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MONETARY POLICY, IMPLICIT INTEREST RATE, AND RELATIVE NET TRADE CREDIT*

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This paper investigates the effects of monetary policy on the implicit interest rate of trade credit as well as the probability of firms becoming net trade borrowers. We compute the implicit interest rate as the difference between the interest payments made to creditors and those received from debtors over the sum of both. Our results show that a tightening of monetary policy leads to: (i) increasing interest rates for trade credit, (ii) firms becoming trade borrowers, (iii) the generation of divergence in the cost of trade credit among firms in the same industrial sector, and (iv) the generation of a complementarity effect in prices between trade and bank financing.

Key words: implicit interest rate, monetary policy, relative net trade credit, trade credit.

JEL classification: E52 G32.

The global financial crisis and the downturn in demand have meant a reduction in the volume of trade credit for firms. Trade credit is one of the most important financial sources for firms and its impact on the overall economic activity is significant [see Demirgürç-Kunt and Maksimovc (2001), Petersen and Rajan (1997), Rajan and Zingales (1998)]. Trade credit permits sellers to delay payments to their customers, depending on the needs of the former and, on the other hand, customers are able to alleviate liquidity restrictions [see Braun and Raddatz (2008), Raddatz (2006, 2010)]. However, compared to other sources of funding (i.e. bank loans) trade credit could be expensive [see Carbó *et al*. (2012), Ng e*t al.* (1999)].

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From an industrial organization point of view, some theoretical studies argue that trade credit allows for price discrimination [see Brennan *et al*. (1988), Ng *et al*. (1999), Pike *et al*. (2005)]. Other authors show that trade credit serves as a guarantee of product quality [see Deloof and Jegers (1996, 1999), Emery and Nayar (1998), Long *et al*. (1993), Klapper *et al*. (2012)]. Others suggest trade credit induces certain levels of relationship-specific investment and ease the credit constraints of trade partners [see Dass *et al*. (2011), Wilner (2000), Wilson and Summers (2002)].

These theories are not able to explain how financial markets' imperfections, e.g. information asymmetry, can affect the demand for trade credit [see Emery (1984)]. Biais and Gollier (1997) introduce a signalling model in which suppliers have monitoring advantages over banks, and hence the former could mitigate their financial constraints. On this point, Burkart and Ellingsen (2004) and Burkart *et al*. (2006) show that while suppliers have informational advantage over banks, this advantage is only applicable to input transactions. This view is strengthened by Fabbri and Menichini (2010) who argue that suppliers achieve monitoring and liquidation advantages by providing financing, meaning that firms could benefit from liquidity advantages from their suppliers. Aktas *et al*. (2012) also allege that the use of trade credit provides valuable information to external investors.

Much of the theoretical and empirical literature analyses separately the functioning of transmission channels of monetary policy, but the fact is that shocks in monetary policy, and changes in interest rates, are transmitted through other channels simultaneously [see Clauss (2011)]. Economic literature has traditionally focused on studying the effects of monetary policy on bank interest rates and credit availability, even considering the trade credit channel as a substitute for the bank lending channel. Consequently, in this paper we propose that the effects of changing the interest rates of monetary policy are also transmitted to the cost of trade credit finance [see Guariglia and Mateut (2006), Mateut *et al*. (2006)].

We construct a proxy to measure the implicit interest rate of trade credit (IIR hereafter) by considering the interest expenses paid for each trade payable. We find that a tightening of monetary policy means more expensive trade credit financing. In addition, we investigate the effect of a tightening of monetary policy on company trade financing behaviour. We also construct a new index to measure the relative weight of trade credit, or trade debit, in firms' current assets: the relative net trade credit (RNTC hereafter). To our knowledge this is the first paper to employ this relative measure defined within a homogeneous rank. Although economic literature offers other indexes, such as net trade credit [see Guariglia and Mateut (2006), Kohler *et al*. (2000), Petersen and Rajan (1997)], these proxies are unable to compare firms homogeneously since they are based on the simple difference between accounts payable and accounts receivable, which means that the results are difficult to compare among firms of different sizes. We contribute to methodology scaling by the total amount of trade financing, which helps to mitigate the problem of comparability between firms. Focusing on our empirical results, we find that a rise in interest rates leads to skewing the balance on the trade credit side; that is to say, firms are more prone to become trade credit borrowers.

We also extend the literature on trade credit channels by examining the effects of monetary policy on the competition and complementarity effect. As for the competition effect, we find that raising interest rates leads to an increase in the distance

between the IIR and the average interest rate of the industrial sector to which the firm belongs. As for the complementarity effect, we also find that the spread between the IIR and the cost of bank financing narrows as monetary policy increases. These results suggest the existence of a complementarity effect between trade credit and the cost of bank financing in an environment of increasing interest rates.

The remainder of the paper proceeds as follows. Section 2 presents the background literature. Section 3 formally discusses the theoretical and empirical approach in order to test the hypotheses of this research. Section 4 outlines the data and sample construction. Section 5 presents an empirical analysis for the testable hypotheses of the study. Finally, Section 6 offers the main conclusions and policy implications.

1. Background literature

The interest rate shows how changes in monetary policy rates are transmitted to the real sector. Some recent studies have suggested the interest rate channel has the largest effect in the transmission of shocks to the real economy [see Clauss (2011)][1]. On parallel, market imperfections play a central role in the transmission of monetary policy through the credit channel [see Romer and Romer (1990, 1994), Hubbard (1998)]. When imperfect information exists, alternative types of credit cannot be taken for granted as perfect substitutes, and their availability and price depend on factors related to the strength of company balance sheets [see Mateut (2005), Mateut *et al*. (2006)].

The bank lending channel approach was introduced by the theoretical model of Bernanke and Blinder (1988), and this framework is based on the view that banks play a special role in the financial system because of the advantage they have in solving asymmetric information problems in credit markets [see Bernanke and Blinder (1992), Bernanke and Gertler (1995), Kashyap and Stein (2000)]. Stein (1998) develops a model in which information problems make it difficult for banks to raise funds with instruments other than insured deposits. The main implication of the bank lending channel for firms' credit and investment are those related with an increase in the monetary policy, which would have a significant impact for those firms most dependent on bank credit [see Kashyap and Stein (2000)]. By contrast, Kashyap *et al*. (1993) show that tighter monetary policy leads to a shift in firms' mix of external financing: commercial paper rises to the detriment of bank loans, thereby reducing bank credit availability.

Recently, Huang (2003) and Huang *et al*. (2011) demonstrate that the dynamic behaviour of bank debt versus non-bank debt shows that the lending channel works through cutting back the loan supplies to small firms; these suffer more than large enterprises because they have no alternative to bank finance, which is consistent with inventory behaviour. Carbó and López (2009) analyse the empirical relationship between liquidity and firms' financial structure in order to assess the importance of monetary policy in the context of firm financing. Using dynamic panel data tech-

(1) The interest rate channel postulates that an expansionary monetary policy leads to a fall in interest rates which in turn lowers the cost of capital, causing a rise in investment expenditure and thereby leading to an increase in aggregate demand output.

niques for Spanish firms, they show that when interest rates increase, firms reduce their dependence on bank lending and maintain a higher level of liquidity[2].

Even though the bank lending channel is declining in importance, Bernanke and Gertler's (1995) balance sheet channel is gaining it. The balance sheet channel arises from the presence of asymmetric information problems in credit markets. Theoretical findings [see Bolton and Freixas (2000), Diamond (1984, 1991), Hoshi *et al*. (1990, 1991), Repullo and Suarez (2000)] predict that weak financial firms find more difficult to access to bank credit in a period of monetary tightening. Bernanke and Gertler (1989, 1995) argue that monetary tightening damages company creditworthiness, and consequently its financial position decreases, and the ability to raise funds from banks or other financial intermediaries is also diminished (the bank lending channel does not work)[3].

The empirical works of Gelter and Gilchrist (1993, 1994) show that the sharpest distinction arises between small and large borrowers, as opposed to bank and non-bank credit. The results of a tight monetary policy mean lending to small firms declines relative to lending to large firms[4]. Ashcraft (2006) and Ashcraft *et al*. (2007) investigate whether borrowers' creditworthiness influences the response of bank lending to monetary policy. These results are consistent with a demand-driven transmission mechanism that works through firms' balance sheets and is independent of the bank lending channel. Bougheas *et al*. (2006, 2009) find empirically that small, young, and risky firms are more significantly affected by tight monetary conditions.

A most recent strand in the economic literature shows that the bank lending channel also operates via bank risk. In recent years, the credit standards applied to bank loans were gradually relaxed, prior to the 2008 financial crisis. This reduced pressure on bank balance sheets was reflected in a decrease in the default rates expected. Altunbas *et al*. (2012) show that institutions with higher risk exposure had less capital, a larger size, a greater reliance on short-term market funding, and aggressive credit growth. On this point, Altunbas *et al*. (2010) show that bank risk plays an important role in determining banks' loan supplies and in sheltering them from a tightening of monetary policy. Low-risk banks can better shield their lending from monetary tightening as they have better and easier access to fundraising. This result is consistent with the bank lending channel view. The greater exposure of high-risk bank loan portfolios to monetary policy shocks is diminished in the expansionary phase, consistent with the hypothesis of a reduction in market perceptions in good times. In particular, securitization used be-

(2) Benito (2005), in a similar approach, uses both a market-based system (the United Kingdom) and a bank-based system (Spain) to examine the sensitivity of inventories to financial pressure and liquidity effects, finding support for the Bank Dependence Hypothesis for the bank lending channel.

(3) The balance sheet channel is closely related to the idea of a "financial accelerator". That theory is constructed on the premise that changes in interest rates from the central bank affect the value of firms' assets and the cash flow of potential borrowers, and consequently their creditworthiness. According to this view, a tightening of monetary policy reduces the net worth and liquidity of borrowers, and increases the effective cost of credit by more than the change in risk-free rates, and therefore might intensify the effects of monetary policy [see Bernanke *et al*. (1996)].

(4) See also Black and Rosen (2007), who show that during periods of tight monetary policy, banks adjust their stocks of credit by reducing the maturity of loans and reallocating their short-term loan supply for small firms to large enterprises.

fore the financial crisis contributed broadly to modify the bank lending channel as well as banks' ability to grant credit, as argued by Altunbas *et al*. (2009). The authors show that the use of securitization also reduces the effectiveness of monetary policy. Moreover, banks making a massive use of securitization tend to grant more loans, and this effect is stronger when the economy is in good shape.

Related to the credit channel view is the so-called broad credit channel approach. Oliner and Rudebusch (1995, 1996b) state that at the heart of the broad credit channel is the proposition that internal and external funds are not perfect substitutes, because of informational asymmetries which are more severe for small than for large firms. Oliner and Rudebusch (1996a) show that the broad credit channel operates through small firms. The broad credit channel stresses that all forms of external finance are imperfect substitutes for internal funds. Therefore, those asymmetries of information result in a cost premium for external funds, as compensation for the expected cost of monitoring, and this premium depends on the stance of monetary policy, which can deteriorate the borrower's balance sheet and reduce collateral.

In this context, the trade credit channel may work as a substitute for the bank lending channel. The trade credit channel deals with the impact of trade credit within the broad credit channel approach. Nilsen (2002) has shown that in times of tight monetary policy small firms and those large firms without sufficiently collateralized assets increase the use of trade credit. A similar result is provided by Guariglia and Mateut (2006) and Mateut *et al*. (2006), who find that during monetary contractions firms increase trade credit, suggesting that both the credit and the trade credit channels operate in the UK, and the latter channels tend to weaken the former[5], whereas Choi and Kim (2005) show that both accounts payable and accounts receivable are increased under tighter monetary policy. Atanasova and Wilson (2003, 2004) find that during monetary contraction corporate demand for bank credit decreases and the supply of bank loans also decreases[6].

We are also concerned to study the effects of monetary policy on the behaviour of working capital financing. We find in the economic literature several arguments supporting the complementarity between the availability of bank lending and trade credit when financing credit constraint is imposed by financial institutions [see Burkart and Ellingsen (2004), Cull *et al*. (2009), Danielson and Scott (2004), Giannetti *et al*. (2011), Petersen and Rajan (1994, 1995, 1997)], providing evidence for pecking order debt financing [see Myers (1984), Myers and Majluf (1984)]. Cook (1999) shows that non-financial firms support the role of other financial intermediaries to solve the problem of informational asymmetries. Ono (2001) argues that for small firms whose liquidity is constrained, the non-transactional factor as an increase in cash flow reduces the need for external financing, and also finds that trade payables act as a complement to bank loans, while Elliehausen and Wolken (1993) find evidence of the complementarity hypothesis consistent with the credit rationing hy-

(5) A similar result is obtained by Kohler *et al*. (2000) focused on the net trade credit.

(6) Ramey (1992) extends the theory of King and Plosser (1984) by recognising that under certain conditions the co-movements between monetary policy and trade credit reveal the existence of underlying financial shocks for most of the fluctuations in money at business cycle frequencies.

pothesis[7]. Recently, Boissay and Gropp (2007) and Cuñat (2007) find that trade creditors are more willing to grant when customers are rationed in the loan market. Carbó *et al*. (2012) also find support for the complementarity hypothesis when analysing the supply side of trade credit. They find a significant sensitivity of the extension of trade credit to bank lending to unconstrained firms, which suggests the role of company lenders due to easier access to bank lending. Love and Zaidi (2010) do not find support for the hypothesis that trade credit could substitute for bank credit in times of crisis. Financially constrained firms receive less trade credit in terms of quantity and length of time, but discount terms rise in both payables and receivables.[8] On the other hand, the economic literature also reports that bank loans are a cheaper substitute for trade credit, supporting the substitution hypothesis. Fukuda *et al*. (2006) has focused on the substitutability of bank loans for trade credit in periods of tight money. A similar result is supported by De Blasio (2005). This is an argument supporting the substitution hypothesis under serious financial turbulences[9]. Those results are consistent with those presented by Tsuruta (2007, 2012) who argues that during economic recessions the amount of trade credit is reduced by suppliers, Uesugi and Yamashiro (2008) find that trade credit and bank loans differ substantially in terms of creditors, and among credit instruments[10]. Finally, Huang *et al*. (2011) highlight a counter-cyclical behaviour between trade credit and bank credit; in other words, the authors find evidence of substitution effects of those forms of short-term financing when production efficiency is greater than one, which is common in the real world. On the other hand, the pro-cyclical pattern of substitution behaviour is possible, but infrequent.

2. Methodology

2.1. Theoretical approach

The theoretical framework employed in our research is based on Oliner and Rudebusch (1995). In this model, which was pioneered by Kashyap *et al*. (1993), a firm minimizes the financial cost of its debt based on the company's stock of bank debt and non-bank debt. The main difference in our model, compared to others, is that we explicitly consider the whole range of funding sources in the liability side[11].

Thus, following Oliner and Rudebusch (1995), we consider first the direct interest payment on firm's bank debt (B), and we also introduce into the model the firm's trade credit (TC), and the firm's shareholders' funds (S). The sum of these

(7) See also Alphonse *et al*. (2006), who find that trade credit helps firms to improve their reputation; this can work as a signal regarding a firm's quality and thus facilitates access to bank debt.

(8) The results of Ono (2001) and Carbó *et al*. (2012) also shed light on the fact that trade credit helps to alleviate the problems derived from a tightening of monetary policy.

(9) Fukuda *et al*. (2006) also find that in financial crises both bank lending and trade credit are seriously constrained.

(10) Cull *et al*. (2009) find recent evidence, for the case of China, that more profitable private domestic firms were more likely to extend trade credit than unprofitable ones. Moreover, trade credit was likely to provide a substitute for loans for these firms' customers, who were shut out of formal credit markets.

(11) We do not consider commercial paper in our model because the European financial system is bank-based while the Anglo-Saxon one is market-based.

funding costs would be $r_B B + r_{TC} TC + r_S S$, where r_B, r_{TC}, and r_S are the interest rates paid ($r = r_B + r_{TC} + r_S$). The second component, which partly offsets these interest costs, are the relationship benefits (R) that the firm derives from the bank borrowing proposed by Kashyap *et al*. (1993) and are given by:

$$R = f\,(B/D)D \qquad [1]$$

where D represents the total liabilities ($D = B + TC + S$), and f (B/D) is an increasing concave function ($f' > 0$, and $f'' < 0$) which means that for a given amount of total debt, the relationship benefit rises with the bank loan share, subject to diminishing returns. To model the effects of the long-term debt, we add the adjustment cost for debt stocks and the model assumes that the cost is greater for long-term rather than short-term debt[12]. Given this, the adjustment cost for firm liabilities ($L = B, TC, S$) will differ to the extent that they have unequal average maturities. Thus, the adjustment cost might be specified as:

$$A_L = \left(\frac{\varphi}{2\delta_L}\right)\left[\frac{L-L_0}{L_0}\right]^2_{L_0} \qquad [2]$$

where L_0 represents the initial volume of liabilities (B_0, TC_0, S_0); whereas L states for the final stocks of these liabilities. We also include the proportion of outstanding liabilities of each type withdrawn each period (δ_L), and the parameter φ is a constant higher than zero [see Oliner and Rudebusch (1995)].

Firms attempt to minimize their financial costs considering the adjustment cost explained above. Company financing is restricted to a given amount of liabilities and a total interest rate that the firm is willing to pay for the above debt. Therefore, we propose the following model in which the firm chooses to minimize its financial cost:

$$\min C = r_B B + r_{TC} TC + r_S S + \left(\frac{\varphi}{2\delta_B}\right)\left[\frac{B-B_0}{B_0}\right]^2_{B_0} + \left(\frac{\varphi}{2\delta_{TC}}\right)\left[\frac{TC-TC_0}{TC_0}\right]^2_{TC_0} + 2\left(\frac{\varphi}{2\delta_S}\right)\left[\frac{S-S_0}{S_0}\right]^2_{S_0} - f\left(\frac{B}{D}\right)D \qquad [3]$$

s.t. $D = B + TC + S$

$r = r_B + r_{TC} + r_S$

Solving the minimizing program [3], we obtain the structural model that relates trade credit cost (r_{TC}) and the factors that influence the choice of the trade credit level.

$$r_{TC} = f'\left(\frac{B}{D}\right) - r_B - r_S - \\ -\varphi\left[\left(\frac{1}{\delta_B}\right)\left[\frac{B-B_0}{B_0}\right]_{B_0} + \left(\frac{1}{\delta_{TC}}\right)\left[\frac{TC-TC_0}{TC_0}\right]_{TC_0} + \left(\frac{1}{\delta_S}\right)\left[\frac{S-S_0}{S_0}\right]_{S_0}\right] \qquad [4]$$

(12) More recently, a similar approach has been adopted by Huang (2003). The main differences are the inclusion of adjustment cost, and we consider all liabilities in our model.

Differentiating [4] with respect to the monetary policy stance implies:

$$\frac{dr_{TC}}{dMP} = f''\left(\frac{B}{D}\right)\left[\frac{d\left(\frac{B}{D}\right)}{dMP}\right] - \frac{dr_B}{dMP} - \frac{dr_S}{dMP} - \\ -\varphi\left[\left(\frac{1}{\delta_B}\right)\left[\frac{\frac{dB}{dMP}}{dB_0}\right]_{B_0} + \left(\frac{1}{\delta_{TC}}\right)\left[\frac{\frac{dTC}{dMP}}{TC_0}\right]_{TC_0} + \left(\frac{1}{\delta_S}\right)\left[\frac{\frac{dS}{dMP}}{dS_0}\right]_{S_0}\right] \quad [5]$$

Equation [5] characterizes the response of the cost of a firm's trade credit to a monetary contraction in the presence of adjustment costs. In general, the movements in the cost of a firm's trade credit are not only dependent on the change of the purely monetary variable, but also in the way that monetary policy affects the other sources of funds included in its liabilities, and therefore, the payment that the firm is committed to making.

Having reviewed the existing economic literature on monetary policy and its different channels of transmission to firms' activity, and considering the theoretical framework presented above, we can formulate the following four testable hypotheses:

Hypothesis 1: A positive relationship is expected between a change in the monetary policy interest rate and the implicit interest rate of trade credit (a tightening of monetary policy induces firms to increase the price of trade financing).

Hypothesis 2: A positive impact of a change in monetary policy interest rates on the relative net trade credit index is expected (a tightening of monetary policy induces firms to maintain a larger proportion of trade credit rather than trade debit in their balance sheets).

Hypothesis 3: A positive effect of a tightening of monetary policy on the spread between the implicit interest rate paid by the firm and the average rate of the industrial sector to which the firm belongs is expected (divergence among competitors in an environment of rising interest rates).

Hypothesis 4: A negative effect of a tightening of monetary policy and the spread between the implicit interest rate of trade credit and the cost of bank financing is also expected (a complementarity effect between both type of firm financing in an environment of rising interest rates).

2.2. Implicit interest rate of trade credit and the approximation of variables

Following the theoretical framework, we assume that a variation in interest rates due to changes in monetary policy has an impact on the IIR of trade credit. Therefore, based on the theoretical discussion and the result obtained from equation [5], we propose the following empirical specification which relates the stance of monetary policy variables (ΔMP_t) as well as firms' financial variables to the change of the IIR:

$$\Delta r_{it}^{TC} = \alpha_0 + \alpha_1 \Delta r_{it}^{B} + \alpha_2 \Delta r_{it}^{S} + \alpha_3 \Delta B_{it} + \alpha_4 \Delta TC_{it} + \alpha_5 \Delta CAP_{it} + \alpha_6 \Delta MP_t + \alpha_7 \Delta LTA_{it} + \alpha_8 \Delta CFA_{it} + \alpha_9 Crisis_t + \sum_{i=1}^{K} \gamma_k IND_{kit} + \sum_{i=1}^{H} \delta_h REG_{hit} + \xi_{it} \quad [6]$$

where the subscripts i = 1…N, refers to the firm, k = 1… K, refers to the industry sector in which the firm operates, and finally, h = 1… H refers to a regional dummy where the firm operates.

The dependent variable is the first differences change of the IIR of trade credit (Δr_{it}^{TC}) proxied as the ratio financial expenses minus interest paid over current assets: creditors. The extension of trade credit leads to an opportunity cost for lending firms which is then translated to a financial cost for borrowing firms. Several papers that consider the IIR employ cross-section survey data in which discount percentage, and discount and net period are asked to entrepreneur [see Ng *et al*. (1999), Wilson and Summers (2002), Mateut (2005)][13]. Since we are concerned to study the effect of monetary policy interest rates on IIR, we need to collect a broad number of periods for several firms and obtain survey for ten-year data, which would be an almost impractical exercise.

The bank lending channel is related through the interest paid for bank loans (Δr_{it}^{B}) measured as interest paid over total assets in first differences. Subsequently, we define the payments that the firm might use for shareholders' funding (Δr_{it}^{S}), measured as shareholders' pay-out over total assets in first differences and representing the proportion of dividends that a firm might pay to its shareholders.

The variation in the amount of bank debt (ΔB_{it}) is the leverage ratio, measured as long-term debt over total assets. The amount of bank debt is an important variable in the bank lending channel due to banks reducing the supply of loans, and firms reduce their demand for loans after a monetary shock [see Kashyap *et al*. (1993)]. Shareholder financing (ΔCAP_{it}) is the capitalization ratio measured as the ratio between shareholder funds and total assets in first differences. Trade credit is represented by ΔTC_{it} and constitutes the first differenced variable of the amount of trade credit. The amount of trade credit is measured as the ratio among accounts payable over total debt. Asymmetric information is present in the relationship between the bank and the firm. Therefore, we take into account the variable ΔLTA_{it}, given by the logarithm of a firm's total assets, which will proxy the availability of information about the company. Since firm financing constraint constitutes an important determinant in substituting financial markets for sellers' financial markets, we include the ratio cash flow over a firm's total assets in first differences (ΔCFA_{it}).

(13) Several papers consider computing the implicit interest rate of trade credit as the percentage discounted in addition to the discount and net period of trade credit granted as:

$$IIR = \left\{ \left(\frac{100}{100 - \text{discount \%}} \right)^{\frac{360}{\text{credit period} - \text{days discount}}} - 1 \right\}$$

Variation in the interest rates of monetary policy (ΔMP_t) is the key exogenous variable employed in our paper. Recent economic literature relies on the three-month interbank interest rate as an indicator of monetary policy [see Kashyap and Stein (2000), Kishan and Opiela (2000, 2006, 2012)]. Therefore, we use the three-month $EURIBOR_t$, and lending facilities (LF_t) as the main measures of the direction of monetary policy[14]. We also employ the bank interest rate, measured as the average price in first differences (ΔP_{jit}) that banks establish for their loans, measured as interest income plus other operating income over bank's total assets from AEB-CECA-UNACC (2010) database (see Maudos and Fernández de Guevara, 2004, 2007; Fernández de Guevara *et al*., 2007). As a robustness check, we introduce in our estimates the $EONIA_t$ since it follows a similar pattern with respect to $EURIBOR_t$ and constitutes the shorter form of bank financing in the ECB.

The most recent economic literature shows the financial crisis has implied a decrease in the volume of trade credit and an increase in IIR [see Love and Zaidi (2010)]. Therefore, we include a time-dummy crisis variable ($Crisis_t$) that takes the value of 1 if the period ranges from 2007 to 2009, and zero otherwise. Finally, we include an industry dummy variable (IND_{kit}) to control for the industry effects of company parameters and regional dummy variables (REG_{hit}) to control for the geographic influence on firm performance.

2.3. Formulation of the relative net trade credit

The second part of our paper analyses the role of monetary policy on the trade financing position. We develop the relative net trade credit ($RNTC_{it}$) beginning with the difference among accounts receivable (Cr_{it}) and accounts payable (Db_{it}) in a numerator over the overall amount of trade credit accumulated in both current assets and current liabilities. Then, both levels of the fraction are divided by a firm's total assets (TA_{it}). Finally, we obtain the ratio of net trade credit ($NTC_{it} = TC_{it}^{TA} - TD_{it}^{TA}$) over the sum of trade credit over total assets (TC_{it}^{TA}) plus trade debit over total assets (TD_{it}^{TA}) that represents the total of a firm's trade credit. To our knowledge, this is the first paper in which this ratio is employed.

$$RNTC_{it} = \frac{Cr_{it} - Db_{it}}{Cr_{it} + Db_{it}} = \frac{\frac{Cr_{it}}{TA_{it}} - \frac{Db_{it}}{TA_{it}}}{\frac{Cr_{it}}{TA_{it}} + \frac{Db_{it}}{TA_{it}}} = \frac{TC_{it}^{TA} - TD_{it}^{TA}}{TC_{it}^{TA} + TD_{it}^{TA}} = \frac{NTC_{it}}{TC_{it}^{TA} + TD_{it}^{TA}} \quad [7]$$

The economic interpretation of this ratio is that if net trade credit is negative (positive), the firm is a net credit extender (receiver). The financial interest of RNTC is on the normalization of trade credit, since the ratio ranges, theoretically rather than empirically, from -1 (meaning that the firm has only trade debit in its balance sheet) to 1 by considering that a firm has only trade credit in its balance sheet. Then, the empirical specification for explaining the effect of monetary policy on a firm's financial position could be expressed as:

(14) The three-month interbank interest rate (EURIBOR) is a common interest rate in the Eurozone; it is established in an auction conducted by the major European banks within the European Central Bank.

$$RNTC_{it} = \beta_0 + \beta_1 \Delta r_{it}^B + \beta_2 \Delta r_{it}^S + \beta_3 \Delta B_{it} + \beta_4 \Delta TC_{it} + \beta_5 \Delta CAP_{it} + \beta_6 \Delta MP_t + \beta_7 \Delta LTA_{it} + \beta_8 \Delta CFA_{it} + \beta_9 Crisis_t + \sum_{i=1}^{K} \gamma_k' IND_{kit} + \sum_{i=1}^{H} \delta_h' REG_{hit} + \xi_{it} \quad [8]$$

2.4. Modelling competition and the complementarity effect

We are concerned with studying the competition effects among enterprises in order to establish the price of trade credit. To test hypothesis 3, we introduce as dependent variables the difference between the IIR paid by the firm and the average IIR for each industrial sector ($\overline{r_{kt}^{TC}}$), since the conditions of trade credit differ accordingly.

$$r^{TC} - \overline{r_{kt}^{TC}} = \delta_0 + \delta_1 \Delta r_{it}^B + \delta_2 \Delta r_{it}^S + \delta_3 \Delta B_{it} + \delta_4 \Delta TC_{it} + \delta_5 \Delta CAP_{it} + \delta_6 \Delta MP_t + \delta_7 \Delta LTA_{it} + \delta_8 \Delta CFA_{it} + \delta_9 Crisis_t + \sum_{i=1}^{K} \gamma_k'' IND_{kit} + \sum_{i=1}^{H} \delta_h'' REG_{hit} + \xi_{it} \quad [9]$$

Moreover, we extend our analysis to the study of complementarity between trade credit and bank financing to test hypothesis 4. Thus, we include as a dependent variable the difference between the IIR and the cost of bank financing[15]:

$$r_{it}^{TC} - r_{it}^B = \varphi_0 + \varphi_1 \Delta r_{it}^S + \varphi_2 \Delta B_{it} + \varphi_3 \Delta TC_{it} + \varphi_4 \Delta CAP_{it} + \varphi_5 \Delta MP_t + \varphi_6 \Delta LTA_{it} + \varphi_7 \Delta CFA_{it} + \varphi_8 Crisis_t + \sum_{i=1}^{K} \gamma_k''' IND_{kit} + \sum_{i=1}^{H} \delta_h''' REG_{hit} + \xi_{it} \quad [10]$$

3. Data and summary statistics

The dataset contains firm level information from Bureau van Dijk's SABI (2010) database. Our sample consists of a broad data panel of 13,634 Spanish firms in the period 1998-2009, which results in a panel dataset of 145,514 observations. We also consider firms with fewer than 250 employees as small and medium-sized enterprises (SMEs), and those with more than 250 employees as large firms.

The second set of variables is related to bank measures. To this end, we create a panel dataset based on credit institutions' balance sheets and income statements obtained directly from the Spanish Banking Association (AEB) for commercial banks data, the Spanish Savings Banks Association (CECA) for savings banks data, and the

(15) The reader may note that we have excluded Δr_{it}^B from the specification to avoid problems of endogeneity.

National Union of Credit Cooperatives (UNACC) for credit cooperatives data[16]. Having obtained both firms' and banks' panel data, we are able to merge the two databases. SABI database contains as a variable the main bank with which firms operate. This variable is very useful in our research because it permits the merging of company and bank databases, and we were therefore able to establish the subsequent relationship between the parameters of each bank and the corresponding firm for each period. Note that the SABI database is updated regularly and information on bank-firm level relations is overwritten. We solve this issue by comparing information from the previous versions of the database. To our knowledge, this is the best way to research the transmission of monetary policy via the bank lending channel, as well as examine other industrial characteristics such as bank market power, bank efficiency, etc.

The third set of variables is directly related to the stance of monetary policy, namely EURIBOR, EONIA and LF, obtained from the Bank of Spain database. We have merged the macroeconomic variables into the final database directly throughout the period variable.

Table 1 contains the definitions and explanatory comments on the main variables employed in this paper.

4. Empirical results

4.1. The effect of monetary policy on the implicit interest rate and relative net trade credit

Table 2 reports the summary statistics of the variables employed in our research. The results reveal that the variation of IIR (Δr_{it}^{TC}) has a mean of 0.001 suggesting that, on average, the cost of trade credit is increasing. The mean of RNTC is negative (-0.25) indicating that the firms included in our sample tend to be overall credit receivers. In addition, the average of the variable employed to measure the competition effect ($r_{it}^{TC} - \overline{r_{kt}^{TC}}$) is negative on average (-0.007) ranging from -0.045 to 0.05. This suggests that the average company pays a higher cost for trade credit that the average company of the industry sector in which they belong to. The variable measuring the complementarity effect ($r_{it}^{TC} - r_{it}^{B}$) is negative indicating that, on average, the cost of bank lending is relatively higher that IIR (-0.004) ranging from -0.036 to 0.082. We are also concerned to clarify the effects of the 2007 financial crisis on our variables[17]. Regarding control variables, the variation of trade credit (ΔTC_{it}) and the variation of bank lending (ΔB_{it}) show negative values (-0.015 and -0.002, respectively) suggesting a reduction in the capacity of companies to obtain external finance. Finally, the variation of macroeconomic interest rates ($\Delta EURIBOR_t$, $\Delta EONIA_t$, ΔLF_t) and bank interest rate (ΔP_{jit}) show a negative sign indicating the negative average trend in the period analysed in this study. Additionally, we estimate Granger's predictability test

(16) The acronyms correspond with the Spanish denominations: *Asociación Española de Banca* (AEB), *Confederación Española de Cajas de Ahorros* (CECA), and *Unión Nacional de Cooperativas de Crédito* (UNACC).

(17) Since our balance sheet data correspond to December 31, we should take as a reference year the onset of the financial crisis in the year 2007, because the financial magnitudes were fully affected at this date.

Table 1: DEFINITION OF VARIABLES

Dependent variables	
Δr_{it}^{TC}	This variable represents the variation of the implicit interest rate (IIR) or trade credit, i.e. the price that firms pay for trade finance. The variable proxies the ratio financial expenses minus interest paid over current assets: creditors
$RNTC_{it}$	Net trade credit measures the net trade financing position and its relationship with firms' market power. We develop the relative net trade credit beginning with the difference between trade credit and trade debit over trade credit plus trade debit in denominator.
$r_{it}^{TC} - \overline{r_{kt}^{TC}}$	This variable measures the competition effect and is a proxy for the difference between the implicit interest rate of trade credit paid by firm i, the average interest trade credit for each period t, and the industrial sector k to which the firm belongs.
$r_{it}^{TC} - r_{it}^{B}$	This variable measures the complementarity effect and is a proxy for the difference between the implicit interest rate of trade credit and the price paid by firms for bank financing.
Explanatory variables	
ΔTC_{it}	This variable is the variation in trade credit and constitutes the first differenced variable of the amount of trade credit. The amount of trade credit is measured as the ratio among accounts payable over total debt.
ΔB_{it}	This variable represents the variation in the amount of bank debt and is the leverage ratio measured as long-term debt over total assets. The amount of bank debt is an important variable in the bank lending channel due to banks reducing the supply of loans, while firms reduce the demand for loans after a monetary shock [see Kashyap *et al*. (1993)].
ΔCAP_{it}	This variable represents the variation in the amount of shareholder financing and is the capitalization ratio, measured as the ratio between shareholder funds and total assets.
ΔMP_{t}	This variable measures the variation in the stance of monetary policy. We use the three-month EURIBOR_{t}, EONIA_{t}, or LF_{t} as the main measures of the stance of monetary policy [see Carbó and López (2009), Kashyap and Stein (2000), Kishan and Opiela (2000, 2012)].
ΔP_{jit}	This variable represents the variation in the bank interest rate i.e. the price that banks establish for their loans, measured as interest income plus other operating income over bank's total assets from the AEB-CECA-UNAC (2010) database [see Maudos and Fernández de Guevara (2004, 2007), Fernández de Guevara *et al*. (2007)].
Δr_{it}^{S}	This variable defines the variation of payments that firms might serve for shareholders funding; it is measured as shareholders' pay-out over firm's total assets and represents the proportion of dividends that firms might pay to their shareholders.
Δr_{it}^{B}	This variable relates the bank lending channel and company trade credit and is the interest paid for bank loans, measured as interest paid over a firm's total assets. The meaning of this variable is the proportion of bank interest that a firm might pay, and is recognised in the firm's balance sheet.
ΔCFA_{it}	This variable measures the variation in the ratio cash flow over firm's total assets [see Atanasova (2007)].
ΔLTA_{it}	This variable represents the variation in company size, measured as the logarithm of firms' total assets.

Table 2: Summary Statistics, 1998-2009

	Observations	Mean	S.D.	Minimum	Maximum
Panel a: summary statistics for the main variables					
Dependent variables					
Δr_{it}^{TC}	75,271	0.0012177	0.0843032	-0.4900578	1.300515
$RNTC_{it}$	92,469	-0.2544931	0.3894728	-0.9817996	0.8421053
$r_{it}^{TC} - \overline{r_{kt}^{TC}}$	88,488	-0.007254	0.0219547	-0.0450484	0.0587834
$r_{it}^{TC} - r_{it}^{B}$	88,942	-0.0043037	0.0260949	-0.0360914	0.0823799
Explanatory variables					
ΔTC_{it}	78,229	-0.015105	0.0938092	-1.322539	1.564509
ΔB_{it}	63,790	-0.0017979	0.0844362	-1.179066	2.375462
ΔCAP_{it}	104,149	0.0061473	0.1019485	-1.045359	1.045359
$\Delta EURIBOR_{t}$	133,043	-0.2452279	1.24778	-2.58	1.49
$\Delta EONIA_{t}$	133,043	-0.2708457	1.124087	-2.14	1.79
ΔLF_{t}	122,053	-0.2454794	1.130524	-2.00	1.75
ΔP_{jit}	130,568	-0.1556383	0.9004671	-13.5709	6.355763
Δr_{it}^{S}	99,033	-0.0039057	0.4831038	-121.4426	15.29185
Δr_{it}^{B}	97,867	-0.0002422	0.0180472	-2.827451	0.6871024
ΔCFA_{it}	116,495	0.0326723	0.1004546	-.3124001	0.3711599
ΔLTA_{it}	104,149	0.1190539	0.4395472	-6.26518	13.40502
Panel b: industry distribution					
Agriculture	145,514	0.0132771	0.1144591	0.00	1.00
Mining	145,514	0.0100746	0.0998659	0.00	1.00
Construction	145,514	0.1325165	0.3390526	0.00	1.00
Manufacturing	145,514	0.3091661	0.4621514	0.00	1.00
Transport	145,514	0.0739173	0.2616371	0.00	1.00
Wholesale	145,514	0.2587792	0.4379656	0.00	1.00
Retail	145,514	0.0463254	0.2101897	0.00	1.00
Services	145,514	0.1293759	0.3356166	0.00	1.00
Other	145,514	0.0144179	0.119206	0.00	1.00

Source: Own elaboration.

in order to demonstrate the strict exogeneity between monetary policy and IIR. Our results show that variations in macroeconomic interest rates are a determinant of the cost of trade credit, but we are unable to demonstrate similar results in the opposite direction. This result is robust whether we introduce into the specification the variation in the average price charged by banks[18].

Table 3 presents the results of estimating equation [6] by using a random effects regression for the complete sample of firms. This tests the first hypothesis. The results suggest that a tightening of monetary policy leads to an increase in the price of trade credit (0.001) when we consider the complete sample, thereby confirming our first hypothesis, but (contrary to our expectations) our estimations show a negative impact (-0.002) when we consider ΔLF_t as the monetary variable.

To further analyse our results, we divide the sample by firm size, taking as criterion the number of employees. The results confirm those obtained above using the whole sample, and also permit us to conclude that the effect of a shock in monetary policy is higher for large firms than for smaller ones. We also find that the negative effect of ΔLF_t is due to the influence of this variable on the price of trade credit for SMEs. The rest of the coefficients for our control variables show the expected sign and level of significance. Thus, we obtain a negative and significant coefficient for ΔTC_{it} (-0.05) because the dependent variable is the variation in the price for trade credit. We also observe that an increase in the amount of bank debt in the firm's balance sheet (ΔB_{it}) leads to an increase in the price paid for trade credit (0.02). This is consistent with the complementarity hypothesis since a highly-leveraged firm means higher risk, and trade lenders seek to compensate for this in order to increase the price of financing. We also observe that the existence of a financial crisis means an increase in IIR, consistent with the results supplied by Love and Zaidi (2010).

The empirical results for the effect of monetary policy on the $RNTC_{it}$ are reported in Table 4. The regressions presented in Table 4 show that a tightening of monetary policy leads to firms becoming net trade lenders (0.02). The explanation of this effect is related to that explained above. Our results demonstrate that during a rise in macroeconomic (or bank) interest rates financial motives of trade credit provision are present rather than those related to transaction motives [see Atanasova (2007), Atanasova and Wilson (2003, 2004), Carbó *et al*. (2012), among others]. We also split the sample by firm size. We do however find that the impact of monetary policy is greater for larger firms since they can borrow more than SMEs. We are also concerned with the effects of financial crises on firms' trade credit position. The results show that a financial crisis inverts the process because cuts in bank credit cause firms to borrow trade credit, thereby becoming trade borrowers. Moreover, the effect of a financial crisis is higher for SMEs because they are more reliant on trade credit. At the same time they are more deeply affected by financial constraints derived from the lending restrictions resulting from these circumstances [see Carbó and López (2009), Huang *et al*. (2011), Kashyap and Stein (2000)].

We also include the variation of EONIA ($\Delta EONIA_t$) in different specifications, replacing the former monetary policy variables. The reason for including EONIA as

(18) Results upon request.

Table 3: The effects of monetary policy on the implicit interest rate depending on firm size, 1998-2009

Dependent variable: variation in the implicit interest rate of trade credit (Δr_{it}^{TC})
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Complete sample			
	(1)	(2)	(3)	(4)
Intercept	0.0126*	0.00515	0.00576	0.0126*
	(2.28)	(1.34)	(1.51)	(2.27)
Δr_{it}^{B}	0.0430*	0.0592**	0.0103	0.0439*
	(1.99)	(2.75)	(0.47)	(2.04)
Δr_{it}^{S}	0.0337***	0.0337***	0.0335***	0.0337***
	(32.45)	(32.38)	(32.23)	(32.44)
ΔB_{it}	0.0108*	0.0129**	0.0102*	0.0111**
	(2.53)	(3.02)	(2.38)	(2.59)
ΔTC_{it}	-0.0526***	-0.0489***	-0.0476***	-0.0523***
	(-13.38)	(-12.36)	(-12.02)	(-13.33)
ΔCAP_{it}	-0.0218***	-0.0223***	-0.0222***	-0.0216***
	(-4.38)	(-4.46)	(-4.41)	(-4.34)
$\Delta EURIBOR_{t}$	0.00111***			
	(4.04)			
ΔLF_{t}		-0.00151***		
		(-4.29)		
ΔP_{jit}			0.00450***	
			(12.69)	
$\Delta EONIA_{t}$				0.00135***
				(3.90)
ΔLTA_{it}	-0.0121***	-0.0105***	-0.0137***	-0.0120***
	(-7.13)	(-6.22)	(-8.01)	(-7.06)
ΔCFA_{it}	0.0325***	0.0362***	0.0334***	0.0328***
	(6.14)	(6.83)	(6.27)	(6.20)
Crisis_{t}	0.00336***	0.00121	0.000154	0.00366***
	(4.59)	(1.62)	(0.21)	(4.80)
Observations	60,448	60,290	59,088	60,448
Wald test	1,445.60***	1,442.41***	1,577.03***	1,444.48***
ρ	0.0956	0.0982	0.0948	0.0957

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Table 3: THE EFFECTS OF MONETARY POLICY ON THE IMPLICIT INTEREST RATE DEPENDING ON FIRM SIZE, 1998-2009 (continuation)

Dependent variable: variation in the implicit interest rate of trade credit (Δr_{it}^{TC})
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Large firms			
	(5)	(6)	(7)	(8)
Intercept	-0.182	-0.220	-0.211	-0.182
	(-0.45)	(-0.70)	(-0.67)	(-0.45)
Δr_{it}^{B}	0.139	0.408	0.121	0.205
	(0.28)	(0.82)	(0.24)	(0.41)
Δr_{it}^{S}	0.0585***	0.0581***	0.0575***	0.0582***
	(5.15)	(5.09)	(5.01)	(5.12)
ΔB_{it}	-0.129	-0.106	-0.115	-0.121
	(-1.54)	(-1.26)	(-1.36)	(-1.45)
ΔTC_{it}	-0.298***	-0.283***	-0.240**	-0.287***
	(-3.60)	(-3.38)	(-2.86)	(-3.47)
ΔCAP_{it}	-0.193*	-0.187*	-0.197*	-0.188*
	(-2.29)	(-2.20)	(-2.29)	(-2.22)
$\Delta EURIBOR_{t}$	0.0228***			
	(4.45)			
ΔLF_{t}		0.0131*		
		(2.03)		
ΔP_{jit}			0.0256***	
			(3.92)	
$\Delta EONIA_{t}$				0.00125***
				(3.94)
ΔLTA_{it}	-0.129***	-0.116***	-0.126***	-0.125***
	(-4.22)	(-3.79)	(-4.05)	(-4.09)
ΔCFA_{it}	-0.329**	-0.322**	-0.323**	-0.326**
	(-3.26)	(-3.18)	(-3.16)	(-3.24)
Crisis_{t}	-0.00814	-0.0156	-0.0396**	-0.00354
	(-0.58)	(-1.08)	(-2.78)	(-0.24)
Observations	9,302	9,253	9,139	9,302
Wald test	276.81***	259.63***	302.31***	272.52***
ρ	0.9182	0.9181	0.9174	0.9182

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.
Source: Own elaboration.

Table 3: The effects of monetary policy on the implicit interest rate depending on firm size, 1998-2009 (continuation)

Dependent variable: variation in the implicit interest rate of trade credit (Δr_{it}^{TC})
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Medium and small firms			
	(9)	(10)	(11)	(12)
Intercept	0.0141*	0.00628	0.00629	0.0141*
	(2.40)	(1.57)	(1.57)	(2.40)
Δr_{it}^{B}	0.0263	0.0408	-0.000837	0.0275
	(1.20)	(1.87)	(-0.04)	(1.26)
Δr_{it}^{S}	0.0521***	0.0521***	0.0517***	0.0521***
	(33.61)	(33.59)	(33.38)	(33.61)
ΔB_{it}	0.0116**	0.0135**	0.0114*	0.0119**
	(2.60)	(3.03)	(2.54)	(2.68)
ΔTC_{it}	-0.0465***	-0.0432***	-0.0418***	-0.0462***
	(-11.45)	(-10.58)	(-10.24)	(-11.40)
ΔCAP_{it}	-0.0125*	-0.0130*	-0.0127*	-0.0124*
	(-2.33)	(-2.42)	(-2.35)	(-2.31)
$\Delta EURIBOR_{t}$	0.00107***			
	(3.73)			
ΔLF_{t}		-0.00139***		
		(-3.74)		
ΔP_{jit}			0.00397***	
			(10.68)	
$\Delta EONIA_{t}$				0.0251***
				(3.43)
ΔLTA_{it}	-0.0102***	-0.00856***	-0.0115***	-0.00996***
	(-5.56)	(-4.70)	(-6.28)	(-5.47)
ΔCFA_{it}	0.0346***	0.0383***	0.0357***	0.0349***
	(6.23)	(6.91)	(6.40)	(6.31)
Crisis_{t}	0.00253***	0.000478	-0.000384	0.00278***
	(3.29)	(0.61)	(-0.51)	(3.45)
Observations	51,146	51,037	49,949	51,146
Wald test	1,427.54***	1,422.78***	1,513.78***	1,425.27***
ρ	0.0979	0.1016	0.0998	0.0982

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Table 4: The effects of monetary policy on firms' relative net trade credit, depending on firm size, 1998-2009

Dependent variable: Relative Net Trade Credit ($RNTC_{it}$)
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Complete sample			
	(1)	(2)	(3)	(4)
Intercept	-0.150***	-0.154***	-0.195***	-0.199***
	(-3.82)	(-3.93)	(-8.09)	(-8.34)
Δr_{it}^{B}	0.238***	0.381***	0.249***	0.286***
	(4.41)	(7.05)	(4.56)	(5.29)
Δr_{it}^{S}	0.000348	0.000341	-0.000172	0.000202
	(0.18)	(0.17)	(-0.09)	(0.10)
ΔB_{it}	0.00731	0.0233*	0.0222*	0.0156
	(0.70)	(2.21)	(2.09)	(1.48)
ΔTC_{it}	0.744***	0.748***	0.787***	0.752***
	(76.53)	(75.95)	(79.77)	(77.17)
ΔCAP_{it}	0.0235	0.0292*	0.0221	0.0266*
	(1.87)	(2.31)	(1.74)	(2.11)
$\Delta EURIBOR_{t}$	0.0194***			
	(28.63)			
ΔLF_{t}		0.0131***		
		(15.06)		
ΔP_{jit}			0.0177***	
			(20.22)	
$\Delta EONIA_{t}$				0.0193***
				(22.65)
ΔLTA_{it}	0.00957*	0.0212***	0.0172***	0.0150***
	(2.21)	(4.90)	(3.93)	(3.47)
ΔCFA_{it}	0.0266*	0.0436***	0.0520***	0.0359**
	(2.02)	(3.29)	(3.90)	(2.72)
Crisis_{t}	-0.0666***	-0.0723***	-0.0922***	-0.0649***
	(-35.89)	(-37.96)	(-49.66)	(-33.45)
Observations	62,402	62,241	61,007	62,402
Wald test	12,897.96***	12,159.45***	12,190.75***	12,528.39***
ρ	0.7218	0.7198	0.7218	0.7205

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Table 4: The effects of monetary policy on firms' relative net trade credit, depending on firm size, 1998-2009 (continuation)

Dependent variable: Relative Net Trade Credit ($RNTC_{it}$)
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Large firms			
	(5)	(6)	(7)	(8)
Intercept	-0.205**	-0.203**	-0.391***	-0.390***
	(-2.73)	(-2.67)	(-6.69)	(-6.69)
Δr_{it}^{B}	0.0667	0.321	0.117	0.148
	(0.38)	(1.83)	(0.65)	(0.85)
Δr_{it}^{S}	0.0121***	0.0120***	0.0110***	0.0118***
	(3.71)	(3.67)	(3.36)	(3.62)
ΔB_{it}	0.000183	0.0196	0.0219	0.00870
	(0.01)	(0.69)	(0.76)	(0.31)
ΔTC_{it}	0.854***	0.858***	0.911***	0.865***
	(30.41)	(30.09)	(32.05)	(30.77)
ΔCAP_{it}	0.00662	0.0143	0.00986	0.0116
	(0.23)	(0.50)	(0.34)	(0.41)
$\Delta EURIBOR_{t}$	0.0240***			
	(13.51)			
ΔLF_{t}		0.0192***		
		(8.60)		
ΔP_{jit}			0.0202***	
			(8.97)	
$\Delta EONIA_{t}$				0.0252***
				(11.46)
ΔLTA_{it}	0.00704	0.0193	0.0175	0.0117
	(0.69)	(1.88)	(1.69)	(1.14)
ΔCFA_{it}	0.0146	0.0221	0.0274	0.0182
	(0.43)	(0.64)	(0.78)	(0.53)
Crisis_{t}	-0.0283***	-0.0326***	-0.0558***	-0.0249***
	(-5.83)	(-6.55)	(-11.48)	(-4.94)
Observations	9,665	9,615	9,497	9,665
Wald test	2,196.90***	2,055.41***	2,026.55***	2,136.46***
ρ	0.7398	0.7373	0.7369	0.7383

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Table 4: THE EFFECTS OF MONETARY POLICY ON FIRMS' RELATIVE NET TRADE CREDIT, DEPENDING ON FIRM SIZE, 1998-2009 (continuation)

Dependent variable: Relative Net Trade Credit ($RNTC_{it}$)
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Medium and small firms			
	(9)	(10)	(11)	(12)
Intercept	-0.185***	-0.188***	-0.176***	-0.188***
	(-7.28)	(-7.39)	(-6.88)	(-7.37)
Δr_{it}^{B}	0.646***	0.701***	0.303**	0.642***
	(6.78)	(7.26)	(3.12)	(6.71)
Δr_{it}^{S}	-0.00138	-0.00180	-0.00184	-0.00169
	(-0.44)	(-0.57)	(-0.58)	(-0.54)
ΔB_{it}	0.0113	0.0276*	0.0265*	0.0200
	(1.00)	(2.43)	(2.31)	(1.76)
ΔTC_{it}	0.729***	0.731***	0.771***	0.737***
	(70.10)	(69.37)	(72.96)	(70.63)
ΔCAP_{it}	0.0280*	0.0309*	0.0224	0.0303*
	(2.00)	(2.19)	(1.58)	(2.15)
$\Delta EURIBOR_{t}$	0.0199***			
	(27.29)			
ΔLF_{t}		0.0141***		
		(14.77)		
ΔP_{jit}			0.0179***	
			(18.95)	
$\Delta EONIA_{t}$				0.0201***
				(21.68)
ΔLTA_{it}	0.00848	0.0188***	0.0122*	0.0134**
	(1.79)	(3.97)	(2.53)	(2.84)
ΔCFA_{it}	0.0243	0.0442**	0.0563***	0.0353*
	(1.70)	(3.08)	(3.90)	(2.46)
Crisis_{t}	-0.0722***	-0.0777***	-0.0985***	-0.0701***
	(-35.59)	(-37.31)	(-48.64)	(-33.05)
Observations	52,805	52,694	51,577	52,805
Wald test	11,079.95***	10,428.34***	10,457.58***	10,746.68***
ρ	0.7223	0.7198	0.7223	0.7209

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

a robustness check is that it corresponds to the rate at which one prime bank is willing to lend to another. In distinction to EURIBOR, which is calculated on a basis of 3 or 12 months, the EONIA is an overnight rate, although the pattern is very close to the rest of the ECB's interest rates. The results maintain the expected sign and magnitudes for all regressions.

4.2. Competition and complementarity effect

This section analyses the effects of monetary policy on competition between trade lenders and the complementarity effect between trade credit and bank lending. The empirical results of the competition effects shown in specification [9] are reported in Table 5. The estimations show that rising macroeconomic (or bank) interest rates also increase the distance between the IIR paid by the firm and the average IIR for each industry. In other words, our results suggest that a tightening of monetary policy increases the distance with respect to the price of trade credit of a firm's competitors. After dividing the sample by firm size, the results show that the distance between companies and their competitors increases more for SMEs. This result could be explained by the fact that SMEs are more dependent on trade credit than large firms, and consequently variations in financing rates distance smaller firms from the rest of their sector. We also find that financial crises draw firms' competitive position closer to the price of the industrial sector to which they belong. The analysis of control variables shows the expected signs and results.

Having analysed the effects on companies' competitive position related to their industrial sector, we examine the influence on the complementarity effects shown in specification [10]; this is reported in Table 6. The results obtained from the whole sample reveal that increases in interest rates narrow difference in price of trade credit and bank financing, indicating the existence of complementarity between the two forms of company financing. The results also show that the effect is higher in absolute value for larger firms than SMEs. This is because the former can impose higher prices for trade credit while paying less for bank credit.

5. Conclusions

In this paper, we have employed a panel of 13,634 firms over the period 1998-2009 to test the effects of monetary policy on the price of trade credit, the balance sheet effect, and the effect within industrial sectors. Two measures are employed to proxy the price for trade credit (the so-called IIR), and the relative position for trade finance within a closed range, thereby making measurement comparable among firms of different size, termed the RNTC. Our main finding confirms that a tightening of monetary policy (via interest rate channel) is transmitted to an increase in the cost for the trade credit paid by firms. As a robustness check, we have also employed the average bank price for credit (via credit channel) on the cost of trade credit and we obtain similar results. In the light of our results, we can also conclude that decisions to increase the reference interest rates of monetary policy result in an increase in the cost of bank financing; such decisions also lead to an increase in the cost of trade credit. To our knowledge, this is the first paper that analyses the effect of monetary policy on the cost of trade credit.

Table 5: THE EFFECTS OF MONETARY POLICY ON THE INCOME EFFECT, DEPENDING ON FIRM SIZE, 1998-2009

Dependent variable: $r_{it}^{TC} - \overline{r_{kt}^{TC}}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Complete sample			
	(1)	(2)	(3)	(4)
Intercept	-0.00586**	-0.00614**	-0.00478***	-0.00593**
	(-3.00)	(-3.13)	(-3.82)	(-3.03)
Δr_{it}^{B}	0.00387	0.0127*	0.0156**	0.00642
	(0.78)	(2.56)	(3.08)	(1.29)
Δr_{it}^{S}	0.00196***	0.00197***	0.00190***	0.00195***
	(8.10)	(8.15)	(7.80)	(8.03)
ΔB_{it}	0.00151	0.00229*	0.00351***	0.00208*
	(1.56)	(2.36)	(3.55)	(2.14)
ΔTC_{it}	-0.00174	-0.00304***	0.000828	-0.00124
	(-1.95)	(-3.37)	(0.91)	(-1.39)
ΔCAP_{it}	-0.00248*	-0.00193	-0.00243*	-0.00219
	(-2.14)	(-1.66)	(-2.06)	(-1.89)
$\Delta EURIBOR_{t}$	0.00178***			
	(28.57)			
ΔLF_{t}		0.00224***		
		(28.11)		
ΔP_{jit}			0.000593***	
			(7.29)	
$\Delta EONIA_{t}$				0.00203***
				(25.81)
ΔLTA_{it}	-0.00235***	-0.00173***	-0.00120**	-0.00202***
	(-5.99)	(-4.43)	(-3.02)	(-5.16)
ΔCFA_{it}	0.00377**	0.00418***	0.00644***	0.00435***
	(3.11)	(3.45)	(5.23)	(3.58)
Crisis_{t}	-0.00306***	-0.00279***	-0.00486***	-0.00268***
	(-18.09)	(-16.17)	(-28.64)	(-15.16)
Observations	60,493	60,335	59,131	60,493
Wald test	1,925.05***	1,895.70***	1,124.01***	1,772.01***
ρ	0.3639	0.3658	0.3592	0.3633

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Table 5: The effects of monetary policy on the income effect, depending on firm size, 1998-2009 (continuation)

Dependent variable: $r_{it}^{TC} - \overline{r_{kt}^{TC}}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Large firms			
	(5)	(6)	(7)	(8)
Intercept	-0.0149***	-0.0151***	-0.00821*	-0.0149***
	(-3.36)	(-3.36)	(-2.36)	(-3.35)
Δr_{it}^{B}	0.0314	0.0354	0.0451*	0.0328
	(1.72)	(1.95)	(2.43)	(1.80)
Δr_{it}^{S}	0.00155***	0.00156***	0.00152***	0.00154***
	(4.15)	(4.18)	(4.07)	(4.13)
ΔB_{it}	0.00431	0.00462	0.00616*	0.00452
	(1.45)	(1.55)	(2.05)	(1.52)
ΔTC_{it}	-0.00131	-0.00242	0.000136	-0.00106
	(-0.45)	(-0.82)	(0.05)	(-0.36)
ΔCAP_{it}	-0.00318	-0.00295	-0.00296	-0.00299
	(-1.05)	(-0.97)	(-0.97)	(-0.99)
$\Delta EURIBOR_{t}$	0.000831***			
	(4.48)			
ΔLF_{t}		0.00123***		
		(5.28)		
ΔP_{jit}			-0.000157	
			(-0.66)	
$\Delta EONIA_{t}$				0.000997***
				(4.34)
ΔLTA_{it}	-0.00420***	-0.00398***	-0.00351***	-0.00412***
	(-4.07)	(-3.87)	(-3.38)	(-4.00)
ΔCFA_{it}	0.00103	0.00105	0.00135	0.00107
	(0.29)	(0.29)	(0.37)	(0.30)
Crisis_{t}	-0.00327***	-0.00304***	-0.00386***	-0.00306***
	(-6.53)	(-5.98)	(-7.71)	(-5.90)
Observations	9,312	9,263	9,149	9,312
Wald test	193.93***	200.40***	172.15***	192.65***
ρ	0.3335	0.3379	0.3379	0.3337

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.
Source: Own elaboration.

Table 5: THE EFFECTS OF MONETARY POLICY ON THE INCOME EFFECT, DEPENDING ON FIRM SIZE, 1998-2009 (continuation)

Dependent variable: $r_{it}^{TC} - \overline{r_{kt}^{TC}}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Medium and small firms			
	(9)	(10)	(11)	(12)
Intercept	-0.00389	-0.00416*	-0.00409**	-0.00399
	(-1.90)	(-2.02)	(-3.12)	(-1.94)
Δr_{it}^{B}	0.00131	0.0105*	0.0128*	0.00386
	(0.26)	(2.05)	(2.45)	(0.75)
Δr_{it}^{S}	0.00300***	0.00303***	0.00296***	0.00299***
	(8.16)	(8.25)	(7.97)	(8.12)
ΔB_{it}	0.000880	0.00172	0.00286**	0.00148
	(0.86)	(1.67)	(2.74)	(1.44)
ΔTC_{it}	-0.00177	-0.00315***	0.000906	-0.00126
	(-1.89)	(-3.33)	(0.95)	(-1.34)
ΔCAP_{it}	-0.00180	-0.00119	-0.00176	-0.00149
	(-1.42)	(-0.94)	(-1.36)	(-1.18)
$\Delta EURIBOR_{t}$	0.00193***			
	(29.08)			
ΔLF_{t}		0.00242***		
		(28.36)		
ΔP_{jit}			0.000710***	
			(8.20)	
$\Delta EONIA_{t}$				0.00220***
				(26.21)
ΔLTA_{it}	-0.00189***	-0.00120**	-0.000612	-0.00150***
	(-4.39)	(-2.80)	(-1.40)	(-3.50)
ΔCFA_{it}	0.00385**	0.00436***	0.00705***	0.00455***
	(2.98)	(3.38)	(5.37)	(3.52)
Crisis_{t}	-0.00298***	-0.00269***	-0.00499***	-0.00255***
	(-16.49)	(-14.53)	(-27.54)	(-13.48)
Observations	51,181	51,072	49,982	51,181
Wald test	1,879.51***	1,835.96***	1,058.23***	1,717.27***
ρ	0.3651	0.3661	0.3599	0.3645

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.
Source: Own elaboration.

Table 6: The effects of monetary policy on the substitution effect, depending on firm size, 1998-2009

Dependent variable: $r_{it}^{TC} - r_{it}^{B}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Complete sample			
	(1)	(2)	(3)	(4)
Intercept	-0.00316	-0.00281	-0.00406	-0.00308
	(-1.30)	(-1.15)	(-1.65)	(-1.26)
Δr_{it}^{S}	0.00242***	0.00242***	0.00242***	
	(11.03)	(10.97)	(10.98)	
ΔB_{it}	0.00180	0.000654	0.000930	0.00243***
	(1.64)	(0.59)	(0.84)	(11.06)
ΔTC_{it}	-0.00551***	-0.00556***	-0.00891***	0.00126
	(-5.44)	(-5.43)	(-8.69)	(1.15)
ΔCAP_{it}	-0.00171	-0.00167	-0.00158	-0.00597***
	(-1.31)	(-1.27)	(-1.20)	(-5.89)
$\Delta EURIBOR_{t}$	-0.00142***			-0.00188
	(-20.26)			(-1.44)
ΔLF_{t}		-0.00108***		
		(-11.92)		
ΔP_{jit}			-0.00182***	
			(-20.16)	
$\Delta EONIA_{t}$				-0.00153***
				(-17.35)
ΔLTA_{it}	0.00210***	0.00146***	0.00174***	0.00181***
	(4.76)	(3.31)	(3.90)	(4.11)
ΔCFA_{it}	-0.00171	-0.00300*	-0.00327*	-0.00230
	(-1.25)	(-2.18)	(-2.37)	(-1.68)
Crisis_{t}	-0.000339	-0.0000128	0.00177***	-0.00057**
	(-1.77)	(-0.07)	(9.28)	(-2.85)
Observations	60,800	60,641	59,436	60,800
Wald test	877.40***	606.60***	865.11***	767.46***
ρ	0.4279	0.4262	0.4285	0.4269

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.
Source: Own elaboration.

Table 6: The effects of monetary policy on the substitution effect, depending on firm size, 1998-2009 (continuation)

Dependent variable: $r_{it}^{TC} - r_{it}^{B}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Large firms			
	(5)	(6)	(7)	(8)
Intercept	-0.00789	-0.00669	-0.00811	-0.00784
	(-1.44)	(-1.22)	(-1.48)	(-1.43)
Δr_{it}^{S}	0.00165***	0.00165***	0.00173***	
	(4.05)	(4.03)	(4.21)	
ΔB_{it}	0.00947**	0.00786*	0.00740*	0.00167***
	(2.81)	(2.32)	(2.17)	(4.10)
ΔTC_{it}	-0.00800*	-0.00767*	-0.0143***	0.00852*
	(-2.40)	(-2.27)	(-4.22)	(2.53)
ΔCAP_{it}	-0.00188	-0.00174	-0.00177	-0.00909**
	(-0.55)	(-0.51)	(-0.51)	(-2.72)
$\Delta EURIBOR_{t}$	-0.00262***			
	(-12.56)			
ΔLF_{t}		-0.00247***		
		(-9.31)		
ΔP_{jit}			-0.00235***	
			(-8.86)	
$\Delta EONIA_{t}$				-0.00282***
				(-10.86)
ΔLTA_{it}	-0.000119	-0.000788	-0.000762	-0.000462
	(-0.10)	(-0.68)	(-0.65)	(-0.40)
ΔCFA_{it}	-0.000215	-0.00101	-0.00173	-0.000624
	(-0.05)	(-0.25)	(-0.42)	(-0.15)
Crisis_{t}	-0.000212	0.0000137	0.00302***	-0.000608
	(-0.37)	(0.02)	(5.27)	(-1.03)
Observations	9,372	9,322	9,209	9,372
Wald test	319.29***	246.79***	235.76***	279.30***
ρ	0.4028	0.3971	0.3985	0.4003

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.
Source: Own elaboration.

Table 6: The effects of monetary policy on the substitution effect, depending on firm size, 1998-2009 (continuation)

Dependent variable: $r_{it}^{TC} - r_{it}^{B}$
Z-statistics in parentheses. Panel data random effect regression.
The complete regressions include industry and regional dummies.

Variable	Medium and small firms			
	(9)	(10)	(11)	(12)
Intercept	-0.00174	-0.00138	-0.00268	-0.00165
	(-0.68)	(-0.54)	(-1.04)	(-0.65)
Δr_{it}^{S}	0.00352***	0.00350***	0.00349***	
	(11.87)	(11.76)	(11.71)	
ΔB_{it}	0.000370	-0.000711	-0.000312	0.00353***
	(0.32)	(-0.61)	(-0.27)	(11.87)
ΔTC_{it}	-0.00520***	-0.00531***	-0.00820***	-0.000103
	(-4.91)	(-4.97)	(-7.65)	(-0.09)
ΔCAP_{it}	-0.00140	-0.00146	-0.00127	-0.00558***
	(-0.98)	(-1.02)	(-0.88)	(-5.28))
$\Delta EURIBOR_{t}$	-0.00124***			
	(-16.78)			
ΔLF_{t}		-0.000866***		
		(-9.00)		
ΔP_{jit}			-0.00172***	
			(-18.05)	
$\Delta EONIA_{t}$				-0.00135***
				(-14.31)
ΔLTA_{it}	0.00261***	0.00194***	0.00230***	0.00233***
	(5.42)	(4.04)	(4.73)	(4.85)
ΔCFA_{it}	-0.00240	-0.00372*	-0.00379**	-0.00298*
	(-1.65)	(-2.55)	(-2.59)	(-2.05)
Crisis_{t}	-0.000366	-0.0000135	0.00158***	-0.000576**
	(-1.79)	(-0.06)	(7.75)	(-2.69)
Observations	51,428	51,319	50,227	51,428
Wald test	685.23***	482.08***	717.89***	607.92***
ρ	0.4352	0.4340	0.4361	0.4343

Notes: *, **, *** are statistically significant at the 10, 5 and 1% level, respectively.

Source: Own elaboration.

Monetary policy also has an important effect on the RNTC. We find that a tightening of monetary policy leads to firms becoming net trade borrowers. Our results demonstrate that during rising macroeconomic (or bank) interest rates financial motives of trade credit provision are present, rather than those related to transaction motives [see Atanasova and Wilson (2003, 2004, 2007), Carbó *et al*. (2012), among others]. Additionally, we have divided the sample on the basis of firm size. We find that that the impact of monetary policy is higher for larger firms since they can obtain more financing than SMEs. We are also concerned with the effects of financial crises on firms' trade credit position. The results show that the current financial crisis has inverted the process because the reduction of bank credit leads firms to obtain trade credit, converting them into trade borrowers. Moreover, the effect of the financial crisis is higher for SMEs since they are more strongly dependent on trade credit while being more deeply affected by financial constraints derived from lending restrictions [see Carbó and López (2009), Huang *et al*. (2011), Kashyap and Stein (2000)].

We extend our analysis to find a competition and a substitution effect. We construct a new indicator based on the difference between the interest rate imposed by the firm and the average IIR of each industrial sector. We segregate our analysis by sectors because each sector displays different patterns of granting trade credit. We find that a tightening of monetary policy leads to the creation of divergence among the diverse IIRs paid by firms in the same sector. This effect might be the results of the increasing cost of trade credit. On the other hand, we are interested in studying the substitutability between trade credit and bank financing. Consequently, we construct the indicator as the difference between the cost of trade credit, IIR, and the price paid for bank financing. We also find that a tightening of monetary policy reduces the distance between the prices of the two forms of financing. This result is also important for economic literature because it supports the complementarity hypothesis in an environment of tightening monetary policy.

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RESUMEN

Este artículo investiga los efectos de la política monetaria sobre el tipo de interés implícito del crédito comercial, así como la probabilidad para las empresas de convertirse en prestatarios netos. Se calcula el tipo de interés implícito como la diferencia en el pago por intereses a acreedores comerciales y el recibido por los deudores sobre la suma de ambos. Los resultados muestran que un endurecimiento de la política monetaria lleva a: (i) incrementar el tipo de interés del crédito comercial, (ii) las empresas se conviertan en prestatarias de crédito comercial, (iii) generación de divergencias en el coste del crédito comercial entre empresas del mismo sector industrial, y (iv) la generación de efectos complementarios en los precios entre financiación bancaria y comercial.

Palabras clave: tipo de interés implícito, política monetaria, crédito comercial relativo neto, crédito comercial.

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