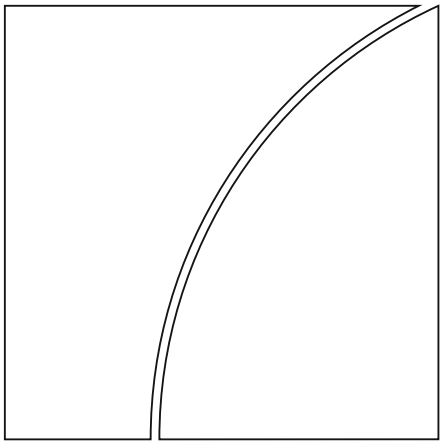

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by Leonardo Gambacorta, Anamaria Illes and Marco J Lombardi

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Has the transmission of policy rates to lending rates been impaired by the Global Financial Crisis?

Leonardo Gambacorta, Anamaria Illes and Marco J Lombardi[1]

Abstract

Central banks of major advanced economies have maintained a very accommodative monetary policy stance in the last few years. However, concerns have surfaced that the transmission of low policy rates to lending rates has been weaker than in the past. Has the transmission of policy rates to lending rates been impaired by the Global Financial Crisis? To answer this question, we first estimate standard cointegrating equations linking policy and lending rates for non-financial firms in Italy, Spain, United Kingdom and United States. We then test for structural change in the cointegration parameters, reporting strong evidence of a break after Lehman Brothers' default. Such structural break is due to a strong increase in the mark-up between the lending rate and the policy rate that standard models assume constant in the long run. The structural shift is explained by compounding the lending rate equation with measures of risk.

Keywords: Monetary policy; lending rates; cointegration; global financial crisis.

JEL classification: E43; E52; C32.

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Introduction

As a response to the Global Financial Crisis and the following deep recession, central banks of major advanced economies brought their policy rates to near-zero and engaged in non-standard monetary policy actions aimed at providing economic stimulus. Such unconventional policy measures have been largely successful in keeping interest rates on government bonds at low levels (Meaning and Zhu (2011)). However, borrowing of households and non-financial corporations remain subdued. Although this is not surprising in the aftermath of a financial crisis, when agents need to repair overburdened balance sheets, some have expressed concern that the loose policy stance has not been transmitted to households and firms – especially the small ones – which would then face "excessively high" borrowing costs.

The goal of this paper is to investigate the pass-through of monetary policy to lending rates to non-financial firms in major advanced economies prior and after the Global Financial Crisis. Are lending rates unusually high in relation to policy rates, and consequently to the desired monetary policy stance? Has the financial crisis impaired the transmission of monetary policy to lending rates? And if it is so, what have been the causes of this? This paper tries to answer these questions.

The literature on the pass-through of monetary policy to lending rates is vast. The early contributions by Borio and Fritz (1995) and Cottarelli and Kourelis (1994) found that the degree of competition and the structural characteristics of the banking systems are key ingredients of the transmission of monetary policy to lending rates. Only a few country-level studies looked at individual bank level data (Weth 2002, Gambacorta 2008). The bulk of the empirical literature has investigated the comovements of policy and lending rates in the framework of cointegrated time series models (Engle and Granger 1987).[2] To account for frictions in the transmission mechanism, asymmetric effects in the short-run adjustment have also been considered (see for example Gambacorta and Iannotti 2007). Due to the different nature of banking systems across component countries, several studies focused on the euro area (Hofmann 2006). Some of the most recent contributions also cover the post-crisis period. Belke at al (2013) employ harmonised data for euro area countries and find considerable cross-country differences. Karagiannis et al (2010) focus instead on differences between the euro area and the US, reporting evidence that during the crisis the transmission mechanism was impaired in both countries.

All the papers mentioned above study the interest rate pass-through by means of error-correction models that establish a long-run relationship between the lending rate and the money market rate. This set-up is supported by economic theory on oligopolistic (and perfect) competition suggesting that, in the long run, the lending rate should be related to the money-market rate, which reflects the marginal yield of a risk-free investment (Klein, 1971). For example, Freixas and Rochet (1997) show that in a model of imperfect competition among N banks, if a part of deposits is invested in compulsory reserves, the long-run relationship between lending ($RLOA$) and money market rates (MMR) is: $RLOA = \alpha + MMR$. These

[2] For an extensive survey of the empirical literature, we refer to de Bondt (2005).

models however do not take into account credit risk: it is implicitly considered constant in the long run, and is incorporated in α, ie the (constant) mark-up.

In line with the rest of the literature, we employ cointegrated models to pin down a long-run relationship between policy and lending rates. The novelty of our approach is twofold. First, we explicitly test for a structural break in the parameters of the standard cointegrating equations after Lehman Brothers' default. Second, we enrich the long-run relationship between lending and policy rates with measures of risk for borrowers and lenders, respectively the delinquency rate for non-financial firms and CDS spreads for banks, to see whether such variables can explain the break in the baseline cointegrating relationship.

Our results suggest that the standard long-run relationship tying together policy and lending rates breaks down during the global financial crisis. Moreover, we document that the structural change of the long run relationship is due to the strong re-pricing of risk. This indicates that monetary policy was transmitted differently, rather than being impaired.

The paper is organised as follows. Section 1 describes the data and its properties, with a special focus on the lending rates. Section 2 reports tests for cointegration to check for the existence of a long run relationship between interest rates, and check for a structural break in the parameters in the aftermath of the Lehman Brothers' default. Section 3 analyses what has impaired the monetary transmission mechanism. The last section summarises the main conclusions.

1. Data and stylised facts

Our study covers Italy, Spain, the United Kingdom and the United States. The main variables used for the analysis are the lending rate on new loans to non-financial firms and the policy rate. The sample starts in January 1989 for the United States, in June 2002 for the United Kingdom and in January 2003 for Italy and Spain. The different time span was required in order to have data with comparable definitions. All rates have a monthly frequency and are expressed in annualised terms.

As far as policy rates are concerned, the standard approach in the empirical literature on the interest rate pass-through is to employ the overnight interbank market rate[3], which is the target of market operations. Collecting comparable lending rates for non-financial firms was a more challenging task, since reporting practices differ across countries, and definitions are not homogeneous. We tried to use rates that match as close as possible. For the two euro area countries, we collected monthly data from the ECB on the interest rate on new loans (over 1 million euros) to non-financial firms. This excludes revolving loans and overdrafts, convenience and extended credit card debt (see ECB (2003) for further details).

For the United States, data is collected from the Federal Reserve Survey of Terms of Business Lending for commercial and industrial loan rates over 1 million

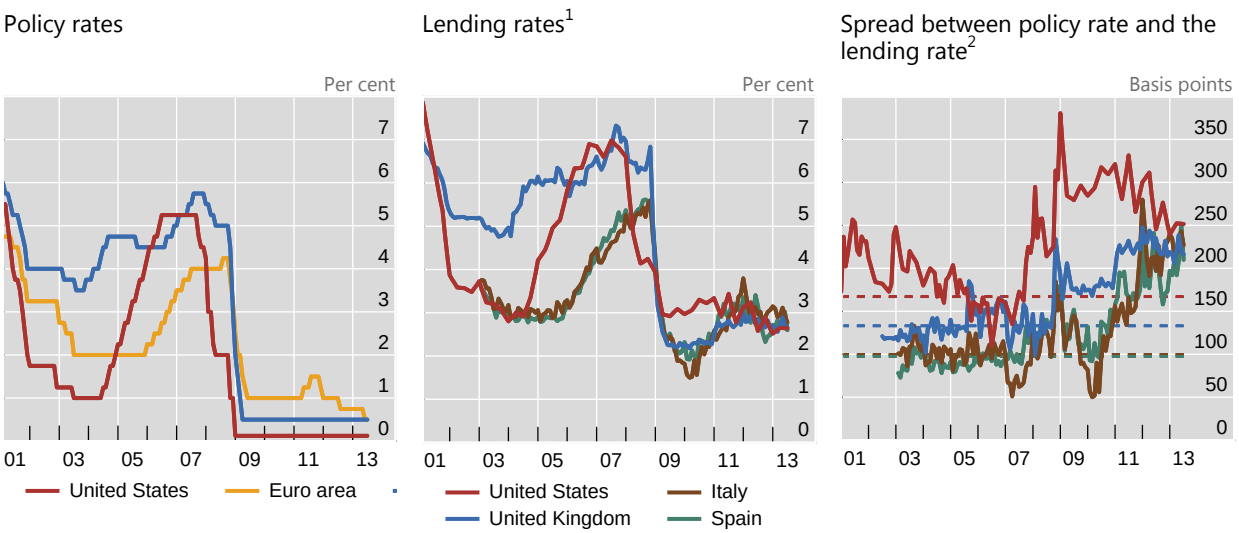
[3] The overnight interbank market rate is obtained from Bloomberg at daily frequency and was converted to monthly frequency by averaging. The overnight rate for the euro area countries is the Euro Overnight Index Average (EONIA), for the United States the effective federal funds rate and for the United Kingdom the overnight GBP LIBOR.

US dollars (see Brady et al (1998) for further details). The data is available only at quarterly frequency, so it was linearly interpolated in order to perform the analysis at monthly frequency.

For the United Kingdom, data is obtained from the Bank of England, which reports the monthly average (across monetary and financial institutions) of the weighted average interest rate on other loans and new advances between 1 and 20 million pounds, given to private non-financial firms (see Reynolds et al (2005) for further details). [4]

Information on the maturity of the loans is more scant. The Fed reports the average maturity of the loans included in the basket, which was less than one year and a half in May 2013. In addition, the Fed reports that the average number of months after the last rate fixation was around 10. For the United Kingdom, Al-Dejaily et al (2012) report that over 90% of the new loans had an original rate fixation period of less than one year. For Italy and Spain, no explicit information on the maturity is available, but the original rate fixation is reported to be less than one year.

Policy rates and lending rates to non-financial corporations — Graph 1



[1] For a detailed definition, see section 1. [2] Dashed lines represent the pre-crisis average (the start of the series is country specific depending on data availability until August 2008).

Sources: Bank of England; European Central Bank; Federal Reserve; Datastream.

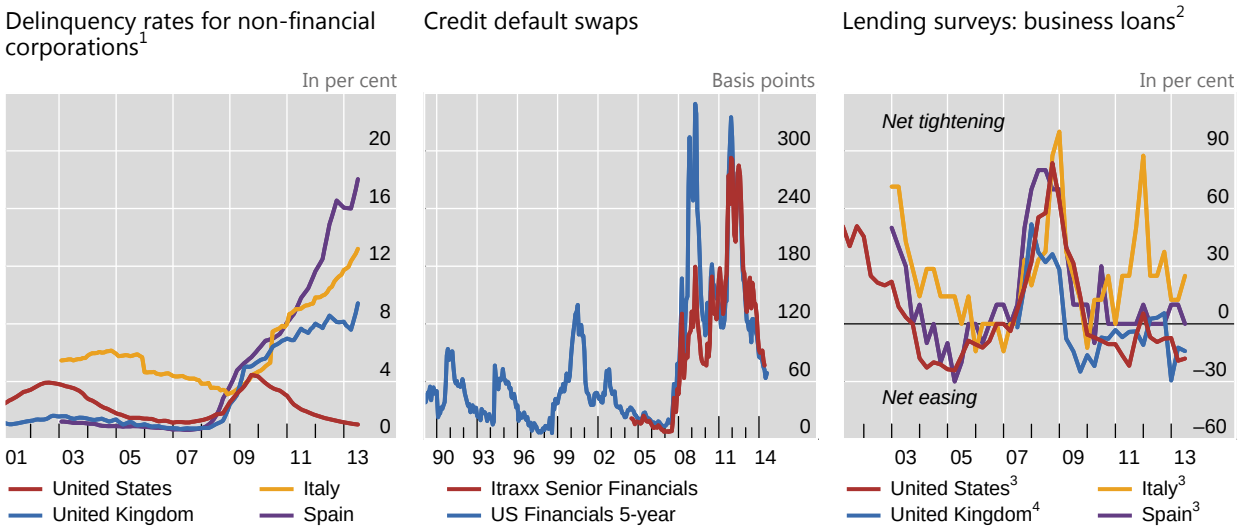
Policy and lending rates are depicted, respectively, in the left and centre panels of Graph 1. Although lending rates have declined following the crisis and now stand at relatively low levels, they are nevertheless at a relatively high level considering that policy rates reached their lower bound. To visualise this more clearly, we report in the right-hand panel the spread between lending and policy rates, together with the pre-crisis average: it is striking how the spreads drift upwards following the onset of the Great recession.

[4] The original series starts in January 2004 and we have backdated it using the fixed lending rate on outstanding loans for non-financial firms to get data back to 2002.

The wedge in the relationship between policy and lending rates is possibly associated with a number of factors. First of all, as the economic situation deteriorated sharply, banks are likely to have charged higher interest rates to compensate for rising default risk of borrowers. A simple gauge for the increase in credit risk is the delinquency rate for non-financial firms, ie the stock of bad loans to the total value of their outstanding loans. The left-hand panel of Graph 2 plots such measures of credit risk. A few patterns emerge. The delinquency rates are all particularly low in the period 2001-2007.[5] And, there is a sudden increase in credit risk after Lehman Brothers' default in September 2008. Third, while credit risk in USA has declined from 2010 onwards, it has progressively increased in European countries reaching very high levels compared to the pre-crisis level.[6]

Credit conditions

Graph 2



[1] For the United States the delinquency rate for commercial and industrial loans; for the United Kingdom the ratio of non-performing loans to total loans for the non-financial sector (where the non-performing loans has been backdated using write-offs); for Italy the net of securitisation ratio of bad debts for non-financial corporations to total lending to the non-financial and quasi-corporations; for Spain the ratio of doubtful loans to total loans for financing of productive activities. [2] For the United States, loans to large and middle-sized businesses; for the United Kingdom Italy and Spain, loans to all businesses. [3] Fraction of banks that reported having tightened standards ("tightened considerably" or "tightened somewhat") minus the fraction of banks that reported having eased standards ("eased considerably" or "eased somewhat"). A positive net balance indicates a net tightening in credit standards. [4] Weighted percentage of banks reporting tightened credit conditions minus weighted percentage of those reporting eased credit conditions (weights are based on relevant market share). A positive weighted net balance indicates a net tightening in credit standards.

Sources: European Central Bank; Federal Reserve; Bloomberg; Datastream; Markit; Moodys' KMV; authors' calculations.

5 This could have been driven, at least partly, by accommodative monetary conditions at the global level, and an associated increase in banks' risk-taking (Altunbas et al., 2014).

6 We acknowledge that definitions are not completely homogenous across the four countries under scrutiny. For the US the delinquency rate is calculated on commercial and industrial loans to match the lending rate definition. For the UK the delinquency rate (non-performing loans to total loans) is available only from 2008:Q3 onwards. We have therefore interpolated the series backwards using data on write-offs. For Italy and Spain the credit risk measure is given by the ratio between bad loans and total loans to non-financial firms. For Italy the series was further corrected by reinserting securitised loans in the numerator and the denominator as for accounting reasons this is originally reported net of securitization activity. This correction was not necessary for Spain as data include already securitized loans.

Furthermore, banks' balance sheets have been hit hard by the collapse in asset valuations and growing funding stress during the financial crisis. The need to repair overburdened balance sheets may have impaired banks' ability and willingness to supply loans. This is well reflected in measures of risk based on credit default swap (CDS) products.[7] The evolution of CDS for the countries in the sample period is reported in the centre panel of Chart 2. In particular the graph shows that risk had probably been underpriced in the pre-crisis period, ie banks were taking risks that were not fully accounted for by financial market indicators at the time (Altunbas et al, 2014).

Changes in the banks' willingness to supply loans can be also analysed by means of Bank Lending Surveys, in which bank loan officers are asked directly about their willingness to grant credit. Therefore, it provides a direct measure of banks' attitudes towards risk. More specifically, the BLS measure of credit conditions is computed as the difference between the number of banks that reported a tightening in a given quarter and the number that reported an easing. So, a positive value indicates net tightening, while a negative value indicates easing.[8]

The right-hand panel of Graph 2 reports the results for the euro area Bank Lending Survey, the Credit Condition Survey for UK banks and the US Senior Loan Officer Opinion Survey on Bank Lending. It is apparent that the crisis was preceded by a prolonged period of lending supply expansion, especially in the UK and the US. Subsequent manifestation of credit risk that emerged at the beginning of 2007 caused a significant drop in the quantity of lending.[9] Similarly, to the analysis of delinquency rates, bank supply conditions remain quite tight in the last part of the

Unit root tests[1] (monthly frequency)

P-values

Table 1

	United States	United Kingdom	Italy	Spain
Augmented Dickey-Fuller				
Lending rate to non-financial corporations	0.048	0.786	0.543	0.446
Target rate	0.092	0.861	0.690	0.690
Delinquency rate	0.068	0.984	1.000	1.000
Banks' CDS	0.063	0.701	0.701	0.701
Phillips-Perron				
Lending rate to non-financial corporations	0.303	0.781	0.428	0.465
Target rate	0.341	0.836	0.736	0.736
Delinquency rate	0.466	0.999	1.000	1.000
Banks' CDS	0.132	0.641	0.666	0.666

[1] The null hypothesis is that the series has a unit root. Sources: BIS calculations.

[7] For European countries we use the iTtraxx Senior Financials index. For the US the series has been calculated as simple average of the 5 year CDS of major banks. As data on CDS for US banks are available from January 2001 we have reconstructed backward the data by means of a regression model that uses as dependent variables the expected default frequency over the 5 years and forecast values of the industrial production.

[8] A detailed description of construction of the BLS indicator is reported in note 3 to Graph 2.

[9] See also Chari et al (2008) and Cohen-Cole et al (2008).

sample period in Italy and Spain, while have been returned to expansionary in US and UK.

Tests for the order of integration of the series used in the analysis are reported in Table 1. Not surprisingly, both the Augmented Dickey Fuller (*ADF*) and Phillips and Perron (PP) tests clearly show that all the series are integrated of order 1 at the 1% significance level.

2. Cointegration and its stability

In this section, we cast the stylised facts presented above in a more formal framework. First of all, we estimate a baseline cointegrating relationship between policy and lending rates. More formally, the baseline equation we estimate is:

$$RLOA_t = \alpha + \beta\, MMR_t + e_t, \qquad (1)$$

where $RLOA_t$ represents the lending rate and MMR_t the policy rate. As discussed above, the policy rate is proxied by the overnight rate.

First, we tested whether the policy and lending rates are cointegrated on the pre-crisis subsample (ie up to August 2008). We employed the tests by Engle and Granger (1987) as well as the Phillips and Ouliaris (1990). Results are reported at the bottom of Table 3 in the columns "Pre crisis" and point indeed to the existence of a long-term relationship tying down policy and lending rates in all countries. In particular, the long run elasticity between the lending rate and the policy rate is quite similar across the countries and not too different from 1 which implies a complete pass-through of the monetary shocks in the long run.

Interestingly, this simple long-run relationship fails to hold if we include in the sample also the period after Lehman Brothers' default. In this case evidence of cointegration is found only for the United Kingdom while it is rejected in the other cases (see the bottom panel of Table 3). Moreover, the long-run elasticities between interest rates are now much smaller, and imply an incomplete pass through.

Motivated by this finding, we formally tested for the existence of a break in the cointegrating relationship after Lehman Brothers' default. Results for the Chow test reported in Table 2 indicate the existence of a break in the long run relationship between the lending rate and the policy rate in September 2008.

Chow test for the existence of a break in the long run relationship[1] Table 2

	United States	United Kingdom	Italy	Spain
T-statistic	94.010	7.038	26.226	117.515
P-value	0.000	0.000	0.000	0.000

[1] The null hypothesis is that the long run relationship between the lending rate and the money market rate represented by equation (1) has a structural break after Lehman Brothers' default in September 2008.

Sources: BIS calculations.

3. What has impaired the transmission mechanism?

The breakdown of the cointegrating relationship after the onset of the Great Recession signals that that the pass-through from low policy rates to bank loans to non-financial firms has been weaker than in the past. But what has impaired a smooth transmission of policy rates? In this section, we argue that the transmission model of the previous section is far too simplistic. Along the lines suggested in section 1, we try to account for various factors that could explain the breakdown of the cointegration relationship.

The first factor is a change in the banks' pricing of the credit risk of their non-financial borrowers. In equation (1) credit risk premium is implicitly assumed to be fixed over time and is accounted for by the constant. While this may be a reasonable approximation during the years of the Great Moderation, it is clearly misleading to assume that the price of risk has not increased with the onset of the Great Recession: the contraction in economic activity may have increased the likelihood that borrowers would be unable to repay their loans. So, an increase in the risk premium could explain part of the wedge that opened between policy and lending rates. As discussed in section 1, we proxy this by the delinquency rate (*DEL*).

Still, the delinquency rate may not fully capture the factors that have led to a higher mark-up. Following a balance sheet recession, banks find themselves in the need of repairing their balance sheets. Therefore, they may be unwilling to lend irrespective of the business conditions. As discussed in section 1, to capture this supply-side factor, we resort to the information contained in the banks' Credit Default Spreads (CDS).

To summarise, the complete specification we estimate for the long-run relationship between lending rates and monetary policy is the following:

$$RLOA_t = \alpha + \beta\, MMR_t + \gamma DEL_t + \delta CDS_t + e_t. \qquad (2)$$

The results reported in the columns of Table 3 that control for changes in risk factors indicate that: i) the inclusion of these risk factor variables restore the existence of a long run relationship in the lending equation (see cointegration tests at the bottom of Table 3); ii) both risk variables are correlated positively with lending rates for non-financial firms; iii) the long run elasticities between interest rates become quite similar across countries and imply a near-complete pass through.

To further investigate the changes in the stability of the relationship between the lending and the policy rate, we also estimated two error-correction models (ECMs), one based on the baseline cointegrating equation (1), and the other one on the equation (2) featuring also the additional explanatory risk factor variables. In particular, the ECM equation we estimate is given by:

$$\Delta RLOA_t = \lambda e_{t-1} + \Sigma_i \beta_i \Delta MMR_{t-i} + \Sigma_j \eta_j \Delta RLOA_{t-j} + z_t, \qquad (3)$$

where e_t is the cointegration residual. The number of lags is chosen according to the Schwarz information criteria; estimation results are reported in Table 4.

A first important test is to verify that the loading coefficient λ on the cointegration residual is significantly negative. This is a necessary condition for the equilibrium relationship to be stable. In fact, it represents the percentage of an exogenous variation between the rates relative to the steady state that is brought back towards equilibrium over the next months. Interestingly, the loading coefficients are significantly negative for all countries only under the complete model (2). The loadings range from -0.07 to -0.41: this means that if an exogenous shock occurs, between 7 and 40 per cent of the deviation of lending rates from policy rates is absorbed within the first month.

A missing element in equation (1) that could explain the breakdown of the cointegrating relationship is the occurrence of unconventional monetary policies. Following the onset of the Great Recession, policy rates have been brought to near-zero levels, and major central banks resorted to a different range of unconventional policy instruments. Therefore, we also checked for the robustness of our results to the inclusion of measures of unconventional policies. Following Gambacorta, Hofmann and Peersman (2014), we use central bank assets to GDP (CBTA/GDP) to represent unconventional monetary policy interventions.

Yet, the pattern of unconventional monetary policies follows closely the evolution of bank risk . Indeed, central bank total assets over GDP and the bank CDS measure are highly correlated (0.9 for euro area countries). So, to avoid problems of collinearity, we replaced CDS with an alternative measure of loan supply conditions, ie the Bank Lending Survey indicator (BLS) presented in section 1. In particular, we estimated the following specification:[10]

$$RLOA_t = \alpha + \beta\, MMR_t + \gamma DEL_t + \psi(CBTA/GDP)_t + \varphi BLS_t + e_t. \qquad (4)$$

Results are reported in Table 5. Even in this case the inclusion of unconventional monetary policy and the BLS indicator tends to restore the existence of the long-run relationship in the lending equation, although results are somewhat mixed for the US and marginally significant for United Kingdom and Spain (see cointegration tests at the bottom of Table 5).[11] A tightening of credit supply condition ($BLS>0$) is associated with higher lending rates. The unconventional monetary policy indicator reflects the increase in bank risk and is also positively correlated with lending rates.

Table 6 reports estimates for the ECM models. Given the quarterly frequency in this specification, loading coefficients are higher than in Table 4 and range from -0.25 to 0.71. However, they are not statistically significant for European countries. This cast some doubt on the use of quarterly data for the analysis as the number of available observations for European countries is very limited (around 40, against 95 for the US).

[10] Since BLS indices are not available at monthly frequency, we performed the estimation using quarterly data.

[11] As the BLS indicator in the UK is available only from the first quarter of 2007 we have also estimated an intermediate model that controls only for unconventional monetary policies (where $\beta_4=0$). Results are qualitatively similar to those obtained from Table 3.

4. Concluding remarks

In the wake of the Great Recession, central banks have been confronted with a weakened monetary transmission mechanism. Our results suggest that the policies implemented by central banks of major advanced economies managed to lower lending rates to non-financial firms only to a smaller extent than in the past: a strong increase in the mark-up between the lending rate and the policy rate emerged since September 2008. This lesser pass-through seems to be related in part to the higher premium for risk required by banks and by the worsening of their financial conditions as well. In particular, it is fully explained by enriching a standard cointergrating model with the delinquency rate of non-financial corporations and banks' CDS index.

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Cointegration tests

Table 3

Dependent variable: Lending rate to non-financial firms	United States			United Kingdom			Italy			Spain		
	Pre-crisis	Full sample	Control for changes in risk factors	Pre-crisis	Full sample	Control for changes in risk factors	Pre-crisis	Full sample	Control for changes in risk factors	Pre-crisis	Full sample	Control for changes in risk factors
MMR (β):	0.926***	0.826***	0.884***	0.980***	0.830***	1.011***	0.982***	0.610***	0.965***	1.162***	0.640***	1.022***
	(0.015)	*(0.019)*	*(0.016)*	*(0.040)*	*(0.017)*	*(0.029)*	*(0.041)*	*(0.067)*	*(0.039)*	*(0.033)*	*(0.066)*	*(0.032)*
DEL (γ)			0.050**			0.112***			0.108***			0.080***
			(0.024)			*(0.026)*			*(0.021)*			*(0.012)*
CDS index (δ)			0.004***			0.001*			0.005***			0.003***
			(0.001)			*(0.001)*			*(0.001)*			*(0.01)*
Constant (α)	1.936***	2.485***	1.833***	1.370***	2.089***	1.086***	1.004***	2.167***	0.402**	0.477***	2.117***	0.741***
	(0.076)	*(0.086)*	*(0.109)*	*(0.186)*	*(0.062)*	*(0.156)*	*(0.119)*	*(0.153)*	*(0.181)*	*(0.096)*	*(0.150)*	*(0.098)*
Sample period	1989:01-2008:08	1989:01-2013:06	1989:01-2013:06	2002:06-2008:08	2002:06-2013:06	2002:06-2013:06	2003:01-2008:06	2003:01-2013:06	2003:01-2013:06	2003:01-2008:08	2003:01-2013:06	2003:01-2013:06
Cointegration tests (1)												
Engle-Granger	0.036	0.175	0.000	0.000	0.001	0.000	0.011	0.527	0.016	0.016	0.548	0.000
Phillips-Ouliaris	0.035	0.115	0.010	0.000	0.002	0.000	0.010	0.616	0.018	0.017	0.664	0.000

Note: The results reported in the table are obtained from the following specification: $RLOA_t = \alpha + \beta MMR_t + \gamma DEL_t + \delta CDS_t + \varepsilon_t$, where $RLOA_t$ is the lending rate to the non-financial firms, MMR_t is the short term money market rate, DEL_t is the delinquency rate of the loans to the non-financial firms, CDS_t is an index of bank risk derived from credit default swap measures. Standard error in brackets. ***, **, * indicate significance at 1, 5, and 10 per cent, respectively. (1) P-values. The null hypothesis is that the series are not cointegrated.

Error correction models

Table 4

Dependent variable: First difference at time t in the lending rate to non-financial firms (RLOA)	United States		United Kingdom		Italy		Spain	
	Baseline model	Complete model	Baseline model	Complete model	Baseline model	Complete model	Baseline model	Complete model
e_{t-1} (λ)	-0.043***	-0.069***	-0.261***	-0.362***	-0.045	-0.276***	-0.056	-0.233**
	(0.014)	*(0.020)*	*(0.089)*	*(0.127)*	*(0.035)*	*(0.057)*	*(0.035)*	*(0.093)*
$RLOA_{t-1}$	0.522***	0.533***	0.035	0.062	-0.155*	-0.106	-0.249**	-0.158
	(0.059)	*(0.059)*	*(0.116)*	*(0.121)*	*(0.092)*	*(0.084)*	*(0.105)*	*(0.113)*
$RLOA_{t-2}$	-0.075	-0.058			-0.195**	-0.170**	-0.126	-0.072
	(0.061)	*(0.061)*			*(0.090)*	*(0.081)*	*(0.103)*	*(0.105)*
$RLOA_{t-3}$	-0.385***	-0.368***						
	(0.062)	*(0.062)*						
$RLOA_{t-4}$	0.187***	0.193***						
	(0.050)	*(0.049)*						
MMR_{t-1}	0.195***	0.185***	0.440***	0.357***	0.464***	0.351***	0.534***	0.457***
	(0.037)	*(0.037)*	*(0.116)*	*(0.130)*	*(0.139)*	*(0.128)*	*(0.149)*	*(0.152)*
MMR_{t-2}	0.167***	0.154***			0.574***	0.484***	0.521***	0.437***
	(0.039)	*(0.040)*			*(0.143)*	*(0.132)*	*(0.149)*	*(0.152)*
MMR_{t-3}	0.175***	0.158***						
	(0.040)	*(0.041)*						
MMR_{t-4}	0.041	0.028						
	(0.041)	*(0.042)*						
Constant	-0.001	-0.002	-0.007	-0.009	0.016	0.009	0.017	0.017
	(0.005)	*(0.005)*	*(0.018)*	*(0.018)*	*(0.016)*	*(0.015)*	*(0.016)*	*(0.015)*
Sample period	1989:02-2008:08	1989:02-2013:06	2002:07-2013:06	2002:07-2008:08	2003:02-2013:06	2003:02-2013:06	2003:02-2008:06	2003:02-2013:06
R-squared	0.771	0.773	0.308	0.307	0.354	0.451	0.345	0.364

Note: The results reported in the table are obtained from the error correction model $\Delta RLOA_t = \lambda e_{t-1} + \Sigma_i \beta_i \Delta MMR_{t-i} + \Sigma_j \eta_j \Delta RLOA_{t-j} + z_t$, where e_{t-1} is the residual from the cointegrating equations (either baseline model (1) or complete model (2)), $RLOA_t$ is the lending rate to the non-financial firms, MMR_t is the short term money market rate, DEL_t is the delinquency rate of the loans to the non-financial firms, CDS_t is an index of bank risk derived from credit default swap measures. Standard error in brackets. ***, **, * indicate significance at 1, 5, and 10 per cent, respectively.

Cointegration tests (quarterly frequency)

Dependent variable: RLOA: Lending rate to non-financial firms	United States				United Kingdom				Italy				Spain			
	Pre-crisis	Full sample	Control for unconventional monetary policies	Control for unconventional monetary policies and credit supply	Pre-crisis	Full sample	Control for unconventional monetary policies	Control for unconventional monetary policies and credit supply	Pre-crisis	Full sample	Control for unconventional monetary policies	Control for unconventional monetary policies and credit supply	Pre-crisis	Full sample	Control for unconventional monetary policies	Control for unconventional monetary policies and credit supply
MMR (β):	0.929***	0.827***	0.919***	0.886***	0.986***	0.821***	1.009***	–	1.029***	0.568***	0.973***	0.962***	1.177***	0.643***	0.992***	0.920***
	(0.023)	*(0.027)*	*(0.022)*	*(0.024)*	*(0.042)*	*(0.024)*	*(0.035)*	–	*(0.040)*	*(0.095)*	*(0.020)*	*(0.021)*	*(0.038)*	*(0.106)*	*(0.033)*	*(0.033)*
DEL (γ)			0.066**	0.046			0.107***	–			0.080***	0.080***			0.039**	0.048***
			(0.028)	*(0.027)*			*(0.035)*	–			*(0.011)*	*(0.010)*			*(0.016)*	*(0.012)*
CBTA/GDP (ψ)			0.080***	0.074***			0.013	–			0.073***	0.071***			0.068***	0.051***
			(0.013)	*(0.012)*			*(0.011)*	–			*(0.004)*	*(0.004)*			*(0.011)*	*(0.010)*
BLS (ϕ)				0.006***				–				0.001				0.004***
				(0.002)				–				(0.001)				(0.001)
Dummy								–	-0.408**	-0.651	-0.416***	-0.394***		0.370	-0.182*	-0.172**
								–	(0.164)	(0.491)	*(0.070)*	*(0.069)*		(0.480)	*(0.105)*	*(0.080)*
Constant (α)	1.927***	2.489***	1.347***	1.516***	1.340***	2.116***	1.034***	–	0.897***	2.297***	-0.280**	-0.239***	0.439***	2.073***	0.070	0.401***
	(0.115)	*(0.121)*	*(0.191)*	*(0.198)*	*(0.194)*	*(0.082)*	*(0.187)*	–	*(0.117)*	*(0.221)*	*(0.109)*	*(0.108)*	*(0.111)*	*(0.253)*	*(0.156)*	*(0.152)*
Sample period	1989:q1-2008:q3	1989:q1-2013:q2	1989:q1-2013:q2	1990:q1-2013:q2	2001:q1-2008:q3	2001:q1-2013:q2	2001:q1-2013:q2	–	2003:q1-2008:q3	2003:q1-2013:q2	2003:q1-2013:q2	2003:q1-2013:q2	2003:q1-2008:q3	2003:q1-2013:q2	2003:q1-2013:q2	2003:q1-2013:q2
Cointegration tests (1)																
Engle-Granger	0.640	0.122	0.612	0.589	0.012	0.208	0.049	–	0.029	0.861	0.026	0.033	0.153	0.951	0.054	0.015
Phillips-Ouliaris	0.007	0.024	0.001	0.000	0.011	0.263	0.046	–	0.023	0.853	0.022	0.028	0.084	0.924	0.045	0.013

Note: The results reported in the table are obtained from the following specification $RLOA_t = \alpha + \beta MMR_t + \gamma DEL_t + \psi(CBTA/GDP)_t + \varphi BLS_t + e_t$, where $RLOA_t$ is the lending rate to the non-financial firms, MMR_t is the short term money market rate, DEL_t is the delinquency rate of the loans to the non-financial firms, $(CBTA/GDP)_t$ is an ratio between central banks' total assets and nominal gross domestic product and BLS_t is the bank lending survey indicator for credit supply (+ for tightening and – for easing). Standard error in brackets. ***, **, * indicate significance at 1, 5, and 10 per cent, respectively. (1) P-values. The null hypothesis is that the series are not cointegrated.

Error correction models (quarterly frequency)

Table 6

Dependent variable: First difference in the lending rate to non-financial firms (RLOA)	United States		United Kingdom		Italy		Spain	
	Baseline model	Complete model	Baseline model	Complete model	Baseline model	Complete model	Baseline model	Complete model
e_{t-1} (λ)	-0.326***	-0.496**	-0.579*	0.709	-0.157	-0.445	-0.142	-0.247
	(0.098)	*(0.190)*	*(0.287)*	*(0.483)*	*(0.114)*	*(0.357)*	*(0.112)*	*(0.418)*
$RLOA_{t-1}$	-0.460***	-0.326**	-0.353	-1.164**	-0.089	-0.166	-0.457	-0.534
	(0.135)	*(0.159)*	*(0.381)*	*(0.456)*	*(0.243)*	*(0.228)*	*(0.325)*	*(0.339)*
$RLOA_{t-2}$				-1.012**				
				(0.405)				
MMR_{t-1}	1.090***	1.036***	0.921**	1.762***	0.701***	0.722***	1.034***	1.134***
	(0.150)	*(0.159)*	*(0.359)*	*(0.430)*	*(0.240)*	*(0.238)*	*(0.328)*	*(0.327)*
MMR_{t-2}				0.728				
				(0.411)				
Constant	-0.021	-0.013	-0.015	0.003	0.034	0.025	0.053	0.059
	(0.036)	*(0.037)*	*(0.051)*	*(0.051)*	*(0.048)*	*(0.050)*	*(0.049)*	*(0.050)*
Sample period	1989:q2-2013:q2	1990:q2-2013:q2	2001q3:2013q2	2001q4:2013q2	2003:q2-2013:q2	2003:q2-2013:q2	2003:q2-2013:q2	2003:q2-2013:q2
R-squared	0.566	0.539	0.458	0.521	0.468	0.463	0.484	0.466

Note: The results reported in the table are obtained from the error correction model $\Delta RLOA_t = \lambda e_{t-1} + \Sigma_i \beta_i \Delta MMR_{t-i} + \Sigma_j \eta_j \Delta RLOA_{t-j} + z_t$, where e_{t-1} is the residual from the cointegrating equations (either baseline model (1) or complete model (4)), $RLOA_t$ is the lending rate to the non-financial firms, MMR_t is the short term money market rate, DEL_t is the delinquency rate of the loans to the non-financial firms, CDS_t is an index of bank risk derived from credit default swap measures. Standard error in brackets. ***, **, * indicate significance at 1, 5, and 10 per cent, respectively. For the UK the complete model does not include the BLS measure as this is available only form 2007.