rates. It is evident from Figure 4 that these two indicators of credit risk for NFCs tend to peak simultaneously in late 2008 and in late 2011. Despite such strong co-movement during periods of acute financial distress, these two series diverge in important ways. Most notably, the retail bank credit spread remains persistently elevated relative to the GM bank credit spread in the aftermath of the 2008 financial crisis.

Finally, in Figures 5 and 6, we compare GM spreads and credit default swap rates, country by country. The latter are unweighted averages of CDS rates on banks or non-

[11] This retail bank interest rate for new business is published in the bottom panel of Table 4.5 in the statistical appendix of the ECB monthly bulletin.

financial firms for each country. An important difference between GM spreads and CDS rates is that the latter are available for only a small number of issuers (typically only a handful of firms) relative to the cross section used to construct GM spreads. This compositional bias explains why, with the exceptions of French banks in 2011 and Italian NFCs in 2009, our credit spreads are typically higher than CDS rates during episodes of financial stress.

2. The Predictive Content of Credit Spreads

We now turn to analysing the predictive content of credit spreads. We first consider the ability of credit spreads to forecast real activity variables such as GDP, unemployment and industrial production, as well as inflation indices as measured by both headline and core inflation. Because we are primarily interested in business cycle dynamics as opposed to near-term forecasting results, we focus on forecasting the growth rate of a given variable at the one-year horizon. Relatedly, this is the horizon over which credit spreads contain the largest gain in forecasting performance for US data, as documented in Gilchrist and Zakrajsek (2012*b*).

We first consider the ability of euro area credit spreads to predict euro area economic activity. Within this framework, we consider both monthly indicators such as industrial production and unemployment as well as quarterly series such as GDP and its individual spending components, consumption, residential investment and non-residential investment. We then turn to a country-level analysis and address the question as to whether country-specific credit spreads help predict country-specific outcomes. We provide a similar analysis for inflation for the euro area and at the country-level. Finally, we extend this analysis to consider the predictive content of credit spreads for the aggregate growth in lending in the euro area as well as the growth rates in lending for each individual country.

2.1. *Real Economic Activity and Inflation*

2.1.1. *Methodology*

In this Section, we present empirical results that examine the ability of credit spreads to predict various measures of real economic activity and inflation. Let $\Delta^h \log Y_{t+h}$ measure the h quarter ahead percent change in a variable of interest.[12] We follow Gilchrist and Zakrajsek (2012*b*) and specify a forecasting equation of the form:

$$\Delta^h \log Y_{t+h} = \alpha_o + \alpha_1 r_t + \alpha_2 \text{term}_t + \gamma \Delta^h \log Y_t + \beta S_t + \varepsilon_t,$$

where r_t measures the real interest rate, $term_t$ measures the term premium and S_t is the credit spread of interest. The real interest rate is measured as the EONIA rate minus the twelve-month euro area inflation rate. The term spread is measured as the difference in yields on ten-year AAA euro sovereign bonds minus the EONIA. For all forecasting regressions, we report separate results using bank credit spreads and credit spreads for non-financial firms as our measure of s_t. We first consider the ability of

[12] When forecasting unemployment we compute the h quarter ahead change in the unemployment rate rather than the log-difference.

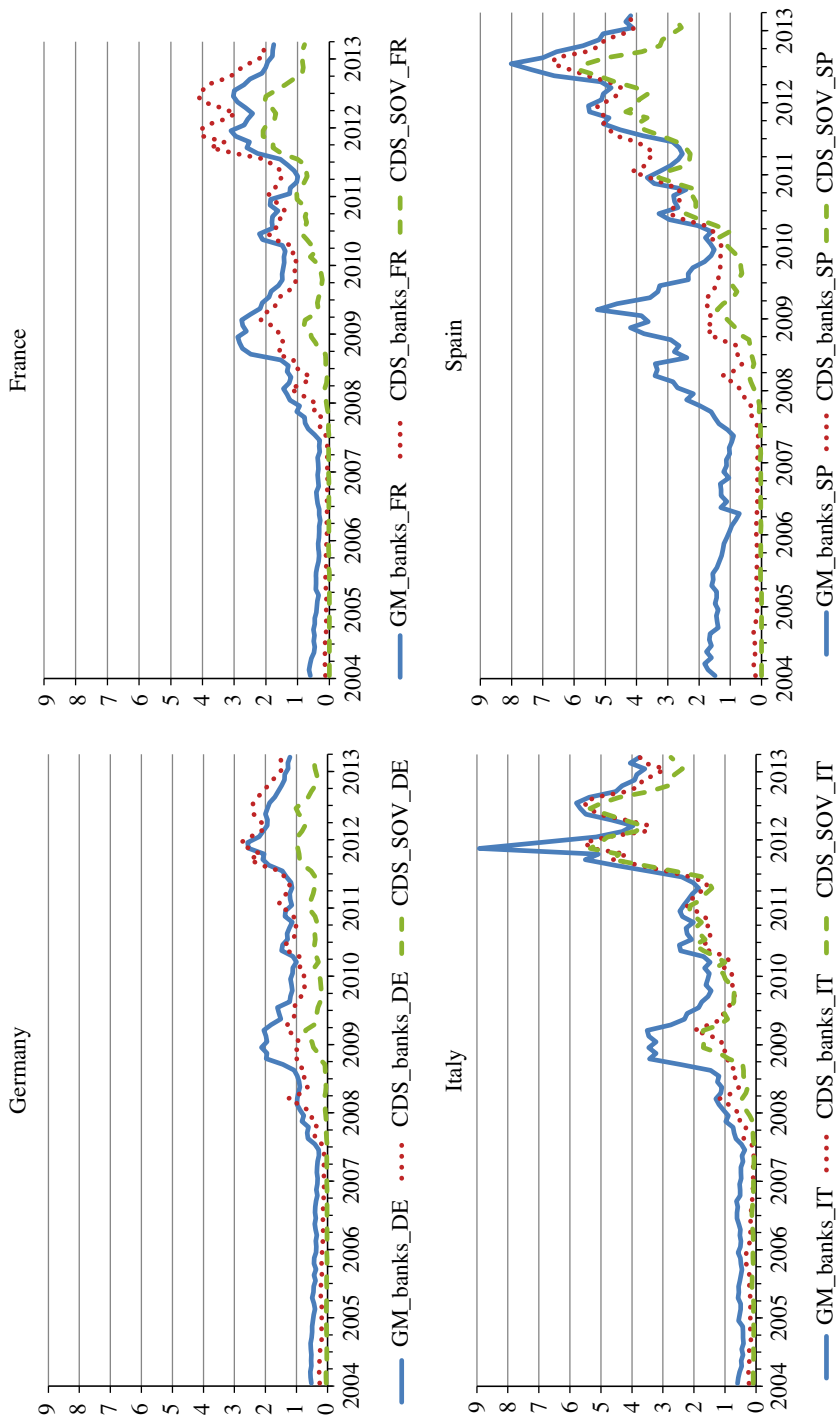

Fig. 5. *GM Bank Credit Spreads Versus CDS Rates*

Note. Colour figure can be viewed at wileyonlinelibrary.com.

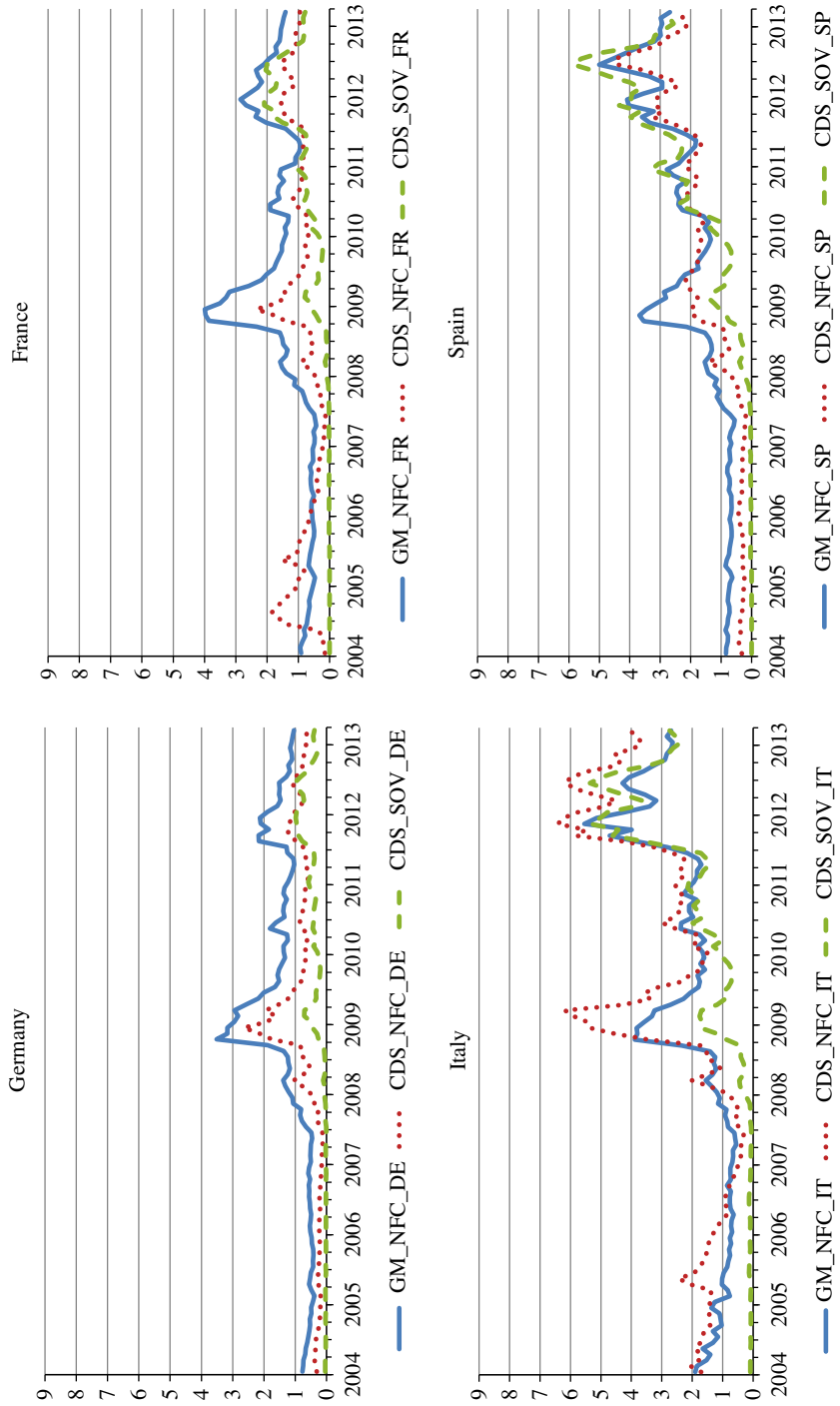

Fig. 6. *GM NFC Credit Spreads Versus CDS Rates*

Note. Colour figure can be viewed at wileyonlinelibrary.com.

credit spreads to forecast the two most commonly used monthly indicators of economic activity – unemployment and industrial production. We then examine the ability of credit spreads to forecast quarterly GDP and its broad spending components. This Section concludes with an analysis of the forecasting power of credit spreads for inflation.

2.1.2. *Economic activity indicators*

We begin by reporting forecasting results for the euro area as a whole. Table 2 presents the main estimation results on the predictive content of credit spreads for monthly economic activity as measured by the four-quarter ahead change in euro area unemployment and industrial production. We report regression results that include the real interest rate and the term spread as a baseline. We then separately add the GM euro area bank credit spread and the NFC credit spread to these baseline regressions.

As shown in Table 2, both the bank credit spread and the NFC credit spread are highly statistically significant predictors of the four-quarter ahead change in the euro area unemployment rate. These credit spreads are also highly statistically significant predictors of the four-quarter ahead change in euro area industrial production. The coefficient estimates imply an economically significant impact of credit spreads on future economic activity – a one percentage point rise in bank credit spreads predicts a 0.8% rise in the euro area unemployment rate and a 2.5% decline in euro area industrial production. As measured by the in-sample change in R^2, the predictive content of credit spreads is large, especially for the euro area unemployment rate where the R^2 increases from 0.3 to 0.7 with the addition of either the bank or NFC credit spread.

Table 2

Credit Spreads and Euro Area Economic Activity (Monthly Series)

	Unemployment rate			Industrial production		
Real EONIA						
Coefficient	−0.51	−0.34	−0.43	2.13	1.08	1.56
SD	(0.12)***	(0.09)***	(0.09)***	(0.80)***	(0.95)	(0.89)*
Term spread						
Coefficient	0.11	0.20	0.05	4.99	4.53	4.53
SD	(0.19)	(0.11)*	(0.09)	(1.54)***	(1.57)***	(1.62)***
Bank credit spread						
Coefficient		0.82			−2.46	
SD		(0.10)***			(1.04)**	
NFC credit spread						
Coefficient			0.81			−2.64
SD			(0.10)***			(1.02)**
R^2	0.31	0.72	0.74	0.38	0.45	0.45

Notes. The sample includes 166 observations from January 1999 to October 2013 for the unemployment rate and 153 observations, from January 2000 to September 2013 for year-over-year changes in the log of industrial production. Real EONIA is the EONIA interest rate minus HICP inflation over the prior 12 months. Term spread is the difference between the euro area AAA ten year interest rate and the 3 month swap EONIA. The Table reports the estimated coefficient and standard error of the 12th lag of each financial variable in regressions of unemployment or industrial production on their own 12th lag and a constant. All standard errors are computed using a Newey-West correction for serial correlation in errors. *, ** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

Table 3 presents forecasting results for euro area quarterly GDP and its spending components. The top panel presents estimation results for the full quarterly sample period 2000:Q1 to 2013:Q3. As in Table 2, the estimation again controls for the real interest rate and the term spread with all interest rates and credit spreads measured as of the final month prior to the start of the quarter. Consistent with the results reported in Table 2 for the monthly economic activity series, we find that both bank and NFC credit spreads are highly statistically significant predictors of four-quarter ahead growth in euro area real GDP. The coefficient estimates imply that a one percentage point increase in bank credit spreads predicts a 1.24% decline in euro area real GDP. Again, the in-sample gains in fit are substantial. The R-squared increases from 0.31 to 0.46 with the inclusion of the bank credit spread and to 0.52 with the inclusion of the NFC credit spread.

The remaining columns of Table 3 report estimation results for the individual spending components, consumption, residential investment and non-residential investment. Both bank and NFC credit spreads are robust predictors of the four-quarter ahead growth in consumption and non-residential investment. The improvement in in-sample fit is particularly impressive for non-residential investment where the R-squared increases from 0.26 to 0.53 with the inclusion of the bank credit spread and to 0.57 with the inclusion of the NFC credit spread. Notably, neither series helps predict residential investment over this period. The finding that credit spreads predict non-residential investment is consistent with the forecasting results documented in Gilchrist and Zakrajsek (2012*b*) for the US. The finding that credit spreads also add significant explanatory power for consumption growth is new and specific to European data however.

In light of the strong relationship between credit spreads and economic activity during the 2008 financial crisis and subsequent European sovereign debt crisis, it is natural to ask whether there is a significant relationship between credit spreads and economic activity prior to these episodes. As a robustness exercise, in the lower panel of Table 3, we report estimation results based on the pre-crisis sample period that covers 2000:Q1 to 2007:Q4. According to the results in the lower panel of Table 3, NFC credit spreads remain statistically significant predictors of four-quarter ahead GDP growth during this time period, although the gain in in-sample fit is relatively small. Bank credit spreads no longer forecast GDP growth in the period prior to 2008 however. These results are not surprising, given that this relatively short sample contains only one business cycle in which, as discussed above, NFC credit spreads widened but bank credit spreads remained relatively stable. More interestingly, both bank credit spreads and NFC credit spreads continue to predict consumption growth over the pre-crisis sample period. Bank credit spreads also remain a robust predictor of non-residential investment spending during the pre-crisis sample. In contrast, NFC credit spreads lose their forecasting power for non-residential investment when we eliminate the post-crisis period. Overall, these findings imply that bank credit spreads are significant predictors of both consumption and non-residential investment over both the full sample period as well as the pre-crisis sample period.

We now consider the ability of country-specific credit spread indices to forecast country-specific measures of economic activity. As discussed above, in our country-level forecasting exercises we define the credit spread as the weighted average of the

Table 3

(a) Credit Spreads and Euro Area Economic Activity (Quarterly Series), Full Sample and (b) Credit Spreads and Economic Activity (Quarterly Series) Euro Area, Prior to 2008

	GDP			Consumption			Residential investment			Non res. investment		
Panel (*a*)												
Real EONIA												
Coefficient	0.73	0.31	0.59	0.49	0.31	0.53	0.85	0.21	0.73	2.07	0.47	1.36
SD	(0.43)*	(0.45)	(0.37)	(0.20)**	(0.16)*	(0.14)***	(0.60)	(0.89)	(0.70)	(1.30)	(1.08)	(1.01)
Term spread												
Coefficient	1.92	1.74	1.80	0.80	0.70	0.79	4.30	4.04	4.27	5.45	4.55	4.35
SD	(1.01)*	(0.95)*	(0.92)*	(0.25)***	(0.22)***	(0.21)***	(1.14)***	(1.32)***	(1.22)***	(3.01)*	(2.62)*	(2.63)
Bank credit spread												
Coefficient		−1.24			−0.86			−1.63			−4.38	
SD		(0.52)**			(0.22)***			(1.07)			(1.15)***	
NFC credit spread												
Coefficient			−1.64			−0.85			−1.03			−5.29
SD			(0.51)***			(0.26)***			(1.11)			(1.20)***
R^2	0.31	0.46	0.52	0.50	0.68	0.65	0.61	0.65	0.63	0.26	0.53	0.57
Panel (*b*)												
Real EONIA												
Coefficient	−1.01	−0.95	−0.74	−0.29	−0.06	−0.03	−3.63	−3.41	−3.67	−2.76	−1.27	−2.59
SD	(0.14)***	(0.15)***	(0.17)***	(0.08)***	(0.08)	(0.09)	(0.49)***	(0.52)***	(0.53)***	(0.54)***	(0.54)**	(0.52)***
Term spread												
Coefficient	−0.60	−0.56	−0.53	0.02	0.22	0.17	−2.25	−2.12	−2.30	−1.48	−0.41	−1.47
SD	(0.38)	(0.38)	(0.38)	(0.12)	(0.10)**	(0.11)	(0.78)***	(0.69)***	(0.79)***	(1.06)	(1.06)	(1.08)
Bank credit spread												
Coefficient		−0.36			−1.42			−1.88			−9.06	
SD		(0.61)			(0.54)**			(2.17)			(3.41)**	
NFC credit spread												
Coefficient			−0.57			−0.60			0.25			−0.50
SD			(0.20)***			(0.15)***			(0.61)			(1.05)
R^2	0.73	0.73	0.75	0.36	0.47	0.53	0.73	0.73	0.73	0.70	0.80	0.71

Notes. (*a*) The sample includes 48 observations, from 2000 Q1 to 2012 Q4 for year-over-year changes in the log of GDP and its spending components. Financial variables are dated as of the final month of the quarter. See notes from Table 2 for a description of variables and estimation procedure. (*b*) The sample includes 28 observations, from 2000 Q1 to 2007 Q4 for year-over-year changes in the log of GDP and its spending components. Financial variables are dated as of the final month of the quarter. See notes from Table 2 for a description of variables and estimation procedure. *, ** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

difference in yields between the private sector bond and the country-specific yield on a zero-coupon sovereign bond of matched maturity, i.e. the spreads plotted in the bottom panels of Figures 1 and 2. We begin by discussing the forecasting results for the three measures of overall economic activity: real GDP, unemployment and industrial production. We then consider forecasting the individual spending components, consumption, residential investment and non-residential investment, at the country level. Table 4 reports the estimation results for forecasting the year-ahead growth in real GDP, unemployment and industrial production for Germany, France, Italy and Spain over the full sample period 2000:Q1 to 2013:Q3 while Table 5 reports the estimation results for the individual spending components.

We start by discussing the predictive content of domestic bank credit spreads – that is the spread between bank bond yields and domestic sovereign bond yields. According to the top panel of Table 4, domestic bank credit spreads are statistically significant predictors of four-quarter ahead growth in real GDP for France, Italy and Spain, and provide marginal explanatory power for Germany where the coefficient is statistically significant at the 10% but not 5% level. The gain in in-sample fit as measured by the increase in R^2 is in all cases substantial. We obtain a similar pattern when predicting the four-quarter change in the unemployment rate. As reported in the middle panel of Table 4, domestic bank credit spreads are highly statistically significant predictors of unemployment in France, Italy and Spain but have no predictive content for Germany. The increase in-sample fit as measured by the increase in R-squared is especially large for the Italian and Spanish unemployment rates. The lower panel of Table 4 reports results for the predictive content of credit spreads for the year-ahead change in industrial production. According to these estimates, bank credit spreads are robust predictors of industrial production in all four countries. Again, the gain in in-sample fit is sizeable as measured by the increase in R-squared across all four countries.

Results look substantially different across countries when we consider the predictive content of domestic non-financial credit spreads for economic activity however. Domestic non-financial credit spreads are statistically significant predictors of four-quarter ahead real GDP growth in France and Germany but have no marginal predictive power for real GDP growth in Spain and Italy. We observe the same pattern for the other two indicators of economic activity. NFC credit spreads provide significant explanatory power for French and German unemployment but have no predictive content for Italian and Spanish unemployment. Similarly, NFC credit spreads are robust predictors of growth in industrial production in France and Germany but have no predictive content for Italy. In the case of Spanish industrial production, the coefficient on the NFC credit spread is positive rather than negative.

To understand the source of the predictive content of credit spreads for economic activity at the country level we again consider the breakdown of GDP into its spending components. These results are reported in Table 5. According to results in the top panel of Table 5, bank credit spreads are statistically significant predictors of consumption growth for France and Italy. In contrast, bank credit spreads have no predictive content for consumption growth in either Germany or Spain.

The next two panels of Table 5 focus on the two broad components of investment spending – residential and non-residential. The forecasting ability of bank credit spreads for these two components of investment spending confirms the previous

Table 4

Domestic Credit Spreads and National Economic Activity

	Germany			France			Italy			Spain		
GDP (4 quarters changes in the log level)												
Real EONIA												
Coefficient	0.29	−0.11	0.28	0.43	0.20	0.40	0.91	0.58	1.04	0.44	0.40	0.52
SD	(0.62)	(0.57)	(0.49)	(0.31)	(0.28)	(0.26)	(0.38)**	(0.44)	(0.39)**	(0.27)	(0.27)	(0.31)
Term spread												
Coefficient	1.57	1.73	1.82	1.54	1.43	1.50	2.12	1.84	2.17	1.95	1.64	1.98
SD	(1.23)	(1.13)	(1.02)*	(0.71)**	(0.66)**	(0.66)**	(0.83)**	(0.88)**	(0.81)**	(0.64)***	(0.47)***	(0.64)***
Bank credit spread												
Coefficient		−1.83			−0.89			−1.92			−1.30	
SD		(0.97)*			(0.36)**			(0.83)**			(0.37)***	
NFC credit spread												
Coefficient			−2.11			−0.93			−0.75			−0.22
SD			(0.86)**			.			(0.79)			(0.36)
R^2	0.18	0.29	0.37	0.39	0.53	0.51	0.38	0.47	0.40	0.66	0.74	0.67
Unemployment rate												
Real EONIA												
Coefficient	0.24	0.29	0.22	−0.43	−0.31	−0.35	−0.48	−0.30	−0.47	0.10	0.03	0.05
SD	(0.10)**	(0.11)**	(0.09)**	(0.06)***	(0.05)***	(0.05)***	(0.09)***	(0.09)***	(0.09)***	(0.28)	(0.27)	(0.31)
Term spread												
Coefficient	0.14	0.12	0.08	0.04	0.04	−0.07	−0.23	−0.22	−0.22	−1.50	−1.33	−1.51
SD	(0.18)	(0.18)	(0.17)	(0.11)	(0.08)	(0.08)	(0.14)	(0.08)**	(0.14)	(0.56)***	(0.45)***	(0.57)***
Bank credit spread												
Coefficient		0.28			0.38			0.93			1.21	
SD		(0.31)			(0.09)***			(0.19)***			(0.52)**	
NFC credit spread												
Coefficient			0.49			0.47			−0.07			0.15
SD			(0.20)**			(0.07)***			(0.22)			(0.35)
R^2	0.09	0.10	0.15	0.70	0.81	0.83	0.39	0.55	0.40	0.28	0.37	0.28

Table 4
(*Continued*)

	Germany			France			Italy			Spain		
Industrial production (12 months changes in log levels)												
Real EONIA												
Coefficient	1.53	−0.15	0.96	1.29	0.64	0.99	2.48	1.58	2.80	1.25	0.67	0.92
SD	(0.66)**	(0.64)	(0.56)*	(0.44)***	(0.50)	(0.45)**	(0.53)***	(0.57)***	(0.60)***	(0.68)*	(0.65)	(0.70)
Term spread												
Coefficient	5.82	5.43	5.58	3.99	3.62	3.64	5.44	4.64	5.60	3.85	2.96	3.90
SD	(1.65)***	(1.59)***	(1.53)***	(1.21)***	(1.22)***	(1.21)***	(1.61)***	(1.57)***	(1.61)***	(1.47)***	(1.17)**	(1.47)***
Bank credit spread												
Coefficient		−5.22			−1.71			−5.13			−4.44	
SD		(1.35)***			(0.60)***			(1.84)***			(1.35)***	
NFC credit spread												
Coefficient			−4.83			−2.12			−1.27			1.01
SD			(1.16)***			(0.68)***			(1.07)			(0.50)**
R^2	0.39	0.49	0.51	0.36	0.43	0.44	0.36	0.43	0.37	0.26	0.36	0.28

Notes. The sample includes 166 observations from January 1999 to October 2013 for the unemployment rate, 153 observations, from January 2000 to September 2013 for year-over-year changes in the log of industrial production and 48 quarterly observations, from 2001 Q1 to 2012 Q4 for year-over-year changes in the log of GDP. Bank and NFC credit spreads are country-specific indices as described in the text. See notes from Table 2 for a description of variables and estimation procedure. *,** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

Table 5

Domestic Credit Spreads and National GDP Components

	Germany			France			Italy			Spain		
Consumption												
Real EONIA												
Coefficient	−0.19	−0.26	−0.16	0.33	0.27	0.40	0.99	0.71	0.91	0.79	0.77	0.69
SD	(0.18)	(0.17)	(0.16)	(0.17)*	(0.14)*	(0.16)**	(0.43)**	(0.33)**	(0.37)**	(0.29)***	(0.31)**	(0.30)**
Term spread												
Coefficient	0.06	0.12	0.18	0.44	0.45	0.52	1.26	1.15	1.20	1.62	1.52	1.61
SD	(0.14)	(0.15)	(0.16)	(0.23)*	(0.22)**	(0.22)**	(0.30)***	(0.27)***	(0.28)***	(0.70)**	(0.61)**	(0.72)**
Bank credit spread												
Coefficient		−0.38			−0.78			−1.99			−0.52	
SD		(0.24)			(0.27)***			(0.72)***			(0.92)	
NFC credit spread												
Coefficient			−0.42			−0.45			0.42			0.34
SD			(0.18)**			(0.27)			(0.38)			(0.34)
R^2	0.10	0.14	0.17	0.27	0.46	0.33	0.39	0.52	0.40	0.50	0.51	0.51
Residential Investment												
Real EONIA												
Coefficient	−2.52	−2.45	−2.53	1.65	0.85	1.42	2.29	1.74	2.35	1.36	1.20	1.47
SD	(0.76)***	(0.93)**	(0.77)***	(0.75)**	(0.83)	(0.72*	(0.49)***	(0.64)***	(0.55)***	(0.80)*	(0.83)	(1.04)
Term spread												
Coefficient	0.56	0.49	0.44	6.11	5.45	5.81	4.46	3.94	4.52	6.96	6.24	7.01
SD	(1.22)	(1.25)	(1.31)	(1.68)***	(1.78)***	(1.69)***	(0.73)***	(0.70)***	(0.83)***	(2.24)***	(1.78)***	(2.37)***
Bank credit spread												
Coefficient		0.40			−2.17			−3.06			−4.61	
SD		(1.97)			(0.82)**			(1.48)**			(1.42)***	
NFC credit spread												
Coefficient			0.44			−2.10			−0.33			−0.31
SD			(1.65)			(0.89)**			(0.94)			(1.33)
R^2	0.39	0.39	0.39	0.61	0.70	0.68	0.64	0.70	0.64	0.74	0.79	0.74

Table 5
(*Continued*)

	Germany			France			Italy			Spain		
Non Res. Investment												
Real EONIA												
Coefficient	0.24	−1.80	−0.10	0.50	−0.27	0.23	3.12	2.39	3.57	2.85	2.63	2.76
SD	(1.76)	(1.10)	(0.99)	(1.06)	(0.84)	(0.90)	(0.76)***	(0.86)***	(0.78)***	(0.72)***	(0.73)***	(0.80)***
Term spread												
Coefficient	3.76	4.72	4.32	2.73	2.62	2.17	4.92	4.54	5.25	7.22	6.51	7.21
SD	(3.02)	(2.56)*	(2.23)*	(2.72)	(2.27)	(2.29)	(1.76)***	(1.72)**	(1.64)***	(1.74)***	(1.49)***	(1.78)***
Bank credit spread												
Coefficient		−9.47			−3.07			−4.89			−2.33	
SD		(2.07)***			(1.27)**			(1.83)**			(1.13)**	
NFC credit spread												
Coefficient			−8.79			−3.42			−2.31			0.29
SD			(1.67)***			(1.45)**			(1.51)			(0.71)
R^2	0.14	0.50	0.58	0.12	0.38	0.35	0.44	0.54	0.48	0.69	0.71	0.69

Notes. The sample includes 48 observations, from 2000 Q1 to 2012 Q4 for year-over-year changes in the log of GDP components. Financial variables are dated as of the final month of the quarter. See notes from Table 2 for a description of variables and estimation procedure. Bank and NFC credit spreads are country-specific indices as described in the text. *,** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

findings for overall economic activity reported in Table 4. In particular, bank credit spreads are statistically significant predictors of both categories of investment in France, Italy and Spain. In the case of Germany, bank credit spreads forecast non-residential investment but add no explanatory power to the regression for residential investment.

Table 5 also reports the results from using NFC credit spreads to forecast the spending components of GDP for individual countries. These results add further confirmation to the finding that NFC credit spreads provide no marginal improvement in forecasting economic activity for either Italy and Spain. For these two countries, the coefficient on the NFC credit spread is substantially smaller than what is obtained for the bank credit spread and, in all cases, is not statistically significant.

For France and Germany, results obtained using NFC credit spreads to forecast the spending components of GDP are mixed. For Germany, the NFC credit spread adds predictive content for consumption and non-residential investment but does not predict residential investment. For France, the NFC credit spread adds predictive content for both investment categories but does not forecast consumption.

In summary, the results reported in Tables 4 and 5 imply that domestic bank credit spreads are robust predictors of overall economic activity for all four countries. In contrast, while NFC credit spreads have roughly the same information content as bank credit spreads for overall economic activity in France and Germany, NFC credit spreads have no marginal forecasting power for economic activity in Italy and Spain. Finally, the breakdown of GDP spending components reinforces these findings. In particular, NFC credit spreads are primarily useful in forecasting non-residential investment for the two European core countries of France and Germany but contain no information content for predicting any of the GDP spending components in the two periphery countries, Italy and Spain.

2.1.3. *Inflation*

We now turn to the predictive content of credit spreads for inflation. Table 6 reports forecasting results for the four-quarter ahead change in headline and core inflation in the euro area. The baseline regressions again include the real EONIA, the term spread and the lagged twelve-month inflation rate as explanatory variables. According to the estimation results, NFC credit spreads are statistically significant predictors of headline inflation. The effect is economically important – a one-percentage point rise in the euro area NFC credit spread predicts a 0.45% decline in euro area headline inflation. Although a rise in bank credit spreads also predicts a decline in inflation, the estimated coefficient is not statistically significant. The second two columns of Table 6 report estimation results for predicting core inflation. Neither bank nor NFC credit spreads help predict year-ahead core inflation in the euro area as a whole. Moreover, the estimated coefficients imply a substantially reduced effect of credit spreads on core inflation relative to headline inflation – a one percentage point rise in either NFC or bank credit spreads predicts a 0.16% decline in core inflation. Finally, it is worth noting that the gains in in-sample fit as measured by the change in R^2 across specifications reported in Table 6 are in all cases relatively modest. In summary, there is little evidence to suggest that euro area credit spreads are robust predictors of euro area inflation, a result that is also consistent with previous findings for the US as discussed in Gilchrist *et al.* (2009).

Table 6

Credit Spreads and Euro Area Inflation (Monthly Series)

	HICP inflation			Core inflation		
Real EONIA						
Coefficient	−0.08	−0.21	−0.13	0.02	−0.03	0.01
SD	(0.09)	(0.13)*	(0.11)	(0.06)	(0.08)	(0.07)
Term spread						
Coefficient	−0.16	−0.20	−0.13	−0.25	−0.24	−0.22
SD	(0.20)	(0.20)	(0.18)	(0.09)***	(0.08)***	(0.09)**
Bank credit spread						
Coefficient		−0.33			−0.16	
SD		(0.21)			(0.11)	
NFC credit spread						
Coefficient			−0.46			−0.16
SD			(0.15)***			(0.11)
R^2	0.65	0.68	0.71	0.55	0.58	0.57

Notes. The sample includes 166 observations from January 1999 to October 2013. See notes from Table 2 for a description of variables and estimation procedure. *,** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

Table 7 documents the predictive content of country-specific credit spreads for inflation at the country level. At the country level, bank credit spreads are strong predictors of headline inflation for France, Italy and Spain while the NFC credit spread is a strong predictor of headline inflation for Germany and Spain. Notably, bank credit spreads are strong predictors of core inflation in the two periphery countries, Italy and Spain. In addition, non-financial credit spreads provide predictive content for Spanish core inflation. Although the improvement in in-sample fit for predicting Italian core inflation is modest, the gain in in-sample fit for Spanish core inflation is sizeable, especially when using bank credit spreads as the predictive variable.

2.2. *Bank Lending Activity*

Our analysis is motivated by the idea that credit spreads may forecast future economic activity because they provide a signal regarding the underlying fundamentals of the real economy and because they provide a measure of credit-supply conditions that directly influences spending behaviour by households and the demand for inputs by firms. To the extent that credit spreads provide information about overall credit conditions as well as expected future economic activity, they should also provide information regarding future lending activity.[13] In particular, as emphasised by Gertler and Gilchrist (1993) and Gilchrist and Zakrajsek (2012*a*), bank lending responds roughly contemporaneously with economic activity over the course of the business cycle.

To study the effect of credit spreads on lending activity, we again consider a regression of the form:

[13] Several recent studies use data from the ECB Bank Lending Survey to show that credit in the euro area responds to banks' credit standards. See in particular de Bondt *et al.* (2010) and van Der Veer and Hoeberichts (2013) and references therein. We provide a complementary market-based indicator of credit risk than can help forecast future loans.

Table 7

Domestic Credit Spreads and National Inflation (Monthly Series)

	Germany			France			Italy			Spain		
HICP year on year inflation												
Real EONIA												
Coefficient	−0.19	−0.30	−0.22	0.09	−0.03	0.06	0.06	−0.07	0.18	0.39	0.22	0.77
SD	(0.09)**	(0.13)**	(0.09)**	(0.09)	(0.11)	(0.10)	(0.11)	(0.12)	(0.12)	(0.14)***	(0.16)	(0.18)***
Term spread												
Coefficient	−0.42	−0.42	−0.36	0.05	−0.00	0.07	−0.05	−0.08	0.10	0.34	0.04	0.62
SD	(0.19)**	(0.19)**	(0.17)**	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.18)	(0.32)	(0.28)	(0.27)**
Bank credit spread												
Coefficient		−0.38			−0.26			−0.58			−1.17	
SD		(0.23)			(0.15)*			(0.28)**			(0.31)***	
NFC credit spread												
Coefficient			−0.52			−0.22			−0.37			−0.66
SD			(0.12)***			(0.14)			(0.20)*			(0.25)***
R^2	0.61	0.65	0.69	0.70	0.74	0.72	0.59	0.59	0.59	0.59	0.67	0.63
Core year on year inflation												
Real EONIA												
Coefficient	−0.20	−0.23	−0.20	0.08	0.04	0.08	0.19	0.14	0.23	0.16	0.16	0.37
SD	(0.05)***	(0.07)***	(0.05)***	(0.07)	(0.07)	(0.07)	(0.06)***	(0.06)**	(0.07)***	(0.12)	(0.08)*	(0.13)***
Term spread												
Coefficient	−0.43	−0.43	−0.42	−0.19	−0.19	−0.19	0.02	0.02	0.06	−0.11	−0.22	0.13
SD	(0.08)***	(0.08)***	(0.08)***	(0.08)**	(0.08)**	(0.09)**	(0.09)	(0.08)	(0.10)	(0.20)	(0.14)	(0.22)
Bank credit spread												
Coefficient		−0.11			−0.11			−0.33			−0.85	
SD		(0.12)			(0.09)			(0.13)***			(0.23)***	
NFC credit spread												
Coefficient			−0.06			0.03			−0.12			−0.56
SD			(0.10)			(0.12)			(0.14)			(0.22)**
R^2	0.63	0.64	0.64	0.52	0.53	0.52	0.60	0.64	0.60	0.28	0.54	0.38

Notes. The sample includes 166 observations from January 1999 to October 2013. Bank and NFC credit spreads are country-specific indices as described in the text. See notes from Table 2 for a description of variables and estimation procedure. *,** and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

$$\Delta^h \log L_{t+h} = \alpha_o + \alpha_1 r_t + \alpha_2 term_t + \gamma \Delta^h \log L_t + \beta S_t + \varepsilon_t,$$

where $\Delta^h \log L_{t+h}$ measures the h quarter ahead change in lending volume, r_t measures the real interest rate, $term_t$ measures the term premium and S_t is the credit spread of interest – either bank or NFC. We separate lending activity into three components – consumer loans, housing loans and loans to non-financial corporations. Table 8 reports the estimation results for each country and lending category.

According to the estimation results, bank credit spreads are statistically significant predictors of euro area loan growth for all three lending categories. A one-percentage point increase in bank credit spreads forecasts a 2.98% decline in consumer loans, a 1.29% decline in housing loans and a 4.55% decline in loans to non-financial corporations. NFC credit spreads also predict euro area consumer and non-financial corporate loan growth but do not forecast housing loan growth. At the country level, bank credit spreads are significant predictors of the four-quarter ahead change in non-financial corporate loan growth in France, Italy and Spain but not Germany. Bank credit spreads also provide significant explanatory power for housing loans in France and Italy, and consumption loans in France. NFC credit spreads are also robust predictors of all three categories of loan growth in France and help forecast NFC loans in Italy but otherwise add little additional information for forecasting loan growth across loan categories in individual countries.

3. VAR Analysis

In this Section, we use VAR analysis to trace out the effect of credit supply shocks on euro area economic activity. We consider two alternative approaches. First, we use the factor-augmented vector autoregression (FAVAR) methodology proposed by Bernanke *et al.* (2005) to identify credit supply shocks and examine their dynamic effect on a large set of macroeconomic variables. The estimation and identification procedure directly follows the methodology of Gilchrist *et al.* (2009). This approach relies on identifying credit supply shocks as movements in credit spreads that are contemporaneously orthogonal to information in current real activity variables as well as a rich array of asset prices. As a robustness check, we also consider a small scale VAR and adopt an alternative approach to identification that relies on the use of a measured shock to liquidity as an external instrument. We first discuss the FAVAR results and then consider the robustness exercise that relies on the external instrument for identification.

3.1. *FAVAR Analysis*

The analysis combines the data on country-specific credit spread indices for banks and non-financial firms with data on euro area and country-specific measures of economic activity, inflation, interest rates and other asset prices. We estimate a FAVAR at the monthly frequency. Accordingly, we use both euro area and country-level growth rates of industrial production and changes in the unemployment rate as measures of real activity. Euro area and country-specific inflation is measured, using both headline and core inflation. Thus, for the euro area as a whole and for each country (Germany, France, Italy and Spain), we have two real activity variables and two inflation variables.

Table 8

Credit Spreads and Loan Volumes (Monthly Series)

	Euro area			Germany			France		
Consumption loans (12 months changes in the log level)									
Real EONIA									
Coefficient	1.10	0.26	1.55	1.71	2.10	1.74	1.14	0.17	0.80
SD	(0.49)**	(0.37)	(0.33)***	(0.35)***	(0.36)***	(0.38)***	(0.34)***	(0.28)	(0.26)***
Term spread									
Coefficient	0.65	0.43	1.00	1.15	1.09	0.92	2.01	1.08	1.53
SD	(0.58)	(0.41)	(0.35)***	(0.39)***	(0.42)**	(0.42)**	(0.56)***	(0.51)**	(0.44)***
Bank credit spread									
Coefficient		−3.94			1.21			−2.16	
SD		(0.78)***			(0.64)*			(0.52)***	
NFC credit spread									
Coefficient			−4.54			1.22			−2.40
SD			(1.14)***			(0.48)**			(0.45)***
R^2	0.28	0.51	0.65	0.38	0.43	0.47	0.46	0.67	0.69
Housing loans (12 months changes in the log level)									
Real EONIA									
Coefficient	0.61	0.38	0.71	−0.50	−0.42	−0.47	0.67	−0.06	0.57
SD	(0.23)***	(0.22)*	(0.23)***	(0.10)***	(0.12)***	(0.11)***	(0.37)*	(0.16)	(0.20)***
Term spread									
Coefficient	2.10	1.80	2.08	0.23	0.22	0.21	2.70	1.47	1.86
SD	(0.29)***	(0.28)***	(0.27)***	(0.06)***	(0.06)***	(0.07)***	(0.57)***	(0.51)***	(0.39)***
Bank credit spread									
Coefficient		−1.62			0.15			−2.19	
SD		(0.47)***			(0.14)			(0.39)***	
NFC credit spread									
Coefficient			−0.63			0.08			−2.40
SD			(0.30)**			(0.11)			(0.45)***
R^2	0.76	0.79	0.77	0.70	0.71	0.70	0.63	0.83	0.82

Table 8
(*Continued*)

	Euro area			Germany			France		
NFCs loans (12 months changes in the log level)									
Real EONIA									
Coefficient	0.97	−0.95	1.22	−0.06	0.15	−0.16	2.13	0.27	0.86
SD	(0.70)	(0.42)**	(0.45)***	(0.46)	(0.76)	(0.51)	(0.45)***	(0.45)	(0.32)***
Term spread									
Coefficient	−1.06	−0.13	0.00	−3.61	−3.75	−3.18	−3.70	−2.21	−0.91
SD	(1.41)	(0.58)	(0.73)	(0.67)***	(0.71)***	(0.84)***	(1.03)***	(0.69)***	(0.63)
Bank credit spread									
Coefficient		−6.17			0.55			−3.21	
SD		(0.97)***			(1.13)			(0.72)***	
NFC credit spread									
Coefficient			−5.85			−0.89			−4.58
SD			(0.60)***			(1.16)			(0.38)***
R^2	0.45	0.78	0.81	0.58	0.58	0.58	0.56	0.77	0.86

	Italy			Spain		
Consumption loans (12 months changes in the log level)						
Real EONIA						
Coefficient	2.36	2.18	1.99	−2.36	−2.34	−1.33
SD	(0.64)***	(0.59)***	(0.67)***	(0.77)***	(0.83)***	(0.81)
Term spread						
Coefficient	3.08	3.15	2.76	3.44	3.40	3.57
SD	(0.69)***	(0.61)***	(0.71)***	(1.66)**	(1.53)**	(1.46)**
Bank credit spread						
Coefficient		−2.48			−0.19	
SD		(0.99)**			(1.82)	
NFC credit spread						
Coefficient			1.21			−3.52
SD			(1.12)			(1.38)**
R^2	0.63	0.65	0.63	0.77	0.77	0.79

Table 8
(*Continued*)

	Italy			Spain		
Housing loans (12 months changes in the log level)						
Real EONIA						
Coefficient	3.12	2.57	2.85	−0.64	−0.70	−0.55
SD	(0.55)***	(0.51)***	(0.69)***	(0.42)	(0.43)	(0.50)
Term spread						
Coefficient	4.99	5.33	4.74	3.39	3.52	3.40
SD	(0.78)***	(0.59)***	(0.77)***	(0.58)***	(0.65)***	(0.58)***
Bank credit spread						
Coefficient		−4.23			0.64	
SD		(1.26)***			(0.65)	
NFC credit spread						
Coefficient			0.85			−0.29
SD			(1.12)			(0.43)
R^2	0.60	0.68	0.60	0.85	0.85	0.85
NFCs loans (12 months changes in the log level)						
Real EONIA						
Coefficient	3.25	2.06	3.98	−2.50	−2.18	−2.41
SD	(0.51)***	(0.43)***	(0.64)***	(0.65)***	(0.66)***	(0.65)***
Term spread						
Coefficient	−1.61	−1.13	−0.47	6.73	6.17	6.72
SD	(1.18)	(0.64)*	(1.07)	(1.15)***	(1.23)***	(1.17)***
Bank credit spread						
Coefficient		−5.26			−2.12	
SD		(0.90)***			(1.04)**	
NFC credit spread						
Coefficient			−3.14			−0.29
SD			(0.96)***			(1.18)
R^2	0.58	0.82	0.66	0.90	0.91	0.90

Notes. The sample includes 107 observations for Germany, France, Italy and Spain from December 2003 to October 2013, 154 for the euro area from January 2000 to October 2013. See notes from Table 2 for a description of variables and estimation procedure. *,**, and *** indicate statistical significant at the 1%, 5% and 10% levels respectively.

To this we add three euro area interest rates: the ECB policy rate as measured by the EONIA, the ten-year yield on German bunds, and the three-month Euribor rate. We also include the five-year yield on sovereign bonds for each country, along with country-specific stock returns based on the overall market and stock returns for that country's banking sector. These are computed as the log difference in the relevant country-specific stock index. Finally, we also include a broad set of asset price information that captures conditions in both euro area and US financial markets. These variables are the stock return on the US S&P 500, the implied volatility from US and European stock options (VIX-USA, VIX-Europe), the US ten-year treasury rate, the log-difference in oil prices measured in US dollars, the log-difference in the US-euro exchange rate and the realised volatility in the US-euro exchange rate measured as the standard deviation of daily rates over the past 30 days.

In sum, these variables encompass euro area and country-specific measures of real activity and inflation, country-specific stock market indices that span financial and non-financial firms, along with both country-specific sovereign yields, euro area interest rates and global asset market indicators that capture exchange rate movements and stock market volatility in both the US and Europe. The remaining eight variables assess conditions in European credit markets as measured by the country-specificl credit spreads for banks and non-financial firms. Because we control separately for sovereign risks, country-specific credit spreads are measured relative to the German bund in this exercise.

We wish to evaluate the macroeconomic impact of disturbances to credit spreads that are uncorrelated with other real activity and asset price movements. We therefore separate the eight country-specific credit spread variables in $X_{2,t}$ $(N_2 \times 1)$ and all the rest of the variables in $X_{1,t}$ $(N_1 \times 1)$. We assume that the information content in $X = [X'_{1,t}\, X'_{2,t}]$ $(N \times T)$ can be summarised in a small set of unobservable factors F_t $(1 \times k)$. A subset of these factors $F_{2,t}$ $(1 \times k_2)$ are factors that are specific to the corporate bond market which we will refer to as credit factors. These credit factors do not contemporaneously influence variables in $X_{1,t}$ but they influence the corporate bond spreads. The rest of the factors $F_{1,t}$ $(1 \times k_1)$ span the information set contained in the entire data set. The relationship between the observed variables and the unobserved factors is assumed to be linear and given by the observation equation:

$$\begin{bmatrix} X_{1,t} \\ X_{2,t} \end{bmatrix} = \begin{bmatrix} \Lambda_{1,1} & \Lambda_{1,2} \\ \Lambda_{2,1} & \Lambda_{2,2} \end{bmatrix} \begin{bmatrix} F'_{1,t} \\ F'_{2,t} \end{bmatrix} + v_t,$$

where

$$\Lambda = \begin{bmatrix} \Lambda_{1,1} & \Lambda_{1,2} \\ \Lambda_{2,1} & \Lambda_{2,2} \end{bmatrix} (N \times k)$$

is the matrix of the factor loadings.

The dynamics of the factors are summarised in a vector-autoregression system:

$$\begin{bmatrix} F'_{1,t} \\ F'_{2,t} \end{bmatrix} = \Phi(L) \begin{bmatrix} F'_{1,t-1} \\ F'_{2,t-1} \end{bmatrix} + \epsilon_t,$$

where $\Phi(L)$ is a lag-polynomial of finite order p. It is assumed that $\mathrm{E}(v_{i,t}\epsilon_{j,t}) = 0$ for all $i = 1..N$ and $j = 1..k$ and $\mathrm{E}(\epsilon_{i,t}\,\epsilon_{l,t}) = 0$ for all $i \neq l$. In this form, the model is a static representation of a dynamic factor model (Stock and Watson, 2005).

To identify the set of credit factors F_{2t}, we impose the following restrictions on the system of equations. First, we assume that $\Lambda_{12} = 0$. This restriction on the factor loading implies that F_{1t} summarises all information contained in the information set X_{1t}. To obtain F_{2t} we first regress X_{2t} on F_{1t} and then obtain the residuals from this regression. We then construct F_{2t} by estimating the factors from these residuals. Thus, by construction, F_{2t} summarises the information contained in X_{2t} that is orthogonal to the first set of factors, i.e. it contains the information in credit spreads that is orthogonal to the factors that summarise real activity and inflation, interest rates, stock prices and other asset market variables.

We estimate the model using a Gaussian MLE method and Kalman filter to construct the likelihood function. However, when N is large and in the presence of identifying restrictions, this method is computationally demanding. We therefore follow the four-step procedure outlined in GYZ as this is simple to implement while directly imposing the necessary identification restrictions.

We estimate a FAVAR model that allows for four factors in F_{1t} and two factors in F_{2t}. The relationship between factors and data can be deduced from their correlation between each data series and each factor. Table 9 reports the correlation between each factor and a subset of the euro area variables. The first factor is highly negatively correlated with euro area stock returns and positively correlated with implied volatility as measured by the euro area VIX. This factor is also negatively correlated with economic activity and positively correlated with both CPI and core inflation and, therefore, appears to act like a 'supply' shock. The second factor is highly positively correlated with yields on five-year French and German government bonds and negatively correlated with both bank and NFC credit spreads. The third factor is most strongly associated with core inflation, while the fourth factor is most strongly

Table 9

Correlation of Euro Area Variables with Factors

	General factors (F1)				Credit risk factors (F2)	
	f1	f2	f3	f4	f5	f6
Industrial production	−0.42	0.29	−0.31	−0.51	0.08	0.33
Unemployment	0.31	−0.62	0.45	0.19	0	0.06
HICP inflation	0.57	0.49	0.43	0.4	0.04	−0.04
Core inflation	0.62	0.25	0.53	0.04	−0.2	0.22
Stock returns	−0.79	0.26	0.42	0.15	0.06	I
Bank stock returns	−0.8	0.3	0.42	0.19	0.04	0.03
Euro area VIX	0.44	−0.45	−0.02	0.43	0.28	0.28
GM spread (bank)	0.12	−0.67	0.35	−0.21	0.58	I
GM spread (NFC)	0.38	−0.64	0.33	0.14	0.51	0.22
German treasury yields (5 years)	0.17	0.75	−0.31	0.45	−0.14	0.1
French treasury yields (5 years)	0.23	0.74	−0.28	0.46	−0.05	0.07
Italian treasury yields (5 years)	0.36	0.4	0.06	0.05	0.64	−0.25
Spanish treasury yields (5 years)	0.27	0.37	0.02	−0.08	0.64	−0.28

associated with industrial production. Roughly speaking the four factors identified in F_{1t} appear to determine stock market activity, inflation, the level of interest rates and measures of real economic activity. The first factor in F_{2t} captures the overall level of credit spreads and has almost no contemporaneous correlation with real activity, inflation or stock returns. This first credit factor is also uncorrelated with yields on French and German five-year sovereign bonds but has a strong positive correlation with yields on Italian and Spanish sovereign bonds. The second credit factor exhibits low but varying correlation across a variety of variables and therefore has no obvious economic interpretation.

To measure the effect of credit supply disruptions on economic activity we compute the impulse response to a one-standard deviation shock to the first credit factor, that is, the first factor in F_{2t}. The impulse response functions for variables that enter the FAVAR in first-differences are cumulated and hence represent the log-deviation from zero at a given horizon (or in the case of unemployment, the percentage-point change in the level of unemployment). These variables include industrial production, inflation, unemployment, stock market indices, oil prices and the exchange rate. The interest rate and credit spread responses are already in level terms and hence do not need to be cumulated.

Figure 7 displays the impulse response of a subset of the euro area variables to a shock to the first factor in F_{2t}. We report bootstrapped 95% confidence bounds along

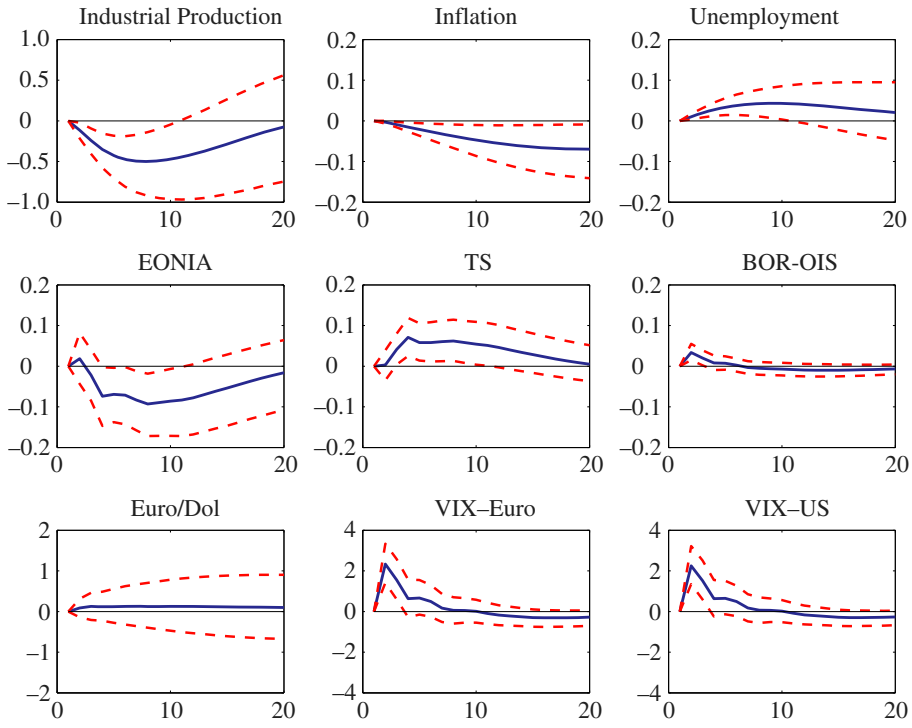

Fig. 7. *Impulse Response: Euro Area Real and Financial Variables*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

with the mean estimated impulse response. As shown in Figure 7, the shock to the first credit factor is contractionary and causes euro area unemployment to rise and industrial production and prices to fall. Industrial production declines 0.5% at its peak contraction approximately eight months after the shock occurs. Both the magnitude and timing of this effect is in line with the estimated effects of a credit shock for the US based on the findings of Gilchrist *et al.* (2009). The inflation and unemployment responses are relatively modest however. The peak response of unemployment is 0.05% and occurs at the eight-month horizon while prices exhibit a 0.07% decline after eighteen months and then appear to level off.

Consistent with the conduct of countercyclical monetary policy, the credit supply shock causes a reduction in short-term interest rates, as measured by the EONIA, and a rise in the term spread, as measured by the difference between the yield on the ten-year German bund and the EONIA. The credit supply shock also leads to a sharp increase in risk factors as measured by the implied volatility in both European (VIX ZE) and US (VIX US) stock markets but appears to have a negligible effect on conditions in the interbank market as measured by the BOR-OIS spread. Finally, contractionary credit supply shocks have very little impact on the US/Euro exchange rate.

Figure 8 displays the impulse responses of industrial production, unemployment and core inflation to the credit supply shock across the four countries. The effect of the credit supply shock on industrial production is relatively uniform across countries and very similar to the results obtained for the euro area reported in Figure 7 – industrial production contracts by roughly 0.5% at its peak response. The response of core inflation and unemployment is also similar in France, Germany and

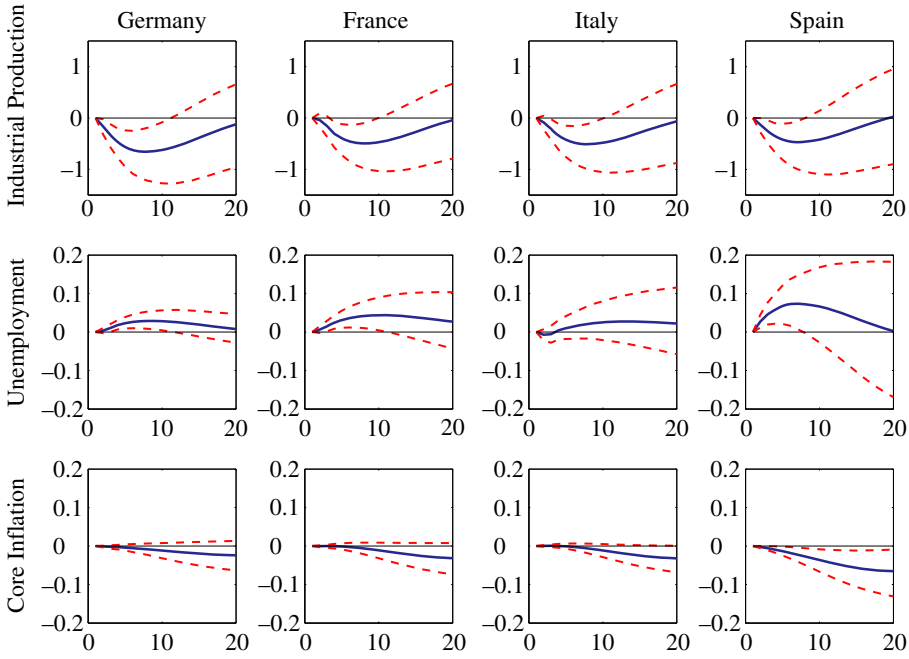

Fig. 8. *Impulse Response: Country-specific Real Activity and Inflation*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

Italy but clearly more pronounced in Spain where the increase in unemployment and the fall in prices is roughly double the response that is observed in the other three countries.

Figure 9 displays the country-level impulse responses to the overall stock market, five-year sovereign bond yields and the bank credit spreads. The credit shock causes a 3% decline in the stock market across all four countries. This decline is eventually reversed however so that credit shocks lead to an immediate fall in stock returns but do not have a lasting impact on the level of asset prices. Yields on five-year bonds also decline by a modest five basis points. There is a differential effect on Italian and Spanish sovereign yields relative to German yields in that Italian and Spanish yields do not fall quite as much as German yields but the effect is quantitatively small. This implies that credit shocks that are contemporaneously orthogonal to sovereign yields do not cause a substantial future increase in sovereign spreads of the riskier countries.

The lower panel of Figure 9 displays the effect of the credit supply shock on bank credit spreads. By construction, credit spreads respond contemporaneously to the credit shock. The size of the increase in credit spreads varies between 0.1 percentage points for German and French banks to 0.2–0.25 percentage points for Italian and Spanish banks respectively.[14] Overall, these results imply that a credit shock that elicits a 0.1–0.2 percentage point increase in euro area credit spreads results in a 0.5%

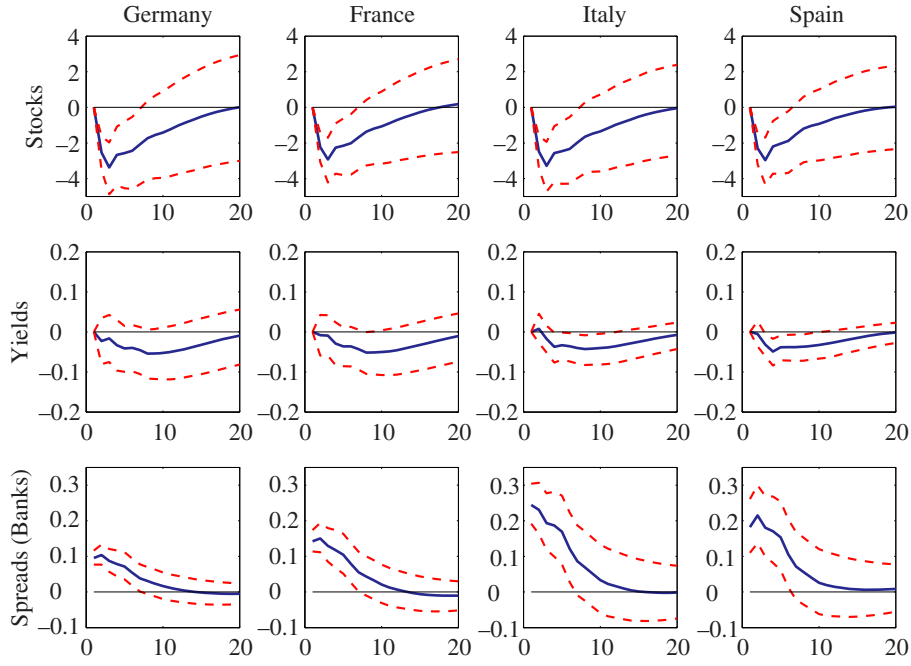

Fig. 9. *Impulse Response: Country-specific Financial Variables*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

[14] Although not reported, we observe a similar reaction of NFC credit spreads. Bank stock returns also respond in a very similar manner to the broad stock indices displayed in Figure 9.

decline in industrial production, a 3% decline in broad measures of stock returns and more moderate effects on inflation and unemployment.

Although not shown, we have also computed the fraction of the variance associated with the shock to the first credit factor for the euro area and country-specific variables displayed in Figures 7–9. Upon impact, the shock to the first credit factor accounts for 85% of the variation in bank credit spreads in Germany, 90% of the variation in France, 70% of the variation in Italy and 45% of the variation in Spain. This is consistent with the notion that shocks originating in the credit markets are the primary driving force for credit spreads in Germany, France and Italy but that credit spreads in Spain are more strongly influenced by other macroeconomic events that are already captured in the real activity and asset price data included in X_{1t}. These credit shocks also account for an important fraction of the variation in economic activity and asset prices – 20% of the variation in country-specific industrial production and stock returns at the peak horizon – and a more modest but not insignificant fraction of the variation in euro area interest rates –between 10% and 15% of the variation at the peak horizon. Finally, although credit shocks account for only 5% of the variation in German and French long-term yields they account for 15% of the variation in Italian and Spanish long-term yields.

3.2. *Liquidity Shocks as an External Instrument*

The FAVAR results described above imply economically significant declines in euro area economic activity in response to credit supply shocks identified as movements in credit spreads that are orthogonal to euro area and country-specific movements in real economic activity and asset prices. We now consider an alternative identification procedure that relies on using measured shocks to liquidity in the German bund market that are transmitted to euro area credit spreads. Specifically, we use a VAR with an external instrument that measures liquidity in the German bund market. Our external instrument for changes in liquidity conditions is the spread between the KFW, a public sector bank whose debt is guaranteed by the German Government, and the bund. Because KFW debt is less liquid than the Bund, a widening of this spread signals a rise in the liquidity premium that is then transmitted to other bond market yields. This proxy for changes in liquidity conditions, which was introduced by Monfort and Renne (2014), is arguably independent of changes in private sector credit risk.

Our external instrument identification procedure follows Stock and Watson (2012) and Mertens and Ravn (2013). It allows us to simulate the effects of an increase in the euro area credit spread that is strictly due to changes in liquidity conditions and, therefore, exogenous with respect to the cyclical dimension of credit risk. We focus on a small-scale VAR for the euro area that includes monthly data on euro area industrial production, core CPI inflation, the EONIA and the euro area credit spread for banks. We estimate this VAR model allowing for 6 lags using data from January 1999 to October 2013.

Figure 10 reports the 95% confidence intervals and the mean estimated impulse response using a recursive wild bootstrap using 1,000 replications.[15] The left panel of

[15] See Mertens and Ravn (2013, section II.B and section II.C) for further details on the methodology.

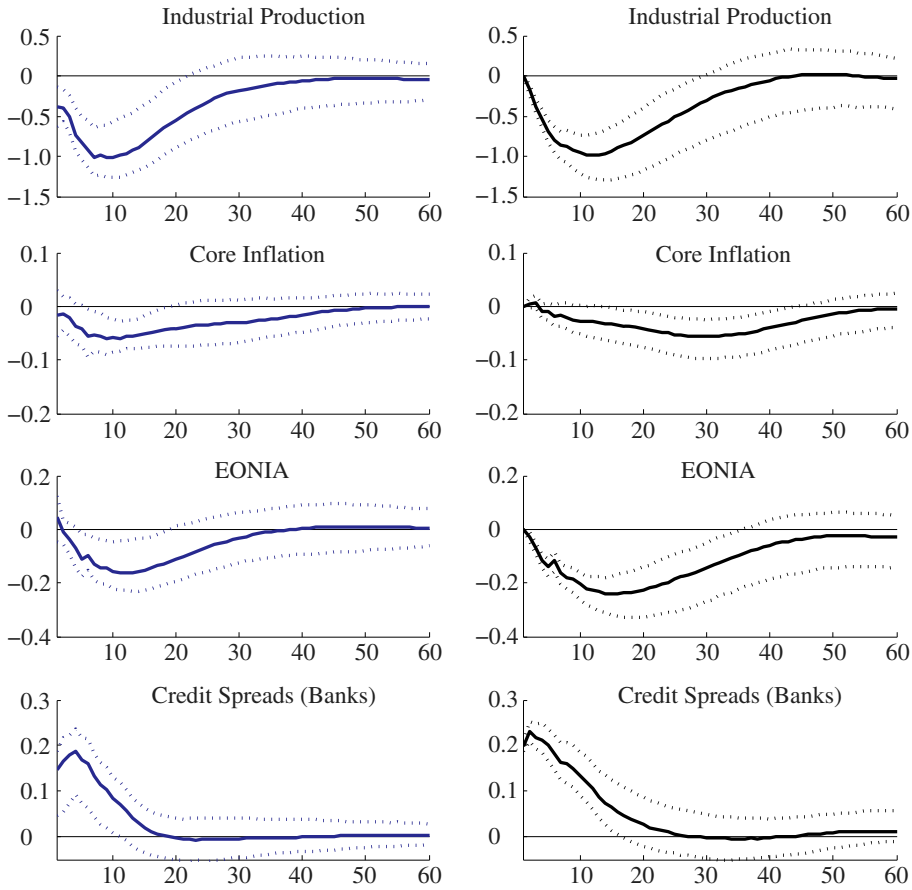

Fig. 10. *Impulse Response: External Instrument (Left Panel) Versus Choleski (Right Panel)*
Note. Colour figure can be viewed at wileyonlinelibrary.com.

Figure 10 reports the impulse response to a movement in credit spreads that is identified using the external instrument. For comparison purposes, the right panel of Figure 10 reports the effects of a shock to the bank credit spread following a Choleski identification, with the credit spread ordered last in the VAR.

Both identification schemes imply very similar quantitative responses of credit spreads and very similar quantitative responses of industrial production. A liquidity shock that leads to a roughly 20 basis point rise in credit spreads implies a contraction in euro area industrial production with a maximum decline of 1% occurring at the 10 month horizon. The orthogonalised shock to credit spreads, reported in the right panel, also implies a 20 basis point rise in credit spreads and a 1% decline in industrial production, with the maximum decline occurring at the 12-month horizon. In both identification schemes, core inflation falls. Consistent with a monetary rule that seeks to stabilise output and inflation, the policy rate also declines in response to the credit shock. The fact that the VAR results are robust to alternative identification procedures strengthens our conclusion that a widening of euro area bank credit spreads leads to

significant declines in euro area economic activity. In particular, shocks to liquidity that are measured independently from our credit spread indices shift credit supply and cause a widening of bank credit spreads and a significant contraction in economic activity.

4. Conclusion

This article provides new indices that measure financial conditions in the euro area using credit spreads obtained from secondary market prices of debt securities issued by both banks and non-financial firms. The evolution of these series over time highlight the increasing fragmentation of the European financial system along national lines as the sovereign debt crisis has emerged since 2010. Consistent with the view that a deterioration in financial conditions has real economic consequences, we document that these financial indices have substantial predictive content for economic activity variables such as industrial production, unemployment and real GDP for the euro area as a whole and for individual countries in the euro area. Moreover, credit spreads also contain substantial predictive content for the volume of loans outstanding. Notably, bank credit spreads outperform non-financial credit spreads in terms of predictive content for economic activity, especially for the two periphery countries, Italy and Spain. These findings are further supported by FAVAR analysis that shows that financial disruptions as measured by shocks to credit spreads that are contemporaneously uncorrelated with real activity and other asset prices cause significant contractions in future output. Overall these results imply that European bond markets provide robust signals regarding future economic outcomes and that disruptions in such markets lead to significanct contractions in euro area economic activity.

Appendix A. Data

A.1. *Where to Find Euro Area Credit Risk Indices*

Our time series of euro area credit risk indices, which is updated monthly, are available in online appendix to Gilchrist and Mojon (2014). This Appendix provides the monthly time series reported in Figures 1 and 2 and the daily corporate bonds interest rates.

A.2. *Sources for Bond Level Data*

Our database is constructed from extracts of datastream for bonds prices, yield to maturity, duration, maturity, size of issuance, currency of issuance, ABS status, etc. However, because the characteristics of the bonds were frequently missing, where necessary, we also extracted bond characteristics from Dealogic and Bloomberg. From this data set, we constructed a sub-sample of non-floating rate, non-callable and non-collaterisable bonds that are denominated in euro. The full data set along with details of the subsample are described in Table A1 of Gilchrist and Mojon (2014). The latter also reports in Table A2 the full list of issuers. From this data set, we have also excluded outliers as follows: bonds with spreads above 30% or less than −5%; bonds with duration or maturity greater than 30 years, or bonds with maturity less than two years. We also exclude observations for which the size of issuance is not reported. Turning to macroeconomic time series used in the regressions and the FAVAR, we used the following variables and sources.

A.3. *Sources for Macroeconomic Data*

A.3.1. *ECB/Eurostat*
EONIA, BOR-OIS is the difference between the Euribor 3 months and the EONIA, the term spread is the difference between the euro area EURO yields 10 years (Average) and the EONIA, Loans to non-financial corporations, loans to households consumer credit, loans for house purchase which we set to be the difference between loans to households and loans to households consumer credit, industrial production, the unemployment rate, HICP inflation, core inflation as HICP All-items excluding energy and unprocessed food.

A.3.2. *OECD*
GDP, final consumption of households and NPISH, residential investment is gross fixed capital formation for housing, investment is the difference between total gross fixed capital formation and residential investment.

Datastream Stock prices, banks stock prices, zero coupon five-year sovereign interest rates, the VIX, the EURO-VIX, the euro dollar exchange rates.

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Accepted: 29 April 2016

Additional Supporting Information may be found in the online version of this article:

Data S1.

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