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# Delaying payments after the financial crisis: evidence from EU companies

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**Abstract**

Isaac Kwame Essien Obeng: **Delaying payments after the financial crisis: evidence from EU companies**

The paper investigates economic impact of delayed payments caused by liquidity crisis in the European Union. Using micro data sets on financial statements of 54,277 firms for the period of 2005 to 2014 inclusive, we perform panel data analysis by estimating fixed effects regression models with selected macroeconomic shocks. The results show a high variability of late payments during the financial crisis compared to period of relative stable economic situation and late payments is significantly evident across countries under different economic conditions. Additionally, we identify a positive relationship between the response variable, late payments, and firm profitability measured with returns on assets, but a negative relationship with firm total assets as it depends on the speed of collections from receivables. The results suggest delays in payment of invoices beyond the given credit period across the different European Union member countries.

**Key words**

Late payments, accounts receivable, accounts payable, credit collection, credit period, financial crisis, macroeconomic shocks

**JEL:** M21

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**Introduction**

This paper investigates the economic impact of late payments caused by liquidity crisis in the European Union (EU). Trade credit, since the year 2005, has played an increasing major financing role for EU firms. Especially, when it is difficult to access bank credit (Ferrando and Mulier, 2013). The EU firms even use increasingly more trade credit after the global financial crisis in 2007 (Ferrando and Mulier, 2013). For example, about 80% of business to business transactions in the United Kingdom are done through trade credit (Wilson and Summers, 2002). In addition, EU firms continue to record high delaying payments. For example, Deloof (2003) pointed out that payments are much late for Belgian firms compare to US firms. Delaying payments increase cost of trade credit extension (Summers and Wilson, 2000) and may lead to high firm trade credit default. Since accounts receivable is recorded as current asset on firm balance sheet, timely collections of receivable is necessary to improve firm cash flow. However, firm late payments have been given little attention by both academic and business researches. The novelty of this paper is the investigation of over half a million observation of EU firms' late payments under negative macroeconomic shocks. This will provoke the interest of researchers in delaying payments.

Considering the literature on trade credit management and working capital management, a large number of papers have made use of firm-level micro data to investigate the links between broad measures of trade credit extension and firm growth (Fisman and Love, 2003; Ferrando and Mulier, 2013). The literature generally found a positive relationship (Paul et al., 2012). But, whilst some of the studies concentrate on direct impact of firms working capital management in general on firm performance (Haq et al., 2011), others concentrate on specific impact of accounts receivable and accounts payable on firm performance and growth and found strong relationships (Ferrando and Mulier, 2013). However, few empirical studies analyse firm late payments, though it is an important element of credit management. Even where late payments are specifically considered it is treated as an explanatory variable where its impact on firms profitability is assessed (see Paul et al., 2012).

The closest study, Zainudin (2008) that analysed trade credit with special interest in late payments did focused on the Malaysian economy where firm heterogeneity is not much pronounced. Since, firms in the same country experiences virtually same financial developments and economic conditions. Also, the study of Zainudin (2008) analysed late payments of trade credit provision with the average collection period instead of the former as dependent variable due to lack of data on firms' credit period. The situation is addressed by this study with access to data on the credit period.

These therefore pull the motivation of the current study to fill such an important gap missing in the literature. Ultimately, this study contributes to the literature in three important ways.

First, the study makes use of cross country firm-level micro data set to analyse firm late payment within the European Union. But, prior studies on late payments either concentrate on analysing firm profitability within specific country (Zainudin, 2008; Paul et al., 2012), or analyse the relationship between trade credit and company growth when the interest is geared towards cross country analysis (Fisman and Love, 2003; Ferrando and Mulier, 2013). The study is set apart by relying on a panel dataset of 54,277 EU firms for the period 2005 through 2014 inclusive.

Second, the study analyses late payments by considering firm heterogeneity in terms of size, liquidity and profitability where different thresholds are used. Also, the study analyses firm late payments across different sectors and EU member countries. Since different sectors experiences delay in payments differently. This is due to differences in product characteristics and in motive for credit provision to customers. In this case, the study's interest explanatory variables go beyond financial crisis situation, to include the levels of firm size, liquidity and profitability measures. Thus, late payment analysis is distinct from that of previous analysis presented by Ferrando and Mulier (2013). The two estimated a dynamic growth model to analyse the relationship between trade credit and firm growth. The study is also distinct from that of Paul et al. (2012), which estimated a firm profitability model to analyse the impact of late payments on profitability.

Third, the study makes immense contribution to the literature by not just investigating late payments of EU firms. The study also, undertakes the analysis by considering the impact of negative macroeconomic shocks. Since the panel data period under study includes the period of global recession that was not experienced by only EU member countries. This makes our analysis pertinent to different economic regions.

Therefore, in order to investigate delaying payments, we analyse how the pattern of late payments among EU companies changed between 2005 and 2014? We argue that high variability of selling firms' late payments is experienced during financial crisis compare to period of relative stable economic situations. Also, late payment is significantly evident across countries under different economic conditions. Additionally, we find differences in late payments experienced under different sectors and different thresholds in terms of company size, profitability and liquidity.

The remainder of the study is organized as follows: next is survey of previous theoretical and empirical literature that attempts to analyse trade credit provisions, followed by methodology used

to answer the research question and data description, then the main results and robustness analysis, and finally discussion and then conclusions.

## 1 Literature review

Credit is the ability to obtain economic value with an agreement of payment made at a later date (Zainudin, 2008). Crucial to credit provision is the specification of the credit period communicated either verbally or written, the economic value of the exchange (Ferris, 1981), and the trust associated with the credit transaction (Wu et al., 2014). The credit period is the duration for payment provided by the selling firm that is communicated to customers. The trade credit provision is reported on the firms' balance sheet as accounts receivable that serve as current assets to the selling firm. That is, the selling firms' liquidity strength is influenced by its accounts receivable. Although firm acceptable liquidity levels differ from industry to industry, any commercial entity should maintain some level of liquid assets in order to meets its short term obligations. Manufacturing firms for instance, should manage its inventory to maintain acceptable levels of accounts receivable if they have to be competitive (Zainudin, 2008; Paul et al., 2012).

Collection period is when customers actually make payments on credits. The collection period should be within the credit period if the firms' credit management's objectives are to be met, otherwise payments either gets late or defaulted. When payments get late, firms turnover reduces affecting liquidity strength of the firm and ability of the firm to obtain external finances in the form of bank loans, though in some economies such as China after the year 2007 accounts receivable could legally be used as collateral for commercial loans (Wu et al., 2014). Late payment occurs when the collection period exceeds the credit period (Zainudin, 2008). Therefore, to avoid late payments firms may want to collect accounts receivable sooner than later, and thus in recent times firms attempt to have well-structured teams to assist in achieving their collection objectives. Hence, an important objective of credit management is the collection of accounts receivable within the credit period given (Wu et al., 2014).

Since late payments on credits extended to customers are to a large extent dependent on accounts payables by credit customers, the selling firms' turnover is positively dependent on payments by credit customers (Zainudin, 2008; Paul et al., 2012). That is operational revenues of credit customers are an important determinant on the firms' ability to make payments on their credits. The credit customer will invariably make payments from its internally generated funds to service trade credit. This implies that credit collections among other things, will vary depending on the industry in question (Zainudin, 2008), financial development within the economy (Fisman and Iove, 2003), and

effects of negative macroeconomic shocks (Ferrando and Mulier, 2013). Also, financial constrained credit customers rely relatively more on trade credit as a reliable source of finance during period of negative macroeconomic shocks (Ferrando and Mulier, 2013).

The credit period is supposed to be accepted period for credit customers to make payments, but in some cases selling firms tend to allow delay in payments. The finance literature provides the main consideration on the optimal delay in payments considered in terms of net benefits gained from trade credit. Early researches such as Walia (1977) considers delay in payments allowed in terms of credit term changes, by comparing the net benefit gain by selling firms to the opportunity cost of funds used in the change in credit terms. Nevertheless, other researches such as Kim and Feist (1995) focused on delay in payments accepted on the new credit terms based on the net benefit gained through net present value of receipts.

Some strand of researches analyses the impact of trade credit on firm inventory by considering the selling firms delay payments identified by analysing the customers economic order quantities, and analysing their economic order quantities under permissible delayed payments (Teng et al., 2011). Delayed payments are sometimes allowed to enable firms that have trade credit extended to them experience the quality of the product provided (Deloof et al., 1996; Ng et al., 1999). Zhang et al. (2014) noted that when payments are delayed an optimal order quantity should be reached by the selling firm reducing trade credit extension to customers to avoid default risk. But, according to Ferrando and Mulier (2013) EU firms could insure their accounts receivable against risk of defaults that could be used as collateral for bank loans.

Although, some trade credit literature has concentrated on trade credit extension characterized by information asymmetries (Petersen and Rajan,1997; Goto et al., 2015), much recent trade credit literature focuses on good credit management with the use of firm accounts receivable (Ferrando and Mulier, 2013). According to Ferrando and Mulier (2013), when analysing non-financial firms in the Euro area, the use of trade credit is more during periods of financial crisis, especially when there is limited bank loans and accounts receivables tend to be an important focus of recent trade credit management. The two argue that both accounts payable and accounts receivable are important determinants of firm performance. In the analysis of firm growth with trade credit, Ferrando and Mulier (2013) extended the static growth model of Fisman and love (2003) with a dynamic growth model. The trade credit literature asserts that financial crisis affects late payments (Zainudin, 2008; Wilson, 2008) and elevates the interest of firms in the management of their late payments of accounts receivable (Paul et al., 2012). So we analyse the effects of financial crisis on late payments of accounts receivable by hypothesizing that with regards to EU firms:

H1. Late payments are positively hit by financial crisis.

Some strand of researches analyses trade credit extension by concentrating on large firms (see Deloof and Jerger, 1996; Pike and Cheng, 2001) and others focuses on small firms (Peel et al., 2000). By focusing on large firms, Pike and Cheng (2001) found firm size to be negatively related to late payments; Deloof and Jerger (1996) found the average collection period to be much longer with large firms. Concentrating on small and mediums size firms (SMEs), some studies found late payments as problem of SMEs (Chittenden and Bragg, 1997; Zainudin, 2008), but others believe late payments could be reduced with focus on small firms (see Peel et al. 2000). Considering the supposed relationship between late payments and firm size, we hypothesize with regards to EU firms that:

H2. Late payments of SMEs compare to that of large firms are positively hit by financial crisis.

The literature on finance have analysed the relationships between working capital management and firm profitability, and mostly found positive impact of accounts receivable on firm profitability, but negative impact of accounts payable on firm profitability. Since delay in accounts payable enables firms to increase liquidity and reduce costs (see Garcia-Teruel and Martinez-Solano, 2007). Petersen and Rajan (1997) identifies a positive relationship between accounts receivable and firms profit margin, in which well managed accounts receivable serve as firms' competitive advantage. Also, Ferrando and Mulier (2013) pointed out that accounts receivable is an important determinant of firm performance. Therefore, to analyse the supposed relationship between accounts receivable and firm profitability, we hypothesize that with regards to EU firms:

H3. Late payments of low profitability firms compare to that of high profitability firms are positively hit by financial crisis.

Some studies on trade credit employs the panel vector auto regression (VAR) models to analyse firms' liquidity, but whilst some studies use aggregate data (Nilsen, 2002), studies such as Kling et al. (2014) uses firm level data with an application of GMM estimation. In their study, Kling et al. (2014) analyses the relationships among cash holding, trade credit and short-term bank finance that affects firms' liquidity. According to Boissay and Gropp (2007) credit customers that have less liquidity turns to trade credit as important source of finance and mostly finance one quarter of financial needs from trade credit. In inventory management, Bougheas et al. (2009) assert that firms could reduce their inventories by managing and increasing their accounts receivable. This enhances the liquidity position of the firm. To analyse the supposed relationship between accounts receivable and firm liquidity level, we hypothesize with regards to EU firms that:

H4. Late payments of low liquidity firms compare to that of high liquidity firms are positively hit by financial crisis.

The trade credit literature has identified several motives for extending credit to customers. Whilst studies such as Wilson and Summers (2002) believes that the selling firms' product market position strategy influences the tendency to extend credit to customers, others believe otherwise. Studies such as Petersen and Rajan (1997) believes trade credit is mainly provided due to product characteristics such as price elasticity of demand for the product that enables the selling firm to increase sales through price discrimination. This means that credit customers are carefully selected by selling firms. According to Giannetti et al. (2011), trade credit is much used in sectors with products of specialized nature compare to sectors that deals in more standardized products that are easily substituted. Mateut et al. (2015) explains that trade credit increases when the transaction product is specialized because of the strength of relationship created between the selling firm and the credit customer. This happens because of the difficulty in finding alternative sellers of specialized products. This implies that trade credit transaction takes place a lot in some sectors compare to others. Therefore, to analyse variability of trade credit extension in relation to late payments under different sectors, we hypothesize with regards to EU firms that:

H5. Late payments of different sectors are all positively hit by financial crisis, but with significant variability across sectors.

## 2 Methodology

To study firms delaying payments in the EU, we develop models to analyse the variability of firm late payments under different macroeconomic conditions. We define delaying payment as when the collection of receivables is beyond the supposed credit period given the credit customer, and specifically compute late payments to measure delaying payments. In line with the study of Zainudin (2008), we measure late payment by subtracting the credit period from the collection period.

In line with previous studies on trade credit extension (Petersen and Rajan, 1997; Wu et al., 2014), we assume a measure of trade credit depends on certain specific characteristics such as: firm-level characteristics, industry specific characteristics and location characteristics, which we control for in our developed models. But, we pay particular attention to our main interest explanatory variables: year dummy variables that identify whether or not the firm's late payment of accounts receivable is

within the period of financial crisis. In line with the study of Brown et al. (2012), we estimate the firm delaying payment models by starting with the following basic model specify in Equation 1.

$$\ln LP_{it} = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 \sum_{j=i}^{n} control_{ijt} + v_i + e_{it} \quad (1)$$

Where *LP* is firm late payments $D_1$ is year dummy variables for period before financial crisis (years: 2005, 2006) $D_2$ is year dummy variables for period after financial crisis (years: 2009-2014); controls variables: average collection period, credit period, return on assets, total assets, turnover, current ratio, gearing ratio. The subscript *i* identifies firms, subscript *t*, time and subscript *j,* the control variable; the prefix: ln is natural logarithm; $v_i$ captures all time-invariant error term, $e_{it}$ is idiosyncratic error component; $\beta_0, \beta_1, \beta_2 \ldots \beta_k$ are parameters to be estimated (financial crisis period is eliminated for dummy variable analysis).

The basic model estimation did not consider the analysis of late payments in terms of firm size. But, in line with the studies of Wu et al. (2014) and Ferrando and Mulier (2013), we believe firm size may influence trade credit extension to customers. As small and medium size enterprises (SMEs) are expected to be in relatively low liquidity position to extend credit to customers, they are expected to have slow pace in collection of accounts receivable, due to the following reasons: first, influential credit customers are aware of the size of their creditors and may delay in their payments in order to improve their liquidity for operations. Second, SMEs comparably are financially constraints and may rely a lot on both accounts receivable and accounts payable as substantial part of business finance.

So, we estimate Equation 2 by modifying Equation 1, to include a dummy variable for firm size. The dummy variable is 1 for SMEs and 0 otherwise. In line with previous studies, we measure size with firm turnover. We use the European Commission (EC) classification of firm size that uses firm annual turnover, annual balance sheet total or staff headcount measure (EC: user guide to SME definition, 2015). The main objective here is to analyse firm delaying payments in relations to firm size under different macroeconomic conditions. Therefore, we estimate the augmented model specify in Equation 2.

$$\ln LP_{it} = \beta_0 + \beta_1 Dsme_1 + \beta_2 Dsme_2 + \beta_3 \sum_{j=i}^{n} control_{ijt} + v_i + e_{it} \quad (2)$$

Where $Dsme_1$ is dummy variables denoting small and medium size firms for period before financial crisis and $Dsme_2$is dummy variables denoting small and medium size firms for period after financial crisis (eliminated is the financial crisis period and the large firms for dummy variable analysis).

The interest explanatory variables are also considered in the model specified in Equation 3, whereby firm late payments are analysed in terms of profitability of the firm. We measure firm profitability with returns on assets (ROA) and consider the level of profitability of the firm using the mean threshold of ROA. Firm profitability level is of the value 1 for low profitability firms and 0 otherwise. Hence, we determine the impact of financial crisis on delaying payments when the profitability of the firm is low (below the mean). The main objective of estimating Equation 3 is to determine the impact of financial crisis on firms delaying payments by comparing low profitability firms to high profitability firms. Therefore, we estimate Equation 3 below.

$$\ln LP_{it} = \beta_0 + \beta_1 Dlopro_1 + \beta_2 Dlopro_2 + \beta_3 \sum_{j=i}^{n} control_{ijt} + v_i + e_{it} \quad (3)$$

Where $Dlopro_1$ is dummy variables denoting low profitability firms for period before financial crisis and $Dlopro_2$ is dummy variables denoting low profitability firms for period after financial crisis (eliminated is the financial crisis period and the high profitability firms for dummy variable analysis).

We also want to investigate delaying payments of EU firms with regards to different liquidity levels. So, we measure firm liquidity with current ratio and use mean current ratio as the threshold for firm liquidity level. Therefore, we create a dummy variable with the value of 1 for low liquidity firms (below the mean) and 0 otherwise. The main objective here is to determine the impact of financial crisis on firm delaying payments by comparing low liquidity firms to high liquidity firms. Therefore, we estimate Equation 4 below.

$$\ln LP_{it} = \beta_0 + \beta_1 Dloliq_1 + \beta_2 Dloliq_2 + \beta_3 \sum_{j=i}^{n} control_{ijt} + v_i + e_{it} \quad (4)$$

Where $Dloliq_1$ is dummy variables denoting low liquidity firms for period before financial crisis and the $Dloliq_2$ is dummy variables denoting low liquidity firms for period after financial crisis (eliminated is the financial crisis period and the high liquidity firms for dummy variable analysis).

Researchers such as Zainudin (2008) and Mateut et al. (2015) found that industry characteristics have effect on trade credit extension. Just like the prior studies, we analyse trade credit extension separately for each sector and compare the results. We differentiate the EU firms according to their NACE Rev. 2 classification to identify variability in delaying payments with regards to sector differences. Different sectors have different credit terms. So, firm delaying payments may differ with regards to the sector it belongs. Some Sectors may have longer credit period than others that obviously affect payments by credit customers. Since, delaying payment is measured with late payment, the sector differences will not be bias base on changes in the credit terms due to firm, industry and sector heterogeneity, as well as yearly differences. We expect late payments of

different sectors to be positively hit by the financial crisis, but with significant variability across sectors (H5). Therefore, we analyse firm delaying payments by estimating the basic model specified in Equation 1 separately for each considered sector.

### 2.1 Estimation method

To decide on the best estimation method for our panel data models, we compare results of pooled OLS, OLS fixed effects and GLS random effects estimations. We initially stick to the fixed effects assumption of arbitrary correlation between the unobserved fixed effects and the explanatory variables for any given period of time. So, we assume (assumption we relax later) that omitted variables that are constant over time such as sector of the firm, and the geographical location of the firm does not vary with time, hence does not affect delaying payments of accounts receivable. We later relaxed the assumption of considering only time varying explanatory variables and assume that at any given time period the explanatory variables are independent of the error term. Thus, we estimate our models with both the GLS random effects estimations and pooled OLS regressions.

To enable us decide on the most appropriate model, we conducted the Breusch and Pagan Lagrange multiplier (LM) test for random effects in panel data to test the significance of the equations, and to decide between random effects regression and the use of pooled OLS multiple regression. The Breusch-Pagan LM test is based on the null hypothesis that the variance of the error term is equal to zero. Thus Var(u) = 0. The test statistic has a Chi-square distribution with one degree of freedom (Chi2 (1)). The results of the Breusch-Pagan LM test show a very large test statistic of 87943.61 (results available on demand). Hence, we reject the null hypothesis of zero variance in the residual component - variance in ($V_{it}$) in favour of the random effects estimation. So, we conducted the Hausman fixed verses random effects test. The Hausman test is based on the null hypothesis of no systematic difference between coefficients of the fixed effects and random effects regressions. The test statistic has a Chi-square distribution with two degrees of freedom (Chi2 (2)). The results show a large test statistic of 625.25 (results available on demand), so we reject the null hypothesis in favor of fixed effects regression.

Therefore, we use the OLS fixed effects, dummy variables regressions that is most appropriate for the models (we use *areg* in STATA, where we absorb firm intercepts because of large firms in the dataset), since the main interest explanatory variables of the developed models are dummy variables. Due to the comprehensive nature of data reported by AMADEUS, we choose 0.05 level of significance for statistical analysis of the estimated coefficients (though, we presented results with significance level of 0.1, as well) and 0.01 level of significance for analysis of the test statistic.

### 2.2 Data description

We build a regression sample of firms of selected EU member countries with coverage in AMADEUS, a commercial European firm-level database compiled by Bureau van Dijk Electronic Publishing. The data on non-financial firms is mainly retrieved from the balance sheets, profit and loss accounts, and other financials. The data comprises of a total of 54,277 EU firms over the period 2005 to 2014 inclusive. Data on all observations within the 10 years under study was used, making it a balanced panel data with 542,770 observations. The data was retrieved on all variables considered in the regression models. Distributions of all continuous variables were skewed so we normalize them by taking their natural logarithms (see Appendix 1 for distribution of selected EU member countries and description of each variable). We arrive at the sample of EU firms by cleaning the data and trimming the 1% tail of all variables to get rid of outliers.

The data on the dependent variable, late payments was generated as excess of the average collection period on the credit period (Zainudin, 2008). We generate time dummy variables for period before the financial crisis (years: 2005 and 2006); period of financial crisis (2007 and 2008); period after the financial crisis (years: 2009-2014) as the main explanatory variables for the basic model specify in Equation 1. Also, we generate dummy variables for the firm characteristics of size base on the EU firm size classification; profitability and liquidity base on their mean as thresholds. In addition, we generate interaction terms for dummy variable interactions for each of the time dummy variables with each of the firm characteristics dummy variables. We just drop the selected baseline dummy variable (peak period of financial crisis, year 2007) to aid in analysis. The data was categorized according to sectors, based on the European Commission NACE Rev.2 classification of economic activities.

## 3 Results

### 3.1 Effects of financial crisis on late payments

The OLS results are presented in Table I (Model 1). The R-squared value of 0.885 shows the explanatory variables together explain about 89% of the variation in firm delaying payments of the sample of 54,277 EU firms. The coefficients of all main interest explanatory variables are significance, which means they affect firm delaying payments.

After controlling for firm levels of return on assets, total assets, turnover, current ratio, gearing ratio, credit period and collection period, the coefficients of the year dummy variables indicating period before financial crisis shows the expected negative sign and significance. This means that late payments were much lower during period before the financial crisis compare to the crisis period.

The numerical coefficient of -0.007 for *y05* and *y06* variables, shows that late payments are estimated as 0.7% lower before the financial crisis than that of the crisis period. Also, coefficient of the dummy variables after the financial crisis of *y08, y09, y10, y11, y12, y13*, and *y14* show the expected positive sign and significance. This means that late payments during the years after the financial crisis is still higher compare to the crisis period. When you compare each of the years: 2008, 2009, 2010, 2011, 2012, 2013, and 2014 to the peak of crisis year in 2007, the results show late payments are much higher after the crisis. For example, the numerical value of the coefficient of 0.025, 0.034, 0.037, and 0.045 for y11, y12, y13, and y14 respectively, show late payments were on the average 2.5%, 3.4%, 3.7% and 4.5% higher in the years 2011, 2012, 2013, and 2014 than the crisis year, 2007. The numerical value of the coefficients also shows much higher values from the year 2009 to 2014 where the financial crisis is gradually diminishing, reflecting the heavy impact of the crisis. Thus, the results are in support of H1 and in line with the study of Wilson (2008) that negative macroeconomic shocks impact late payments, positively.

The coefficient of the profitability measure, return on assets shows the expected positive sign for all the estimated models, when other variables are held constant (see Table I). This implies that as the return on assets of EU firms increase, late payments of accounts receivable from credit customers, increase. This positive effect of firms' profitability on late payments might seem a bit difficult to understand, since as the profitability of the firm increase one might expect reduction in late payments. The possible reasons in the case of our empirical results could mean as the profitability of the firm increases, the credit provision firms relax on their collections of accounts receivable. This often exceeds the credit period provide. It could also mean that credit customers in the bid to increase their return on assets may end up delaying accounts payable.

Thus, on the average, an annual increase in return on assets (ceteris paribus) leads to annual increase in the late payments of EU firms and vice versa. The numerical coefficient value of 0.009 of return on assets variable for models 1 and 2 is significance at the 0.01 level. It shows that annual 1% increase in return on assets (ceteris paribus) leads to an increase in the rate of late payments of 0.01% and vice versa. The constant elasticity value remains the same over the years considered.

The coefficient of the total asset variable shows the expected negative sign and significance at the 0.01 level, which means that a percentage increase in total assets of EU firms, with other things being held constant, leads to percentage decrease in late payments. The negative relationship implies that as the total assets of the firm increases late payments decreases. For example, the numerical coefficient value of -0.080 for models 1 and 2, shows that as total assets of the firm increase by 1% that leads to decrease in late payments to the firm of 0.08%. The possible explanation is that EU

firms on the average make early payments on their accounts payable when they increase their total assets, thus facilitating collections.

Firm turnover could have either negative or positive impact on late payments depending on whether the firm uses accrual basis of accounting or cash basis of accounting. Thus, the relationship between late payments and firms' operational revenue may be negative, because increase in firms' operational revenue means the firms is able to turn its credit into sales at an expected speed. Also, the relationship between late payments and firm turnover could be positive when the firm reports accounts receivable as part of total revenue, which better measures the profitability of the firm. However, the results as presented in Table I show a positive coefficient for the firm turnover variable. This finding shows that for our study EU firms, accounts payable is delayed to increase operational revenues. The coefficient value, 0.059 of models 1 and 2 is significance at the 0.01 level and is an elasticity value, which explains a 1% increase in turnover is associated with a 0.06% increase in late payments.

The measure of liquidity of EU firms used, current ratio, shows the expected positive coefficient sign for all the estimated models. This means positive effects of the current ratio variable on late payments of accounts receivable. For example, the numerical value of the coefficient of model 1 and 2 is 0,057 and significance at the 0.01 level. Thus, as the current ratio of the firm increases, it leads to increase in late payments. This result supports Chittenden and Bragg (1997) that late payments push selling firms to require more liquidity. This is evident with the observed positive coefficient of the current ratio variable.

The firm's credit period was controlled for in the estimated models. As other explanatory variables are held constant, the results show the coefficient of the credit period variable is negative and significance at the 0.01 level for all estimated models. This means that as EU firms increase the number of days for the credit period to customers, their payments get better, thus late payments reduce. In practice, firms tend to assist in this way by providing flexible credit terms to customer in order to gain their trust. The elasticity value of -0.6, means a 1% increase in the average number of days given as credit period leads to 0.6% decrease in late payments by credit customers.

The average collection period was controlled for in order to analyse impact of the financial crisis on late payments of accounts receivable. It was important to control for the collection period, since the variable is sometimes used in place of late payments to assess delay in collection, when data on the latter is not available. But, as Zainudin (2008) pointed out, late payment is better variable in terms of assessing firms delay in collections of accounts receivable. Apparently, the strength of relationship

between collection period and late payments is as important as the observed sign. The coefficient of the collection period variable appeared with the expected positive sign and significance at the 0.01 level, implying that as the average collections period increases, late payment increases vice versa. The result is in support of Paul (2007) that poor credit management causes payments to be late. This means that as EU firms aim at improving their credit management by improving on their collection of accounts receivable in time, late payments will obviously be minimal. The numerical value of the coefficient is 1.686 for models 1 and 2. This shows that a 1% increase in the collection period increases late payments as high as 1.7%. The results provide empirical evidence to, probably, prove the recent increase in interest by EU firms on trade credit management and early collection of accounts receivable, in order to reduce late payments and defaults on credit.

Table 1: OLS regressions, Dependent variable: late payments

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| *y05* | -0.007* | -0.007* | -0.033*** | -0.029*** |
| | (0.004) | (0.004) | (0.005) | (0.005) |
| *y06* | -0.007* | -0.007* | -0.026*** | -0.029*** |
| | (0.004) | (0.004) | (0.005) | (0.005) |
| *y08* | 0.019*** | 0.019*** | 0.006 | 0.002 |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y09* | 0.031*** | 0.031*** | 0.016*** | 0.014*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y10* | 0.026*** | 0.026*** | 0.006 | 0.009** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y11* | 0.025*** | 0.025*** | 0.005 | 0.009** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y12* | 0.034*** | 0.034*** | 0.011*** | 0.016*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y13* | 0.037*** | 0.037*** | 0.012*** | 0.021*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *y14* | 0.045*** | 0.045*** | 0.023*** | 0.028*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *lncol* | 1.686*** | 1.686*** | 1.682*** | 1.684*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *lncre* | -0.602*** | -0.602*** | -0.605*** | -0.603*** |
| | (0.003) | (0.003) | (0.003) | 0.003) |
| *lnroa* | 0.009*** | 0.009*** | 0.008*** | 0.008*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| *lnta* | -0.080*** | -0.080*** | -0.064*** | -0.074*** |
| | (0.005) | (0.005) | (0.004) | (0.004) |
| *lntov* | 0.059*** | 0.059*** | 0.058*** | 0.055*** |
| | (0.004) | (0.004) | (0.004) | (0.004) |
| *lncr* | 0.057*** | 0.057*** | 0.062*** | 0.062*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| *lnger* | 0.009*** | 0.010*** | 0.008*** | 0.009*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| *Constant* | -1.694*** | -1.694*** | -1.788*** | -1.681*** |
| | (0.039) | (0.039) | (0.037) | (0.038) |
| *Observation* | 281,580 | 281,580 | 281,580 | 281,580 |
| *R-squared* | 0.885 | 0.885 | 0.885 | 0.885 |
| *Adj. R-squared* | 0.863 | 0.863 | 0.863 | 0.863 |

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

### 3.2 Effects of firm size on late payments

In order to analyse the variability of late payment across different thresholds of firm sizes under different macroeconomic conditions, we estimated the augmented model as specified in Equation 2. The results presented in Table I (Model 2), shows a high R-squared value of 0.885 indicating the explanatory variables together explain about 89% of the variation in firm delaying payments. Each of the coefficients of explanatory variables appeared significance, which shows them independently, affects variability of the dependent variable, late payments.

As all levels of other explanatory variables held constant (as in the estimation of the basic model), results of the regressions presented in Table I (Model 2), show proportionate variability of late payments of SMEs in relations to large firms during financial crisis. The numerical values of coefficients of the small and medium size firms are negative before the financial crisis and positive after the crisis. The coefficients of SMEs are -0.007 for both *y05* and *y06* variables and significance. The dummy variable regressions mean that late payments of small and medium size firms before the financial crisis are estimated to be proportionally low, compare to the financial crisis period and large firms. Late payments of SMEs are 0.7% lower before the crisis compare to the crisis period and large firms.

In addition, coefficients of the dummy variables denoting years after the financial crisis for SMEs appear with the expected positive sign as presented in Table I (Model 2). This implies that late payments of SMEs are on the average much delayed after the financial crisis than the crisis period. For example, the numerical coefficient values of 0.019, 0.031, and 0.026 of *y08, y09,* and *y10* respectively, show that late payments of SMEs are estimated to be 1.9%, 3.1% and 2.6% higher in the years 2008, 2009 and 2010 respectively, compare to the crisis year, 2007 as well as large firms. The results of Model 2 are similar to Model 1, because 99.97% of the sample EU firms are classified as SMEs.

The results imply that, EU SMEs find much difficulty in the collection of accounts receivable during and after the crisis. The possible reason could either be because credit customers of SMEs have much bargaining power and much control over their accounts payable, and hence control credit transactions, or could be that SMEs in their tendency to maintain customers and grow, may dance to the tune of customers as much as possible. The results confirm the hypothesis (H2) that late payments of SMEs compare to that of large firms are positively hit by financial crisis. Also, the estimated coefficients of the control variables show similar results as presented in Table I (Model 1).

### 3.3 Effects of firm profitability on late payments

To analyse the effect of firm profitability on late payments under different macroeconomic conditions, the model specified in Equation 3 was estimated. The results as presented in Table I (Model 3) shows an R-squared value of 0.885, implying that the explanatory variables together explain about 89% of the variation in delaying payments. Key explanatory variables were significance at the 0.01 or 0.05 levels, meaning all those explanatory variables independently affect delaying payments.

The coefficient of the interest variables, low profitability firms during years before the financial crisis and years after, show the expected negative sign before and positive sign after. This means that low profitability firms, measured with below average ROA, before the financial crisis experience low late payments compare to the crisis period and high profitability firms. Apparently, the financial crisis hits low profitability firms much heavier than the high profitability once. So it is expected they will be much aggressive on their collections in order to increase their turnover and reinvest their accumulated capital (Zainudin, 2008). The coefficient of low profitability firms before the crisis appears with a numerical value of -0.033 and -0.026 for the variables *y05* and *y06* respectively. Meaning low profitability firms have 3.3% and 2.6% reduced late payments for the years 2005 and 2006 before the crisis in relation with the financial crisis year, 2007 and high profitability firms. Also, the coefficients of 0.011, 0.012, and 0.023 of *y12*, *y13,* and *y14* respectively, show late payments are on the average 1.1%, 1.2% and 2.3% delayed for low profitability firms after the financial crisis compare to the crisis period and high profitability firms. Therefore, the hypothesis (H3) that late payments of low profitability firms compare to that of high profitability firms are positively hit by the financial crisis is confirmed. The control variables show their expected signs similar to the estimates of the basic model, hence the same explanation holds for analysis of this regression.

### 3.4 Effects of firm liquidity on late payments

We are also interested in delaying payments of firms with different liquidity threshold. So we estimated the model specified in Equation 4 and found a high R-squared value of 0.885, which means that the explanatory variables together explain about 89% variation in delaying payments. Key coefficients of the explanatory variables were significance at the 0.01 or 0.05 levels, meaning they all individually affect delaying payments.

The results as presented in Table I (Model 4) for the interest variables, low liquidity measured by below average current ratio, shows the expected signs, negative for years before the financial crisis and positive after. The numerical coefficient is -0.029 for both *y05* and *y06* before the financial crisis, and 0.014, 0.009, 0.009, 0.016, 0.021, and 0.028 for *y09, y10, y11, y12, y13,* and *y14* respectively

after the crisis, and all significance at the 0.01 or 0.05 levels. This means that, when controlling for same selected firm characteristics as the estimation of the previous models, firms with low liquidity have their late payments 2.9% lower before the financial crisis than the crisis period, and firms with high liquidity levels. Also, for instance, low liquidity firms are estimated as having 2.1% and 2.8% increases in late payments for the years 2013 and 2014 respectively, after the financial crisis, compare to the crisis period and high liquidity level firms.

Thus, firms need to be in adequate liquidity position to manage their business operations well, especially in financial crisis situation whereby it is much difficult to obtain external finances from the capital markets and loans from commercial banks. It is also true that firms with liquidity constraints may be much serious about collection of accounts receivable, especially during financial crisis period in order to remain in operation. Therefore, hypothesis (H4) that late payments of low liquidity firms compare to that of high liquidity firms are positively hit by the financial crisis is confirmed.

### 3.5 Effects of firm sector differences on late payments

Previous studies such as Zainudin (2008) and Mateut et al. (2015) believe in variability of measures of trade credit extension across different industries. So, we estimated the basic model specified in Equation 1, separately for each EC NACE sector classification to analyse the variability of delaying payments across different sectors. The results presented in Table II, shows at least a high R-squared of 0.868. This means that the explanatory variables together explain about 87% of the variation in the dependent variable, late payments.

When we control for other explanatory variables, the coefficients of the interest variables: years before financial crisis and years after financial crisis show the expected negative and positive signs respectively, and significance at the 0.01 or 0.05 levels. This means that across those sectors with significance coefficients, late payments were better before the financial crisis, but much delayed afterwards in relation with the crisis period. The numerical value of the coefficient for the sector (G, H, I) is -0.016 for *y05* and significance at the 0.05 level. This means that late payments are 1.6% lower for that aggregate sector, before the financial crisis of 2005 compare to the crisis year, 2007. The result implies that late payments of Wholesale and retail trade, transportation and storage, accommodation and food service activities (G, H, I) sectors were better before the financial crisis than the crisis period. The possible reason could be the highly competitive nature of the said industries in terms of customer retention.

Also, the numerical coefficient values of the years after financial crisis variable for the Manufacturing, mining and quarrying and other industry (B, C, D, E) sectors; Construction (F) sector;

and Wholesale and retail trade, transportation and storage, accommodation and food service activities (G, H, I) sectors are all positive. This means late payments are much delayed for years after the financial crisis for those sectors compare to the crisis year of 2007. For example, the coefficients of the years after financial crisis variables for the years, 2013 and 2014 for construction (F) are 0.104 and 0.118 respectively and is much higher than the sectors: Manufacturing, mining and quarrying and other industry (B, C, D, E) of 0.028 and 0.036, and that of the sectors: Wholesale and retail trade, transportation and storage, accommodation and food service activities (G, H, I), which is 0.041 and 0.050 for the same years of 2013 and 2014 respectively. This means late payments for the EU construction sector is much higher after the financial crisis with relation to the crisis period compare to the other sectors considered.

Apparently, construction projects require huge investments; hence late payments are expected and even permissible, some times. The construction sector deals in products whereby minimal levels of inventory should be kept due to their bulkiness. So they are pushed to extend a lot of trade credit, which makes them maintain big accounts receivable. Not all the sample 10 NACE classification sectors have enough observation for the OLS regressions. So, the results are reported on only those sectors with significance coefficients levels of the interest variables. The results confirm hypothesis (H5), that late payments of different sectors are all positively hit by financial crisis, but with significant variability across sectors.

Table 2: Effects of firm sector difference on late payments

| | Sectors | | |
|---|---|---|---|
| Variable | B,C,D,E | F | G,H,I |
| *y05* | 0.010 | -0.013 | -0.016** |
| | (0.006) | (0.013) | (0.008) |
| *y06* | -0.003 | -0.016 | -0.008 |
| | (0.006) | (0.013) | (0.007) |
| *y08* | 0.022*** | 0.034*** | 0.014** |
| | (0.006) | (0.012) | (0.007) |
| *y09* | 0.042*** | 0.068*** | 0.019*** |
| | (0.006) | (0.012) | (0.007) |
| *y10* | 0.027*** | 0.098*** | 0.017** |
| | (0.006) | (0.012) | (0.007) |
| *y11* | 0.022*** | 0.086*** | 0.018** |
| | (0.006) | (0.012) | (0.007) |
| *y12* | 0.031*** | 0.097*** | 0.034*** |
| | (0.006) | (0.012) | (0.007) |
| *y13* | 0.028*** | 0.104*** | 0.041*** |
| | (0.006) | (0.013) | (0.007) |
| *y14* | 0.036*** | 0.118*** | 0.050*** |
| | (0.006) | (0.013) | (0.007) |
| *lncol* | 1.900*** | 1.841*** | 1.729*** |
| | (0.008) | (0.015) | (0.009) |
| *lncre* | -0.734*** | -0.688*** | -0.648*** |
| | (0.007) | (0.012) | (0.006) |
| *lnroa* | 0.014*** | 0.007** | 0.008*** |
| | (0.002) | (0.003) | (0.002) |
| *lnta* | -0.081*** | -0.158*** | -0.111*** |
| | (0.008) | (0.016) | (0.009) |
| *lntov* | 0.083*** | 0.129*** | 0.087*** |
| | (0.008) | (0.013) | (0.009) |
| *lncr* | 0.062*** | 0.052*** | 0.089*** |
| | (0.005) | (0.011) | (0.006) |
| *lnger* | 0.006*** | 0.016*** | 0.019*** |
| | (0.002) | (0.003) | (0.001) |
| *Constant* | -2.360*** | -2.087*** | -1.803*** |
| | (0.071) | (0.121) | (0.080) |
| *Observation* | 98,423 | 28,542 | 82,783 |
| *R-squared* | 0.868 | 0.868 | 0.882 |
| *Adj. R-squared* | 0.845 | 0.843 | 0.859 |

legend: * p<.1; ** p<.05; *** p<.01; Robust standard errors in parentheses

EU NACE sector classification sections: B, C, D, E-Manufacturing, mining and quarrying and other industry; F-Construction; G, H, I-Wholesale and retail trade, transportation and storage, accommodation and food service activities.

## 4 Robustness analysis

The analysis was centred on all sampled EU firms. So we attempt to estimate the model specify in Equation 1, separately for each of the sample EU member countries. But, only report the results of the countries with significance coefficient of the interest variables. This is to confirm the previous results, when sample countries are analysed separately. The results are presented in Table III and show at least a high R-squared of 0.861. This means that the explanatory variables together explain about 86% of the variation in the dependent variable, late payments. Most of the coefficients of the explanatory variables are significance at the 0.01 or 0.05 levels.

The results show significance negative coefficients value of the *y05,* before financial crisis dummy variable for the Czech Republic that is -0.047, and Spain, -0.019 for *y06* (see Table III). This means for the two EU countries late payments were better before the crisis, compare to the crisis period. With, higher proportions to the Czech Republic of less than 4.7% compare to Spain, 1.9%. Also, the results show significance positive coefficient values of the years after financial crisis dummy variables for Belgium, Czech Republic, Spain and France, but not the UK that show negative coefficients. The numerical value of the coefficient however, varies from country to country. For example, considering the coefficients of the variables for years, 2011 and 2012, Belgium is 0.026 and 0.040; Czech Republic is 0.034 and 0.029; France is 0.045 and 0.055; Spain is 0.097 and 0.102; UK, -0.020 and -0.015, respectively. This implies that late payments are much delayed in Spain after the financial crisis than any of the EU member countries considered. The results also show that for UK, the analysis did not support our claim, due to estimated reduction in the proportion of late payments after the financial crisis. Although, the coefficient values are small for the significance years, it shows good improvements in credit management by UK firms after the financial crisis. Nonetheless, the analysis for Belgium, Czech Republic, France and Spain supported our claim of positive impact of the financial crisis on late payments. Thus, there is increases in late payments after the financial crisis, compare to the financial crisis period, with only Belgium that shows the *y06* variable with a positive sign, 0.025, but all subsequent years show much high values of the coefficient of the year dummy variables (see Table III).

Table 3: OLS Regression for selected EU member countries

| Variable | Belgium | Czech Republic | France | Spain | United Kingdom |
|---|---|---|---|---|---|
| *y05* | 0.001 | -0.047** | -0.009 | -0.006 | 0.002 |
| | (0.013) | (0.020) | (0.006) | (0.009) | (0.008) |
| *y06* | 0.025** | -0.025 | -0.005 | -0.019** | -0.011 |
| | (0.012) | (0.018) | (0.006) | (0.008) | (0.008) |
| *y08* | 0.015 | 0.011 | 0.013** | 0.096*** | 0.001 |
| | (0.012) | (0.017) | (0.006) | (0.007) | (0.008) |
| *y09* | 0.011 | 0.042** | 0.043*** | 0.097*** | -0.006 |
| | (0.012) | (0.017) | (0.006) | (0.008) | (0.008) |
| *y10* | 0.004 | 0.024 | 0.053*** | 0.084*** | -0.017** |
| | (0.012) | (0.017) | (0.006) | (0.008) | (0.007) |
| *y11* | 0.026** | 0.034** | 0.045*** | 0.097*** | -0.020*** |
| | (0.012) | (0.016) | (0.006) | (0.008) | (0.007) |
| *y12* | 0.040*** | 0.029* | 0.055*** | 0.102*** | -0.015* |
| | (0.012) | (0.017) | (0.006) | (0.008) | (0.008) |
| *y13* | 0.046*** | 0.024 | 0.064*** | 0.096*** | -0.007 |
| | (0.013) | (0.017) | (0.006) | (0.008) | (0.007) |
| *y14* | 0.049*** | 0.031* | 0.069*** | 0.108*** | -0.000 |
| | (0.013) | (0.017) | (0.007) | (0.008) | (0.008) |
| *lncol* | 1.928*** | 1.832*** | 1.902*** | 1.536*** | 1.584*** |
| | (0.018) | (0.019) | (0.009) | (0.007) | (0.009) |
| *lncre* | -0.863*** | -0.775*** | -0.841*** | -0.438*** | -0.517*** |
| | (0.014) | (0.016) | (0.007) | (0.004) | (0.006) |
| *lnroa* | 0.003 | 0.012** | 0.011*** | 0.003* | 0.006** |
| | (0.004) | (0.005) | (0.002) | (0.002) | (0.002) |
| *lnta* | -0.078*** | -0.120*** | -0.069*** | -0.080*** | -0.046*** |
| | (0.013) | (0.024) | (0.008) | (0.010) | (0.009) |
| *lntov* | 0.057*** | 0.107*** | 0.042*** | 0.083*** | 0.041*** |
| | (0.013) | (0.024) | (0.008) | (0.008) | (0.010) |
| *lncr* | 0.039*** | 0.031** | 0.057*** | 0.055*** | 0.059*** |
| | (0.009) | (0.013) | (0.005) | (0.005) | (0.006) |
| *lnger* | 0.011*** | 0.014*** | 0.007*** | 0.013*** | 0.009*** |
| | (0.003) | (0.004) | (0.001) | (0.002) | (0.002) |
| *Constant* | -1.827*** | -1.790*** | -1.762*** | -1.837*** | -1.639*** |
| | (0.143) | (0.141) | (0.067) | (0.080) | (0.090) |
| *Observation* | 26,571 | 14,425 | 99,266 | 74,305 | 49,660 |
| *R-squared* | 0.861 | 0.867 | 0.876 | 0.890 | 0.886 |
| *Adj. R-squared* | 0.834 | 0.840 | 0.855 | 0.868 | 0.865 |

legend: * p<.1; ** p<.05; *** p<.01; Robust standard errors in parentheses

## 5 Discussion

Firm delaying payment variability is found to be quite intense during and after negative macroeconomic shocks. This supports the argument of Ferrando and Mulier (2013) that the financial crisis period is characterized by economic and financial downturn, which makes it much difficult for firms in general to access the capital market and virtually impossible for financing constrained firms to obtained external financing for investment projects. Even when possible, external funds get very expensive that it serves as a barrier to be conveniently accessed. Apparently, firms in order to be in operation, seeks other sources of financing such as trade credit that is relatively cheaper (Petersen and Rajan, 1997; Fisman and Love, 2003; Wu et al., 2014). This evidence also, supports our findings that Late Payments gets much delayed for SMEs compare to the larger firms.

Also, the results are in line with the findings of Zainudin (2008), when the collection period is used as proxy of late payments and Malaysian firms were studied. Our findings are similar to that of Zainudin (2008) that sector differences affect late payments differently. Even when different subsectors are studied under the manufacturing sector. Our results seem to be distinct in the literature because of data availability for measuring late payments and consideration of the financial crisis period.

The explanation for our findings in a more general sense may be in line with the argument of Mateut et al. (2015) that during the period of negative macroeconomic shocks firm payments of accounts receivable are much delayed. Also, during period of financial crisis and after EU firms extending trade credit experience late in their payments of accounts receivable. This is because of delay in credit customers' accounts payable, which is mainly caused by overall economic and financial hardship.

Although our panel data analysis of 54,277 EU firms allowed us to some extent identifies the impact of financial crisis on delaying payments, much could not be said about the variability of firms delaying payments caused by past late payments under negative macroeconomic shocks, which require the use of a dynamic model. Also, an important aspect of delaying payments this study did not investigate, due to its objectives, is the direct consideration of the quality of the environments of which different EU firms operate.

## Conclusions

The study argued that the economic impact of delaying payments of accounts receivable was mainly caused by the 2007, 2008 financial crisis experienced in the EU and the world at large. Using a sample of 54,277 EU firms, we estimated the impact of financial crisis on firm delaying payments, by

controlling for characteristics such as firm profitability measures, liquidity measures, firm size, sector differences, country differences, credit collections and credit period. We employed the OLS dummy variable regressions for our panel data set, and the results supported our claim that the financial crisis has a significant impact on EU firms delaying payments of accounts receivable.

The OLS results for almost all the estimated models show a positive impact of the financial crisis on delaying payments, with the situation different when analysing UK firms, which show significance negative coefficient values for the years after financial crisis variables, and Belgium firms that show significance positive coefficient value for the year 2006 variable. Thus, collections of accounts receivable were much late after the financial crisis, but earlier before the crisis, compare to the crisis period. When we analyse firm size heterogeneity, the results show positive coefficients after the crisis and negative before the crisis. This proved that small and mediums size firms compared to their large counterparts have their late payments much delayed. Also, small and medium firms, though have reduced late payments before the financial crisis, their late payments on average is much delayed after the crisis compare to the crisis year of 2007. In addition, we estimated the models for different thresholds for profitability and found that low profitability EU firms have late payments much delayed, compare to high profitability firms due to the impact of the financial crisis.

When firm liquidity was considered, different thresholds were used. The results show that EU firms with low liquidity levels though have early collections of accounts receivable before the crisis, they have significant delays in collections of accounts receivable after the crisis in relation to the financial crisis period. We also considered the impact of financial crisis on delaying payments across different sectors and found variability of firm late payments across different sectors. All of the sectors considered show lower late payments before the crisis, but late payments much delayed after the crisis compare to the financial crisis period. Robustness analysis was undertaken to check the impact of financial crisis on delaying payments by comparing firms in individual EU member countries. The results show that, though delaying payments are variable across selected EU countries, late payment of accounts receivable were much delayed after the crisis, with an improvement in the UK only, which show a decline in late payments. Late payments before the financial crisis across selected EU countries were better than the crisis period. Therefore, the results confirmed our hypotheses H1 to H5.

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**Appendix 1**

**Distribution of selected EU member countries**

The data for the study is retrieved on 10 selected EU member countries with the distribution presented in Table IV, below. France has the highest number of observed firms of 18,289; followed by Spain, 14,655 firms; then United Kingdom, 9,917 firms; with Austria the lowest number of observed firms of 183. The disparity of distribution of the sample firms for EU member country was not a concern, due to the objective of the study of analysing the variability in late payments caused by the financial crisis. Since there is no particular interest in the differences in number of firms for individual countries, once the observations are large enough for the OLS regressions.

Table 4: Distribution of sample firms

| EU Country | Number of observed firms |
|---|---|
| Austria | 183 |
| Belgium | 5,190 |
| Czech Republic | 3,002 |
| Finland | 1,145 |
| France | 18,289 |
| Germany | 1,286 |
| Ireland | 336 |
| Netherlands | 274 |
| Spain | 14,655 |
| United Kingdom | 9,917 |
| Total firms | 54,277 |
| Number of years | 10 |
| Number of observation | 542,770 |

The description of each variable used in the analysis is presented in Table V below.

Table 5: Description of each variable

| Variable | Description |
|---|---|
| $\ln LP_{it}$ | Natural log. of late payment = collection period-credit period, (annual), 2005-2014 |
| $\ln col_{it}$ | Natural log. of collection period, (annual), 2005-2014 |
| $\ln cre_{it}$ | Natural log. of credit period, (annual), 2005-2014 |
| $\ln roa_{it}$ | Natural log. return on assets (annual), 2005-2014 |
| $\ln ta_{it}$ | Natural log. of total asset (annual), 2005-2014 |
| $\ln tov_{it}$ | Natural log. of operational revenue (annual), 2005-2014 |
| $\ln cr_{it}$ | Natural log. of current ratio=current assets/current liabilities (annual) 2005-2014 |
| $\ln ger_{it}$ | Natural log. of leverage (annual), 2005-2014 |
| $D_t$ | Year dummy variables for period of financial crisis, 2007 and 2008 |
| $D_1$ | Year dummy variables for period before financial crisis, 2005 and 2006 |
| $D_2$ | Year dummy variables for period after financial crisis, 2009-2014 |
| $small_i$ | Firms with annual turnover ≤10 million, 2005-2014 |
| $medium_i$ | Firms with annual turnover ≤50 million, 2005-2014 |
| $l\arg e_i$ | Firms with annual turnover >50 million, 2005-2014 |
| $lopro_i$ | Firms with annual return on assets< mean, 2005-2014 |
| $loliq_i$ | Firms with annual current ratio< mean, 2005-2014 |

The NACE Rev. 2 sector classification of economic activities of EU firms is presented in Table VI.

Table 6: NACE Rev. 2 classification

| No. | Sections | Description |
|---|---|---|
| 1 | A | Agriculture, forestry and fishing |
| 2 | B,C,D,E | Manufacturing, mining and quarrying and other industry |
| 3 | F | Construction |
| 4 | G,H,I | Wholesale and retail trade, transportation and storage, accommodation and food service activities |
| 5 | J | Information and communication |
| 6 | K | Financial and insurance activities |
| 7 | L | Real estate activities |
| 8 | M,N | Professional, scientific, technical, administration and support service activities |
| 9 | O,P,Q | Public administration, defense, education, human health and social work activities |
| 10 | R,S,T,U | Other services |

## Appendix 2

### Summary statistics

When we consider the full sample of EU firms, the mean credit period given by firms is about 43 days, and the mean collections of accounts receivable is about 73 days. Thus, the average EU firm delays on payment of its accounts payable. The average late payment is as high as 30 days (see Table VII), which have a lot of economic implications, since time value of money might not be factored into the credit provision. In fact, permissible delay in payment may be due to the firm's long term strategic marketing objectives, rather than addressing firms' immediate liquidity concerns that is directly related to the firm's short term survival. The EU firms on average have healthy businesses as shown by the mean value of current ratio. This may relate to high late payments, since firms with good liquidity positions may not be pushing their customers very hard for collections, in order to have entrenched market position. The mean annual turnover of over €145 million is far above the threshold of ≤50 million for small and medium size firms (SMEs), yet they form 99.97% of the sample of EU firms. This implies collection of accounts receivable should be pertinent to EU firms, since high percentage of them are SMEs, which are considered to be relatively financial constraint.

Table 7: Summary statistics

| Variable | Unit | Mean | Std. Dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Late payment | days | 30.09 | 76.52 | -998.00 | 1000.00 |
| Collection period | days | 72.59 | 74.35 | 0.00 | 1000.00 |
| Credit period | days | 42.51 | 49.46 | 0.00 | 999.00 |
| Return on assets | % | 5.22 | 8.53 | -99.98 | 99.38 |
| Total assets | EUR(mill) | 170.49 | 3,040.59 | 0.00 | 351,210.00 |
| Turnover | EUR(mill) | 145.05 | 2,469.72 | 0.00 | 372,513.40 |
| Current ratio | ratio | 2.62 | 4.76 | 0.00 | 99.96 |
| Gearing | % | 73.09 | 112.17 | 0.00 | 999.77 |

Number of observation for each variable is 542,770

## Appendix 3

### Firm characteristics variables

To analyse the economic impact of financial crisis on firm delaying payments, we control for firm size, profitability, liquidity and the sector the firm belongs. The study measures firm size with annual turnover, firm profitability is measured with return on assets (ROA), firm liquidity with current ratio, and identifies the sector of the firm with EC NACE industry/sector classification.

**Firm size**

Firm size is use a lot by researches that study trade credit extension and those that undertake micro econometric analysis of firms. The usage of firm size is even commonly used as an explanatory variable. This is mainly because of firm heterogeneity in terms of size and the fact that size is an important determinant of performance. Firm's sales revenue or/and total assets are usually used to measure firm size (Guariglia et al., 2011). The trade credit literature commonly measures firm size with total assets or turnover (Zainudin, 2008). We control for firm size in all the estimated models by including both the total assets and turnover. We therefore use natural logarithm of firm annual turnover to measure firm size. When analysing the effects of the proportion of firm size, we introduce firm size as a dummy variable in the model specify in Equation 2.

**Firm profitability**

The literature on trade credit and credit management identifies measures of firm profitability when analysing firm performance and growth (Zainudin, 2008; Petersen and Rajan, 1997; Paul et al., 2012). The literature mostly uses either the return on assets or return on equity or both as measure of firm profitability. In some cases, profitability measure of return on equity is decomposed to its constituent parts (for DuPont analysis), the profit margin and asset turnover to determine the profitability share of each component (Reynaud and Thomas, 2013; Chang et al., 2014). The trade credit literature either determine the impact of ROA on measures of trade credit extension (Zainudin, 2008) or determine the impact of measure of trade credit extension on the response variable, profitability (Paul et al., 2012). This study follows previous literature and control for profitability measure, ROA in the firm delaying payment regression models. We use natural logarithm of ROA in all the models and, also analyse impact of the proportion of profitability in the model specify in Equation 3, as a dummy variable.

**Firm liquidity**

We control for liquidity of the firm and measure the variable with current ratio, which we include in all the models. Current ratio is defined as current assets/current liabilities, an accounting ratio, which we measure in natural logarithm. In addition to controlling for liquidity in all the models, we assess the impact of the proportion of liquidity in the model specified in Equation 4 as a dummy variable.

**Firm sector**

The sector of the EU firm is included as an important explanatory variable in the regression, by estimating the basic model specify in Equation 1 separately for each sector. We use the NACE classification of sectors of EU firms. The NACE classification is presented in Table VI.