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Factors Determining Trade Credit Dynamics During Crisis: Panel Data Analysis for Macedonian Firms

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ABSTRACT

The study is aimed at determining the factors influencing the trade credits dynamics for twenty three firms registered on the Macedonian Stock Exchange, as well as at checking for crisis effects from 2011 to 2015. The study includes a review of the literature on commercial credit factors; elaborately analyzed descriptive statistics of the collected data and dependent variable variance; tests for unobservable effects and their functional form; evaluation of panel regression and interpretation of the results. The authors have proved that net trade credits for these firms depends mainly on the growth potential of lagging firms and their vulnerability, and the crisis effects are significant only for the latter factor. Moreover, the overall efficiency of firms' assets and their ability to convert income into cash does not have a significant impact in the crisis and post-crisis periods. The growth opportunities and profitability demonstrate a negative impact, meaning that growing and more profitable firms on average tend to expand and receive more trade credits than counterparties. Profitability has a significant impact on trade credit and the effect is seen during the first year after the crisis. Thus, the dynamics of trade credits of registered Macedonian firms is largely determined by the internal factors of a firm, and not by the external macroeconomic situation. Therefore, better financial management is suggested to improve the trade credit policy. One of the directions for further research is the evaluation of the autoregressive component of the trade credit dynamics, as well as including spatial effects in the regression equation.

Keywords: trade credit dynamics; panel data; crisis; Macedonia; analysis of variance; fixed effects; random effects; Hausman test

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Факторы, определяющие динамику торгового кредита во время кризиса: панельный анализ данных для македонских компаний

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АННОТАЦИЯ

Цель исследования — определение факторов, влияющих на динамику коммерческих кредитов для двадцати трех фирм, зарегистрированных на Македонской фондовой бирже, а также проверка наличия кризисных эффектов в период с 2011 по 2015 г. Исследование включает в себя: обзор литературы, посвященной факторам коммерческого кредита; подробный анализ описательной статистики собранных данных и анализ дисперсии зависимой переменной; проведение тестов на наличие ненаблюдаемых эффектов и их функциональную форму; оценку панельной регрессии и интерпретацию результатов. В статье доказано, что показатель чистого коммерческого кредита для рассматриваемых фирм главным образом зависит от возможностей роста отстающих фирм и их уязвимости, а последствия кризиса для компаний значимы только для последнего фактора. Кроме этого, общая эффективность активов фирм и их способность

конвертировать доходы в денежные средства не оказывают существенного влияния как в кризисный, так и в посткризисный периоды. Возможности роста и прибыльность демонстрируют негативное влияние, а это означает, что растущие и более прибыльные фирмы в среднем имеют тенденцию расширяться и получать больше торговых кредитов, чем контрагенты. Рентабельность оказывает существенное влияние на торговый кредит, и этот эффект ощутим в первый год после кризиса. Таким образом, динамика торговых кредитов македонских компаний, котирующихся на бирже, в значительной степени определяется внутренними факторами фирмы, а не внешней макроэкономической ситуацией. Поэтому для улучшения политики в области коммерческих кредитов рекомендуется совершенствование финансового управления. Одним из направлений дальнейших исследований является оценка авторегрессионной составляющей динамики коммерческих кредитов, а также включение пространственных эффектов в регрессионное уравнение.

Ключевые слова: динамика коммерческого кредита; панельные данные; кризис; Македония; дисперсионный анализ; фиксированные эффекты; случайные эффекты; тест Хаусмана

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1. INTRODUCTION

It is very difficult or even impossible to do all trading transactions in cash only. Generally, firms buy and sell on credit. Trade credit received from suppliers is a source of funds, whereas trade credit provided to clients is an investment. Finding the best level of trade credit is not an easy task. Purchasing and selling are closely connected. For example, Petersen and Rajan [1] revealed that firms with better access to credit provide more trade credit to other firms. Thus, trade credit accessibility is a determining factor for many SMEs [2].

Various studies covering different samples and methodologies have provided different evidences. For example, Koralun-Bereźnicka [3], in her study examining a sample of firms from nine countries, showed that the mean value of trade accounts receivables and payables divided by net turnover is 0.234 and 0.183 respectively. Gianneti, Burkart and Ellingsen [4] found out that accounts receivable to sales and payables to assets were 0.100 and 0.20 respectively. Rajan and Zingales [5], in their study of non-financial firms, found out that in the G7 countries accounts receivable/debtors to total assets were as following: United States (17.8), Japan (22.5), Germany (26.9), France (28.9), Italy (29.0), United Kingdom (22.1), and Canada (13.0). On the other hand, accounts payable/creditors to total liabilities and shareholders' equity were as following: United States (15.0), Japan (15.4), Germany (11.5), France (17.0), Italy (14.7), United Kingdom (13.7), and Canada (13.3).

Firms prefer to use cheaper sources of funds: for example, accounts payable in contrast to bank credits because the former have free interest rate. Firms would prefer to be financed by trade credit rather than by financial institutions [1]. However, even trade credit cost is not explicitly indicated, it is set in the price list of products [6]. Trade credit can serve as an alternative source of finance for firms in poorly developed financial markets [7]. However, some findings of Gianneti,

Burkart and Ellingsen [4] challenge the traditional interpretation that trade credit is mainly the last source of funds for firms when they cannot rely on bank credit.

Sources of funds affect the firm's economic and financial indicators, making them successful or unsuccessful. In their study, Carpenter and Petersen [8] revealed that growth of firms was constrained by internal finance. Historically, sources of funds were the basic concern of firms. During financial crisis this concern rises even more. In this regard, there are some studies performed for firms in different countries, but the case of Macedonia yet remains undiscovered. Previous studies as [9] examined trade credit, but without financial crisis effects for registered Macedonian firms. Osmani and Deari [10] examined financial performances and economic recession of firms, but they didn't include trade credit in their study. Therefore, this study in an extension of the previous one; it strives to provide a pioneering evidence of the impact of financial crisis on trade credit for the case of registered Macedonian firms. The findings of this study will be advanced in the next ones and will contribute to both theoretical and empirical evidence for decision makers in micro and macro perspective.

The rest of the paper is organized as follows: section 2 presents the literature overview; section 3 describes the data and methodology; empirical results are discussed in section 4; section 5 provides the conclusion.

2. LITERATURE OVERVIEW

The abundant literature on trade credit can be divided into two major groups: from the firm-microeconomic and macroeconomic perspective. The decision makers in both groups are interested to improve economic and financial indicators, whether at the firm's or the country's economy level. In this regard, researchers identified several factors that are supposed to be linked and affect trade credit dynamics.

2.1. Empirical evidence of previous studies

Biais and Gollier [11] showed that firms respond to monetary contractions. Deloof and Jegers [12] examined Belgian industrial and wholesale distribution firms, and provided evidence that investment in accounts receivable was decreased while a firm lacked cash; whereas trade credit policy was not affected by a surplus of cash.

Moreover, several studies were focused on measuring effects of financial crisis in trade credit and testing whether trade credit is a substitute of bank credit. For example, Blasio [13] examined Italian manufacturing firms and provided evidence that trade credit substituted bank credit during money tightening. Furthermore, Blasio [13] explained that the high level of trade credit of the firms presented in the balance sheet was mostly due to unavailability of alternative funding sources and information asymmetry.

In their study, Love, Preve and Sarria-Allende [14] found out that before the crisis firms with a high level of short-term debt provided trade credit, while after the crisis they decreased it and increased obtained trade credit.

Ono [15] found out that trade payables complemented bank credits in case of Japanese manufacturing firms. Similar evidence was provided by other studies including Santos and Silva's [16] (the case of Portuguese industrial firms). It showed that financially constrained firms used trade credit as another financing source during financial crisis. Bellouma [17] (the case of Tunisian firms) found out the substitute effect between trade credit and bank credit, and confirmed that during the financial crisis firms relied more on trade credit. Ellingsen, Jacobson and Schedvin [18] revealed that clients preferred trade credit over other available funding sources. Sevim, Ekiyor and Tosyali [19] found out that due to crisis effects, firms were driven to sell on credit in order not to lose clients.

2.2. Measures of trade credit — dependent variable

Despite there are numerous measures of trade credit, they seem to be less or more consistent with each other. Love et al. [14] used three measures-dependent variables such as: trade receivables divided by total sales, trade payables divided by cost of goods sold, and the difference between trade receivables and trade payables divided by total sales, usually known as net trade credit. The measures used by Alatalo [20] include trade receivables per sales; trade payables per cost of goods sold; and net trade credit. Nadiri [21] considered trade credit as selling expenses, whereas Huyghebaert [22] used ratio of accounts payable to

total assets. Demirgiu-Kunt and Maksimovic [23] used receivables turnover calculated as total sales divided by accounts receivable; payables turnover calculated as total costs of goods sold divided by accounts payable; and short-term debt to accounts payable. Grave [24] used trade receivables divided by total assets; trade payables divided by total assets; and trade receivables minus trade payables divided by total assets.

Following the previous studies, we apply net trade credit defined (trade receivables – trade payables) / sales as the dependent variable in this study. In our preliminary regression results, we used net trade credit with total assets in the denominator, but the first net trade credit measure provided better statistical results.

2.3. Independent variables

Cash to current assets, as opposed to cash to total assets, results in more “qualitative” information. Usually, the ratio of cash to total assets is negligibly small. Thus, dividing cash and its equivalents by current assets will result not just in a more convenient statistical measure of cash participation, but also indirectly provides us with information about the rest current assets composition. For example, what is the portion of inventory or accounts receivables to current assets? Even if accounts receivables are more liquid than inventory, they are not yet cash. Accounts receivables are accompanied by the risk of non-collecting money on time or at all.

The ratio of operating cash flow to assets presents how much money of operating cash flow is generated by each denar of total assets. A firm can make sales on credit, but this doesn't imply that it has cash. Thus, using this indicator, we are interested to test efficiency of firms and their ability to generate operating cash flow from assets.

Using the growth we are testing whether trade credit and a firm's growth are related. In other words, we test whether firms which are growing more, use more or less trade credit than their partners.

Current assets to current liabilities ratio is known as a current ratio. According to the rule of thumb, it should be 2:1. With this ratio, we test whether more liquid firms used less or more net trade credit vis-à-vis the counterparties. Moreover, we test whether trade credit policy was affected by this ratio view on two perspectives: before and after the crisis.

Current liabilities to sales have been examined by Li [25], who argues that firms with higher ratio and, consequently, the ability to get external financing, would offer more trade credit to their clients. Accounts payable belong to current liabilities, so increasing

Table 1

Sample composition

Business	Freq.	Percent	No. of firms
Agriculture	5	4	1
Catering	15	13	3
Construction	10	9	2
Industry	35	30	7
Services	25	22	5
Trade	25	22	5
Total	115	100	23

Source: compiled by the authors.

accounts payable will increase current liabilities too. Thus, firms that have more ability to purchase on credit would prefer and be motivated to offer more credit to their clients.

Current liabilities to total assets present how much each denar total assets is financed by current liabilities. We are interested to test whether firms with higher ratio used less or more trade credit than the counterparties.

Sales to assets characterize total assets efficiency and measure how much sales of total assets is generated by each denar. We test whether firms with better assets efficiency used less or more net trade credit during and after the crisis compared to the counterparties.

Net income to sales, which is also known as net profit margin, measures how much net income of sales each denar generates. We test whether firms with higher net profit margin used less or more net trade credit during and after the crisis.

As for operating cash flow to net income, besides using operating cash flow to assets, it brings new information. The data used in this study and other similar studies for trade credit are accounting data. Accounting data have their own characteristics and we should read them carefully. For example, purchasing land or another asset on credit in December will increase total assets as liabilities too. However, this purchased asset has not yet been used to generate cash. It has just been calculated and does not have brought any effects yet. This increased amount in total assets at the end of the fiscal year (as it is December 31 in Macedonia) will make the ratio of operating cash flow to assets to be lower. Using another ratio as operating cash flow to net income will show not how much operating cash flow each asset generates, but how much operating cash flow is generated by each net income denar. Hence, we

try to estimate whether firms that are able or efficient to generate operating cash flow from total assets and from net income use more or less net trade credit than the counterparties; and what the effect of financial crisis was.

Crisis variable (hereafter the names of the variables are in italic) takes its values depending on the change in real GDP growth in the Republic of Macedonia. The corresponding data are used from the National Bank of the Republic of Macedonia [26]. In 2011 and 2012, the changes in real GDP growth in the Republic of Macedonia were negative, whereas in the other years — positive. So, we consider the first two years of the sample as crisis years and the last three years of the sample — are post-crisis years. We introduce three dummy variables — one for crisis years (*crisis*) and two for the first and the second post-crisis years (*post1* and *post2*).

3. DATA AND METHODOLOGY

3.1. Data

We have used accounting data from 23 registered firms for the period of 2011–2015. The sample consists of 115 observations. Selected firms, registered in the Macedonian Stock Exchange, are required to prepare annual reports in accordance with the International Accounting Standards (IAS) and International Financial Reporting Standards (IFRS). The data are extracted from the annual reports of the selected firms as presented in [27].

Selected firms belong to six business sectors such as: agriculture, catering, construction, industry, services, and trade. The major of them belongs to the industry sector and there is only one firm from the agriculture sector. The distribution of the firms by the economic sector is presented in *Tabl. 1*. Boxplots and average

Table 2

List of variables

Variable name	Meaning	Purpose
NTC	Net trade credit, (Trade receivables – Trade payables) / Sales	Dependent variable
Post1	Dummy variable, which is equal to 1 for 2013 meaning the first year after crisis	Crisis variable
Post2	Dummy variable, which is equal to 1 for 2014 meaning the second year after crisis	Crisis variable
Cashcurras	Ratio of cash and its equivalents to current assets	Liquidity measure
Ocftotas	Net cash flow from operating activities / Total assets	Liquidity measure
Salesgrow	Growth of sales, (Salest – Salest-1) / Salest-1	Firm's growth opportunity measure
Currascurliab	Ratio of current assets to current liabilities	Vulnerability measure
Curlibsales	Ratio of current liabilities to sales	Vulnerability measure
Curlibtotas	Ratio of current liabilities to total assets	Vulnerability measure
Totalasseffc	Sales / Total assets	Total assets efficiency
Profsales	Ratio of net income to sales	Profitability measure
Coanetincome	Net cash flow from operating activities / Net income	Liquidity measure

Source: compiled by the authors.

values with error bars for the studied variables are presented in Fig. 1 in the Appendix.

3.2. Methodology

The analysis has been performed by means of R statistical programming language [28]. Prior to the analysis, the data are checked for unusual observations – for example, sales or assets cannot be negative. This study contains 115 observations for 23 firms from 2011 to 2015 which constitute a balanced panel.

Tabl. 2 presents variables meaning and purpose based on the literature overview above. In fact, the ratios from the balance sheet, the income statement and the cash flow statement have been used.

We followed [14] in terms of dependent and some independent variables. However, this study provides some extensions to the variable set under consideration. For example, Love et al. [14] use operating cash flow to assets, while we add operating cash flow to net income; Love et al. [14] use cash to assets, and we use cash to current assets. We also examine some independent variables, not considered by Love et al. [14], such as current assets to current liabilities, net income to sales, sales to assets, and current liabilities to sales.

Following [14], we consider further specifications of model equation. The first equation is aimed at in-

vestigating the behavior of the aggregate firms with respect to trade credits in crisis and post-crisis periods.

$$NTC_{it} = \alpha_i + \beta_1 \cdot crisis_t + \beta_2 \cdot post1_t + \beta_3 \cdot post2_t + \beta_4 \cdot ocftotas_{it} + \beta_5 \cdot cashcurras_{it} + (1) + \beta_6 \cdot salesgrow_{it} + \varepsilon_{it}.$$

The second equation tests the hypothesis that crisis affects more vulnerable firms more intensively, and results in the increase of the trade credits from their suppliers.

$$NTC_{it} = \alpha_i + \beta_1 \cdot crisis_t + \beta_2 \cdot post1_t + \beta_3 \cdot post2_t + \beta_4 \cdot curlibsales_{it} + \beta_5 \cdot curlibsales_{it} \cdot crisis_t + \beta_6 \cdot curlibsales_{it} \cdot post1_t + \beta_7 \cdot curlibsales_{it} \cdot post2_t + \beta_8 \cdot ocftotas_{it} + \beta_9 \cdot cashcurras_{it} + \beta_{10} \cdot salesgrow_{it} + \varepsilon_{it}. \quad (2)$$

We also added equation (3) with the extended set of regressors. Equation (3) is aimed at investigating the influence of net profit margin on net trade credit during crisis and non-crisis periods. *ocftotas* is chosen as a liquidity measure; vulnerability measures

currascurreliab, *curlibsales* and *curlibtotas* are taken into account. Moreover, the dynamics of net trade credit is controlled to convert a firm's net income to cash (*coanetincome*) and total assets efficiency (*totalasseffc*).

$$\begin{aligned} NTC_{it} = & \alpha_i + \beta_1 \cdot crisis_t + \beta_2 \cdot post1_t + \\ & + \beta_3 \cdot post2_t + \beta_4 \cdot profsales_{it} + \\ & + \beta_5 \cdot profsales_{it} \cdot crisis_t + \beta_6 \cdot profsales_{it} \cdot post1_t + \\ & + \beta_7 \cdot profsales_{it} \cdot post2_t + \beta_8 \cdot ocftotas_{it} + \\ & + \beta_9 \cdot currascurreliab_{it} + \beta_{10} \cdot curlibsales_{it} + \\ & + \beta_{11} \cdot curlibtotas_{it} + \beta_{12} \cdot coanetincome_{it} + \\ & + \beta_{13} \cdot totalasseffc_{it} + \beta_{14} \cdot salesgrow_{it} + \varepsilon_{it}. \end{aligned} \quad (3)$$

To compare the behavior of more/less efficient firms, we estimate equation (4), which investigates how the efficiency of firms affects the net trade credit dynamics controlling for liquidity (*ocftotas*), firm's vulnerability (*curlibsales*) and growth opportunities (*salesgrow*).

$$\begin{aligned} NTC_{it} = & \alpha_i + \beta_1 \cdot crisis_t + \beta_2 \cdot post1_t + \\ & + \beta_3 \cdot post2_t + \beta_4 \cdot totalasseffc_{it} + \\ & + \beta_5 \cdot totalasseffc_{it} \cdot crisis_t + \\ & + \beta_6 \cdot totalasseffc_{it} \cdot post1_t + \\ & + \beta_7 \cdot totalasseffc_{it} \cdot post2_t + \beta_8 \cdot ocftotas_{it} + \\ & + \beta_9 \cdot salesgrow_{it} + \beta_{10} \cdot curlibsales_{it} + \varepsilon_{it}. \end{aligned} \quad (4)$$

To compare the behavior of firms, taking into account their ability to convert income to cash, we estimate equation (5). As in equation (4), we control liquidity, vulnerability and growth opportunities.

$$\begin{aligned} NTC_{it} = & \alpha_i + \beta_1 \cdot crisis_t + \beta_2 \cdot post1_t + \\ & + \beta_3 \cdot post2_t + \beta_4 \cdot coanetincome_{it} + \\ & + \beta_5 \cdot coanetincome_{it} \cdot crisis_t + \\ & + \beta_6 \cdot coanetincome_{it} \cdot post1_t + \\ & + \beta_7 \cdot coanetincome_{it} \cdot post2_t + \beta_8 \cdot ocftotas_{it} + \\ & + \beta_9 \cdot salesgrow_{it} + \beta_{10} \cdot curlibsales_{it} + \varepsilon_{it}. \end{aligned} \quad (5)$$

The estimation of equations (1)–(5) is conducted by the standard panel data models: pooled OLS, random effects and fixed effects. The general equation, which nests all the above mentioned panel models is presented in (6).

$$y_{it} = \alpha_i + \beta^T X_{it} + \varepsilon_{it}, \quad (6)$$

where y_{it} is dependent variable of i th firm at time t ; X_{it} is the vector of k independent variables of i th firm at time t ; α_i is a parameter which can be treated as a fixed effects term in the corresponding model, a part of error term ε_{it} in the random effects model or a constant in the pooled OLS model; β is $k \times 1$ vector of coefficients; uppercase T means transposition [29]. To account for autocorrelation and heteroskedasticity in errors we use feasible generalized least squares panel data estimator.

4. EMPIRICAL RESULTS

In this section, the results from the descriptive statistics, analysis of variance and regression results are presented and discussed.

4.1. Descriptive statistics

The descriptive statistics presented in *Tabl. 3* show that on average, the selected firms have sold more than purchased on credit. This is denoted with the average positive NTC. Furthermore, on average, the findings are the following:

- Firms have much more short-term liquidity measured by current assets to current liabilities comparing to the rule of thumb (2:1), i.e. short-term assets are 4.41 times higher than current liabilities.
- Each 100 denars of sales generate roughly 15 denars of profit.
- Cash and its equivalents amount to 8% of current assets.
- There is negative value of net cash flow from operating activities to net income, which means lower ability to convert income into cash.
- Each 100 denars of total assets generate approximately 58 denars of sales.
- Current liabilities to sales ratio is around 84%.
- Total assets are financed with current liabilities by around 26%, indicating that the rest percent is a mix of long-term liabilities and equity.
- Each 100 denars of total assets generate around 4 denars of cash flows from operating activities.
- Finally, in the current year, sales were decreased by 6% comparing to the previous year.

4.2. Analysis of variance

We compare the meaning of the variables, when $crisis = 1$ and $crisis = 0$. If p-value is higher than 5%, then there is no difference between non-crisis and crisis periods, *Tabl. 4*.

According to the ANOVA test above, the meanings of the variables during non-crisis and crisis periods are the same for all variables except *profsales*. For *profsales*, the null hypothesis is rejected at 10%. Thus,

Table 3

Descriptive statistics

Variable name	N	Min.	1stQ.	Mean	Median	3rdQ.	Max.	St.dev.	Skewn.	Kurt.
NTC	115	-0.520	-0.029	0.139	0.089	0.232	3.780	0.422	5.718	46.255
Currascurreliab	115	0.245	0.706	4.406	1.887	3.187	70.668	8.863	4.600	26.753
Profsales	115	-0.554	-0.002	0.149	0.026	0.085	9.850	0.951	9.254	91.113
Cashcurras	115	0.000	0.012	0.081	0.034	0.088	0.875	0.134	3.328	12.739
Coanetincome	115	-1284.379	-0.092	-6.495	0.974	2.479	1115.583	172.483	-1.377	39.671
Totalasseffc	115	0.015	0.171	0.572	0.399	0.783	2.742	0.544	2.097	5.281
Curlibsales	115	0.035	0.217	0.835	0.483	0.700	13.258	1.596	5.235	32.783
Curlibtotas	115	0.003	0.107	0.255	0.194	0.424	0.708	0.195	0.628	-0.756
Ocftotas	115	-0.111	0.002	0.037	0.034	0.070	0.236	0.054	0.483	1.095
Salesgrow	115	-0.982	-0.134	-0.064	-0.020	0.043	0.921	0.210	-0.151	7.387

Source: compiled by the authors.

there is no difference between two periods, non-crisis and crisis, for the studied variables. The result is presented in Fig. 2 in the Appendix. At a closer look at the results and the yearly analysis, on average, NTC increased in 2012 by 24%, in 2013 by 136%, and in 2014 and 2015 it decreased by 55%, respectively 22%. NTC calculation implies that it can be affected by accounts receivable, accounts payable, and by sales. Increasing accounts receivable, accounts payable, and sales means that NTC is increasing, decreasing and decreasing respectively.

In 2012, compared to 2011, the increase of NTC by 24% was caused by decreasing in sales amounts by 5%, increasing accounts receivable by 1%, and decreasing accounts payable by 13%. In 2013, the increase of NTC by 136% was caused by decreasing in sales amounts by 11%, decreasing accounts receivable by 2%, and decreasing accounts payable by 2%. In 2014, the decrease of NTC by 55% was caused by decreasing in sales amounts by 8%, decreasing accounts receivable by 22%, and decreasing accounts payable by 20%. In 2015, the decrease of NTC by 22% was caused by decreasing in sales amounts by 7%, decreasing accounts receivable by 12%, and increasing accounts payable by 3%. The results above show clearly that there is a negative trend for the triple: accounts receivable, accounts payable and sales. In other words, during and after the crisis, business activity of the firms has declined. Probably, this happened due to the crisis effects. During the crisis in 2012, NTC was increased by 24%, while next year there was enormous increase at 136%. From the NTC perspective, this denotes that the firms sold much more than they bought on credit. There are some possible explanations for this crisis year and the following years.

ANOVA

Table 4

Variable name	P-value
NTC	0.4654
Currascurreliab	0.3594
Profsales	0.0965
Cashcurras	0.4570
Coanetincome	0.8956
Totalasseffc	0.2204
Curlibsales	0.1144
Curlibtotas	0.5381
Ocftotas	0.5846
Salesgrow	0.2787

Source: compiled by the authors.

Crisis effects may remain after the crisis due to the contracts signed and other economic events. For example, firms sold merchandise or performed services during the crisis, but they have to collect debtors, or to pay creditors the next year.

In 2012, trade credit use decreased by 13%. It means that the creditors of these firms were concerned about nonpayment and would probably prefer to sell in cash, not on credit. On the one hand, these firms provided trade credit to their client just at 1% more than in the previous year. The relationship between the trade credit provided and obtained is a kind of an action-reaction link. Since the firms didn't get trade credit from their

Table 5

P-values for Wooldridge, Hausman and Breusch-Godfrey tests

Equation	(1)	(2)	(3)	(4)	(5)
Wooldridge	0.0543	0.0608	0.0929	0.1383	0.1882
Hausman	0.9958	0.9994	0.9992	—	—
Breusch-Godfrey	0.0035	0.6455	0.8386	0.7066	0.1786

Source: compiled by the authors.

suppliers, they do not seem to be motivated to offer it to their clients (or at least to provide a low percentage not to lose them). However, in 2013, there might be many debtors from the previous year who have not yet paid. We are not sure if there was a 2% decrease in 2013, but both accounts receivable and payable are due to old debtors/creditors, or from the previous ones. In fact, this is a limitation of this study which doesn't classify debtors and creditors by days as some authors did, for example [14]. However, this has been done due to few observations available: each classified group would have very few observations, not sufficient for further analysis.

Furthermore, in 2013 and 2014 from the changes in trade receivables and payables, it seems that there is a balance of what is sold and bought on credit. Even though in 2014 there was a sharp drop in NTC that continued the next year. From the perspective of NTC, in the last two years the firms sold less than purchased on credit. One rational argument is that the firms were financially constrained in the last two years; they reformulated their trade credit policies. To confirm this, there are also findings of trade receivables and payables over total assets, such as: 2012 (–3% and –9%), 2013 (–7% and –2%), 2014 (–13% and –7%), and 2015 (–9% and 2%).

4.3. Estimation and testing

First, we estimated the standard panel data models, including the pooled panel, fixed effects and random effects (with different estimators of random effects) for each of the equations (1) to (5). Then, we run several tests to choose the appropriate models. We apply 10% level of significance to the testing procedures, since the number of observations is not so big. P-values of all tests are presented in *Tabl. 5*.

First, we run general Wooldridge test aimed to define if there are any unobserved effects in the residuals of the pooled OLS model [29]. According to *Tabl. 5*, the first three equations demonstrate unobserved effects in the pooled OLS model residuals. Equations (4) and (5) do not provide any unobserved effects according

to the test, so we'll use the pooled OLS estimator for these equations.

Hausman test is to distinguish between the fixed and random effects models [30]. We see that for equations (1)–(4) both fixed and random effects are consistent, so we should use the efficient estimator — random effects model.

We also do two tests [31, 32] to define the character of the effects: individual effect, time effect or both. Two different estimators of this test show the same result: there are individual effects, but no time or two-sided effects. The results are valid both at 5% and 10% levels of significance.

Standard Breusch-Godfrey test [29] is used to check if there is a serial correlation in errors. According to *Tabl. 5* the hypothesis of the absence of autocorrelation is not rejected at any reasonable level for models (3)–(5). At the same time, the errors in models (1) and (2) demonstrate significant autocorrelation.

To sum up, there are unobserved effects in the data for equations (1)–(3) and the effects are related to individual effects, because time effects are insignificant. Since both fixed effect and random effect estimators are consistent, the latter one is used due to its efficiency. Besides, model (1) shows a significant serial correlation in the errors. The serial correlation can be considered if using the robust covariance or the FGLS estimator.

4.4. Discussion

Considering the results of diagnostic testing conducted in section 4.3, we apply the following estimators for equations (1)–(5): the random effects model is applied for equations (1)–(3) and the pooled OLS — for the others. In order to correct standard errors for autocorrelation in equation (1) we take the FGLS estimator [33].

The estimates of equation (1) are presented in *Tabl. 6*.

As seen from the ANOVA test, there are no crisis effects because *crisis*, *post1* and *post2* variables are insignificant. The only variable which affects NTC is *salesgrow*. Multiple R-squared is 18.5%. As a matter of fact, the dynamics of trade credit amounts for Macedonian firms

Table 6

Results for equation (1), RE FGLS estimator

	Estimate	Std. Error	t-stat	Pr(> t)	
(Intercept)	0.0514	0.0775	0.6633	0.5072	
Crisis	0.0560	0.0573	0.9764	0.3289	
Post1	0.1531	0.1381	1.1092	0.2673	
Post2	0.0614	0.0812	0.7563	0.4495	
Ocftotas	-0.6155	0.4712	-1.3064	0.1914	
Cashcurras	0.1476	0.2145	0.6882	0.4913	
Salesgrow	-0.6790	0.0953	-7.1264	0.0000	***

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1, ' ' 1.

Source: compiled by the authors.

is driven only by sales growth. Since the coefficient is negative, receivables tend to decrease when sales grow. At the same time the amount of payables go up with sales growth. So generally, the firms tend to give less and take more trade credits when the turnover grows.

The random effects estimates for equation (2) are presented in *Tabl. 7*. Multiple R-squared is 75.2%. Equation (2) checks the hypothesis that more vulnerable firms suffer more from the crisis. From *Tabl. 7* it is seen that the effect of vulnerability is significant and positive for one year after the crisis. It means that more vulnerable firms in average tend to give more and take less trade credits right after the crisis comparing to 2015. The other measures of vulnerability are insignificant at any level. Sales growth negatively affects the dynamics of net trade credits.

Since equation (3) does not show the serial correlation in the errors, we apply the usual random effects estimator. The results are presented in *Tabl. 8*. The results for equation (3) reveal that net profit margin has significant influence on net trade credits. As in the previous case, the effect is perceptible during the first year after the crisis and more profitable firms demonstrate higher net trade credits right after the crisis than in more stable periods later. Sales growth remains a significant factor for NTC dynamics.

The results for equations (4) and (5) are similar, see *Tabl. 9* and *Tabl. 10*. Both regressions are significant, multiple R-squared is 63.6% and 64% respectively. The results show no strong evidence that the total assets efficiency of the firms and their ability to convert income into cash have significant influence during the crisis and post-crisis periods. The main determinants of NTC dynamics are sales growth and the ratio of current liabilities to sales.

To summarize, the estimations of equations (1)–(5) do not provide convincing evidence of the impact of the crisis on the dynamics of the net trade credit for registered Macedonian firms. The main factors determining the dynamics of the net trade credit are the growth opportunities of firms and their vulnerability, measured as the ratio of current liabilities to sales.

5. CONCLUSION

In this article, we have offered and evaluated five models to study the dynamics of the net trading creditworthiness of Macedonian registered firms during the crisis and post-crisis periods. We have studied general net trade credit behavior of the firms before and after the crisis (model (1)) and have evaluated how such factors as financial vulnerability (2), profitability (3), effectiveness (4) and the ability to generate cash (5) affect this behavior.

The research methodology includes the analysis of variance, estimation of standard panel data models with the correction for the serial correlation, heteroscedasticity in errors and diagnostic tests of Wooldridge, Hausman and Breusch-Godfrey.

We have collected the panel data from the financial statements of 2011–2015 and estimated the appropriate panel data models basing on several diagnostic tests. According to the Wooldridge test for the unobserved effects, they are significant to three of five models at 10% level. Thus, the other two models have been estimated by a simple pooled OLS. The random effect estimator has been chosen as an effective one for the first three models. This is due to the Hausman test which showed the null hypothesis was not rejected for these three models

Table 7

Results for equation (2), RE estimator

	Estimate	Std. Error	t-stat	Pr(> t)	
(Intercept)	-0.0345	0.0673	-0.5135	0.6090	
Crisis	0.0800	0.0577	1.3858	0.1696	
Post1	-0.0196	0.0510	-0.3849	0.7013	
Post2	0.0155	0.0524	0.2966	0.7675	
Curlibsales	0.1274	0.0252	5.0633	0.0000	***
Ocftotas	-0.6223	0.3818	-1.6302	0.1070	
Cashcurras	0.0706	0.2060	0.3429	0.7325	
Salesgrow	-0.2280	0.1055	-2.1608	0.0337	*
Crisis*curlibsales	0.0147	0.0634	0.2324	0.8168	
Post1*curlibsales	0.1576	0.0252	6.2557	0.0000	***
Post2*curlibsales	0.0349	0.0298	1.1741	0.2438	

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1, '' 1.

Source: compiled by the authors.

Table 8

Results for equation (3), random effects estimator

	Estimate	Std. Error	t-stat	Pr(> t)	
(Intercept)	-0.2711	0.1461	-1.8559	0.0673	.
Ocftotas	-0.6959	0.4136	-1.6827	0.0965	.
Salesgrow	-0.4325	0.0999	-4.3295	0.0000	***
Profsales	-0.3595	0.1825	-1.9695	0.0525	.
Crisis	0.1407	0.0523	2.6891	0.0088	**
Post1	0.0946	0.0481	1.9667	0.0528	.
Post2	0.0637	0.0482	1.3231	0.1897	
Currascurliab	0.0055	0.0035	1.5479	0.1258	
Curlibsales	0.2533	0.0215	11.7918	0.0000	***
Curlibtotas	-0.6913	0.3396	-1.9706	0.0524	.
Coanetincome	-0.0000	0.0001	-0.0734	0.9416	
Totalasseffc	0.4708	0.1637	2.8764	0.0052	**
Profsales*crisis	0.1200	0.2803	0.4282	0.6697	
Profsales*post1	0.6588	0.2121	3.1067	0.0026	**
Profsales*post2	0.1314	0.2870	0.4578	0.6484	

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1, '' 1.

Source: compiled by the authors.

Table 9

Results for equation (4), pooled OLS estimator

	Estimate	Std. Error	t-stat	Pr(> t)	
(Intercept)	-0.1675	0.0790	-2.1194	0.0371	*
Ocftotas	-0.3592	0.4948	-0.7258	0.4700	
Salesgrow	-0.4890	0.1372	-3.5629	0.0006	***
Crisis	0.2182	0.1113	1.9605	0.0534	.
Post1	0.2539	0.1084	2.3424	0.0216	*
Post2	0.1121	0.1067	1.0511	0.2963	
Totalasseffc	0.0629	0.1079	0.5833	0.5613	
Curlibsales	0.1937	0.0167	11.5879	0.0000	***
Crisis*totalasseffc	-0.1317	0.1458	-0.9028	0.3693	
Post1*totalasseffc	-0.2006	0.1509	-1.3291	0.1875	
pPost2*totalasseffc	-0.0652	0.1475	-0.4421	0.6596	

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1, ' ' 1.

Source: compiled by the authors.

Table 10

Results for equation (5), pooled OLS estimator

	Estimate	Std. Error	t-stat	Pr(> t)	Pr(> t)
(Intercept)	-0.1182	0.0642	-1.8414	0.0692	.
Ocftotas	-0.5479	0.5090	-1.0765	0.2849	
Salesgrow	-0.5035	0.1362	-3.6976	0.0004	***
Crisis	0.1242	0.0786	1.5800	0.1180	
Post1	0.1434	0.0779	1.8412	0.0693	.
Post2	0.0692	0.0779	0.8876	0.3774	
Coanetincome	0.0003	0.0002	1.2949	0.1990	
Curlibsales	0.1971	0.0160	12.3368	0.0000	***
Crisis*coanetincome	-0.0008	0.0011	-0.7009	0.4854	
Post1*coanetincome	-0.0005	0.0003	-1.6156	0.1101	
Post2*coanetincome	0.0002	0.0005	0.3804	0.7046	

Significance codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1, ' ' 1.

Source: compiled by the authors.

at any level. The Breusch-Godfrey test did not reject the serial correlation only for the first model where the FGLS estimator was applied.

As a result, the main factor determining net trade credits for Macedonian registered firms is sales growth that has a significant and negative impact on the former. At the same time the crisis effects are insignificant in our sample for all cases except profitability. The same is for effectiveness and the

ability to generate cash. On the other hand, vulnerability of firms, measured as the ratio current liabilities to sales and profitability, evaluated as net income over sales, significantly affects NTC.

The results show that the dynamics of trade credits of Macedonian registered firms is greatly driven by internal firm factors rather than external macroeconomic situation. Thus, a better financial management is suggested to improve the trade credit policy.

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Appendix

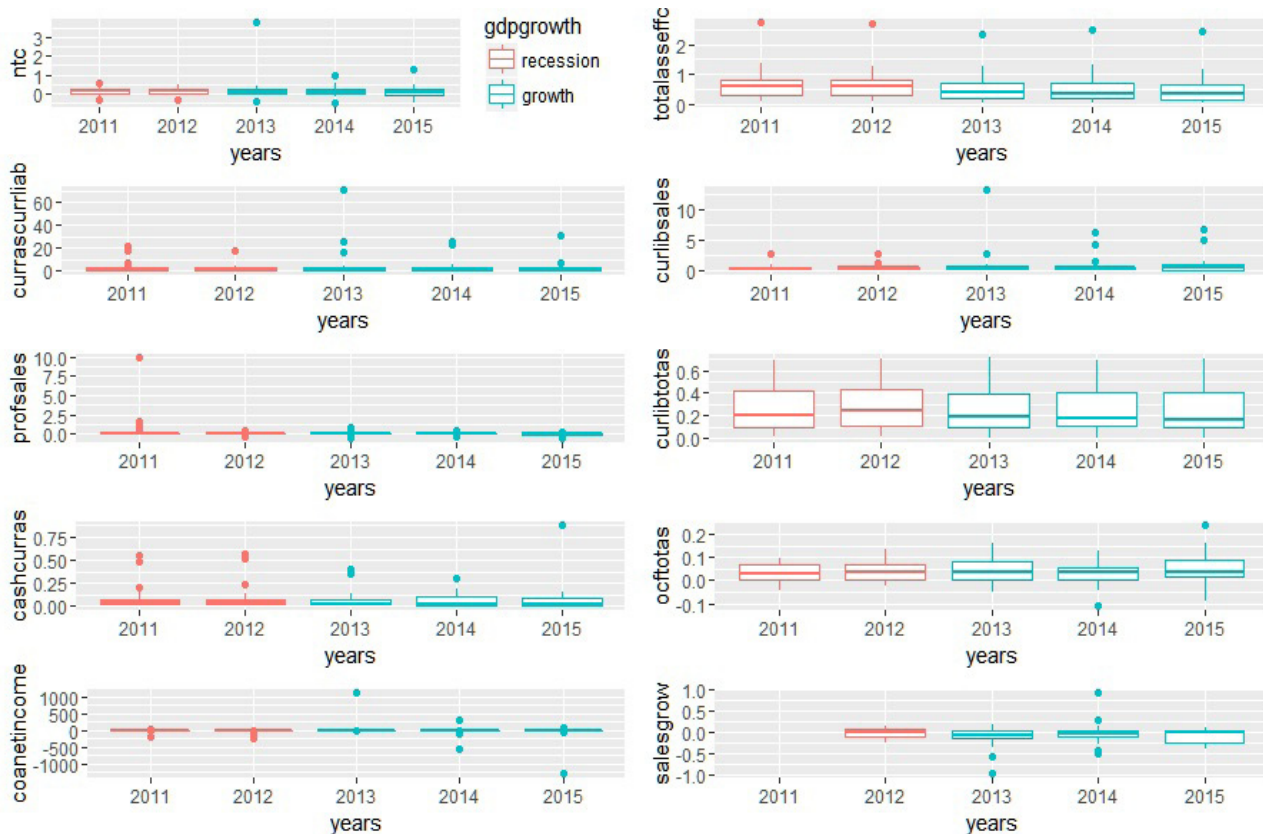


Fig. 1. Boxplots for selected variables

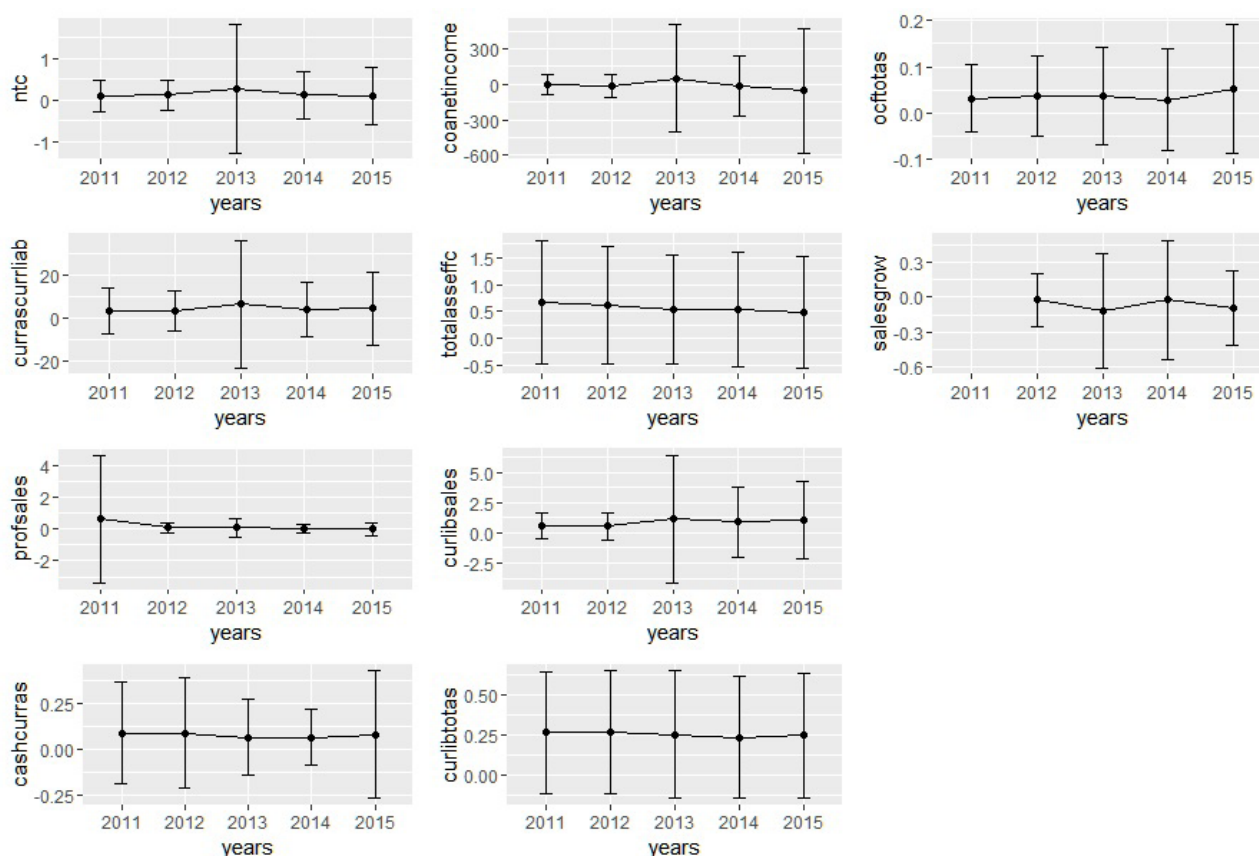


Fig. 2. Average values with error bars for selected variables

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