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Modelling the impact of macroeconomic variables on aggregate corporate insolvency: case of Croatia

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ABSTRACT
The majority of research papers dealing with corporate failure and insolvency in transition countries use a combination of financial ratios in investigating corporate failures, i.e., the microeconomic approach. By relying solely on the microeconomic approach, it is not possible to completely capture the complexity of business operations. In recent years, there has been a growing interest in exploring the predictive power of macroeconomic variables in forecasting insolvencies. As the macroeconomic approach has been applied mainly in the analysis of developed economies, this article investigates the influence of macroeconomic variables on aggregate corporate insolvency in Croatia, using the vector error-correction model (VECM) for the period 2000–2011. The results have shown a long-run dynamic connection between the corporate insolvency rate and the rate of unemployment while corporate credits, long-term interest rates and industrial production have a short-term effect on the corporate insolvency rate.

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1. Introduction

Recent developments in Croatia and the rest of the world again proved that, in times of crisis, the majority of companies, regardless of their sector, ownership or organisational structure, face negative rates of return and/or problems of illiquidity. This results in insufficient funds to cover current liabilities, or in more severe cases, insolvency. In times of crisis, companies fail to pay their obligations to creditors and try to solve their financial problems by taking on even more debt, which further exacerbates the problems and eventually leads to insolvency, i.e., company failure.

There are many definitions of company failure. It is generally believed that there are two main reasons for this. Failure may occur due to a company's withdrawal from unprofitable operations, even though they are actually capable of covering liabilities. Insolvency is another reason why companies cease their operations. The difference lies in a company's ability to pay their obligations to creditors (Dunis & Triantafyllidis, 2003).

Among the first to make the distinction between the terms 'failure', 'insolvency' and 'bankruptcy' was Altman (1971). The term *failure* implies the inability to achieve an adequate return on investment. The company can be operational for years before they cease

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their business operations. Insolvency means that the company cannot pay its liabilities when they fall due, which may be a temporary situation (technical insolvency) or a permanent situation (permanent insolvency) during which liabilities exceed the value of company's assets. Bankruptcy is the judicial proceeding of settling debts by selling the debtor's assets and distributing the collected funds to creditors. During bankruptcy, it is possible to develop a bankruptcy or restructuring plan to preserve the activities of the debtor. If the restructuring plan fails, the company enters the liquidation stage, during which, all the company's assets are sold and distributed among creditors.

Various methods and models, both at micro- and macro-level, have been developed in order to provide information for stakeholders on whether a company is heading for bankruptcy. Most of the authors have based their studies on analysing financial ratios, i.e., they have used the microeconomic approach in predicting a company's bankruptcy. In doing so, the authors used previous research results to derive models which would be applicable to their country's specific conditions. The derived models are based, for the most part, on multivariate statistical techniques such as the multiple discriminant analysis, logit and probit models.

Recently, in financial literature, significant attention has been paid to the changes and the effects of the macroeconomic environment on business failure and thus, company insolvency. The number of unsuccessful firms is higher during recession than in times of prosperity, which logically implies that macroeconomic variables should be included in predicting insolvency and company failure. Nevertheless, the majority of papers predicting business failures and insolvency include only the microeconomic approach, and only a few take into consideration the influence of macroeconomic variables.

The purpose of this article is to fill this gap by investigating the dynamic causal relationship between corporate insolvency and macroeconomic variables.[1] These could include variables such as: nominal and real gross domestic product (GDP), industrial output, aggregate corporate credit, inflation, interest rates, exchange rate, exports, money supply, bond yields and the price of credit default swap (CDS) for Croatia. The article examines which of the abovementioned macroeconomic factors have an impact on the corporate insolvency ratio. The scientific contribution of the article lies in the analysis of the dynamic interaction between macroeconomic variables and corporate insolvencies by applying the vector error-correction model (VECM). The employed model is designed to capture the dynamic response of corporate insolvencies to the changes in macroeconomic variables, as well as their dynamic interactions. The article analyses short-run intertemporal co-movements between the corporate insolvencies and macroeconomic variables as well as their long-run equilibrium.

The initial model was revised by testing different model specifications and using different combinations of independent variables. Some of the tested variables were rejected due to their statistical insignificance and multicollinearity. The final model included the following endogenous variables: ratio of insolvent to active companies, aggregate corporate credit, long-term interest rate and unemployment rate.

The article is organised as follows: section 2 provides overview of existing literature on the effects of macroeconomic variables on the corporate sector, while section 3 presents the data and the methodology used in the econometric modelling. The empirical results are presented in section 4 while section 5 presents the results of variance decomposition and diagnostic testing. Finally, section 6 summarises the findings and draws conclusions.

2. Literature review

A majority of research on corporate failures is mainly focused on cross-sectional analysis and does not take into consideration the actual behaviour of the variables affecting the survival of the company over time. One of the most criticised flows in this approach is the neglect of the macroeconomic environment in which companies operate, and which undoubtedly plays a significant role in determining the financial health of companies (Liu, 2004).

Altman (1971, 1983) was the first to recognise the influence of the macroeconomic environment in forecasting corporate bankruptcy. He analysed the interrelation of the corporate decline rate in the US and different macroeconomic factors. In his research, one of the most important causes of bankruptcy was the 'credit squeeze', especially in times of restrictive monetary and credit policy. He found that the possibility of corporate failures rises in times of decreased economic growth (measured by gross national product (GNP)), tight money supply (M2) and low investor expectations. Desai and Montes (1982) investigated the impact of interest rates and money supply growth on company failures in Britain from 1945 to 1980. They found that interest rates, unlike money supply, have a positive effect on failures. Hudson (1986) used the real interest rate and the birth rate of new companies as explanatory variables of compulsory and voluntary liquidations. He noted that real interest rates have a negative sign. In times of recession, when interest rates are usually higher, only the high-debt businesses will take on additional debt since they are the first to face insufficient financial resources. In determining the causes of company failures in the period from 1964 to 1981, Wadhwani (1986) discovered that inflation is a significant variable, since the rise in nominal interest rates can result in insolvency if the rise in interest rates is not followed by a proportional rise in revenues. He finds that real wages, real input prices, capital gearing, real and nominal interest rates and measures of aggregate demand are significant in explaining the liquidation rate of companies. Davis (1987) extends Wadhwani's theoretical model and uses the error correction model to avoid spurious regression which is frequently found in non-stationary time series. He found that the nominal interest rate, real GNP, real input prices and the dept/GNP ratio are significant variables in predicting corporate failures.

Platt and Platt (1994) investigated the impact of macroeconomic variables on corporate failure in the US from 1969 to 1982 by using the cross-sectional correlated autoregressive model for four subgroups of US states. They took the real interest rate, real wage costs, profits, change in employment (a proxy variable for business cycles) and the business formation rate as explanatory variables. Their results confirmed the theoretical expectations according to which the corporate failure rate is negatively related to the measures of economic activity (change in employment and profits) and positively related to costs (real wages and business formation rate).

Young (1995) focused on the impact of interest rates on corporate liquidations. He upgraded Wadhwani′s model and found that the unanticipated component of the real interest rate, the growth rate of new companies, aggregate demand, real input prices, the nominal interest rate and the ratio of bank debt to the replacement cost of capital are significant in predicting the liquidation rate. Moreover, he found that a higher interest rate than expected was the main cause for the increase in the number of liquidations in the early 1980s, while in the 1990s the main cause of liquidations was the rise in the debt levels.

Cuthbertson and Hudson (1996) found that different measures of profitability and the birth rate of new companies are significant variables in explaining compulsory liquidations. They were the first to introduce the dummy variable (Insolvency Reform Act in 1985–86) in the study of bankruptcies in 1988.

To conclude, the abovementioned authors analysed the impact of macroeconomic variables such as interest rates (Desai & Montes, 1982; Hudson, 1986; Liu & Wilson, 2002; Turner, Cotts, & Bowden, 1992), GDP (Dunis and Triantafyllidis and many other authors), money supply growth (Desai & Montes, 1982), inflation (Wadhwani, 1986), foreign exchange rate (Goudie & Meeks, 1991), birth rate of new companies (Cuthbertson & Hudson, 1996) and changes in bankruptcy legislation (Liu & Wilson, 2002). Due to the methodology used in the earlier stage of corporate failure analysis, it was quite difficult to separately interpret long- and short-term behaviour of corporate failures in terms of macroeconomic activity.

In order to separate the short- and long-term effects of macroeconomic variables on corporate failures, most authors used a variety of time series techniques, among which the most commonly used were the VECM and the Autoregressive Distributed Lag (ARDL) models. Liu and Wilson (2002) explored the impact of aggregate economic variables in UK, such as interest rates and legislation for the time period 1966–1998. In her later studies, Liu (2004, 2009) used the VECM to investigate the short- and long-term impact of macroeconomic determinants on corporate failures in the UK from 1966 to 1999. The results showed that failure rates are related to interest rates, debt, profitability, price and company birth rates. Liu suggested that nominal interest rates influence the movement of the corporate failure rate both in short and the long run and thus can be used as a useful monetary policy instrument in reducing corporate failures. In addition, she confirmed the significance of the dummy variable, the 'Insolvency Act' reform in 1986. Vlieghe (2001a, 2001b) used the ARDL approach and developed the model according to which the rate of corporate liquidations depends on the determinants of profitability (real wages, aggregate demand, real interest rates which have better explanatory power than aggregate profits), level of indebtedness and inflation. He found that the birth rate of new companies, the index of property prices and the nominal interest rates have significant short-term influence on the liquidation rate. Property prices are found to be significant since property is often used as collateral for corporate borrowing. The same applies to the birth rate of new companies, since younger companies are more likely to fail than more established businesses, and therefore the increase in these variables most commonly results in the increase in corporate failures. He also found that significant long-run determinants of the liquidation rate included real interest rates (consistent to the debt-deflation theory), debt to GDP ratio, deviations of GDP from trend and the costs of real wages. Like Cuthberston, Hudson and Liu, Vlieghe also included a dummy variable in his model representing the temporary effect of the Insolvency Act 1985–86 and found it insignificant. Halim et al. (2008) examined macroeconomic determinants of corporate failures in Malaysia and found that in the long-run, the average lending rate, inflation and GDP had strong impact on corporate failures. The results revealed that the Asian financial crisis significantly contributed to rise of the corporate failure rate in Malaysia. Salman, Friedrichs and Shukur (2011) analysed macroeconomic factors influencing corporate failure using the VECM. They found that of Swedish SME manufacturing companies, in the long-run, corporate failure is negatively related to the level of industrial activity, money supply, GNP and the economic openness rate, and positively related to real wages. They introduced the 'economic openness rate' as an important variable for small open economies, which is measured by the exports, and which has a positive influence on the growth of companies and a negative influence on bankruptcies.

Research on this issue is relatively scarce in Central and Eastern European (CEE) countries as these countries have a short tradition of operating in market conditions (most companies were state owned). Therefore, the data is relatively scarce and inaccessible to key stakeholders (Sajter, 2008). Jakubik and Schmieder (2008), in their study on credit risk, point out the unavailability of data as the main constraint for serious research in these countries. They highlighted the problem of short and volatile time series, which were additionally affected by various structural breaks thus further complicating research.

All of the above mentioned may be considered as the main cause for the lack of research dealing with corporate insolvency from a macroeconomic point of view, making it a challenging research topic.

3. Methodology and data

Vector autoregression (VAR) emerged as an important tool in the empirical analysis of macroeconomic time series in the early 1980s (Cooley & Dwyer, 1998). The key property in a VAR model is the stationarity[2] of all variables included in the model. To examine the stationarity of variables, it is necessary to apply well known unit root tests such as the Augmented Dickey-Fuller test (ADF) and the Phillips-Peron test (PP). In this sense, if variables are not stationary, they have to be transformed to become stationary. In practice, macroeconomic time series are often non-stationary. By differencing non-stationary variables, it is possible to make them stationary, and as such, include them in VAR models.

This is also the main drawback of the VAR model as the differencing of variables omits important information about the dynamics of the mutual phenomena (e.g. the existence of cointegration among the variables), and at the same time, does not improve the efficiency of the estimated autoregression models.

Although most economic series are non-stationary, it is possible to have a stationary linear combination of integrated variables. Such variables are said to be cointegrated. If two variables are cointegrated, i.e., tend to reach a long-term equilibrium, the causality must exist at least in one direction. The appropriate way to treat this kind of variables is to apply the VECM because it allows better understanding of non-stationary variables and also improves longer term forecasting (Žiković & Vlahinić-Dizdarević, 2011).

In order to analyse whether macroeconomic variables have an impact on aggregate corporate insolvency in Croatia, the VECM was applied.

3.1. Cointegration and the Vector Error Correction Model

Recent research indicates that the VAR model is valid only if the underlying variables are not cointegrated. Namely, if the variables are cointegrated, the VECM should be estimated rather than the VAR (Granger, 1988). In a VAR model, the long-run information is removed by the first differencing of variables, and can recognise only the short-run relationship between variables. VECM can avoid such shortcomings and distinguish between long and short run relationships among variables. Moreover, it can identify sources of causality that cannot be detected by the usual Granger causality test. According to the Granger representation theorem, this causality can be expressed through the error-correction model derived from the long-run cointegrated vectors.

A general VAR(k) of $I(1)$ x (ignoring the constant and deterministic trends):

$$x_t = \sum_{i=1}^{k} \Pi_i x_{t-i} + \varepsilon_t \tag{1}$$

where $x_{t} = [x_{1t} \ldots x_{nt}]'$ is the time series vector of corporate failure and macroeconomic variables, Π_i is an n x m matrix of unknown parameters, while ε_t is an uncorrelated white-noise disturbance.

The **error correction** representation of the form ($x_t = x_{t-1} + \Delta x_t$):

$$\Delta x_t = \sum_{i=1}^{k-1} \Pi_i \Delta x_{t-i} + EC_{t-k} + \varepsilon_t \tag{2}$$

where x_t is the ($nx1$) vector ($x_1, x_2, \ldots x_n$), $EC_{t\text{-}k} = \alpha\beta' x_{t\text{-}k}$ the single cointegration vector in which $\alpha = (\alpha_1, \alpha_2, \ldots\alpha_n)'$ is the speed of adjustment and $\beta = (1, \beta_2, \beta_3, \ldots\beta_n)'$ is the cointegration vector. By estimating the parameters Π_i and $\alpha\beta'$, it is possible to find a connection between the short- and long-term dynamics of the variables in the system. A total change in x_t can be decomposed into a response to the last period's disequilibrium, a moving average and a white noise.

Therefore, the error-correction specification of the empirical model applied in this research is as follows:

$$\Delta INS\_RATE_t = \alpha_0 + \sum_{i=1}^{k-1} \alpha_{1i} \Delta INS\_RATE_{t-i} + \sum_{j=1}^{m} \sum_{i=1}^{k-1} \alpha_2 j, i \Delta X_{j,t-i} + EC_{t-k} + \varepsilon_t \tag{3}$$

where the first three terms in the equation represent short-run dynamics in which m is the number of explanatory macroeconomic variables and the last, fourth term i.e. $EC_{t\text{-}k}$ represents the long-run dynamics. It measures the change in the insolvency rate per unit change in deviation from the equilibrium state between the insolvency rate and macroeconomic variables.

Johansen (1988) used the maximum likelihood approach to examine the cointegration rank and test linear restrictions on vectors by using the standard asymptotic inference. If x_t has n non-stationary components, there may be as many as n-1 linearly independent cointegrated vectors. For instance, if x_t contains only two variables, there is only one independent cointegrating vector. The number of cointegrating vectors is called the cointegration rank of x_t (Enders, 2010).

As in the VAR analysis, innovation analysis can also be used to obtain information concerning the interaction among the variables in the VECM. In fact, VECM can be easily transformed into a function of orthogonalised 'innovations' in macroeconomic variables to interpret the evolution of corporate insolvencies. Consequently, it is possible to analyse the dynamics of corporate insolvencies in terms of the relative contribution of endogenous shocks in macroeconomic variables and their transmission effects (Cooley & Dwyer, 1998; Liu, 2004). In determining the order of variables, the Cholesky factorisation is used in which the largest variance is attributed to first ranked variable. Since the focus of this article is on the analysis of macroeconomic shocks on corporate insolvencies, the variance decomposition is performed on the corporate insolvency ratio.

3.2. Data

The impact of macroeconomic variables on corporate failures and interactions between them is estimated based on the following vectors of endogenous variables: industrial production, aggregate corporate credit, long-term interest rate, unemployment rate and ratio of insolvent companies to the number of active companies in Croatia. The time series consist of quarterly data for the period 1Q2000–4Q2011. All variables are seasonally adjusted and all, except the long-term interest rate and the unemployment rate, are expressed in logarithms.

The data on industrial production (IND), unemployment rate (UNEMP) and the number of active companies are obtained from the Croatian Bureau of Statistics, while aggregate corporate credit (CRED) and long-term interest rates (IRL) from the Croatian National Bank (CNB). The data on the total number of insolvent companies were available only on annual basis. Therefore, for the needs of this article, the quarterly data was acquired from the Financial Agency (FINA). The total number of insolvent companies[3] was divided by the number of active companies to obtain the ratio of insolvent to active companies (INS_RATE).

4. Empirical results

In order to find the best model specification, the author developed a model which satisfies the expected signs of coefficients in accordance with economic theory. Different model specifications were tested, including different combinations of explanatory variables and lags.

The empirical analysis consisted of several steps. First, the unit root tests were used to examine the presence of stochastic non-stationarity in variables. Secondly, the existence of cointegration between the corporate insolvency ratio and macroeconomic variables (including monetary variables) was investigated. Finally, the achieved results were used to estimate the VECM relationship. Considering the fact that some of the independent variables were statistically insignificant, the final model specification included only those variables which were found to be significant. The lag length was chosen by the Akaike (AIC) and Schwartz Bayesian information criteria (SBC). The employed tests showed that the optimal lag structure is three. The Wald test was performed to test the exclusion of insignificant lags. The condition that has to be fulfilled in order to perform a cointegration analysis is that each of the variables must be integrated of the same order. To determine the existence of cointegration, one must first test whether each variable contains a unit root and if variables are integrated of the same order. Since the analysis was performed on a relatively small sample, and unit root tests have low power in small samples, two unit roots tests were applied – ADF and PP. The results are presented in Table 1.

ADF and PP tests take non-stationarity as the null hypothesis, i.e., the underlying variable has a unit root. The (a) part of Table 1 shows stationarity tests in levels while (b) reports

Table 1. Unit root test results.

Variable	ADF value Constant included	ADF value Constant and trend included	Phillips-Perron t, Constant included	Phillips-Perron t, Constant and trend included
(a) Levels				
LINS_RATE	-1.533545 (0.5081)	-0.480784 (0.9811)	-1.581019 (0.4842)	-0.480784 (0.9811)
LIND	-1.770832 (0.3894)	-0.145807 (0.9924)	-2.662008 (0.0883)	-3.035449 (0.1338)
LCRED	-1.333513 (0.6061)	-1.754772 (0.7102)	-0.860651 (0.7919)	-1.403828 (0.8470)
IRL	-1.944578 (0.3094)	-1.560358 (0.7917)	-2.477483 (0.1273)	-2.015703 (0.5778)
UNEMP	-1.719489 (0.4144)	-1.228960 (0.8913)	-1.537733 (0.5060)	-1.396638 (0.8492)
(b) First differences				
First diff.	ADF value Constant included	ADF value Constant and trend included	Phillips-Perron t. Constant included	Phillips-Perron t. Constant and trend included
ΔLINS_RATE	-5.533792 (0.0000)	-5.815135 (0.0001)	-5.533792 (0.0000)	-5.758925 (0.0001)
ΔLIND	-6.531380 (0.0000)	-7.465403 (0.0000)	-6.547002 (0.0000)	-7.497703 (0.0000)
ΔLCRED	-5.140215 (0.0001)	-5.092101 (0.0008)	-5.145045 (0.0001)	-5.092572 (0.0008)
ΔIRL	-2.120940 (0.0409)	-3.023099 (0.0047)	-9.271769 (0.0000)	-10.23944 (0.0000)
ΔUNEMP	-2.648292 (0.0917)	-2.792581 (0.2082)[a]	-5.870426 (0.0000)	-6.422889 (0.0000)

[a]The ADF test with constant and trend showed that the unemployment rate in first-difference is not stationary. A decisive role was attributed to the results of the PP test, which showed that the differenced unemployment rate variable is stationary and integrated of order one.

Notes: Δ is the difference operator. MacKinnon (1996) critical values are used for the rejection of the hypothesis of a unit root (*p*-values in brackets). Unit root tests include constant and trend. The optimal lag lenght is chosen by the Schwarz Information Criterion.

Source: Author's calculations.

stationarity tests in first differences. As the unit root cannot be rejected at a significance level of 5% or more, all variables in levels are non-stationary whereas, all first-differences variables are found to be stationary and therefore are integrated of order one I(1). Since the series are non-stationary in levels, one can assume that a cointegration relationship is possible. In order to determine the number of cointegrating vectors, the Johansen multivariate cointegration procedure (Johansen, 1991, 1988) was used. The procedure was based on two test statistics in order to establish the number of cointegrating vectors: the trace (λ_{trace}) and the maximum eigenvalue statistics (λ_{max}). The null hypothesis for the trace test was that the number of the cointegrating vectors is less than or equal to r. In the maximum eigenvalue test, the null hypothesis was that there are r cointegrating vectors present against the alternative hypothesis that there are (r+1). In addition, the small samples biases and normalisation problems inherent in the OLS approach do not arise under the Johansen method.

Since cointegration is a precondition for estimating VECM, the cointegration relationship between the five variables (LINS_RATE, LCRED, LIND, IRL, UNEMP) was investigated. Table 2 shows obtained results i.e. the number of cointegrating vectors containing three lags.

The trace test indicates one cointegration vector. The same results are obtained by the max-eigenvalue test. Hence, it can be concluded that variables are bound together by a long-term equilibrium relationship. The cointegration rank test results indicate that the best model contains constant term but no trend in the cointegration vector, and does not contain constant or trend in VAR.[4]

Once the cointegration vector had been detected, the VEC model was estimated. The VEC model allows for the long-term behaviour of the endogenous variables to converge

Table 2. Estimation of cointegration vectors.

Unrestricted Cointegration Rank Test (Trace)

Hypothesised No, of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.599160	87.58555	76.97277	0.0062
At most 1	0.480292	51.93200	54.07904	0.0767
At most 2	0.324881	26.40696	35.19275	0.3197
At most 3	0.200276	11.08518	20.26184	0.5339
At most 4	0.058938	2.369121	9.164546	0.7037

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No, of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.599160	35.65355	34.80587	0.0395
At most 1	0.480292	25.52504	28.58808	0.1172
At most 2	0.324881	15.32178	22.29962	0.3491
At most 3	0.200276	8.716057	15.89210	0.4649
At most 4	0.058938	2.369121	9.164546	0.7037

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

Source: Author's calculations.
* denotes rejection of the hypothesis at the 0.05 level.
**MacKinnon-Haug-Michelis (1999) *p*-values.

Table 3. Error correction model estimates (short- and long-run).

LINS_RATE(-1)	Coefficients	Standard error	t-statistics
Long run dynamics (cointegration equation)[a]			
UNEMP(-1)	0.769009	(0.18631)	[4.12747]
Constant	0.016741		
Short term dynamics			
EC term[b]	-0.240687	(-0.07007)	[-3.43518]
D(LINS_RATE(-1))	-0.508503	(-0.16511)	[-3.07979]
D(LINS_RATE(-2))	-0.516446	(-0.17441)	[-2.96113]
D(LCRED(-3))	-1.739679	(-0.71128)	[-2.44583]
D(LIND(-1))	-1.394531	(-0.47045)	[-2.96426]
D(LIND(-2))	-1.091186	(-0.51468)	[-2.12011]
D(IRL(-1))	0.093238	(-0.04531)	[2.05793]
D(IRL(-2))	0.135604	(-0.05536)	[2.44934]
D(IRL(-3))	0.087976	(-0.04351)	[2.02202]

[a]Cointegration equation can also be expressed as follows: $LINS\_RATE = 0.0769009\ \mathrm{UNEMP} + 0.016741$
[b]Adjustment parameter (EC term) was defined based on the cointegration equation as follows: $\mathrm{EC\ term} = LINS\_RATE - 0.0769009\ \mathrm{UNEMP} - 0.016741$ and was included in the VEC model. As such it represents the relationship between short-term and long-term dynamics of the variables in the system.
Notes: Standard error in parentheses and t-statistics in brackets.
Source: Author's calculations.

to their equilibrium state, as well as short-term dynamics between them. The estimates of the VEC model are presented in Table 3.

The only variable proven to be statistically significant in the long-run is the unemployment rate. This indicates that any movement in the unemployment is cointegrated with the changes in the corporate insolvency ratio, i.e., they move in the same direction. If the number of companies that are unable to pay their obligations increases the unemployment rate will also increase. When companies are faced with financial difficulties, they tend to cut costs and lay off employees. If the situation deteriorates further, companies will be unable to pay salaries, which will result in further employee outflow and thus higher unemployment rate.

Based on the cointegration equation, the relevant adjustment parameter of the underlying vector (coefficient of the error correction term) was defined and included in the VEC model. Table 3 shows that the adjustment coefficient has the appropriate negative sign and is statistically significant. This implies that the null hypothesis of no cointegration can be rejected. The adjustment coefficient measures the speed with which corporate insolvency ratio converges to its long-run equilibrium, meaning that 24% of deviations are eliminated from the long-run equilibrium in each quarter. The short run dynamics of the model consisted of LINS_RATE, LCRED, LIND, IRL, the adjustment coefficient (EC term) measuring the speed of variables convergence to their long-run equilibrium and a constant. Only the significant variables are reported.

As expected, results indicated that aggregate corporate credit is a significant explanatory variable in the short-run, implying that the corporate insolvency rate is strongly influenced by shortage of bank loans. This is not surprising given that the companies in Croatia are funded mainly through bank loans. In this case, the 'crowding out' effect[5] is especially pronounced. In late 2008 and early 2009, higher interest rates were caused by the liquidity crises in the money market. During that period, the market was extremely volatile and the demand for money had significantly increased while the supply declined. During this period, over-night interest rates reached levels of almost 40% per annum (Nižetić, 2011). Despite abundant inflow of additional liquidity from the central bank through repo auctions, banks' liquidity was insufficient. In times of recession and tight money supply, highly indebted companies were unable to get funds from other sources and thus fail to pay their obligations, leading to insolvency.

The 'crowding out' effect is dangerous for several reasons. First, it increases the cost of capital due to increased interest rates. Thus, highly indebted companies repay their debts due even harder. As results indicate, long-term interest rates move in the same direction as corporate insolvencies. Secondly, the increase in the interest rates lead to the appreciation of domestic currency which has a negative effect on the trade balance. Third, the 'crowding out' effect usually results in rise of interest rates for the general public. The problem is deepened even further in Croatia since consumer spending is mostly financed through bank loans and credit cards. Thus, higher interest rates will have a negative impact on consumer spending and company profitability due to the reduced demand for their products and services. This process is even more pronounced in the current recession where consumer demand is falling, unemployment rising, and the state can barely pay its obligations (Buturac, Rajh, & Teodorović, 2009). An additional problem is the fact that industrial production in Croatia has gradually been disappearing over the last 20 years and today Croatia is at 69% of its pre-war industrial production.

Another significant problem lies in the fact that the biggest generators of insolvency are central and local government, major retail chains and other large companies. Size, influence and ambition surpasses their income or budget, but enables them to transfer the burden of insolvency onto small businesses. A further problem arises from the fact that Croatian companies are forced to pay VAT on issued invoices (not upon collection) although they are not certain whether they will get paid. It often happens that companies have to take liquidity loans with high interest rates to pay for VAT obligations.

In 2011, in order to solve corporate insolvency, the newly elected government presented a set of measures for economic recovery and tackling the general illiquidity. This included: (1) settling all state debts towards the private sector; (2) initiating bankruptcy procedures for companies that have not covered their obligations due within a 60-day period as prescribed by law; and (3) creating a legal framework enabling companies to pay VAT on collection and not upon invoice issuance, which has largely contributed to the general illiquidity.

In times of recession, highly indebted companies start to feel the financial pressure and are forced to sell their assets and withdraw deposits to pay for their obligations. This leads to a decrease in asset value, reducing the net worth and consequently increasing the probability of insolvency. If deposits and loan repayment decrease, they cause disturbances in money markets and a drop in asset prices. Bernanke and Gertler (1990) presented a model which showed that a drop in a firm's value can result in limited access to loans due to their lower creditworthiness as well as high interest rates. In accordance with this, the results (Table 3) show that increasing long-term interest rates will lead to an increase in the corporate insolvency rate in all three lags. These results are consistent with studies by Desai and Montes (1982), Hudson (1986), Turner etal. (1992), Liu and Wilson (2002) and Liu (2004). The achieved results confirm a positive short-run relationship between long-term interest rates and the corporate insolvency rate in Croatia.

5. Variance decomposition and diagnostic testing

Further analysis of the relationships between corporate insolvencies and macroeconomic variables, can be explained using variance decomposition of the insolvency rate. Table 4 presents how insolvency rate responds to macroeconomic shocks.

As expected, the corporate insolvency ratio is largely explained by its own shocks. Variations in the unemployment rate explain the corporate insolvency ratio better than other variables. During the two-year (eight quarters) time span, the proportion of variance explained by the unemployment rate reaches almost 20%. The variance explained by the long-term interest rates and corporate credits should not be ignored since they account for 13.6% of variation. The adequacy of different models is examined by several misspecification tests. The employed tests show that there is no autoregression or heteroscedasticity in the residuals. Cholesky Variance Orthogonalization and Shapiro-Wilk/Francia test results show that the residuals are normally distributed. Overall, diagnostic statistics indicate that the model is adequately specified, therefore, we can conclude that the model is statistically acceptable.[6]

Table 4. Variance decomposition of the corporate insolvency rate.

Period	S.E.	LINS_RATE	LCRED	UNEMP	LIND	IRL
1	0.080319	97.88519	1.564545	0.000000	0.000000	0.550264
2	0.100087	72.58448	1.431433	17.19862	5.048049	3.737417
3	0.102567	71.55403	1.825660	16.41825	5.570078	4.631982
4	0.111781	67.43680	2.350569	20.65715	4.767252	4.788232
5	0.123726	63.91376	6.327376	18.16415	4.274903	7.319807
6	0.125988	64.60274	6.176979	17.94351	4.216169	7.060603
7	0.136072	62.16463	5.599449	20.19718	4.428084	7.610654
8	0.143244	62.84797	5.790520	19.48101	4.050277	7.830218

Source: Author's calculations.

6. Conclusion

Obtained results reveal a long-term relationship between the unemployment rate and the corporate insolvency ratio in Croatia, while corporate credit, long-term interest rates and industrial production are significant only in the short-run. The monetary policy arrangement affects corporate failures in the short-run, indicating its importance in the survival of companies during financial distress. The results confirm that the number of corporate failures will increase with restrictive monetary policy.

The ongoing financial crisis has caused a rise in borrowing costs in all transitional countries. This caused a rise in domestic interest rates and, at the same time, led to a reduction in corporate loans. The results confirm that the reduction in lending activity and the increase in interest rates limits investment opportunities and reduces consumer spending. In financing domestic companies, the role of capital markets is negligible, and the needs of companies are dependent upon the banks' lending capacity.

Unfavourable macroeconomic conditions combined with the central bank's decision to hold an appreciated foreign exchange rate negatively influenced industrial production which also consequently resulted in increased corporate insolvency. From the 2008 the industrial production in Croatia has been declining at an accelerated rate. This is mainly linked with the decreased activity in the manufacturing industry, the most important component of overall industrial production. Negative trends are also present in other industrial sectors: mining, quarrying, electricity, gas and water. Unfavourable developments in the Croatian industry can only be partly explained by the recession in the EU. Even prior to the current recession, due to the accumulated structural problems, the industry was plagued by bureaucratic barriers, high taxes, appreciated domestic currency and the lack of new investments in the production facilities. Recovery of industrial production is difficult to imagine without seriously altering the monetary and fiscal policies, improving import substitution, strengthening exports and encouraging new investment.

Notes

1. A detailed literature survey on the macroeconomic indicators used in explaining financial distress is given in Tomas and Dimitrić (2011).
2. Mean and variance of underlying variables do not change over time.
3. Bankruptcy law in most transition countries, including Croatia, has little practical effect. For example, if a company is unable to pay its due debts (illiquidity) or its assets are lower than its liabilities (over-indebtedness) it has to declare bankruptcy. In Croatia, managers are required to declare bankruptcy if a company has unpaid debt over 60 days. The main problem is a high degree of tolerance towards insolvent companies which have not declared bankruptcy although they have been insolvent for over 60 days. There is a big difference between the number of companies which are insolvent over 60 days and the number of companies that have declared bankruptcy. For this reason, in examining corporate failures it is necessary to take into consideration the data on insolvent companies rather than the data on bankrupt companies.
4. For more details on model specification see Bahovec and Erjavec (2009), pp. 382–384.
5. When government borrowing increases, the prevailing interest rates rise to a point that makes it too expensive for corporations to borrow, thus affecting their access to credit.
6. Specification tests are available from the author upon request.

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