CROATIAN NATIONAL BANK

Working Papers W-44

Microeconomic Aspects of the Impact of the Global Crisis on the Growth of Non-financial Corporations in the Republic of Croatia

Tomislav Galac

Zagreb, July 2015

WORKING PAPERS W-44

PUBLISHER
Croatian National Bank
Publishing Department
Trg hrvatskih velikana 3, 10002 Zagreb
Phone: +385 1 45 64 555
Contact phone: +385 1 45 65 006
Fax: +385 1 45 64 687

WEBSITE
www.hnb.hr

ISSN 1334-0131 (online)

CROATIAN NATIONAL BANK

WORKING PAPERS W-44

Microeconomic Aspects of the Impact of the Global Crisis on the Growth of Non-financial Corporations in the Republic of Croatia

Tomislav Galac

Zagreb, July 2015

Abstract

The conducted research shows linear relationships between individual corporation characteristics before the outbreak of the global financial and economic crisis in 2008 and corporation growth measured by the number of employed persons during the economic crisis in the period 2009 – 2013. The most important conclusion is that the characteristics associated with faster corporation growth in the pre-crisis period (2003 – 2007) were mainly the same as those associated with faster growth during the crisis, from 2009 – 2013, but only if corporation management during crisis is not factored in. The second most important conclusion is that corporation management during the crisis is relevant for growth. However, even when corporation management during the crisis is factored in, it can be concluded that smaller corporations, state-owned enterprises, corporations that engaged at least to some extent in exporting and corporations that relied less on internal funding, operated on a more efficient scale and were less labour-intensive before the crisis, grew faster during the crisis. The relationships found to exist at this stage of research between growth and other corporation characteristics are only partial correlations in the context of assumed linear models.

Keywords:
global crisis, Croatia, corporation growth

JEL:
D22, E32, J23, L25

Contents

1 Introduction

This paper uses detailed data on the operation of non-financial corporations in Croatia to improve the understanding of microeconomic aspects of the impact of the global crisis on the Croatian economy. This is important because standard macroeconomic data and statistics are not capable of showing the asymmetrical impact of the crisis (or in general, the cyclic fluctuations of aggregate economic activity) on different corporations based on their size, activity, earning power, financial power, ownership structure, geographic location and other key individual characteristics. Therefore, a better understanding of the microeconomic aspects of an economic crisis should improve the ability of economic policy creators to manage the crisis, and in general to lessen the negative social consequences of cyclic fluctuations of the economy in the future and the ability of entrepreneurs to act in a more "counter-cyclical" way when formulating their business strategies.

In general, the global crisis in the small open economies of Central and Eastern Europe led at the beginning to a sudden and sharp fall in domestic and foreign aggregate demand and a significant slowdown in foreign direct investments and inflow of loans (see, for instance Backe et al., 2010). In the first stage of the crisis, Croatia saw a sudden and sharp fall in real activity from the second quarter of 2008 and its culmination in the first quarter of 2009 (for details, see, for instance, Broz et al., 2008 – 2010).

In the second stage of the crisis, from the second quarter of 2009 onwards, economic activity decreased at a much slower rate than at the peak of the crisis. However, at this stage, the impact of the crisis began to be felt much more in the household sector as a result of the late adjustment of corporations and the government to the crisis. Faced with a disproportion between their income and expenditures, it was only at this stage that the government and corporations resorted to more radical saving measures, increasing the fiscal burden and reducing wages and employment (see CNB 2010, 2011).

This prompted increased efforts on the part of fiscal authorities in the second stage of the crisis, which, supported by monetary authorities, launched a number of initiatives to mitigate the effects of the crisis (the Government of the Republic of Croatia, 2009). Unfortunately, not even by end-2013, or five years after the outbreak of the crisis, had the measures taken succeeded in making any significant impact on economic recovery. Quite the opposite, the macroeconomic indicators pointed to a further fall in economic activity from 2011 – 2013. (see CNB, 2012, 2013, 2014).

In the meantime, microeconomic statistical data that became available for the period up to end-2013 enable a deeper analysis of the impact of the global crisis on the Croatian economy in the period 2008 – 2013, which is the aim of this paper. This paper uses the annual financial reports of entrepreneurs in the Republic of Croatia for the period 2002 – 2013 to determine, by means of a statistical analysis, the specific characteristics of those entrepreneurs that were less (more) affected by this crisis than otherwise comparable entrepreneurs, as reflected by their slower (faster) relative growth during the crisis.

The main results of the analysis are summarised in the text below.

The conducted research sets the guidelines for further research into the capacity for corporation growth in the Republic of Croatia during periods of economic crises. The conclusions on the relationship between corporation growth during the crisis and corporation characteristics prior to the crisis should be interpreted as a partial correlation in the context of the assumed linear model. As regards the implications for the pursuit of economic policy and financial risk management (of financial institutions), this paper provides plenty of statistical evidence that corporations with a lower scale of efficiency, higher labour intensity and greater reliance on internal funding will grow more slowly during a crisis. This paper does not show whether this slower growth in the number of employed persons in these corporations during the crisis, compared to otherwise similar corporations, is a reflection of the manner in which these corporations adapt to the crisis or whether it is a direct consequence of the crisis that affects these corporations more severely than otherwise similar corporations, with the slower-growing corporations reaping little if any benefit from taking such actions.

The key conclusion is that the characteristics associated with faster corporation growth in the pre-crisis period (2004 – 2007) were mainly the same as those associated with less negative growth during the crisis from 2009 to 2013 but only if corporation management during the crisis is not factored in. The second most important conclusion is that corporation management during the crisis is relevant for growth, i.e. that the fate of a corporation is not fully "predetermined" by its pre-crisis characteristics which can be actively changed by a corporation's management board. Once corporation management during the crisis is factored in, it can be concluded that smaller corporations, state-owned enterprises, corporations that engaged at least to some extent in exporting and corporations that relied less on internal funding, operated at a higher scale of efficiency and were less labour-intensive before the crisis grew faster during the crisis.

In addition, as expected, the fall in the number of employed persons in corporations in the construction activity was bigger than could be explained by other characteristics of such corporations while growth of these corporations in the pre-crisis period had been faster than would have been expected according to the other characteristics of such corporations.

The literature used as a starting point for the selection of independent variables in the assumed model of corporation growth is listed in the next chapter of this paper. The data used for the construction of the dependent variable and independent variables and the manner in which they are constructed are shown in chapter three. Chapter four assumes the model of corporation growth in the Republic of Croatia and gives an overview of the methods used for the estimate of parameters of this model. The results of these estimates are shown in detail and discussed in chapter five, while chapter six offers an interpretation of these results and guidelines for further research into the determinants of growth of Croatian corporations.

2 Literature overview

Kolasa, Rubaszek and Taglioni (2009) analyse the impact of the global financial and economic crisis on entrepreneurs in Poland, using financial reports of some 14 000 entrepreneurs employing a minimum of 50 persons. Their research shows that it was easier for bigger and foreign-owned corporations to withstand the impact of the first wave of the crisis on their operations, i.e. that the fall in their income and the increase in their funding costs were less pronounced during the crisis in these types of corporations than in comparable smaller corporations and domestic corporations. The control variables used were the first two digits from the national classification of activities (activity), the share of income from sale abroad in the total income according to the national scheme (exporter status) and the natural logarithm of the total number of fully employed persons in a corporation (size).

Oberhofer (2010) analyses the full panel of financial data for approximately 104.5 thousand entrepreneurs from 14 EU countries available from AMADEUS, a commercial database. The results obtained in this paper indicate that domestic cyclical fluctuations play a key role in the way a corporation will respond to an

economic cycle (measured by the growth rate of fully employed persons in a corporation) both during years of growth and during crisis. Neither the general trends in the EU nor affiliation with a specific group of activity (defined in accordance with the first three digits of activity classification codes) within a specific country can account well for the changes in the level of employment in corporations. However, the results show that some other variables have an impact on the growth rate of employment in corporations so employment growth in smaller and younger corporations and corporations focussed on the domestic market is more sensitive to cyclical fluctuations, both in the upward and downward phase of the cycle.

Amendola et al. (2010) use a full panel of data to analyse the impact of the global crisis on the market exit rate of corporations in Italy in the period 2008 – 2010, compared to the pre-crisis period 2002 – 2008. The preliminary results of this analysis show that a corporation's size and age are positively correlated with a corporation's market survival but that this connection becomes weaker during a crisis. The positive impact on the probability of maintaining exporter status as well as solvency and liquidity measures is stronger during a crisis. The status of branch of a foreign corporation and the status of corporation in a high technology activity have a positive impact on survival only during a crisis, when this status is of high economic importance. However, the analysis does not show any general connection between a corporation's activity and the probability of its survival during a crisis.

As regards the analysis of the impact of the global crisis on Croatian corporations, Čengić et al. (2011) use a statistical survey method to determine the impact of the crisis on the metal processing and wood processing industry and to determine how corporations in these industries adapted to crisis conditions, focussing on developments in employment. The conclusions of the research indicate that managers of the surveyed corporations identified on time the impending crisis that would hit these two industries in several waves and were able to adapt their operations to the new conditions promptly. This adaptation was seen primarily in the suspension of investment in research and development, in significant layoffs and reductions in the scope of manufacturing and other measures aimed at reducing all types of operating expenses. The initial level of corporation leverage and state aid measures introduced to help the businesses were not crucial for the formulation of these measures. On the other hand, it seems that corporations that had grown faster before the crisis found it easier to withstand the impact of the crisis on their operations.

These researches, except Čengić et al. (2011), base their findings on theoretical and empirical works in the area of what is called industrial demography, which explores the factors of the statistical distribution of the growth of individual corporations. An interesting and detailed overview of recent empirical literature in this area can be found in Coad (2009), while Lehtoranta (2010) gives a fresh and highly detailed overview of theoretical and empirical literature.

Lehtoranta (2010) presents the main features of the best known theories on the size and growth of corporations and their implications for empirical research. Thus, according to neoclassical theory, under the assumption of perfect market competition, a corporation increases its income until it reaches the minimum point on the curve of average costs. Therefore, income growth is an asymptotically falling function of the relative size of a corporation in the activity or market in which it competes, i.e. on the same market, smaller corporations grow faster than large corporations and all corporations "wish" to grow until they reach the "efficient" scale, at which point they stop growing. However, in the conditions of imperfect market competition prevailing in practice, a corporation may use its dominant market position to increase income even above the threshold of efficiency specific for its activity, which may be additionally pronounced if it has not fully used its own growth potential based on the economy of scale (diversification).

In the theory of industrial dynamics, using measures of own profitability, corporations gradually come to identify their advantages and disadvantages compared with the competition and with time the efficient corporations survive and grow while less efficient corporations stagnate and exit the market. This results in a negative empirical correlation between growth and age of a corporation and a positive correlation between age and probability of survival on the market. This leads to an overestimation of the expected growth of smaller corporations at any given moment, if the exit of smaller stagnating corporations from the market is not factored in explicitly, which in turn leads to a negative correlation between growth and the size of a corporation in empirical research. However, this is not an issue since, for a subgroup of corporations which do not exit the market

during a certain period, corporation growth under industrial dynamics models is in theory also negatively correlated with corporation size.

And finally, under one of the most influential theories in this field, corporation growth is proportionate to the speed with which a corporation develops or adopts and implements and applies new technological solutions, organisational and managerial skills and natural, human and technological resources. However, the complications associated with the empirical testing of this theory and its extensions, due to a lack of reliable quantitative measures of relevant corporation characteristics, led to this branch of corporation growth theory having a bigger impact on research associated with strategic management and competitiveness of a corporation than on research primarily exploring corporation growth.

Lehtoranta (2010) also presents the findings of influential empirical research associated with the growth of individual corporations. In short, most theoretical forecasts have not been supported by empirical analysis since in practice corporation growth rates exhibit a pronounced stochastic trend (i.e. a corporation's size follows the model of "random walk") and the ostensible relationships between growth rates of individual corporations are temporary and unforeseeable. As a result, the theoretical new generation models, which are still being developed, accept the stochastic nature of corporation growth rate and are focussed on the explanation of the impact of stochastic "jumps" in their time line occurring as a result of return on investment in innovation in the form of an often sudden, significant and unforeseeable increase in income. In empirical terms, the explanation of corporation growth rates by means of innovation activities of corporations is made difficult by the fact that return on innovation is uncertain, both in its financial and time dimension and data on the quantity and quality of innovation on the level of individual corporations are generally not readily available and reliable in the way that the financial data of corporations are, the data most commonly used in similar empirical research.

However, despite the stochastic nature of growth due to which the determining characteristics of corporations fail to provide a good explanation of the differences between growth rates of different corporations (a low R-squared), the empirical research still shows a strong statistical relationship between some of the determining characteristics and the smaller share of growth rate variability they explain. Firstly, the geographical location in the capital or in some other market where aggregate demand is concentrated, the costs of advertising, the market share of the corporation within the activity and the above-average growth in aggregate demand within the activity compared to other activities have a positive empirical relationship with a corporation's growth. By contrast, the size and age of a corporation have a negative relationship with a corporation's growth. Stochastic "jumps" caused by innovation therefore have a permanent indirect impact on future innovative corporation's growth rate since they immediately lead to a change in its size.

Coad (2009) also gives an overview of relevant empirical researches on the subject of corporation growth. The most widely accepted results of these researches are the following: Firstly, the empirical statistical distribution of unconditional corporation growth rates approximates the double exponential distribution (the so called Laplace distribution). This observation proved robust to different measures of corporation growth (income, employment and added value growth) as well as to different degrees of disaggregation of statistical population of corporations according to their activities. The main implication is that the most important corporations in economic terms can be found in the right tail of the empirical distribution of the growth rate, making it rather pointless from an economic standpoint to analyse the average (the expected value) of this distribution, which is common in econometric research of the regression type.

Secondly, the relationship between size and the expected corporation growth rate is very complex in practice. While most researches have found a small negative relationship between the size of a corporation and its expected growth rate, even after taking into account a bigger number of control variables, of which the most prominent are the probability of survival in a sample, the activity that a corporation engages in and, the least efficient scale of a corporation in that activity, some researches have concluded that there is not sufficient statistical evidence to reject Gibrat's law, under which the size of a corporation and its expected growth rate are statistically independent. Before such conclusions may be drawn, corrections for measurement errors, self-selection, autocorrelation and heteroskedacity of corporation growth rate are made in the sample, all of which may influence the outcome of the estimate of the relationship between a corporation's size and its expected growth rate.

Thirdly, the question of the form and stability of empirical distribution of corporation growth rate at different stages of the economic cycle is not a trivial one since the mean and kurtosis of this distribution are procyclical, while standard deviation and skewness are countercyclical in nature. This points to the importance of the inclusion of macroeconomic variables in the explaining variables for the analysis (distribution) of corporation growth rate on a panel of data that includes data from various stages of the economic cycle. In addition, there seems to be an interaction between the size of a corporation and the stage of the economic cycle, so that in the upward phase of the cycle smaller corporations grow faster while in the downward phase and recovery phase, bigger corporations grow faster.

Fourthly, the statistical relationship between a corporation's size and standard deviation in its growth rate from its average over time is negative in practice. This means that larger corporations' growth rates are less volatile over time than the growth rates of otherwise comparable smaller corporations. Another result of this observation is that autocorrelations of growth rates of individual corporations are also determined by the size of an individual corporation. Thus, the empirical regularity is that autocorrelation of the growth rate is positive for bigger corporations and negative for smaller corporations. It has been demonstrated that autocorrelation of corporation growth rate also depends on the actual growth rate of an individual corporation over the previous periods. Thus, corporations the growth rates of which were closer to the distribution average of all corporations over a single period will have an expected growth autocorrelation over the next period close to zero, while it is more probable that corporations with an extremely high or extremely low growth rates will have a negative autocorrelation of the growth rate over the next period.

Fifthly, according to Coad, a vast majority of researchers agree that there is a negative causality going from a corporation's age to its growth rate, although it does not necessarily need to be linear (it has been observed that in some samples older and younger corporations grow faster than medium-aged corporations). In addition, economists agree that successful innovation has a positive causal impact on a corporation's growth (income), however, the statistical analysis of this impact is also greatly impeded by the problem of measuring the significance of an individual innovation and a time shift involved in its impact on corporations. In addition, an innovation in the form of an improved production process may be negatively correlated with a corporation's growth measured by the number of employed persons, with a simultaneous positive correlation with growth measured by a corporation's income. Finally, innovation may have an indirect impact on other corporations vertically or horizontally connected with the innovating corporation or competing with that corporation, making statistical analysis even more difficult.

Sixthly, despite the theoretical attractiveness of the assumption that more profitable and efficient (more productive) corporations grow faster, there is no strong empirical evidence to support either of the two hypotheses (for a subgroup of corporations which do not exit the market over a certain period) even though research has shown that the probability of a corporation's exit from the market is still, as expected, negatively correlated with its productivity. Of other characteristics of corporations which should, according to theoretical considerations, be associated with a corporation's growth, there are strong indications that corporations consisting of several units, foreign-owned corporations and limited liability corporations grow faster than the average, while state-owned enterprises, corporations managed by the owner and more diversified corporations grow slower than the average.

Seventhly, and lastly, there are strong indications that a faster growth in an individual activity as a whole (due to higher demand) has a positive impact on the growth of the biggest corporations in that activity and particularly in activities that have a high degree of market concentration. At the same time, as could be expected, a corporation's growth seems to be negatively influenced by the growth of competition, *ceteris paribus*.

3 Data and variables

The data used for this research were taken from the register of unconsolidated annual financial statements of entrepreneurs (RGFI) for the period 2002 – 2013, i.e. that part of the data set relating to balance sheet and profit and loss statement, while cash flow statements, statement of changes in equity and distribution of profits are not available. The data relate to all entrepreneurs falling within the sphere of the Accounting Act, i.e. to all legal and natural persons subject to corporation income tax. The database does not include financial statements of other natural persons that are entrepreneurs (including the numerous category of craftsmen) or legal persons such as financial institutions, non-profit organisations and government and public administration bodies.

Data from the original database are far from perfect in many aspects. Deficiencies and structural breaks were bridged to the extent possible and the research was conducted on the statistical population of entrepreneurs – legal persons in non-financial activity over a period 2002 – 2013. The qualitative characteristics of the entrepreneurs initially taken into account were: legal code of the size, age, geographic location of the head office, ownership structure, "inactivity" (liquidation or bankruptcy), existence of foreign capital in a corporation ownership (10% and more) and the existence of income from exports. As expected, on an aggregate level, the developments in the standard financial indicators of these entrepreneurs (Annex 1) confirm the already mentioned observations of other researchers that are based on macroeconomic statistics. For example, the measures of aggregate profitability of entrepreneurs diminish abruptly in the period 2000 – 2010 and so do most of the aggregate measures of the liquidity and efficiency of business operations. However, in 2011, there was a small recovery, most probably as a result of cost reduction measures, as measures of corporation activity in 2010 and 2011 were showing signs of stabilisation. However, in 2012 and 2013 most of the aggregate measures of performance of entrepreneurs in the Republic of Croatia worsened again slightly.

Further in this research, disaggregated data of individual corporations – legal persons are used, to obtain an as formal as possible estimate of the relationship between qualitative and quantitative characteristics of non-financial corporations and their growth as influenced by the global crisis. Excluded from the analysis are also corporations without income and corporations with fewer than two fully employed employees, to mitigate the undesired impact on the results associated with inactive corporations, corporations in the development stage,

Table 1 Overview of the main characteristics of entrepreneurs in the Republic of Croatia, 2002 – 2013

	Fina – entrepreneurs			CNB – non-financial corporations – legal persons			Sample – employed persons > 1 and income > 0		
	Number of entrepreneurs	Number of employed persons	Total income (million HRK)	Number of entrepreneurs	Number of employed persons	Total income (million HRK)	Number of entrepreneurs	Number of employed persons	Total income (million HRK)
2002	63,561	754,186	392,243	61,337	751,053	381,470	38,819	735,940	369,270
2003	68,084	796,896	451,948	65,811	791,312	439,300	40,205	775,706	423,746
2004	68,981	811,776	484,079	66,843	798,717	470,378	40,831	783,283	453,774
2005	71,803	813,762	523,712	69,591	809,179	507,622	41,733	793,835	491,389
2006	78,509	865,883	593,140	73,959	839,399	565,833	43,209	823,737	546,145
2007	83,532	896,013	655,561	78,329	868,612	617,763	44,544	852,273	596,156
2008	89,656	933,958	709,827	83,570	904,389	681,418	45,929	886,956	657,713
2009	91,320	889,396	613,367	84,966	856,954	588,879	45,192	838,408	566,933
2010	96,758	859,808	598,187	90,041	833,363	573,582	44,663	812,990	552,689
2011	98,530	851,386	624,807	91,904	830,585	599,579	43,911	809,606	576,317
2012	97,254	829,874	610,376	90,781	809,792	586,575	42,600	788,853	564,104
2013	101,191	830,928	612,441	94,825	807,402	588,796	42,096	784,823	563,955

Sources: Fina and author's calculation.

corporations with a special purpose (for instance investment property, with no other activity) and corporations which are just a form of self-employment.

The comparison (for the period 2002 – 2013) of aggregated basic characteristics of entrepreneurs in RGFI in both the reduced and "cleaned" database used in this report is shown in Table 1.

Corporation growth (**G**) in this research was measured on the basis of the more favourable of the two measures of (real) size of corporations which are typically used in this type of research. They are: 1) growth in real[1] operating income (**IG**) and 2) growth in the total number of fully employed persons at the end of the year (**EG**). Therefore, the measure of growth selected was **EG** and it was calculated as a logarithmic change in the total number of fully employed persons at the end of the year from the end of the previous year. Such a selection is made to avoid any additional complication of the deflation of longer time series of data by deflators specific for a corporation's activity (which are not sufficiently explored in the case of the Republic of Croatia), which would occur if real operating income as a measure of a corporation's size were used. As a result, a vast majority of researchers use employment as a measure of a corporation's size to calculate its growth.[2] The calculation of the measure of a corporation's growth based on employment as a measure of the size of a corporation is given in the following expression:

$$\mathbf{G}_t = \mathbf{EG}_t = 100(\ln(\mathbf{EMP}_t+1) - \ln(\mathbf{EMP}_{t-1}+1)) \quad \text{for } t = 2003, \ldots, 2013,$$

where **EMPt** = the total number of fully employed persons in a corporation at the end of the year t.

Graphic analysis and descriptive statistics (Figure 1) show that the unconditional empirical distribution of **G (EG)** is very different from the Normal distribution (Figure 1(a)). It is characterised by extremely "fat tails", while the increase in its middle part (Figure 1(b)) shows that **G** is almost "uniformly" distributed in the middle with the exception of its modal value, which is zero (0), which might point to the reluctance of corporations to change the number of employed persons. In addition, it seems that distribution of **G** is characterised by a small positive autocorrelation arising from the previous year's growth, which may statistically even be zero (0) since its volatility is extremely high around the value of $\mathbf{G}_{t-1} = 0$ and then falls sharply as the previous year's growth increases or decreases (Figure 1(c)). Also, it seems that **G's** volatility falls in the positive half of the distribution as the absolute value of **EMP** increases (Figure 1(d)), which might point to a statistical dependence of volatility **G** on the size of a corporation.

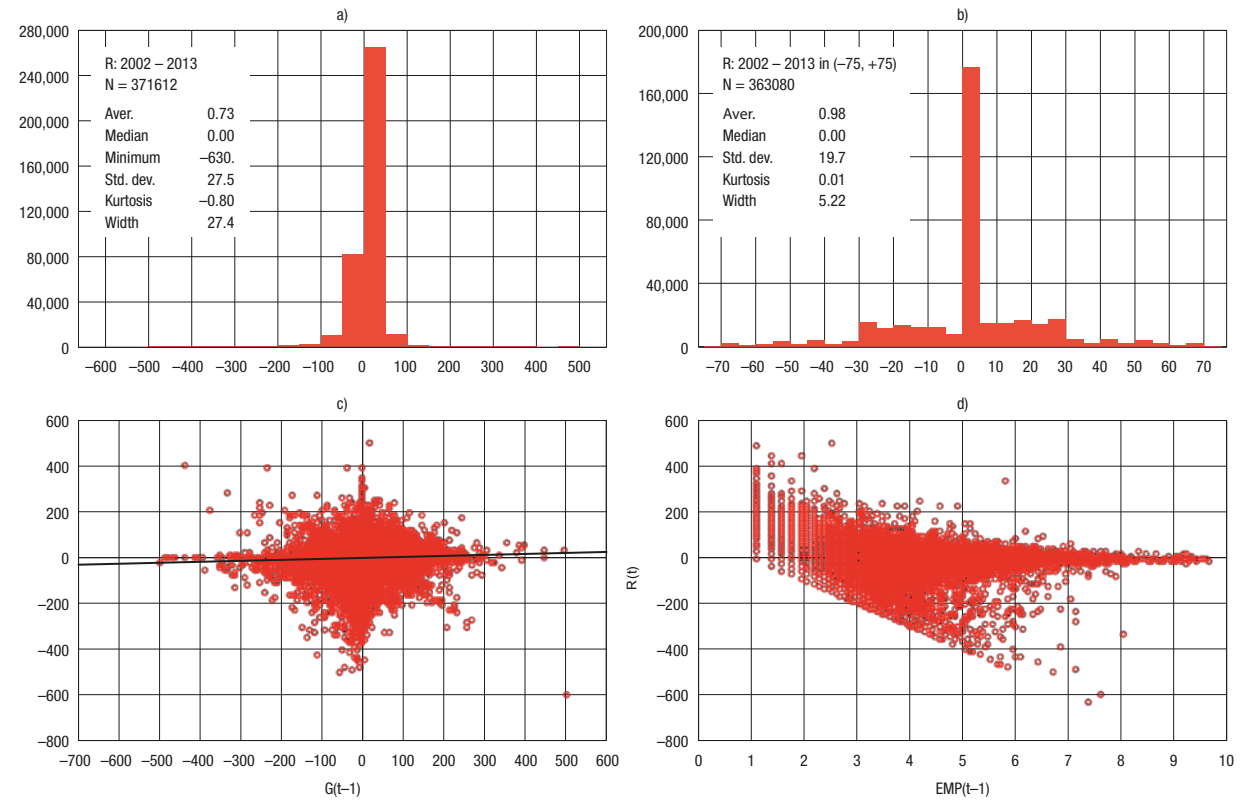
The initial group (vector) of independent variables [**X Z**] for standard modelling of the independent variable $\mathbf{Y} = \mathbf{G} = f(\mathbf{X},\mathbf{Z},\beta,\varepsilon)$ consists of measures of all characteristics of a corporation which are, according to the literature referred to in the previous chapter, associated with their growth, either on a theoretical or on an empirical basis and which may be measured according to the available data, with the subgroup **X** comprising quantitative and the subgroup **Z** qualitative characteristics of entrepreneurs. As noted already, it was not possible to measure with precision all the potentially relevant aspects of a corporation's growth from the available data. The aspect of "innovation" was not measured at all, while, for instance "location" and "size" according to administrative sources do not measure necessarily that which should be measured; the former because it relates to the registration of the head office of a corporation and not the location of its economic interest and the latter because of structural breaks in the definition in a time series. The final group of variables used in the conducted research is described in Table 2.

The selected descriptive statistics of the dependent variable **G(t)** by values of qualitative (discrete) independent variables referred to in Table 2 are shown in Annex 2. They give some very useful information on the

1 Nominal operating income (OI) deflated by GDP deflator: I = real OI = OI × real GDP/GDP.

2 The formula includes the number of employed persons + 1 to calculate the logarithmic change in the number of employed persons in corporations having 0 employees in the period (t–1) although the growth of such corporations is not analysed later in this paper and such corporations appear only in aggregates in Annex 1. In further research, the calculation of the measure of growth could be adjusted to accommodate the specific focus of the researchers. In practice, one such measure is calculated as a weighted average of the absolute and relative growth (the so called Birch index) to attach greater importance to economically more significant corporations in the calculation of average growth in the sample (population). The second such measure is the growth in the ratio between a corporation's size and the size of the activity in which a corporation operates, which may also be calculated in several ways, depending on the depth of sample distribution by activity and the selected measure of a corporation's size/activity. A percentage growth measure may also be used, but in such a case the empirical distribution of the growth rate is largely influenced by outliers. The same observation applies to the measure of absolute growth which is as a rule not used in research of this type.

Graph 1 Growth of entrepreneurs in the Republic of Croatia – descriptive statistics, 2003 – 2013



Sources: Fina and author's calculation.

characteristics of data analysed in this paper, particularly in the context of qualification of individual results for some subgroups of corporations.

The descriptive statistics referred to in Annex 2 offers an insight into some significant characteristics of the dependent variable **G(t).** Firstly, the "bottom" in employment lags one year behind the "bottom" measured by real GDP growth. Secondly, larger corporations on average reduced the number of employed persons also in the pre-crisis period (2003 – 2007), while other corporations resorted to labour cuts only during the crisis (2009 – 2013). As expected, this average decrease is greater in absolute amounts during the crisis. Thirdly, younger corporations grew faster in the pre-crisis period and in relative terms saw a smaller fall in employment growth than older corporations.

Fourthly, the picture of growth in corporations according to their (main) activity shows that they can roughly be divided into two groups. In the first group, due to a very high negative impact of the crisis on averages, some activities saw a fall in the number of employed persons in the period 2003 – 2013 as a whole: 1) agriculture, forestry and fishing; 2) mining and quarrying; and 3) manufacturing. Average growth rates close to zero during the entire period were also recorded in 4) construction; 5) trade and 6) hotels and restaurants. This could also mean that average growth rates of corporations in these six activities are the result of secular trends associated with the general transformation of the economy: smaller shares of labour in some branches or/and consolidation and informatisation in other branches while in construction it could be the result of the bursting of the bubble in the real estate sector as a whole.

In the second group, all but two activities showed a much above-average growth in the period 2003 – 2013 as a whole, while public and social activities and education showed a positive average growth in the number of employed persons even in the pre-crisis period. In each case, the activity plays a role as a potentially important independent variable, both for the statistical analysis and in the context of a wider discussion on the optimum structure of the Croatian economy and its resilience to cyclic fluctuations in the economic activity.

Table 2 Initial group of independent variables

Name	Description	Formula	Impact on growth
$YEAR_t$	Year (1997 – 2012)	Indicator of calendar year, as a measure of the impact of the macroeconomic environment on average growth	(+/–)
$LIQBTC_{it}$	In liquidation/bankruptcy	Indicator showing that corporation ***i*** is undergoing bankruptcy or liquidation at the end of the year ***t***.	(–)
NCA_{it}	Activity (A–T)	Indicator of activity (main industrial branch) of corporation ***i*** in year ***t*** according to NCA 2002.	(+/–)
LOC_{it}	Location (1–21)	Indicator of the county of the head office of corporation ***i*** in ***t***.	(+/–)
OWN_{it}	Ownership (1–4)	Indicator of the form of ownership of corporation ***i*** at the end of the year ***t***.	(–)
FOR_{it}	Foreign cap. (0–1)	Indicator showing that corporation ***i*** at the end of the year ***t*** had over 10% foreign share in the capital.	(+)
$EXPINT_{it}$	Export intensity	Ln of the share of income from sale abroad in total expenditures of corporation ***i*** in year ***t***.	(+/–)
EMP_{it}	Size	The natural logarithm (Ln) of the number of employed persons in corporation ***i*** at the end of the year ***t***.	(–)
INC_{it}	Income	Ln of operating income of corporation ***i*** during the year ***t***.	(–)
AGE_{it}	Age	Ln (1 + number of years from the year of establishment of corporation ***i*** in year ***t***).	(–)
$SHARE_{itk}$	Market power	Share of income of corporation ***i*** in total income of all corporations with NACE code ***k*** less the median of those shares for all corporations with NACE code ***k***.	(+)
$EFIC_{itk}$	Efficient scale	Ln of the ratio of the number of employed persons in corporation ***i*** and the median number of employed persons in its activity under code ***k*** of the NCA.	(+)
FIN_{it}	Cost of funding	The ratio of financial and total expenditures of corporation ***i***, as a measure of availability of funding in ***t***.	(+)
INT_{it}	Internal funding	The ratio of short-term liabilities and expenditures of corporation ***i***, as a measure of reliance on internal financing in ***t***.	(+/–)
LEV_{it}	Financial leverage	The ratio of long-term debt and expenditures of corporation ***i***, as a measure of reliance on long-term financing in ***t***.	(+/–)
$TECH_{it}$	Degree of technological advancement	The share of intangible assets in total assets of corporation ***i***, as a measure of the degree of technological advancement in ***t***.	(+)
LAB_{it}	Labour intensity	The ratio of employee expenditures and total expenditures of corporation ***i***, as a measure of labour intensity in ***t***.	(+/–)
$SKILL_{it}$	Labour force skill	Empoloye expenditures of corporation ***i*** per employee, as a measure of labour force skill in ***t***.	(+)

Fifthly, it is considered that ownership form may have an impact on corporations' growth and their resilience to cyclic fluctuations of the economy. In our population of corporations, the described statistics point to almost equal average growth of state-owned enterprises and private corporations before the crisis in the period 2003 – 2013 as a whole, but this could just be due to the fact that growth of state-owned enterprises was much less affected by the crisis than that of private corporations. At the same time, corporations in cooperative ownership and corporations in mixed, state and private ownership showed negative average growth also in the period 2003 – 2013 as a whole: This should probably be explained by secular trends in ownership structure of economic entities and points to, as in the previously stated similar cases, the possible need for a separate statistical analysis excluding cooperatives and mixed corporations from the sample.

Sixthly and lastly, the presence of foreign investment, a very frequent topic of public discussion on economic structure in Croatia, also has a potential impact on growth of corporations and their resilience to cyclic fluctuations of the economy. In this context, the descriptive statistics indicate that corporations with 10% or more foreign capital grew faster on average both before and during the crisis, and that, although the crisis had a negative impact on the number of employed persons of these corporations, their number decreased on average much less than the number of employed persons of other corporations (with less than 10% of foreign capital).

Overall, the observations given in this and the previous chapter point to the relevance of the selection of independent variables shown in Table 2 for modelling corporation growth in the Republic of Croatia and the impact of the economic crisis in the period 2009 – 2013 on that growth as well as to the need for a thorough

statistical analysis for the modelling of that growth. For example, some of the mentioned independent variables not revealed by the descriptive statistics in this chapter (there is a typical correlation between the age and the size of a corporation) may be correlated. It is also very probable that, before the impact of independent variables is taken into account, some corporations' growth may be characterised by an inclination toward fluctuations around the trend (negative autocorrelation), while average growth is generally more volatile for smaller than for bigger corporations, as shown in Figure 1(d) at the beginning of this chapter. Such and similar characteristics of a group of observations in this research will be taken into account in the interpretation of the results of the conducted research but will not be explicitly included in the process of modelling the growth of corporations in the Republic of Croatia owing to the reasons described in the next chapter of this paper.

Finally, one additional important characteristic of the database used that may influence the results of the analysis is the distribution of the observation periods to "crisis" and "pre-crisis". As discussed in the introductory part of this paper, the year 2008 is in a way a "transition year", i.e. the first half belongs to the so called "pre-crisis" and the second to the "crisis" subperiod. It makes sense, therefore, to model the pre-crisis period as 2003 – 2007, and the crisis period as 2009 – 2013, with the year 2008 being best left out of both subperiods.

4 Methodology

The discussion in the previous two chapters shows that any response to the question of the impact of an economic crisis on a corporation's growth is relatively complex from an analytical standpoint. As a result, in their approach to the issue of modelling a corporation's growth, researchers often rely on advanced statistical techniques.

The approach used in this paper is different because it follows the so called standard linear (regression) model for panels[3], to set up the initial model for estimating corporation growth in the Republic of Croatia during the crisis. The need for such a less sophisticated model arises from the fact that, to the knowledge of the author of this paper, this is the first paper which deals with microeconomic aspects of growth of all the corporations in Croatia based on data at the level of individual corporations (there are papers dealing with corporation growth on the level of activities according to NCA)[4].

At the same time, attempts will be made to eliminate the deficiencies involved in conclusions reached on the characteristics of corporation growth based on a standard linear regression, which prompted the development of more advanced analytical techniques. For this purpose, an analysis was made of the whole population and of several special subsamples of specific interest; several alternative methods were used to estimate model coefficient to verify their robustness. To verify additionally the sensitivity of the results of the analysis to initial assumptions, two alternative calculations of the dependent variable $\mathbf{G}_t$ were used. First, $\mathbf{EG1}_{it}$ is defined, where the only difference between this new measure and the original measure $\mathbf{EG}_{it}$ is that exit of corporations from the sample in year **t** is recorded as $\mathbf{EG1}_{it} = -100 \times \ln(\mathbf{EMP}_{i,t-1} + 1)$, while $\mathbf{EG}_{it}$ in such cases has a missing observation in year **t**. In addition, $\mathbf{EG2}_{it}$ is defined similarly to $\mathbf{EG1}_{it}$ but $\mathbf{EG2}_{it}$ takes into account cumulative growth in the past five years (while $\mathbf{EG}_{it}$ and $\mathbf{EG1}_{it}$ both measure annual growth).

The basic linear (regression) model used in this paper has the following form:

$$G_{it} = E(G_{it} | 1, X_{t-1}, Z_t) + u_{it} = a_0 + bX_{it-1} + cZ_i + dY_t + u_{it} \quad (1)$$

3 For an overview of more advanced statistical methodologies which do not belong to the class of linear models of conditional means for panels, see, for example Coad (2009). The approach used in this paper follows the instructions for work with "linear panel models" (Wooldridge, 2002).

4 At the time of writing this paper, a paper by Valdec and Zrnc (2015) was published which uses sophisticated statistical methods on individual data of corporations to determine the causal relationships between exports orientation and performances of corporations in the Republic of Croatia in the period 2002 – 2012.

where for a corporation ***i*** in year ***t*** for measure of growth $\mathbf{G}_{it}$, a logarithmic change in the number of employed persons $\mathbf{EG}_{it}$ or $\mathbf{EG1}_{it}$ or $\mathbf{EG2}_{it}$ is used and where $\mathbf{X}_{it}$ is the vector of the explaining variables shown in Table 2, the values of which (as a rule) differ from corporation to corporation and from year to year within the same corporation, and $\mathbf{Z}_i$ is the vector of variables shown in Table 2, the values of which differ from corporation to corporation but remain unchanged within the same corporation over time. Symbol $\mathbf{u}_{it}$ represents the usual "regression error" of the model. The model also contains dummy variables for years $\mathbf{Y}_t$, to eliminate the impact of average growth of all corporations in year **t** on coefficient estimates in the model with variables representing individual characteristics of corporations.

For a statistical distribution of a regression error in research of this type, the following distributional assumptions are considered:

a) normal distribution of a regression error, with a constant autocorrelation and a variance depending on ***t*** – $\mathbf{u}_{it} \sim \mathbf{N}(\rho \mathbf{u}_{it-1}, \sigma_t^2)$;
b) the so called "random effects" for corporations, i.e. $\mathbf{u}_{it} = \gamma_i + \varepsilon_{it}$, where γ_i is the same accidental variable, error ε_{it} has a correlation depending on ***i*** and a variance depending on ***t*** – $\varepsilon_{it} \sim N(\rho_i \varepsilon_{it-1}, \sigma_t^2)$, and $\mathrm{Corr}([\mathbf{X}\ \mathbf{Z}], \gamma_i) = 0$;
c) the so called "fixed effects" for corporations, i.e. $\mathbf{u}_{it} = \gamma_i + \varepsilon_{it}$, where γ_i represents the same constants for each ***t***, and error ε_{it} has an autocorrelation depending on ***i***, and a variance depending on ***t*** – $\varepsilon_{it} \sim N(\rho_i \varepsilon_{it-1}, \sigma_t^2)$.

Model (1) parameters are estimated by means of the so called OLS procedure when process a) is assumed, by means of a GLS procedure (the so called random effects or RE estimators) when process b) is assumed and by means of the so called within estimators (better known as fixed effects or FE estimators) when process c) is assumed, with PCSE estimators of coefficient covariance being used in all the three cases. Assumption c) avoids bias of the estimator under items a) and b) due to the missing variable γ_i which represents the "unobserved/unmeasured initial difference" between corporation **i** and a "typical" corporation used in the sample. This bias occurs whenever the actual model of corporation growth has a regression error given in expression c), while the estimated model has an assumed regression error given in expression a) or b).

However, the FE estimators for the assumption under c) may not be used for the estimation of coefficient in vector $\mathbf{Z}_i$, but only for the estimation of coefficients with variables in vector $\mathbf{X}_{it}$, while the focus of this research is on variables in vector $\mathbf{Z}_i$. As a result, only estimators a) and b) were used in the conducted analysis and the estimates obtained must then be interpreted as partial correlation relationships between corporation growth and initial differences between corporations, without implying the direction of causal relationships (since the "missing variable" would have to be taken into account to obtain a causal link γ_i).

In addition, for the independent variables in (1), which by their definition are simultaneously correlated with ε_{it} since their calculation also includes $\mathbf{EMP}_{i,t-1}$, instrumental variables have been included in OLS and GLS estimations. These are variables $\mathbf{EMP}_{i,t-1}$, $\mathbf{EFIC}_{i,t-1}$ and $\mathbf{SKILL}_{i,t-1}$, in those specifications of the regression model (1) in which vector $\mathbf{X}_{i,t-1}$ is not empty, and natural instruments $\mathbf{EMP}_{i,t-2}$, $\mathbf{EFIC}_{i,t-2}$ and $\mathbf{SKILL}_{i,t-2}$ were selected as their instruments. The problem of possible simultaneity of other independent variables with the dependent variable has been resolved by simple inclusion of $\mathbf{X}_{i,t-1}$ instead of $\mathbf{X}_{i,t}$ in model (1), serving themselves as instruments[5].

The results of the analysis are shown in the following chapter.

5 Under the assumption that growth in the previous period is an important control variable it would also be usual to try to estimate parameters by applying the GMM method (as in Coad, 2007). However, in the light of considerations stated in the previous chapter of this paper, there is a real possibility that autocorrelation of the dependent variable is not a key independent variable for a vast majority of non-financial corporations in the Republic of Croatia so GMM estimates of this class of model parameters have been left to be dealt with in some future research.

5 Results

Regression models for $\mathbf{G}_{it}$ as defined in chapter three were estimated first, i.e. for each corporation **i** operating in year **t** its growth in year **t** is given in expression $\mathbf{G}_{i,t} = \mathbf{EG}_{i,t} = 100(\ln(\mathbf{EMP}_{i,t}+1) - \ln(\mathbf{EMP}_{i,t-1}+1))$ for **t** = 2003, ..., 2013, where $\mathbf{EMP}_{it}$ = is the total number of fully employed persons in a corporation **i** at the end of the year **t**. The estimate OLS1 presented in Table 3 shows the "basic model": growth in 2009 – 2013 has been assumed to be in a linear relationship with corporation characteristics in 2008, at the time of the outbreak of the crisis. Therefore, **t** = 2009, ..., 2013, vector $\mathbf{X}_{it}$ is empty, and vector $\mathbf{Z}_i$ includes the values of corporation characteristics in 2008 described in Table 2.

The estimates of OLS1 point to a positive correlation between a corporation's growth during a crisis and its market share (SHARE↑), efficient scale (EFIC↑), share of exports in total income (EXPINT↑) and skills (cost) of labour (SKILL↑). The same estimates point to the expected negative correlation between growth (during crisis) and age (AGE↓) and size (EMP↓) as well as to the negative correlation with funding costs (FIN↓) and labour intensity (LAB↓).

Also, when compared to a "typical corporation" which is an active corporation (LIQBTC = 0) belonging to the trade activity (NCA = "G") with a head office in Zagreb (in table results OUTZG = 0 for LOC ≠ "Zagreb" is used) which does not export (EXPORT = 0 for EXPINT = 0 is used, and is 90% or more domestically-owned (FOR = 0) and over 50% privately-owned (GOV = 0 for OWN ≠ "Government") – state-owned enterprises grew faster during the crisis (GOV = 1↑), corporations which engaged in exporting (at least to some extent) (EXPORT= 1↑), corporations with a head office outside Zagreb (OUTZG = 1↑) and corporations in the non-trading activity, except in construction (NCA = "F"↓) and personal services activities; (NCA = "LMNRS"↓), which grew at a slower rate. As expected, corporations undergoing liquidation or bankruptcy proceedings (LIQBTC = 1↓) also grew at a slower rate.

The estimate of OLS1a presented in Table 3 shows the "pre-crisis model": growth in years 2004 – 2007 has been assumed to be in a linear relationship with corporation characteristics in 2002. Therefore, **t** = 2004, ..., 2007, vector $\mathbf{X}_{it}$ is empty again, and vector $\mathbf{Z}_i$ includes the values of corporation characteristics in 2002 described in Table 2. The comparison with estimates in model OLS1 reveals which corporation characteristics are associated with growth in a similar and which in a different way in corporations during the crisis as compared to thepre-crisis period. It should be noted that in 2002 not a single corporation reported being in a winding-up or liquidation procedure and as a result the coefficient with the variable LIQBTC could not be evaluated for the pre-crisis period.

The comparison of the relationship between corporation growth and corporation characteristics in the crisis and in the pre-crisis period reveals that partial correlations generally have the same signs, while several variables have shown that their linear relationship with growth is statistically significant in only one of the two periods. Corporations in construction and personal services activities are an exception, having grown relatively faster than typical corporations in the pre-crisis period and relatively slower in the crisis period. Also, export intensity (EXPINT) is positively statistically significantly correlated with growth during the crisis period but negatively statistically significantly correlated with growth during the pre-crisis period.

The OLS2 estimate shown in Table 3 again relates to the crisis period, the only difference compared to the OLS1 estimate being that this time vector $\mathbf{Z}_i$ includes not only the values of variables present in 2008 but also their changes compared to the year 2003. This enables the exploration of whether "pre-crisis behaviour" influences corporation resilience to the crisis: if it does not, then OLS2 estimates should be similar to OLS1 estimates. The deficiency of this comparison lies in the exclusion from analysis under the OLS2 model of all corporations which were not operating in 2003, due to the inclusion of changes in variables from 2003 to 2008 in the model, while model OLS1 also includes these corporations in the analysis.

Under the assumption that the said decrease in population has no effect on comparison, the similarity of OLS1 and OLS2 estimates shows that corporation characteristics in 2008 are still useful for forecasting corporation growth during the crisis, even if corporation behaviour in the preceding period is taken into account.

In other words, most signs and the statistical significance of coefficient estimates with variables representing corporation characteristics in 2008 have not changed compared to OLS1 estimates. The exceptions include internal funding (INT) and the presence of foreign capital (FOR=0), which were negatively correlated with growth during the crisis period in corporations that were operating in 2003 – 2008, after their behaviour in the period 2003 – 2008 is taken into account.

The OLS3 estimate shown in Table 3 shows a regression model of growth during the crisis period which has the same vector $\mathbf{Z}_i$ as the OLS1 model, but this time vector $\mathbf{X}_{it}$ is not empty and includes values in **t** = 2009, ..., 2013 of the variables shown in Table 2, which generally change from year to year in each corporation. This enables the exploration of whether "crisis behaviour" influences corporation resilience to crisis: if it does not, then OLS3 estimates should be similar to OLS1 estimates. The deficiency of this comparison lies in the exclusion from the analysis under the OLS3 model (in contrast with OLS1 model) of all corporations which also did not operate in 2007 (because the values for 2009 for the three variables in vector $\mathbf{X}_{it}$ were instrumentalised by their 2007 values).

The comparison of OLS1, OLS2 and OLS3 estimates shows a much smaller similarity between OLS3 and OLS1 estimates (in contrast with OLS2 and OLS1 estimates). This suggests that corporation growth during the crisis is not predetermined by corporation characteristics at the time of the outbreak of the crisis, but that it can be influenced by corporation management. Thus, OLS3 estimates differ significantly from OLS1 estimates for almost all coefficients (with the exception of the EFIC coefficient) with variables that represent variable corporation characteristics in 2008 (those whose annual values also appear in vector $\mathbf{X}_{it}$). The relationships between growth and variables that do not change over time remain unchanged (variables in vector $\mathbf{Z}_i$). An example of this is the positive correlation between growth and state-ownership (STA = 1) and the presence of exports (EXPORTS = 1) and the negative correlation between growth and inactivity (LIQBC = 1), age (AGE) and the initial value (EMP).

Models RE1 – RE3, shown in Table 3, are specified in the same way as models OLS1– OLS3, the only difference being that the coefficients with independent variables of the first two models were estimated by RE estimators described in the previous chapter and not by OLS estimators. The comparison of pairs RE1 – OLS1, RE2 – OLS2 and RE3 – OLS3 can then tell us whether there is any normally distributed accidental unobserved, i.e. unmeasured difference in the "capacity for growth in crisis" between corporations. If such a "capacity" exists, RE estimates will differ from OLS estimates for each pair. As shown in Table 3, almost all coefficients have the same sign, irrespective of whether OLS or RE estimators of their values are used, and as a result we cannot say that the "capacity for growth in crisis" has a normal distribution among corporations.

In Table 4 (at the end of the chapter), the analysis the results of which are shown in Table 3 was performed again, this time using the definition $\mathbf{EG1}_{it}$ as the dependent variable, which treats a corporation's exit from the market as a one hundred percent decrease in employment (in contrast with $\mathbf{EG}_{it}$ where such a corporation is not even included in the sample in the year of exit). As a result, such a definition of the dependent variable leads to increased number of observations, decreased average value and increased volatility of employment growth in each of the models whose estimates are shown in Table 4, compared to the comparable model shown in Table 3.

The estimates of coefficients of regression models using the alternative measure of growth shown in Table 4 in general coincided in terms of signs with estimates under regression models using the original dependent variable shown in Table 3. The more pronounced differences relate to a statistically significant negative correlation between reliance on internal funding (INT) and growth, both in crisis and pre-crisis period, compared to the mainly statistically insignificant correlation shown in Table 3. An unexpected positive correlation was observed between age (AGE) and growth, in contrast with the negative correlation shown in Table 3. It is most probably a direct consequence of a dependent variable redefinition: younger corporations are more inclined to exit the market, and this exit is reflected in a negative value of $\mathbf{EG1}_{iT}$ in year **T** of market exit, while no $\mathbf{EG}_{iT}$ has been defined in year **T** for such corporations.

In addition, in estimates OLS3 and RE3, which take into account corporation "behaviour" during crisis, a difference was observed in the signs of coefficients with a degree of reliance on financial leverage (LEV) and with labour intensity (LAB), compared to estimates shown in Table 3. Thus the coefficient with LEV becomes

positive and the coefficient with LAB becomes negative. This means that, *ex ante*, a higher degree of leverage and lower labour intensity predict slower growth during the crisis; however, after corporation management during crisis is taken into account, the opposite is true. If estimates OLS1 and OLS3 shown in Table 4 are compared to each other instead of to estimates shown in Table 3, the coefficients with three corporation characteristics maintain their sign (EFIC has a positive sign and INT and LAB have negative signa). This means that these three pre-crisis characteristics have a statistical strength in *ex post* forecasts of corporation growth during a crisis even if corporation behaviour during the crisis is taken into account.

Table 5 also shows OLS estimates of regression model of corporation growth for the dependent variable $\mathbf{EG2}_{it}$, defined as a five-year corporation growth (where corporation exit from the sample is treated as negative growth, in a manner similar to that in the measure of annual growth of $\mathbf{EG1}_{it}$). A big similarity in signs of the estimated coefficients can be observed between these estimates and estimates shown in Tables 3 and 4. Where differences do exist, a five-year growth perspective does not contribute to highlighting the observed differences between coefficient estimates shown in Tables 3 and 4.

And finally, Table 6 shows OLS1 estimates for each economic activity (NCA = A, ..., Q) to determine whether the results of the conducted analysis are in a non-linear relationship with corporations' affiliation to a certain activity, in which case this affiliation has not been adequately modelled by indicator variable NCA in models shown in Tables 3 – 5. The estimates shown in Table 6 show high homogeneity of most of the signs of coefficients of different activities. Particularly pronounced are negative correlations with growth during the crisis of funding costs (FIN), size (EMP) and labour intensity (LAB) before the crisis as well as positive relationships with labour force skills (costs) (SKILL), age (AGE), state-ownership (GOV = 1) and a corporation's head office outside Zagreb OUTZG = 1).

Generally speaking, the econometric estimates shown in Tables 3 – 6 show that during the last crisis, corporations in the Republic of Croatia characterised at the onset of the crisis by higher market shares, an efficient size, higher export intensity and better labour force skills as well as younger, smaller, less labour intensive corporations and corporations with lower funding costs, grew faster during the crisis. In addition, corporations in state ownership, those that at least to some extent engaged in exporting and those that had their head office outside Zagreb before the crisis grew faster, while corporations in construction and personal services activities grew slower. However, similar estimates also apply to the pre-crisis period, the only exception being corporations in construction and personal services activities which had grown faster and corporations with higher export intensity which had grown slower than otherwise similar corporations.

After factoring in corporation "management during crisis", the coefficients with all but one variable pre-crisis corporation characteristic (with variables from vector $\mathbf{X}_{it}$) generally changed their sign. This means that corporation management during the crisis was an extremely important factor of corporation growth during the crisis. However, the coefficients with invariable corporation characteristics (with variables from vector $\mathbf{Z}_i$) generally maintained their signs and statistical significance even after factoring in corporation management during the crisis, which means that it does not change the observation that younger and smaller corporations, state-owned enterprises and corporations that engaged in exporting at least to some extent grew faster.

Further analysis has shown that after "market exit" of individual corporations is taken into account, corporations that relied more heavily on internal funding and were more labour intensive before the crisis grew slower during the crisis while corporations operating at greater scale of efficiency grew faster, even when corporation management during crisis is factored in simultaneously. Further analysis has also shown that younger corporations do not grow faster than similar older corporations but that the observation in the initial analysis was the result of a higher market exit rate of younger than older corporations.

Other pre-crisis corporation characteristics were statistically not significantly correlated with corporation growth during the crisis.

Table 3 Growth (EG_{it}) of corporations surviving the pre-crisis and crisis period – OLS and RE estimates

G(t) = ln(EMP(t)/EMP(t−1))

	Estimate "OLS1"[a,b,c] 2009 – 2013 N = 36347		Estimate "OLS1a"[a,b,c] 2003 – 2007 N = 31759		Estimate "OLS2"[a,b,c,d] 2009 – 2013 N = 22454		Estimate "OLS3"[a,b,c,e] 2009 – 2013 N = 34805		Estimate "RE1"[a,b,c,f] 2009 – 2013 N = 36347		Estimate "RE2"[a,b,c,d,f] 2009 – 2013 N = 22454		Estimate "RE3"[a,b,c,e,f] 2009 – 2013 N = 34805	
X(t−1)/Z(t)	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error
C	30.23	1.30 ***	27.66	1.27 ***	18.70	1.81 ***	26.00	1.39 ***	31.61	1.37 ***	19.50	1.91 ***	52.88	3.41 ***
SHARE	0.579	0.141 ***	0.229	0.182	0.447	0.198 **	–3.367	0.547 ***	0.630	0.148 ***	0.490	0.207 **	–4.996	0.976 ***
EFIC	18.15	0.89 ***	11.97	1.00 ***	14.67	1.10 ***	19.66	1.05 ***	19.11	0.94 ***	15.47	1.15 ***	96.37	3.14 ***
EXPINT	0.013	0.003 ***	–0.018	0.004 ***	0.026	0.006 ***	–0.023	0.006 ***	0.012	0.003 ***	0.026	0.006 ***	–0.035	0.011 ***
FIN	–0.105	0.015 ***	–0.125	0.021 ***	–0.177	0.029 ***	0.102	0.022 ***	–0.117	0.016 ***	–0.191	0.031 ***	0.041	0.047
INT	0.043	0.125	0.189	0.290	–1.512	0.790 *	–0.034	0.247	0.041	0.128	–1.792	0.829 **	–0.876	0.421 **
LEV	0.000	0.000 *	0.002	0.001 ***	0.005	0.002 ***	0.000	0.000 ***	0.000	0.000 *	0.005	0.002 **	–0.001	0.000 ***
TECH	0.013	0.013	–0.018	0.016	–0.019	0.021	0.000	0.021	0.011	0.014	–0.023	0.023	–0.056	0.046
LAB	–0.051	0.005 ***	–0.009	0.002 ***	–0.026	0.007 ***	0.116	0.010 ***	–0.052	0.005 ***	–0.026	0.007 ***	0.285	0.031 ***
SKILL	0.023	0.002 ***	0.046	0.003 ***	0.029	0.003 ***	–0.009	0.005 *	0.023	0.002 ***	0.030	0.003 ***	–0.384	0.048 ***
LIQBTC	–12.03	2.83 ***			–13.03	3.02 ***	–11.49	2.99 ***	–12.22	2.96 ***	–12.94	3.16 ***	–24.22	6.74 ***
AGE	–1.527	0.106 ***	–3.095	0.140 ***	–0.076	0.301	–0.805	0.120 ***	–1.400	0.111 ***	0.153	0.316	–1.627	0.329 ***
EMP	–20.05	0.81 ***	–13.58	0.89 ***	–16.28	1.00 ***	–19.31	0.85 ***	–21.09	0.85 ***	–17.15	1.05 ***	–37.51	2.21 ***
GOV	6.156	0.651 ***	3.256	0.667 ***	5.281	0.746 ***	6.579	0.677 ***	6.529	0.686 ***	5.610	0.784 ***	12.29	1.74 ***
FOR	0.454	0.346	1.046	0.498 **	–0.883	0.455 *	–0.515	0.381	0.404	0.364	–0.953	0.478 **	–7.326	1.260 ***
EXPORT	1.098	0.231 ***	2.194	0.255 ***	0.559	0.275 **	0.767	0.240 ***	1.205	0.243 ***	0.659	0.289 **	1.036	0.595 *
OUTZG	0.562	0.174 ***	0.213	0.183	0.702	0.208 ***	0.888	0.183 ***	0.544	0.183 ***	0.659	0.218 ***	2.493	0.489 ***
NCA = "A"	8.370	0.638 ***	4.057	0.756 ***	7.325	0.773 ***	8.083	0.667 ***	8.756	0.672 ***	7.710	0.812 ***	9.977	1.671 ***
NCA = "B"	1.580	1.456	12.45	1.67 ***	1.565	1.639	2.417	1.519	1.917	1.534	2.239	1.723	–3.329	3.706
NCA = "C"	6.358	0.367 ***	4.772	0.447 ***	4.867	0.438 ***	6.109	0.386 ***	6.661	0.386 ***	5.116	0.460 ***	5.256	0.962 ***
NCA = "DE"	11.38	0.88 ***	7.477	1.310 ***	9.64	1.01 ***	10.59	0.91 ***	11.95	0.92 ***	10.17	1.07 ***	17.02	2.31 ***
NCA = "F"	–2.699	0.279 ***	7.230	0.444 ***	–3.392	0.350 ***	–2.153	0.293 ***	–2.861	0.293 ***	–3.604	0.368 ***	–3.112	0.716 ***
NCA = "HJ"	0.734	0.319 **	0.611	0.380	0.808	0.377 **	1.189	0.333 ***	0.685	0.335 **	0.841	0.396 **	–0.523	0.823
NCA = "I"	2.708	0.384 ***	–1.033	0.434 **	2.737	0.485 ***	3.036	0.403 ***	2.941	0.404 ***	3.032	0.509 ***	3.540	0.992 ***
NCA = "LMNRS"	–1.817	0.298 ***	1.172	0.243 ***	–1.488	0.365 ***	–1.272	0.320 ***	–1.893	0.314 ***	–1.503	0.383 ***	–11.07	0.870 ***
NCA = "O"	15.51	4.78 ***	–3.352	5.575	17.89	6.44 ***	17.83	5.08 ***	15.43	5.03 ***	17.68	6.78 ***	17.09	11.33
NCA = "P"	8.606	0.700 ***	4.438	0.772 ***	5.793	0.821 ***	8.867	0.728 ***	9.055	0.737 ***	6.121	0.862 ***	10.36	1.84 ***
NCA = "Q"	10.83	0.70 ***	4.704	0.764 ***	9.51	0.90 ***	11.16	0.73 ***	11.46	0.74 ***	10.10	0.95 ***	17.14	1.87 ***
Adjusted R-squared	0.03		0.02		0.03		0.04		0.03		0.02		–0.17	
MSE	30.38		28.94		28.21		29.69		29.43		27.19		28.15	
F-statistics	145.9 ***		109.2 ***		64.2 ***		120.0 ***		119.7 ***		51.5 ***		169.0 ***	
Aver. (Y)	–3.85		1.79		–5.25		–4.29		–3.85		–5.25		–4.29	
S.D. (Y)	30.86		29.30		28.59		30.32		30.86		28.59		30.32	

Note: Symbols ***, ** and * denote statistical significance at the level of 1%, 5% and 10%.

[a] OLS estimate of coefficients with dummy variables for years. [b] PCSE correction of covariances for correlation and heteroskedacity of growth in time but not between corporations. [c] The values of all variables (except year indicator) fixed at 2008 and 2002 values, respectively, (a-estimates). [d] The model also includes changes in 2008 variables relative to their value in 2003. [e] The model also includes the original time-varying variables. Additionally, in the estimation process, EMP, EFIC and SKILL are instrumented by their lagged values. [f] GLS coefficient estimate with Wansbeek-Kapteyn estimate of variance components in (t).

Sources: Fina and author's calculation.

Table 4 Growth ($EG1_{it}$) of all corporations during the pre-crisis and crisis period – OLS and RE estimates

G(t) = ln(EMP(t)/EMP(t−1))[a]

	Estimate "OLS1"[b,c,d] 2009 – 2013 N = 41518		Estimate "OLS1a"[b,c,d] 2003 – 2007 N = 34298		Estimate "OLS2"[b,c,d,e] 2009 – 2013 N = 24397		Estimate "OLS3"[b,c,d,f] 2009 – 2013 N = 39163		Estimate "RE1"[b,c,d,g] 2009 – 2013 N = 41518		Estimate "RE2"[b,c,d,e,g] 2009 – 2013 N = 24397		Estimate "RE3"[b,c,d,f,g] 2009 – 2013 N = 39163	
X(t−1)/Z(t)	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error
C	−5.303	2.379 **	1.790	2.174	−24.12	3.354 ***	−8.680	2.486 ***	−11.76	3.028 ***	−38.64	4.086 ***	3.082	4.525
SHARE	0.736	0.275 ***	0.817	0.324 **	−0.272	0.373	−5.794	1.048 ***	0.967	0.358 ***	−0.206	0.459	−6.520	1.339 ***
EFIC	11.28	1.64 ***	5.128	1.712 ***	4.20	2.05 **	13.68	1.89 ***	10.40	2.10 ***	0.42	2.50	56.62	3.64 ***
EXPINT	0.009	0.006	−0.040	0.007 ***	0.032	0.011 ***	−0.057	0.008 ***	0.005	0.007	0.031	0.013 **	−0.048	0.012 ***
FIN	−0.423	0.027 ***	−0.452	0.034 ***	−0.539	0.054 ***	0.221	0.037 ***	−0.551	0.034 ***	−0.667	0.065 ***	0.083	0.060
INT	−0.374	0.182 **	−2.193	0.431 ***	−8.850	1.435 ***	−0.561	0.222 **	−0.459	0.219 **	−11.84	1.742 ***	−0.409	0.358
LEV	0.001	0.000 ***	0.006	0.001 ***	0.000	0.003	0.001	0.000 ***	0.001	0.000 ***	−0.003	0.004	0.002	0.000 ***
TECH	0.010	0.024	−0.061	0.026 **	−0.058	0.040	0.047	0.037	−0.005	0.030	−0.076	0.048	0.058	0.059
LAB	−0.112	0.009 ***	−0.001	0.003	−0.074	0.012 ***	−0.091	0.010 ***	−0.143	0.011 ***	−0.093	0.015 ***	−0.206	0.017 ***
SKILL	0.051	0.003 ***	0.095	0.005 ***	0.070	0.005 ***	−0.028	0.010 ***	0.062	0.004 ***	0.089	0.006 ***	0.177	0.021 ***
LIQBTC	−27.32	4.77 ***			−19.41	5.01 ***	−29.16	4.86 ***	−34.47	5.93 ***	−20.93	5.94 ***	−44.46	8.55 ***
AGE	3.777	0.191 ***	0.441	0.237 *	7.132	0.559 ***	4.410	0.209 ***	6.268	0.241 ***	10.57	0.68 ***	4.999	0.386 ***
EMP	−15.56	1.48 ***	−9.294	1.529 ***	−8.47	1.86 ***	−15.10	1.54 ***	−15.57	1.89 ***	−5.74	2.27 **	−18.22	2.84 ***
GOV	12.53	1.25 ***	−1.771	1.160	9.83	1.44 ***	11.56	1.27 ***	17.61	1.62 ***	13.50	1.77 ***	28.55	2.34 ***
FOR	−0.391	0.638	1.636	0.858 *	−1.981	0.857 **	−3.023	0.710 ***	−1.205	0.815	−2.557	1.051 **	1.060	1.332
EXPORT	4.398	0.425 ***	4.585	0.443 ***	2.500	0.521 ***	3.094	0.434 ***	6.228	0.544 ***	3.581	0.640 ***	7.296	0.792 ***
OUTZG	2.737	0.319 ***	1.777	0.314 ***	2.687	0.387 ***	3.067	0.332 ***	3.633	0.406 ***	3.467	0.472 ***	3.179	0.611 ***
NCA = "A"	9.012	1.186 ***	0.345	1.300	5.984	1.448 ***	9.275	1.213 ***	9.746	1.520 ***	5.454	1.772 ***	8.829	2.238 ***
NCA = "B"	1.273	2.723	9.766	2.894 ***	−1.374	3.113	4.064	2.776	1.958	3.493	−0.877	3.826	3.607	5.052
NCA = "C"	3.828	0.677 ***	2.098	0.770 ***	1.412	0.817 *	3.775	0.698 ***	3.469	0.866 ***	0.443	0.999	−0.836	1.275
NCA = "DE"	11.60	1.65 ***	18.20	2.32 ***	9.99	1.93 ***	10.81	1.68 ***	11.70	2.13 ***	9.71	2.38 ***	12.35	3.09 ***
NCA = "F"	−5.662	0.502 ***	6.846	0.764 ***	−7.779	0.643 ***	−5.030	0.516 ***	−6.997	0.637 ***	−9.726	0.782 ***	−9.316	0.937 ***
NCA = "HJ"	2.730	0.588 ***	0.678	0.651	2.761	0.706 ***	2.698	0.601 ***	3.238	0.752 ***	3.341	0.863 ***	3.769	1.104 ***
NCA = "I"	2.336	0.699 ***	−1.239	0.738 *	4.068	0.904 ***	3.067	0.720 ***	3.420	0.891 ***	5.824	1.105 ***	4.187	1.325 ***
NCA = "LMNRS"	3.945	0.548 ***	3.908	0.418 ***	3.385	0.679 ***	3.664	0.578 ***	6.395	0.699 ***	5.818	0.829 ***	5.052	1.082 ***
NCA = "O"	−5.445	8.342	−13.64	9.46	−24.94	11.176 **	−8.020	8.696	−11.68	10.468	−42.70	13.239 ***	−8.173	15.588
NCA = "P"	16.67	1.33 ***	6.417	1.335 ***	11.01	1.57 ***	16.05	1.35 ***	21.68	1.72 ***	13.40	1.93 ***	24.79	2.50 ***
NCA = "Q"	21.72	1.34 ***	9.604	1.343 ***	18.26	1.73 ***	20.71	1.36 ***	27.98	1.73 ***	22.27	2.13 ***	34.77	2.53 ***
Adjusted R-squared	0.02		0.02		0.02		0.03		0.02		0.02		0.03	
MSE	55.25		49.87		51.62		53.92		48.72		45.94		42.90	
F-statistics	132.0 ***		85.5 ***		62.1 ***		125.9 ***		122.1 ***		54.2 ***		167.3 ***	
Aver. (Y)	−17.36		−7.43		−15.74		−16.92		−17.36		−15.74		−16.92	
S.D. (Y)	55.95		50.32		52.24		54.83		55.95		52.24		54.83	

Note: Symbols***, ** and * denote statistical significance at the level of 1%, 5% and 10%.

[a] If a corporation does not operate in year t, then G(t) = −ln(EMP(t−1)). [b] OLS estimate of coefficients with dummy variables for years. [c] PCSE correction of covariances for correlation and heteroskedacity of growth in time but not between corporations. [d] The values of all variables (except year indicator) fixed at 2008 and 2002 values, respectively, (a-estimates). [e] The model also includes changes in 2008 values relative to their value in 2003. [f] The model also includes the original time-varying variables. Additionally, in the estimation process, EMP, EFIC and SKILL are instrumented by their lagged values. [g] GLS coefficient estimate with Wansbeek-Kapteyn estimate of variance components in (t).

Sources: Fina and author's calculation.

Table 5 Five-year growth (**EG2**$_{it}$) of all corporations during the pre-crisis and crisis period

G(t) = ln(EMP(t)/EMP(t−5))[a]

	Estimate "OLS1"[b,c] 2013 N = 24615		Estimate "OLS1a"[b,c] 2007 N = 22986		Estimate "OLS2"[b,c,d] 2013 N = 16511	
X(t−1)/Z(t)	Coef.	St. error	Coef.	St. error	Coef.	St. error
C	62.50	5.28 ***	62.37	7.35 ***	50.28	7.45 ***
SHARE	1.522	0.547 ***	0.527	1.000	1.304	0.861
EFIC	28.43	3.62 ***	30.17	5.75 ***	26.38	4.50 ***
EXPINT	0.121	0.017 ***	–0.039	0.025	0.158	0.022 ***
FIN	–0.166	0.066 **	–0.455	0.125 ***	–0.370	0.123 ***
INT	–0.087	1.361	–3.133	2.434	2.486	3.447
LEV	0.001	0.000	–0.005	0.003	0.015	0.007 **
TECH	0.147	0.053 ***	0.111	0.092	0.004	0.089
LAB	–0.140	0.020 ***	–0.400	0.031 ***	–0.083	0.027 ***
SKILL	0.034	0.007 ***	0.171	0.017 ***	0.066	0.011 ***
LIQBTC	–20.53	14.01		***	–31.33	14.97 **
AGE	–6.207	0.440 ***	–6.007	0.814 ***	–4.747	1.250 ***
EMP	–34.92	3.28 ***	–37.99	5.15 ***	–32.32	4.12 ***
GOV	11.47	2.57 ***	22.24	3.84 ***	11.93	2.97 ***
FOR	2.257	1.415	2.586	2.842	–1.580	1.863
EXPORT	1.304	0.985	7.336	1.466 ***	0.443	1.118
OUTZG	2.254	0.712 ***	2.287	1.061 **	3.394	0.854 ***
NCA = "A"	14.52	2.58 ***	8.88	4.40 **	15.78	3.17 ***
NCA = "B"	–7.562	5.880	25.34	9.59 ***	–9.789	6.551
NCA = "C"	10.82	1.49 ***	15.05	2.60 ***	10.22	1.79 ***
NCA = "DE"	22.91	3.48 ***	20.53	7.27 ***	21.70	4.03 ***
NCA = "F"	–6.077	1.171 ***	24.43	2.57 ***	–7.864	1.478 ***
NCA = "HJ"	3.484	1.296 ***	4.199	2.198 *	1.751	1.538
NCA = "I"	6.791	1.585 ***	2.947	2.551	7.331	1.988 ***
NCA = "LMNRS"	–1.262	1.211	14.74	1.48 ***	–2.882	1.497 *
NCA = "O"	72.54	22.39 ***	9.35	29.43	73.08	27.89 ***
NCA = "P"	18.59	2.77 ***	32.86	4.36 ***	13.32	3.27 ***
NCA = "Q"	20.63	2.75 ***	29.47	4.30 ***	18.67	3.57 ***
Adjusted R-squared	0.07		0.05		0.05	
MSE	49.91		71.69		48.19	
F-statistics	68.8 ***		43.3 ***		27.4 ***	
Aver. (Y)	–6.66		0.64		–11.62	
S.D. (Y)	51.74		73.38		49.55	

Note: Symbols***, **and * denote statistical significance at the level of 1%, 5% and 10%.
[a] If a corporation does not operate in year t, then G(t) = –ln(EMP(t−1)). [b] OLS estimate of coefficients. [c] The values of all variables fixed at 2008 and 2002 values, respectively, (a-estimates). [d] The model also includes changes in 2008 variables relative to their value in 2003.
Sources: Fina and author's calculation.

Table 6 Growth ($EG1_{it}$) of corporations during the crisis – OLS estimates by activities

G(t) = ln(EMP(t)/EMP(t−1))[a,b,c,d]

	NCA = "C" 2009 – 2013 N = 23744		NCA = "F" 2009 – 2013 N = 19533		NCA = "G" 2009 – 2013 N = 51353		NCA = "HJ" 2009 – 2013 N = 12759		NCA = "I" 2009 – 2013 N = 8283		NCA = "LMNRS" 2009 – 2013 N = 33325	
X(t−1)/Z(t)	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error	Coef.	St. error
C	36.65	10.27 ***	15.47	12.82	2.128	6.051	22.49	7.07 ***	21.59	18.81	−19.90	2.58 ***
SHARE	1.012	0.580 *	56.64	13.16 ***	9.844	2.797 ***	−2.070	0.684 ***	22.78	7.33 ***	2.092	0.817 **
EFIC	28.76	5.76 ***	28.93	9.01 ***	15.04	4.34 ***	32.90	5.05 ***	33.31	13.35 **	−5.058	2.090 **
EXPINT	0.079	0.018 ***	0.056	0.049	0.001	0.014	0.048	0.020 **	0.043	0.064	−0.008	0.006
FIN	−1.126	0.117 ***	−0.612	0.084 ***	−0.468	0.056 ***	−0.284	0.101 ***	−0.245	0.108 **	−0.094	0.044 **
INT	−4.705	1.921 **	0.017	0.232	−11.39	1.67 ***	4.557	1.129 ***	−18.67	5.75 ***	−10.31	1.32 ***
LEV	0.009	0.006	0.001	0.000 **	−0.005	0.003 *	−0.005	0.005	0.019	0.004 ***	−0.006	0.002 ***
TECH	0.089	0.092	−0.160	0.142	0.003	0.046	−0.073	0.078	0.129	0.052 **	−0.003	0.040
LAB	−0.290	0.027 ***	−0.134	0.027 ***	−0.178	0.017 ***	−0.095	0.030 ***	−0.041	0.054	−0.002	0.014
SKILL	0.023	0.005 ***	0.079	0.015 ***	0.074	0.006 ***	0.046	0.011 ***	0.063	0.023 ***	0.054	0.005 ***
LIQBTC	−35.31	10.22 ***	−50.22	17.29 ***	−14.08	9.06	−156.9	26.9 ***	11.16	27.98	23.42	12.67 *
AGE	4.602	0.565 ***	5.062	0.597 ***	3.323	0.359 ***	4.585	0.652 ***	6.264	0.795 ***	2.176	0.331 ***
EMP	−32.07	5.32 ***	−34.79	8.07 ***	−19.26	3.85 ***	−33.61	4.53 ***	−37.71	11.73 ***	−1.466	1.805
GOV	−0.869	4.594	21.54	5.00 ***	7.531	3.925 *	11.26	3.46 ***	14.25	6.24 **	8.179	2.047 ***
FOR	−1.026	1.733	−4.146	2.873	−1.126	1.025	2.291	2.101	3.393	3.229	−4.751	1.214 ***
EXPORT	4.780	1.185 ***	2.666	2.409	4.302	0.693 ***	0.995	1.338	2.087	4.035	2.977	0.781 ***
OUTZG	1.234	1.035	4.624	1.100 ***	2.108	0.514 ***	3.956	1.054 ***	5.459	1.611 ***	2.384	0.565 ***
Adjusted R-squared	0.03		0.03		0.02		0.02		0.03		0.02	
MSE	64.22		65.73		51.14		52.32		61.43		47.49	
F-statistics	34.2		26.7 ***		56.5 ***		13.8 ***		11.9 ***		34.3 ***	
Aver. (Y)	−20.12		−28.03		−16.96		−14.41		−19.57		−12.45	
S.D. (Y)	65.11		66.58		51.69		52.84		62.23		47.96	

Note: Symbols***, ** and* denote statistical significance at the level of 1%, 5% and 10%.

[a] If a corporation does not operate in year t, then G(t) = −ln(EMP(t−1)). [b] OLS estimate of coefficients with dummy variables for years. [c] PCSE correction of covariances for correlation and heteroskedacity of growth in time but not between corporations. [d] The values of all variables (except year indicator) fixed at 2008 and 2002 values, respectively, (a-estimates).

Sources: Fina and author's calculation.

6 Conclusion

The research conducted sets the guidelines for further research into the capacity for growth of corporations in the Republic of Croatia during an economic crisis. It starts with a linear model of "*ex post* forecast" of corporation growth adjusted for the "panel structure" of data for the period 2002 – 2013. Corporation growth is measured as a change in the logarithm of the number of employed persons in a corporation at the end of the year. The model was then used to examine the type of corporations which found it easier to withstand the 2009 – 2013 crisis, i.e. the pre-crisis characteristics of these corporations which were associated with faster or slower growth (a bigger decrease) in the number of employed persons during the crisis compared to corporations with which they share other characteristics in common.

The key conclusion is that the characteristics associated with faster corporation growth in the pre-crisis period (2004 – 2007) were mainly the same as those associated with less negative growth during the crisis, from 2009 to 2013, but only if corporation management during the crisis is not factored in. The second conclusion by order of importance is that corporation management during the crisis is relevant for growth, i.e. that the destiny of a corporation is not fully "predetermined" by its pre-crisis characteristics, which may be changed by active efforts on the part of the management. If corporation management during the crisis is factored in, it can be concluded that smaller corporations, state-owned enterprises, corporations that engaged at least to an extent in exports and companies that relied less on internal funding, operated at a a greater scale of efficiency and were less labour-intensive before the crisis grew faster during the crisis.

Also, as expected, the fall in the number of employed persons in corporations in the construction activity during the crisis was bigger than that which could be explained by other characteristics of such corporations, in contrast with the pre-crisis period when their growth was faster than that which could be implied by the other characteristics of such corporations.

These conclusions on the relationships between growth and other corporation characteristics should be interpreted as a partial correlation in the context of the assumed linear model. In assessing the parameters of this model standard measures were used to reduce the impact on the estimate of the relationship between growth and individual corporation characteristics: 1) simultaneity (the values of the previous year's independent variables were used rather than the current year's values) and 2) unobserved heterogeneity of corporations (it was estimated by means of corporation characteristics at the beginning of the period). However, the conducted analysis does not necessarily reveal the direction of the causal relationships since the stated measures do not fully eliminate the so called statistical endogeneity of the independent variables, i.e. corporation growth in the past may "determine" some of its characteristics today, which in turn determine future growth.

The natural follow-up to the conducted research would be to examine the functional forms of the independent variables in the model or/and conduct quantile regressions to identify possible nonlinearity in the relationship between corporation growth and its characteristics (including interactions between several characteristics), already suggested by the analysis described in chapter three. Also, one could perform a model parameter estimate, checking a corporation's affiliation with an activity determined on the basis of the first two digits of the activity code (NCA), instead of on the basis of the first digit, while "pairing" methods could provide an additional confirmation of the significance of individual characteristics of a corporation to its growth. One could also examine the "dynamics" of corporation growth adjustment to the crisis using GMM estimation of parameters of dynamic models, which assume an autocorrelated measure of corporation growth, the existence of which was evidenced to an extent in the descriptive analysis given in chapter three of this paper.

As regards the implications for the pursuit of economic policy and financial risk management (of financial institutions), this paper provides plenty of statistical evidence that corporations that enter the crisis with a low scale of efficiency, highr labour intensity and heavy reliance on internal funding will grow at a slower rate during the crisis. This paper does not show whether this slower growth in the number of employed persons (i.e. their greater decline) during the crisis characteristic of the described corporations, compared to otherwise similar corporations, is a reflection of the way in which such corporations adapt to the crisis (and by doing

so avoid further worsening of the corporation's financial stability) or whether it is a direct consequence of the crisis, which hits such corporations more severely than otherwise similar corporations, with slower growing corporations reaping few if any benefits from slower growth. For such a conclusion to be drawn, additional research would need to be performed.

7 References

Amendola, A. (2010): *How is the 2007 crisis affecting firm survival? Evidence from Italy*, a paper presented at the 12th European Trade Study Group Conference, organised by the University of Lausanne from 9 to 11 September 2010.

Backe, P. et al. (2010): *How Did the Global Financial Crisis Affect the CESEE Region and Latin America? A Comparative Analysis*, Focus on European Economic Integration, Österreichische Nationalbank, No. 1, pp. 49-66.

Broz, T. et al. (2008): *Aktualna ekonomska kretanja*, Economic Trends and Economic Policy, The Institute of Economics, Zagreb, No. 116-117.

Broz, T. et al. (2009): *Aktualna ekonomska kretanja*, Economic Trends and Economic Policy, The Institute of Economics, Zagreb, No. 118-121.

Broz, T. et al. (2010): *Aktualna ekonomska kretanja*, Economic Trends and Economic Policy, The Institute of Economics, Zagreb, No. 122-125.

Capasso, M., E. Cefis, and K. Frenken (2009): *Do Some Firms Persistently Outperform?*, LEM Papers Series 2009/15, Laboratory of Economics and Management (LEM), Sant'Anna School of Advanced Studies, Pisa, Italy.

Coad, A. (2007): *Testing the principle of 'growth of the fitter': The relationship between profits and firm growth,* Structural Change and Economic Dynamics, Vol. 18, No. 3, pp. 370-386, September.

Coad, A. (2009): *The Growth of Firms: A Survey of Theories and Empirical Evidence,* Edward Elgar: Cheltenham, UK.

Correa, P., and M. Iootty (2010): *The Impact of the Global Economic Crisis on the Corporate Sector in Europe and Central Asia: Evidence from a Firm-Level Survey,* Enterprise Note Series, World Bank, No. 9.

Croatian National Bank (2010): *Annual Report 2009*, Zagreb.

Croatian National Bank (2011): *Annual Report 2010*, Zagreb.

Croatian National Bank (2012): *Bulletin No. 176*, Zagreb.

Croatian National Bank (2013): *Annual Report 2012*, Zagreb.

Croatian National Bank (2014): *Annual Report 2013*, Zagreb.

Čengić, D. et al. (2011): *Poduzeća, kriza i strategije opstanka: socio-ekonomska analiza rezultata empirijskoga istraživanja u hrvatskoj metaloprerađivačkoj i drvoprerađivačkoj industriji: neka iskustva od 2008. do 2010. godine*, Konrad Adenauer Foundation, Zagreb, May.

Geroski, P.A. (1999): *The Growth of Firms in Theory and Practice*, Centre of Economic Policy Research Discussion Paper Series, No. 2092, London: Centre of Economic Policy Research.

Government of the Republic of Croatia (2009): *Odluka Vlade RH o mjerama za gospodarski oporavak i razvitak*, http://www.vlada.hr/hr/content/download/115198/1649828/file/36-01.pdf.

Hölzl, W. (2011): *Persistence, Survival and Growth: A Closer Look at 20 Years of High-Growth Firms in Austria*, WIFO Working Papers, WIFO, No. 403.

Kim, M. (2013): *FDI and Export Spillovers through Horizontal and Vertical Linkages in South Korea Using Heckman's Two Step Approach*, Korea and the World Economy, Vol. 14, No. 2, pp. 259-280, August.

Kolasa, M., M. Rubaszek, and D. Taglioni (2010): *Firms in the great global recession: The role of foreign ownership and financial dependence*, Emerging Markets Review, Elsevier, Vol. 11, No. 4, pp. 341-357, December.

Lehtoranta, O. (2010): *Innovation, Collaboration in Innovation and the Growth Performance of Finnish Firms*, VTT Publications, No. 729, pp. 17-76.

Oberhofer, H. (2010): *Firm growth, European industry dynamics and domestic business cycles*, FIW Working Paper 55, Österreichischen Institut für Wirtschaftsforschung.

Pradhan, J. P. (2009): *Firm Performance during Global Economic Slowdown: A View from India*, MPRA Paper 17145, University Library of Munich, Germany.

Santarelli, E. (2002): *Is subsidizing entry an optimal policy?*, Industrial and corporation Change, Oxford University Press, Vol. 11(1), pp. 39-52.

Santoro, E. (2006): *Macroeconomic fluctuations and the firms' rate of growth distribution: Evidence from UK and US quoted companies*, Discussion Papers, Universita Degli Studi di Trento, No. 6.

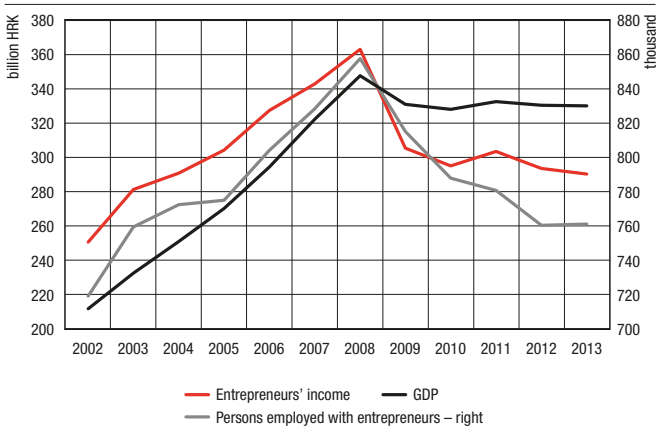
Valdec, M., and J. Zrnc (2015): *The direction of causality between exports and firm performance: microeconomic evidence from Croatia using the matching approach*, Financial Theory & Practice, The Institute of Public Finance, Vol. 39, No. 1, pp. 1-30.

Wooldridge, J. M. (2002): *Econometric analysis of cross section and panel data*, MIT Press, Cambridge, Massachusetts, pp. 247-291.

8 Annexes

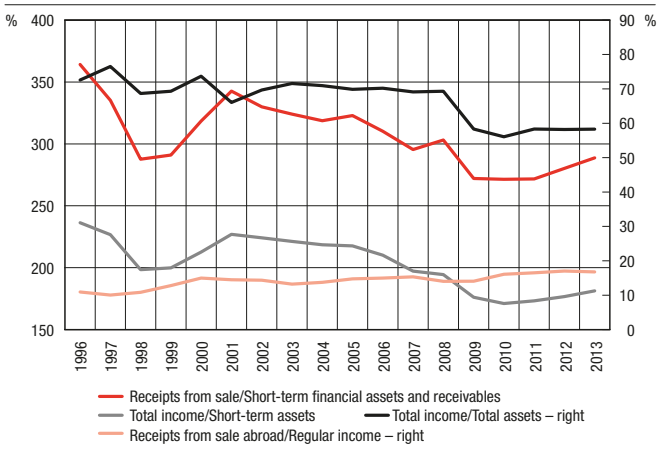
Annex 1 Macroeconomic and aggregate indicators of entrepreneurs' business operations in the Republic of Croatia, 2002 – 2013

Figure 1 Macroeconomic aggregates and gross income of non-financial legal persons, 2002 – 2013



Sources: Fina, CBS and author's calculation.

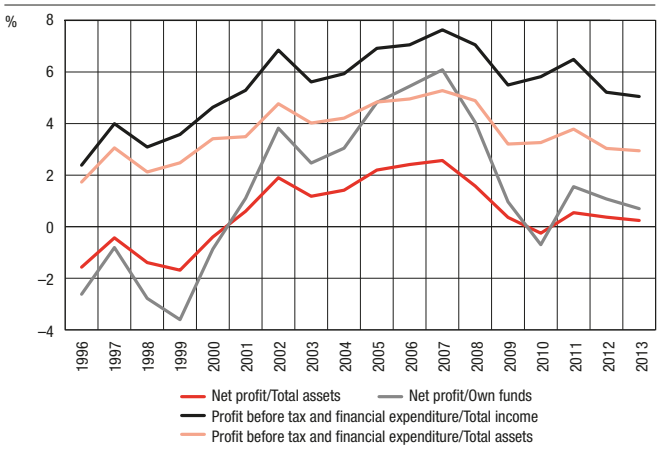
Figure 2 Activity of entrepreneurs – legal persons from non-financial activities



Sources: Fina and author's calculation.

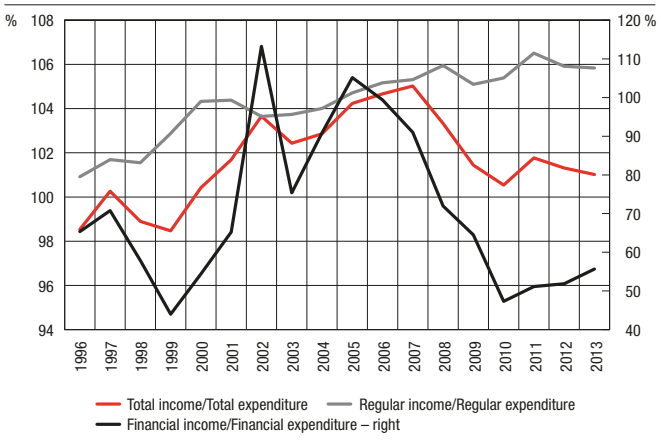
Annex 1 (continued) Financial analysis of entrepreneurs – legal persons from non-financial activities

Figure 3 Profitability of entrepreneurs – legal persons from non-financial activities



Sources: Fina and author's calculation.

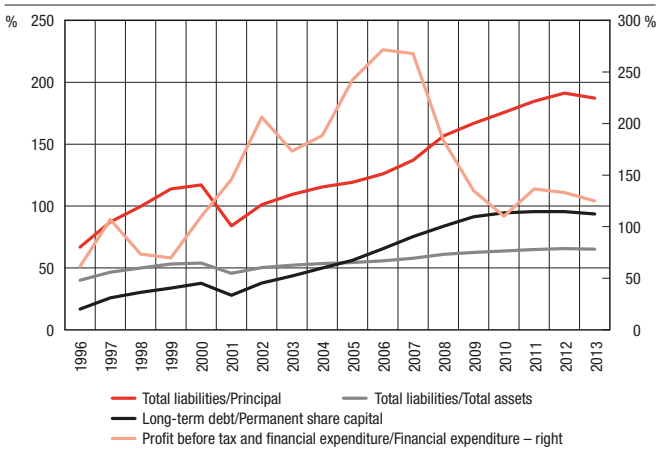
Figure 4 Cost-effectiveness of entrepreneurs – legal persons from non-financial activities



Sources: Fina and author's calculation.

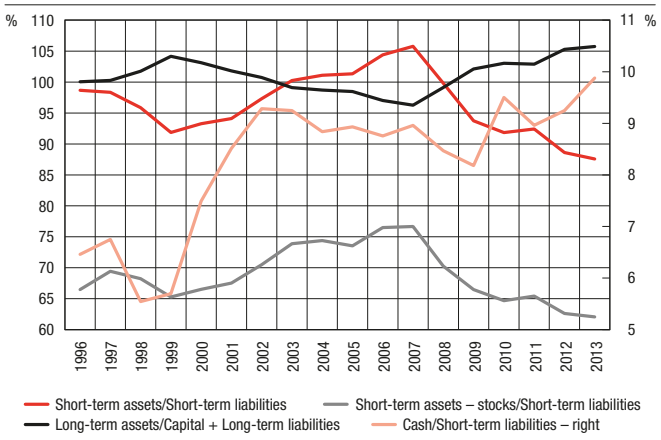
Annex 1 (continued) Financial analysis of entrepreneurs – legal persons from non-financial activities

Figure 5 Indebtedness of entrepreneurs – legal persons from non-financial activities



Sources: Fina and author's calculation.

Figure 6 Liquidity of entrepreneurs – legal persons from non-financial activities



Sources: Fina and author's calculation.

Annex 2 Descriptive statistics of the measure of growth of non-financial corporations (G_t)

Table 1 Growth and macroeconomic environment

Year	GDP growth	Growth in the number of employed persons – G(t)		
		Average	St. dev.	N
2002	5.2			
2003	5.6	3.9	27.3	31,311
2004	4.1	2.8	27.8	32,621
2005	4.2	2.5	26.8	32,436
2006	4.8	3.2	26.4	32,904
2007	5.2	3.2	26.3	33,897
2008	2.1	2.2	26.7	34,749
2009	–7.4	–3.5	27.9	35,005
2010	–1.7	–4.0	28.5	34,579
2011	–0.3	–0.9	27.4	35,037
2012	–2.2	–0.7	27.5	34,631
2013	–0.9	0.2	28.1	34,442
All	**1.5**	**0.7**	**27.5**	**371,612**

Sources: Fina and author's calculation.

Table 2 Growth and size

Line 1	Average	G(t)		
Line 2	Mean			
Line 3	SD			
Line 4	N	2003 – 2007	2009 – 2013	2003 – 2013
EMP (t–1)	2–5	5.3	2.4	3.9
		0.0	0.0	0.0
		24.0	23.7	23.9
		89,274	93,446	200,946
	6–50	0.9	–6.4	–2.7
		0.0	0.0	0.0
		28.2	30.1	29.3
		63,803	69,460	147,540
	51+	–2.7	–8.1	–5.1
		1.0	–1.6	0.0
		38.3	39.2	38.4
		10,092	10,788	23,126
	All	3.1	–1.8	0.7
		0.0	0.0	0.0
		26.9	27.9	27.5
		163,169	173,694	371,612

Sources: Fina and author's calculation.

Table 3 Growth and age

Line 1	Average	G(t)		
Line 2	Mean			
Line 3	SD			
Line 4	N	2003 – 2007	2009 – 2013	2003 – 2013
AGE (t)	1–3	19.3	10.3	14.7
		6.3	0.0	0.0
		42	40	40.5
		5,471	5,775	12,563
	4–11	6.6	1.3	3.8
		0.0	0.0	0.0
		32	33	32.3
		35,007	43,704	87,463
	12+	1.4	–3.4	–0.9
		0.0	0.0	0.0
		24	25	24.6
		122,643	124,210	271,532
All ages		3.1	–1.8	0.7
		0.0	0.0	0.0
		26.9	27.9	27.5
		163,121	173,689	371,558

Sources: Fina and author's calculation.

Table 4 Growth and activity

Line 1	Average	G(t)		
Line 2	Mean			
Line 3	N	2003 – 2007	2009 – 2013	2003 – 2013
NCA (t)	A	0.2	–1.2	–0.4
		0.0	0.0	0.0
		3,704	3,596	8,000
	B	5.4	–6.5	–0.6
		0.0	0.0	0.0
		470	487	1,060
	C	2.1	–2.9	–0.3
		0.0	0.0	0.0
		26,629	26,531	58,348
	DE	1.8	0.6	1.3
		0.5	0.0	0.0
		730	2,243	3,361
	F	5.1	–5.3	0.0
		0.0	0.0	0.0
		18,032	20,406	42,888
	G	2.6	–2.3	0.5
		0.0	0.0	0.0
		63,064	53,206	127,958
	HJ	3.2	0.0	1.4
		0.0	0.0	0.0
		8,894	14,266	25,871
	I	1.5	0.1	0.6
		0.0	0.0	0.0
		7,254	10,063	19,046
	LMNRS	4.2	–0.1	1.9
		0.0	0.0	0.0
		29,938	37,759	74,598
	O	5.0	8.6	6.1
		0.0	0.0	0.0
		35	32	76
	P	5.7	0.3	2.8
		0.0	0.0	0.0
		2,098	2,525	5,075
	Q	5.4	2.1	3.9
		0.0	0.0	0.0
		2,321	2,580	5,331
All activities		3.1	–1.8	0.7
		0.0	0.0	0.0
		163,169	173,694	371,612

Sources: Fina and author's calculation.

Table 5 Growth and type of ownership

Line 1	Average	G(t)		
Line 2	Mean			
Line 3	No. of observations	2003 – 2007	2009 – 2013	2003 – 2013
	State	1.8	–0.2	1.2
		0.0	0.0	0.0
		3,003	3,031	6,593
	Private	3.3	–1.7	0.8
		0.0	0.0	0.0
		155,885	167,510	356,891
	Cooperative	–0.3	–2.0	–1.0
		0.0	0.0	0.0
		886	976	2,066
	Mixed ownership	–6.0	–7.1	–6.3
		0.0	–1.4	0.0
		3,395	2,177	6,062
All corporations		3.1	–1.8	0.7
		0.0	0.0	0.0
		163,169	173,694	371,612

Sources: Fina and author's calculation.

Table 6 Growth and foreign investment

Line 1	Average	R(t)		
Line 2	Mean			
Line 3	No. of observations	2003 – 2007	2009 – 2013	2003 – 2013
	Foreign ownership (> 10% FDI)	7.3	–0.6	2.5
		0.0	0.0	0.0
		5,867	11,137	19,095
	Others (0% – 10% FDI)	2.9	–1.9	0.6
		0.0	0.0	0.0
		157,302	162,557	352,517
All corporations		3.1	–1.8	0.7
		0.0	0.0	0.0
		163,169	173,694	371,612

Sources: Fina and author's calculation.

The following Working Papers have been published:

No.	Date	Title	Author(s)
W-1	December 1999	Croatia in the Second Stage of Transition, 1994–1999	Velimir Šonje and Boris Vujčić
W-2	January 2000	Is Unofficial Economy a Source of Corruption?	Michael Faulend and Vedran Šošić
W-3	September 2000	Measuring the Similarities of Economic Developments in Central Europe: A Correlation between the Business Cycles of Germany, Hungary, the Czech Republic and Croatia	Velimir Šonje and Igeta Vrbanc
W-4	September 2000	Exchange Rate and Output in the Aftermath of the Great Depression and During the Transition Period in Central Europe	Velimir Šonje
W-5	September 2000	The Monthly Transaction Money Demand in Croatia	Ante Babić
W-6	August 2001	General Equilibrium Analysis of Croatia's Accession to the World Trade Organization	Jasminka Šohinger, Davor Galinec and Glenn W. Harrison
W-7	February 2002	Efficiency of Banks in Croatia: A DEA Approach	Igor Jemrić and Boris Vujčić
W-8	July 2002	A Comparison of Two Econometric Models (OLS and SUR) for Forecasting Croatian Tourism Arrivals	Tihomir Stučka
W-9	November 2002	Privatization, Foreign Bank Entry and Bank Efficiency in Croatia: A Fourier-Flexible Function Stochastic Cost Frontier Analysis	Evan Kraft, Richard Hofler and James Payne
W-10	December 2002	Foreign Banks in Croatia: Another Look	Evan Kraft
W-11	October 2003	The Impact of Exchange Rate Changes on the Trade Balance in Croatia	Tihomir Stučka
W-12	August 2004	Currency Crisis: Theory and Practice with Application to Croatia	Ivo Krznar
W-13	June 2005	Price Level Convergence: Croatia, Transition Countries and the EU	Danijel Nestić
W-14	March 2006	How Competitive Is Croatia's Banking System?	Evan Kraft
W-15	November 2006	Microstructure of Foreign Exchange Market in Croatia	Tomislav Galac, Ante Burić, Ivan Huljak
W-16	December 2006	Short-Term Forecasting of Inflation in Croatia with Seasonal ARIMA Processes	Andreja Pufnik and Davor Kunovac
W-17	February 2008	Modelling of Currency outside Banks in Croatia	Maroje Lang, Davor Kunovac, Silvio Basač and Željka Štaudinger
W-18	June 2008	International Business Cycles with Frictions in Goods and Factors Markets	Ivo Krznar
W-19	December 2008	Use of the Hedonic Method to Calculate an Index of Real Estate Prices in Croatia	Davor Kunovac, Enes Đozović, Gorana Lukinić, Andreja Pufnik
W-20	May 2009	Contagion Risk in the Croatian Banking System	Marko Krznar
W-21	October 2009	Optimal International Reserves of the CNB with Endogenous Probability of Crisis	Ana Maria Čeh and Ivo Krznar
W-22	December 2009	The Impact of the Financial Crisis and Policy Responses in Croatia	Nikola Bokan, Lovorka Grgurić, Ivo Krznar, Maroje Lang
W-23	April 2010	Habit Persistence and International Comovements	Alexandre Dmitriev and Ivo Krznar
W-24	April 2010	Capital Inflows and Efficiency of Sterilisation – Estimation of Sterilisation and Offset Coefficients	Igor Ljubaj, Ana Martinis and Marko Mrkalj
W-25	April 2010	Income and Price Elasticities of Croatian Trade – A Panel Data Approach	Vida Bobić
W-26	December 2010	Impact of External Shocks on Domestic Inflation and GDP	Ivo Krznar and Davor Kunovac
W-27	December 2010	The Central Bank as Crisis-Manager in Croatia – A Counterfactual Analysis	Tomislav Galac
W-28	January 2011	A Credit Market Disequilibrium Model And Periods of Credit Crunch	Ana Maria Čeh, Mirna Dumičić and Ivo Krznar
W-29	November 2011	Identifying Recession and Expansion Periods in Croatia	Ivo Krznar
W-30	November 2011	Estimating Credit Migration Matrices with Aggregate Data – Bayesian Approach	Davor Kunovac
W-31	November 2011	An Analysis of the Domestic Inflation Rate Dynamics and the Phillips Curve	Ivo Krznar
W-32	January 2012	Are Some Banks More Lenient in the Implementation of Placement Classification Rules?	Tomislav Ridzak
W-33	January 2012	Global Crisis and Credit Euroisation in Croatia	Tomislav Galac
W-34	April 2012	Estimating the Impact of Monetary Policy on Household and Corporate Loans: a FAVEC Approach	Igor Ljubaj
W-35	November 2012	Estimating Potential Output in the Republic of Croatia Using a Multivariate Filter	Nikola Bokan and Rafael Ravnik

No.	Date	Title	Author(s)
W-36	March 2013	Pricing behaviour of Croatian Companies: results of a Firm survey and a Comparison with the eurozone	Andreja Pufnik and Davor Kunovac
W-37	April 2013	Financial Conditions and Economic Activity	Mirna Dumičić and Ivo Krznar
W-38	August 2013	The borrowing costs of selected countries of the European Union – the role of the spillover of external shocks	Davor Kunovac
W-39	September 2014	Nowcasting GDP Using Available Monthly Indicators	Davor Kunovac and Borna Špalat
W-40	June 2014	Short-term Forecasting of GDP under Structural Changes	Rafal Ravnik
W-41	December 2014	Financial Stress Indicators for Small, Open, Highly Euroised Countries – the Case of Croatia	Mirna Dumičić
W-42	September 2015	Determinants of Labour Cost Adjustment Strategies during the Crisis – Survey Evidence from Croatia	Marina Kunovac
W-43	September 2015.	Financial Stability Indicators – the Case of Croatia	Mirna Dumičić

Guidelines to authors

In its periodical publications *Working Papers, Surveys* and *Technical Papers*, the Croatian National Bank publishes scientific and scholarly papers of the Bank's employees and other associate contributors.

After the submission, the manuscripts shall be subject to peer review and classification by the Manuscript Review and Classification Committee. The authors shall be informed of the acceptance or rejection of their manuscript for publication within two months following the manuscript submission.

Manuscripts are submitted and published in Croatian and/or English language.

Manuscripts submitted for publication should meet the following requirements:

Manuscripts should be submitted via e-mail or optical storage media (CD, DVD), accompanied by one printed paper copy. The acceptable text format is Word.

The first page of the manuscript should contain the article title, first and last name of the author and his/her academic degree, name of the institution with which the author is associated, author's co-workers, and the complete mailing address of the corresponding author to whom a copy of the manuscript with requests for corrections shall be sent.

Additional information, such as acknowledgments, should be incorporate in the text at the end of the introductory section.

The second page should contain the abstract and the key words. The abstract is required to be explicit, descriptive, written in third person, consisting of not more than 250 words (maximum 1500 characters). The abstract should be followed by maximum 5 key words.

A single line spacing and A4 paper size should be used. The text must not be formatted, apart from applying bold and italic script to certain parts of the text. Titles must be numerated and separated from the text by double-line spacing, without formatting.

Tables, figures and charts that are a constituent part of the paper must be well laid out, containing: number, title, units of measurement, legend, data source, and footnotes. The footnotes referring to tables, figures and charts should be indicated by lower-case letters (a,b,c…) placed right below. When the tables, figures and charts are subsequently submitted, it is necessary to mark the places in the text where they should be inserted. They should be numbered in the same sequence as in the text and should be referred to in accordance with that numeration. If the tables and charts were previously inserted in the text from other programs, these databases in the Excel format should also be submitted (charts must contain the corresponding data series).

The preferred formats for illustrations are EPS or TIFF with explanations in 8 point Helvetica (Ariel, Swiss). The scanned illustration must have 300 dpi resolution for grey scale and full colour illustration, and 600 dpi for lineart (line drawings, diagrams, charts).

Formulae must be legible. Indices and superscript must be explicable. The symbols' meaning must be given following the equation where they are used for the first time. The equations in the text referred to by the author should be marked by a serial number in brackets closer to the right margin.

Notes at the foot of the page (footnotes) should by indicated by Arabic numerals in superscript. They should be brief and written in a smaller font than the rest of the text.

References cited in the text are listed at the last page of the manuscript in the alphabetical order, according to the authors' last names. References should also include data on the publisher, city and year of publishing.

Publishing Department maintains the right to send back for the author's revision the accepted manuscript and illustrations that do not meet the above stated requirements.

All contributors who wish to publish their papers are welcomed to do so by addressing them to the Publishing Department, following the above stated guidelines.

The Croatian National Bank publications

Croatian National Bank – Annual Report
Regular annual publication surveying annual monetary and general economic developments as well as statistical data.

Croatian National Bank – Semi-annual Report
Regular semi-annual publication surveying semi-annual monetary and general economic developments and statistical data.

Banks Bulletin
Publication providing survey of data on banks.

Croatian National Bank – Bulletin
Regular monthly publication surveying monthly monetary and general economic developments and monetary statistics.

Croatian National Bank – Working Papers
Occasional publication containing shorter scientific papers written by the CNB employees and associate contributors.

Croatian National Bank – Surveys
Occasional publication containing scholarly papers written by the CNB employees and associate contributors.

Croatian National Bank – Technical Papers
Occasional publication containing papers of informative character written by CNB employees and associate contributors.

The Croatian National Bank also issues other publications such as, for example, numismatic issues, brochures, publications in other media (CD-ROM, DVD), books, monographs and papers of special interest to the CNB as well as proceedings of conferences organised or co-organised by the CNB, educational materials and other similar publications.

ISSN 1334-0131 (online)