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Measuring Enterprise Growth: Pitfalls and Implications

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***Abstract*—**Enterprise growth is generally considered as a key driver of competitiveness, employment, economic development and social inclusion. As such, it is perceived to be a highly desirable outcome of entrepreneurship for scholars and decision makers. The huge academic debate resulted in the multitude of theoretical frameworks focused on explaining growth stages, determinants and future prospects. It has been widely accepted that enterprise growth is most likely nonlinear, temporal and related to the variety of factors which reflect the individual, firm, organizational, industry or environmental determinants of growth. However, factors that affect growth are not easily captured, instruments to measure those factors are often arbitrary, causality between variables and growth is elusive, indicating that growth is not easily modeled. Furthermore, in line with heterogeneous nature of the growth phenomenon, there is a vast number of measurement constructs assessing growth which are used interchangeably. Differences among various growth measures, at conceptual as well as at operationalization level, can hinder theory development which emphasizes the need for more empirically robust studies. In line with these highlights, the main purpose of this paper is twofold. Firstly, to compare structure and performance of three growth prediction models based on the main growth measures: Revenues, employment and assets growth. Secondly, to explore the prospects of financial indicators, set as exact, visible, standardized and accessible variables, to serve as determinants of enterprise growth. Finally, to contribute to the understanding of the implications on research results and recommendations for growth caused by different growth measures. The models include a range of financial indicators as lag determinants of the enterprises' performances during the 2008-2013, extracted from the national register of the financial statements of SMEs in Croatia. The design and testing stage of the modeling used the logistic regression procedures. Findings confirm that growth prediction models based on different measures of growth have different set of predictors. Moreover, the relationship between particular predictors and growth measure is inconsistent, namely the same predictor positively related to one growth measure may exert negative effect on a different growth measure. Overall, financial indicators alone can serve as good proxy of growth and yield adequate predictive power of the models. The paper sheds light on both methodology and conceptual framework of enterprise growth by using a range of variables which serve as a proxy for the multitude of internal and external determinants, but are unlike them, accessible, available, exact and free of perceptual nuances in building up the model. Selection of the growth measure seems to have significant impact on the implications and recommendations related to growth. Furthermore, the paper points out to potential pitfalls of measuring and predicting growth. Overall, the results and the implications of the study are relevant for advancing academic debates on growth-related methodology, and can contribute to evidence-based decisions of policy makers.

***Keywords*—**Growth measurement constructs, logistic regression, prediction of growth potential, small and medium-sized enterprises.

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I. Introduction

QUESTION of enterprise growth is one of the central issues of entrepreneurship research, alongside innovation and venture creation [1]. Understanding how micro and small-sized enterprises grow is of special interest since it is the medium-sized, growth-oriented enterprises that make most tangible contribution to economic growth and job creation. In line with that, studying enterprise growth provides insights into the market dynamics, competitive landscape of SMEs world, and perhaps even the growth of the national economy.

Factors that influence growth potential of an enterprise have usually been understood in terms of three main categories: the entrepreneur, the firm and the strategy [2]. In such framework, many factors have been found to be particularly associated with high-growth firms. In terms of characteristics of an entrepreneur, willingness to become involved in situations with uncertain outcomes, mid-management experience [3], education and entrepreneur's aspiration to grow [4] have been singled out as relevant growth factors. On the firm level, age and size of an enterprise, strategic orientation [5]-[7], level of R&D [8], innovation [9], [10], financial structure and productivity [11] are shown to positively influence potential for growth. In addition to these factors, macroeconomic environment and its stakeholders play an important role in facilitating or obstructing the growth of SMEs sector.

Overall, enterprise growth is not a random or chance event but is associated with the specific enterprise attributes, behaviors, strategies and decisions [1]. Most of the attributes are to a great extent reflected in financial statements through various forms such as assets structure and financial leverage. In other words, firm's potential for future growth depends on and can be predicted by the current state and structure of firm's assets, liabilities, equity, revenues and expenses.

Whereas from the theoretical standpoint, enterprise growth is determined by entrepreneur-level, enterprise-level and environment-level factors; from the methodological point of view, the structure of a prediction model as well as its predictive power depends heavily on the choice of growth metric. Previous studies [1] employed various measures of

enterprise growth with the increase in revenues (sales), assets and number of employees being the most common ones. Whereas exploring the suitability of various growth measures as prospective dependent variables is a standard and needful step in development of growth prediction model, the inconsistency of growth measures across studies in the field limits the comparability of the models and may hinder theory development. To resolve some of the issues related to employment of different growth measures and to shed a new light on potential pitfalls in interpretation and comparison of such models, this paper aims at answering following questions. Firstly, what is the relationship between particular growth measure and the structure of the model? In other words, the paper empirically examines the changes in the structure of the model (presented by a set of financial indicators) induced by the alternation of dependent variable. Secondly, the paper examines if the enterprises selected as high-growth based on one growth measure will be classified as high-growth by models using different growth measure. Specifically, this study focuses on the linkage between changes in revenues, assets and number of employees in order to detect alignment (or misalignment) among these measures (e.g. whether an increase in revenues is accompanied with an increase in assets and number of employees). And finally, the study explores the role of selected individual financial indicators to determine the direction of their influence relative to specific growth measure. In other words, to determine if the change in dependent variable (growth measure) can result in particular financial indicator having positive influence on growth potential in one model, and negative influence on growth potential in the other model.

To answer the research questions, the authors employed logistic regression procedure to develop growth prediction models with three most frequently used growth measures – change in revenues, assets and number of employees. The models were tested on several samples to assess their predictive power as well as sensitivity to changes in dependent variable.

The structure of the paper proceeds as follows. The next section sets the theoretical framework and displays the major findings of studies devoted to methodological issues in growth measurement and prediction. Section III is devoted to research methodology with subsections related to data and variables, and methods applied in the study. Results of the analysis are presented in Section IV, while Section V contains discussion, conclusion and implications for further research.

II. Theoretical Framework

Enterprise growth is multidimensional phenomenon that can be researched from different points of view (e.g. macroeconomic and microeconomic perspective, management and entrepreneurship perspective) and on various levels (e.g. in relation to entrepreneur's characteristics, firm strategy, organizational policies and culture, industry specifics and business environment). Plethora of theoretical frameworks is available for researchers to use in their research on enterprise growth, with the resource based view, the life-cycle model, the strategic adaptation perspective and motivational perspective being most frequently used [12]. From the methodology point of view, growth can be measured quantitatively, e.g. in terms of revenue generation, physical output or business volume expansion, and qualitatively, e.g. in terms of quality of products or market position. Taking into account many theoretical frameworks and perspectives that can be used to examine enterprise growth and considering a landscape of prospective growth measures [13], [14], it is no wonder that research in the field of enterprise growth seems rather fragmented and inconsistent (or sometimes even contradictory) in terms of results and implications. Studies with similar sample characteristics have yielded growth prediction models with different structures of predictors [15]. In such hectic and fast-growing field with a multidisciplinary approach, it is of utmost importance for researchers to understand that, despite exploring the same theoretical concept of enterprise growth, it is the methodology design, or more precisely, the way the dependent variable is operationalized that has great influence on the prediction model.

Several studies have focused on using predominantly financial determinants of growth. Reference [16] directed their research at growth SMEs and concluded that the most important determinants seem to be the capacity to invest, particularly in R&D. Reference [17] focused on the identification of the distinguishing factors of high growth SMEs, and they showed that rapid-growth firms are characterized by a lower availability of financial resources in the years immediately preceding their growth. This is consistent with [18] and [19] who concluded that searching for and exploiting opportunities contributes to accelerated growth more than efficiently managing acquired financial resources. On the other hand, [20] showed that availability of external finance and internationalization are positively related to firm's growth. In the context of transition countries, [11] has suggested that firm growth is determined not only by the traditional characteristics of size and age but also by other firm-specific factors such as indebtedness, internal financing, future growth opportunities, process and product innovation, and organizational changes. Reference [21] has identified the balance sheet ratios that enable managers to predict which enterprises are better candidates for a high-growth path. The study pointed out that firm size, firm age and, primarily, internal cash flows (despite bank loans), are of most relevance to the growth and success of a firm. Moreover, there is an unambiguous tendency of external financing resources to negatively affect growth. Furthermore, [22] performed a quantile regression using sales rates obtained from Spanish manufacturing data to assess the influence of financial variables on firm growth. Their study found a non-linear relationship between firm capital structure (mainly an increase in equity) and firm growth.

The most common growth measures in studies focused on predicting enterprise growth are defined as change in sales (revenues), number of employees and value of assets [13], [14]. Other growth measures that can be found in previous research relate to market share, profit, capacity and equity. In

addition, researchers tend to intermittently use relative and absolute measures of growth [23]-[26], [14] as well as various lengths of time span over which growth is studied [27]. Besides, various growth measures are apt to be weakly correlated [15] presuming the differences in the structure of growth prediction models. The field is still lacking a deeper understanding of what happens to growth prediction models when the dependent variable is replaced with a different measure of growth [15].

III. Data and Methodology

A. Data and Variables

Financial data of 53 434 small and medium-sized enterprises (SMEs), that were active in period from 2008 to 2013, was provided by Croatian central financial agency FINA. Medium-sized enterprises account for less than 2% of the SMEs population (1029 medium-sized enterprises were included in the analysis). The main sources of data were financial statements (balance sheet and income statements) from which a set of 27 financial indicators was derived and used in calculation of input variables for model development. Size of samples used for modeling and testing purposes are presented in the Table I.

TABLE I
SAMPLE SIZES

Sample	Growth measure		
	Assets	Sales	Employees
Total population	53430	43350	33910
High growth	746	820	174
Non-high growth	52687	42530	33736
Development	650	750	150
Testing	96	70	24

TABLE II
DESCRIPTIVE STATISTICS AND CORRELATION FOR GROWTH MEASURES

	Mean	Standard Deviation	Assets Growth	Revenues Growth	Employees Growth
Assets Growth	0,013	0,115	1	0,182	0,081
Revenues Growth	0,017	0,129	0,182	1	0,173
Employees Growth	0,005	0,072	0,081	0,173	1

Dependent variable (enterprise growth) was measured in three ways, as an increase in revenues, assets and number of employees (see Table II). These are the most common measures of growth employed in [15]. For an enterprise to be selected as high growth, it has to achieve annual growth rate of 20% and more over a three year period [28]. Growth measures were derived from financial statements from the 2010-2013 period, while dataset from the 2008-2010 period was used to calculate independent variables presented in a form of financial ratios. In addition to financial indicators calculated for years 2008, 2009 and 2010, the change in value of the indicators in periods 2008-2009 and 2009-2010 was also recorded and used as input variable. The only dichotomous variable was related to technology intensity of the industry enterprise operates in. In total, the dataset consisted out of 131 independent variables, out of which 130 were continuous, and one dichotomous.

B. Methodology

Regression in general for r independent variables $x_1, x_2, \dots x_r$ is used to obtain $r \in \mathbb{N}$ coefficients. The dependent variable in this paper is binominal: 1 if the enterprise is high growing, 0 otherwise. Logistic regression was used to create a function that predict the probability of an enterprise becoming a high-growth. It has the following form:

$$p = \frac{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_r x_r}}{1+e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_r x_r}} \quad (1)$$

Unknown are β_i, $i = 1,2, \dots, r$. To be able to estimate them a linear form is preferable, a usual approach is to use logistic transformation:

$$logit(y) = \ln\frac{p}{1-p} = \ln e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_r x_r} = g(x)$$
$$= \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_r x_r \quad (2)$$

By denoting y_i to be realisation of the dependent variable, and $x_i' = (1, x_{i,1}, \dots, x_{i,r})$ to be observed corresponding r explanatory variables, where $i = 1, \dots n$ and n being the sample size, where $p_i = \frac{e^{g(\boldsymbol{x_i})}}{1+e^{g(x_i)}}$ [29] the entire sample likelihood function conditional on $\boldsymbol{x_i}$ is:

$$L(\beta|\boldsymbol{y}) = \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} \quad (3)$$

Again the logarithm is used to obtain a more manageable form:

$$\ln L(\beta|\boldsymbol{y}) = \ln\prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} = \sum_{i=1}^{n} \ln p_i^{y_i}(1-p_i)^{1-y_i}$$
$$= \sum_{i=1}^{n} y_i \ln p_i + (1-y_i)\ln(1-p_i) \quad (4)$$

To estimate β, (4) is maximized through partial differentiation, there is no analytical result. The solution is obtained using iterative processes [30].

Prior to conducting logistic regression, it is necessary to choose which independent variables will be inserted, and this procedure may be challenging [31]. In this study, forward and backward selection procedures were used. The forward procedure starts with choosing one variable with the lowest p-value and adding it the model. Variables are added one by one, again each with the lowest p-value, until the desired number of variables is reached. Backwards selection procedure starts with putting all variables into the model, and leaving out the one with the highest p-value. This step is repeated until the desired number of variables is left in the model [32]. Next step of the analysis included correlation analysis, after which the variables were tested using KS (Kolmogorov-Smirnov) statistic [33]. Following denotation was used: m_1 marked the number of high-growth enterprises with, m_2 marked the number of non-high growth enterprises, I marked the indicator function (1 if all its conditions are met, and 0 otherwise) and s_i was score of the $i-th$ client.

$F_{m_2,BAD}$ and $F_{m_1,GOOD}$ were defined as:

$$F_{m_1,GOOD} = \frac{1}{m_1}\sum_{i=1}^{m_1} I(s_i \le a \;\&\&\; y_i = 1)$$

$$F_{m_2,BAD} = \frac{1}{m_2}\sum_{i=1}^{m_2} I(s_i \le a \;\&\&\; y_i = 0) \quad (5)$$

The KS function has the following shape:

$$KS = \max_{a\in[L,H]}\left|F_{m_2,BAD}(a) - F_{m_1,GOOD}(a)\right| \quad (6)$$

where L and H are, respectively, the minimum and maximum values of scores from the observed model.

Another measure of model quality is the ROC (receiver operating characteristic) curve. It is based on the measure of true positive rate and the false positive rate, calculated from

$$tp\ rate = \frac{\text{Positives correctly classified}}{\text{Total positives}}$$

$$fp\ rate = \frac{\text{Negatives incorrectly classified}}{\text{Total negatives}} \quad (7)$$

for all possible cut-offs. The curve is obtained by plotting $tp\ rate$ on the y axis by and $fp\ rate$ on the x axis. The more the curve is concave the better model with the area under the ROC curve ranging from 0.5 to 1 [34].

IV. Results

The first step of statistical analysis included descriptive analyses of input variables (see Table III). Firstly, individual financial ratios were divided into four groups: liquidity, activity (turnover ratios), leverage and profitability ratios. The fifth group of independent variables included two additional measures – the level of technology intensity and value of nontangible assets. Secondly, three growth measures (growth in revenues, assets and number of employees) were calculated for all enterprises. Within each of the three cases, enterprises were marked as high-growth or non-high growth depending on their growth rate for the selected three-year period.

Several insights can be drawn from the descriptive analysis of independent variables. One of the major differences among three cases is that when growth is measured by change in assets, high-growth enterprises have higher liquidity (measured by median value) relative to non-high growth enterprises, while in the case of growth measure derived from sales figures, the opposite applies. The situation is similar in a group of activity indicators; turnover ratios, that show higher values among high-growth enterprises in case of growth measured in assets, tend to have lower values among high-growth enterprises when growth is measured as change of sales, and vice versa. Based solely on descriptive analysis of high-growth and non-high growth enterprises in each of the three cases, it is reasonable to expect differences in prediction models based on three growth measures, and those differences may be related to a direction of influence of particular individual ratios included in the models. In terms of similarities across the three cases, high-growth enterprises use higher leverage to fuel their growth and they tend to operate in industries with higher technology intensity.

TABLE III
Descriptive Statistics of the Financial Ratios[a] According to Different Measures of Growth

Var. code	Asset Median (IQR)		Employees Median (IQR)		Sales Median (IQR.)	
	High	Non-high	High	Non-high	High	Non-high
Liquidity ratios						
c_cacl	1.12 (1.91)	1.2** (2.15)	1.06 (1.41)	1.13 (1.12)	0.97 (1.59)	1.23*** (1.89)
l_incl	0.92 (1.81)	0.87 (1.77)	0.85 (1.33)	0.86 (1.13)	0.68 (1.36)	0.9*** (1.74)
l_cata	0.84 (0.43)	0.75*** (0.6)	0.73 (0.48)	0.7 (0.5)	0.71 (0.55)	0.74 (0.53)
l_cash	0.12 (0.57)	0.09** (0.45)	0.08 (0.31)	0.06 (0.35)	0.07 (0.36)	0.1** (0.47)
Turnover ratios						
t_trta	1.79 (2.58)	0.99*** (1.62)	1.4 (1.55)	1.12 (1.61)	0.95 (1.49)	1.2*** (4.32)
t_trfa	9.63 (26.26)	3.78*** (14.16)	5.09 (16.03)	4.98 (17.28)	3.27 (10.7)	4.7*** (16.82)
t_trca	2.39 (3.89)	1.73*** (2.44)	2.24 (2.26)	2.09* (2.15)	1.77 (2.7)	2.02*** (2.38)
t_sata	1.66 (2.52)	0.86*** (1.57)	1.29 (1.48)	0.99 (1.65)	0.85 (1.43)	1.12*** (1.28)
t_sawc	0 (6.07)	0.44 (4.32)	0.54 (8.44)	1.33 (7.27)	-0.01 (4.2)	1.37*** (6.27)
t_csal	0.31 (0.42)	0.4*** (0.6)	0.36 (0.39)	0.37 (0.5)	0.49 (0.98)	0.37*** (0.52)
t_coll	37 (87)	54*** (119)	57 (118)	61 (105)	63 (160)	58 (99)
t_pay	43 (120)	74*** (150)	91 (178)	91 (181)	70 (200)	75 (151)
t_inv	9.66 (31.69)	5.37*** (15.28)	8.5 (19.22)	5.66** (18.14)	6.86 (9.9)	5.46** (17.4)
t_casa	0.37 (0.51)	0.56*** (0.78)	0.46 (0.43)	0.53** (0.67)	0.68 (1.31)	0.53*** (0.65)
Leverage ratios						
z_tdta	0.79 (0.87)	0.71*** (0.59)	0.78 (0.38)	0.72* (0.47)	0.86 (0.66)	0.68*** (0.58)
z_tdeq	0.44 (3.7)	0.77*** (2.78)	1.76 (4.94)	1.16 (3.67)	0.62 (5.01)	0.87** (2.9)
z_blta	0 (0)	0*** (0.06)	0 (0.15)	0 (0.11)	0 (0.06)	0** (0.12)
z_eqta	0.19 (0.87)	0.28*** (0.56)	0.17 (0.37)	0.27** (0.45)	0.12 (0.62)	0.29*** (0.55)
z_loca	0 (0.04)	0*** (0.31)	0.02 (0.81)	0** (0.36)	0 (0.36)	0 (0.23)
z_cleq	0.47 (1.91)	0.35*** (3.06)	0.74 (3.09)	0.8 (3.06)	0.45 (3.84)	0.63** (2.15)
Profitability ratios						
p_nisa	0.02 (0.08)	0.02 (0.06)	0.03 (0.08)	0.01** (0.05)	0.01 (0.07)	0.01** (0.07)
p_pm	1.17 (23.6)	1.12 (16.92)	2.72 (7.68)	1.17** (9.28)	0.63 (35.3)	1.09*** (9.04)
p_roa	1.9 (31.9)	0.79 (9.19)	2.53 (9.43)	0.99* (10.41)	0.49 (18.8)	1.12*** (9.86)
p_roe	23.46 (56.12)	7.61*** (33.25)	24.76 (64.7)	12.6** (45.19)	16 (53.7)	8.2*** (43)
p_reta	0 (0.78)	0.05*** (0.35)	0.02 (0.16)	0.09** (0.25)	0.01 (0.44)	0.07*** (0.29)
Other variables						
c_ntan	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
c_tech	48%	42%**	42%	42%	44%	42%

[a] description of variable codes is given in the appendix

Following procedure included development of three growth

prediction models based on three growth measures: assets, sales and number of employees. The results are presented in the following tables.

TABLE IV
ASSET GROWTH PREDICTION MODEL

Var. code	Variable description	Regression coefficient
	Liquidity ratios	
l_cata	current assets/total assets	0.962**
	Turnover ratios	
t_trfa	fixed assets/revenue	0.001
t_sata	sales/total assets	0.344 ***
t_casa	current assets/sales	0.018
	Leverage ratios	
z_cleq	current liabilities/equity	0.04 *
z_tdta	total debt/total assets	0.183
	Profitability ratios	
p_roe	net income/equity	0.001 *
p_reta	retained earnings/total assets	0.091
	Other variables	
c_ntan	non-tangible assets/total assets	3.654 **
c_tech	high-tech industry	0.531 ***
	Accuracy measures:	
	Total hit rate	66.22%
	High growth hit rate	63.04%
	Non-high growth hit rate	71.43%
	AUC	0.731
	KS	45.96%

Statistical significance ***1% **5% *10%

TABLE V
SALES GROWTH PREDICTION MODEL

Var. code	Variable description	Regression coefficient
	Turnover ratios	
t_inv	sales/inventory	$1.57*10^{-5}$
	Leverage ratios	
z_tdeq	total debt/equity	-0.001
z_blta	bank loans/total assets	-0.432 *
z_loca	long-term debt/current assets	0.099 ***
	Profitability ratios	
p_roe	net income/equity	0.001
p_reta	retained earnings/total assets	-0.212 ***
	Accuracy measures:	
	Total hit rate	64.2%
	High growth hit rate	63.4%
	Non-high growth hit rate	65%
	AUC	0.67
	KS	33.6%

statistical significance ***1% **5% *10%

Growth prediction model based on change in assets as measure of growth includes all four groups of financial ratios and two additional variables. Turnover ratios that are most represented in the structure of the model which is logical since they provide information on how well the management is using company's assets to generate revenues. It is worth noticing that the high-tech company has higher potential to grow in assets compared to non high-tech company. Based on the hit rates, Kolmogorov Smirnov statistics and area under curve (AUC), the overall predictive power of the model is satisfactory.

Sales growth prediction model incorporates fewer predictor variables relative to assets growth model, yet perform similar predictive power based on the selected statistics. Leverage ratios are the most represented in the model, while liquidity ratios did not end up in the model.

TABLE VI
EMPLOYEE GROWTH PREDICTION MODEL

Var. code	Variable description	Regression coefficient
	Turnover ratios	
t_trfa	fixed assets/revenue	0.001
t_csal	(current assets-inventory)/sales	0.237 *
	Leverage ratios	
z_cleq	current liabilities/equity	-0.013 *
z_loca	long-term debt/current assets	0.267 *
z_tdta	total debt/total assets	0.588 *
	Profitability ratios	
p_pm	net income/total revenue	0.012 *
p_roe	net income/equity	0.06 **
p_reta	retained earnings/total assets	0.303
	Other variables	
c_trem	total revenue/number of employees	$7*10^{-7}$ ***
	Accuracy measures:	
	Total hit rate	76%
	High growth hit rate	85.71%
	Non-high growth hit rate	63.63%
	AUC	0.701
	KS	49.35%

Statistical significance ***1% **5% *10%

Growth model that predicts increase in number of employees has the best score in total hit rates among all three models. Same as sales growth model, it does not include any liquidity ratios.

Looking at the individual ratios, it can be noticed that some of them are present in more than one growth model. However, the direction of their influence is not necessarily the same in both models. Table VII presents the signs of regression coefficients of all individual indicators used in the model development.

It is evident that some financial indicators exhibit opposite influence on growth depending on how the growth variable is conceptualized and operationalized. According to Table VII, more than half of the financial indicators that were used as input variables (15 out of 26 indicators or 58%) recorded inconsistencies in direction of influence indicating that the nature of relationship between specific indicator (independent variable) and growth measure can be both positive and negative depending on the growth measure. Furthermore, the predictive power of the model changes when applied on different sample. In Table VIII there are results of testing each model on all samples – model developed on assets growth definition is applied on firms that grow in sales and those that grow in number of employees. The average hit rates in both cases are under 50%. The same was done for sales growth and employment growth definition. The results showed that with

the model that predicts sales growth it is not possible to predict growth in assets or employees. The same applies to the other two models.

TABLE VII
SIGNS OF ALL FINANCIAL RATIOS ACCORDING TO DIFFERENT GROWTH MEASURES

Variable code[a]	Growth measure		
	Assets	Sales	Employees
c_cacl	- *	-	-
l_incl	+	-	+
l_cata	+ **	-	+ *
l_cash	-	+ *	-
t_trta	- *	+ *	-
t_trfa	- *	+	+
t_trca	+	- *	+
t_sata	+ *	- *	+
t_sawc	- *	-	-
t_csal	+ ***	+ **	+ *
t_coll	- ***	- **	-
t_pay	+	+ *	+
t_inv	-	+ *	- *
t_casa	- **	- *	- *
z_tdta	+	+ *	- *
z_tdeq	-	+	+
z_blta	- *	- *	-
z_eqta	-	+ *	- *
z_loca	- *	+ **	+ *
z_cleq	+	-	- *
p_nisa	+ **	+	+ *
p_pm	- *	- *	-
p_roa	+	+ *	+ *
p_roe	+ *	-	+
p_reta	+	+	+
c_ntan	+ *	+	+

[a] description of variable codes is given in the appendix
statistical significance ***1% **5% *10%

TABLE VIII
TESTING EACH MODEL ON DIFFERENT SAMPLES

Model vs sample	Average hit rate	High growth hit rate	Non-high growth hit rate	AUC	KS
Asset vs asset	67.24	63.04	71.43	0.731	45.96
Asset vs sales	47.7	37.5	57.89	-	-
Asset vs employee	23.03	3	43.05	-	-
Sales vs sales	64.2	63.4	65	0.67	33.6
Sales vs asset	30.79	14.28	47.29	-	47.87
Sales vs employee	24.78	5.26	44.3	-	-
Employee vs employee	74.67	85.71	63.63	0.701	49.35
Employee on asset	48.72	33.33	64.1	0.538	25.64
Employee on sales	51.58	40	63.16	-	-

V. DISCUSSION AND IMPLICATIONS FOR FURTHER RESEARCH

In this study the authors provided empirical evidence of using various measures of enterprise growth in developing growth prediction model and the implications it has on the structure and predictive power of the model. The results of statistical analyses revealed that the way a growth variable is operationalized has a strong influence on the structure and predictive power of the model, as well as a specific role (direction of influence) each individual predictor has. These finding should be acknowledged particularly in following situations. First, when building upon previous studies, researchers should pay close attention to the way dependent variable was operationalized in those studies and use appropriate previous work to set their research questions and hypotheses. Second, when comparing the results of the study with previous findings, it also important to avoid a pitfall of comparing conceptually similar, but methodologically very different growth measures. And third, when interpreting the structure of the model and creating the recommendations for business owners and policy makers, it is of utmost importance not to reach unwarranted conclusions due to a lack of understanding of limitations and specifics of methodology design.

Finally, this study confirmed weak correlation between various growth measures. Additionally, descriptive analysis of independent variables in assets growth and sales growth model showed strong differences between high-growth and non-high growth enterprises of one model relative to the other.

Despite systematic approach and sound methodology, this study has certain limitation that are primarily related to the data itself. Financial ratios cover only one part of known predictors that can be used for growth prediction. Growth can be measured not only with percentage change in sales, assets and employees but with other measures such as market share, productivity or growth in profit. Finally, there are other methods besides logistic regression that can be used for modelling. Therefore, ideas for further research will be oriented to include soft variables in the existing data set such as innovation, strategic orientation, entrepreneurs' motivation, and to explore if their influence of different growth measures also differs. Furthermore, new growth measures can be used for model development with new methods such as neural networks or decision trees.

APPENDIX

TABLE IX
DESCRIPTION OF THE VARIABLES

Variable code	Variable description
	Liquidity ratios:
l_cacl	Current assets/current liabilities
l_incl	(current assets-inventory)/ current liabilities
l_cata	Current assets/total assets
l_cash	Cash/current liabilities
	Turnover ratios:
t_trta	Total revenue/total assets
t_trfa	Total revenue/fixed assets
t_trca	Total revenue/current assets
t_sata	Sales/total assets
t_sawc	Sales/net working capital
t_csal	(Current assets-inventory)/sales
t_coll	365/receivables turnover
t_pay	365/payables turnover
t_inv	Sales/inventory
t_casa	Current assets/sales
	Leverage ratios:
z_tdta	Total debt/total assets
z_tdeq	Total debt/equity
z_blta	Bank loans/total assets
z_eqta	Equity/total assets
z_loca	Long-term debt/current assets
z_cleq	Current liabilities/equity
	Profitability ratios:
p_nisa	Net income/sales
p_pm	Net income/total revenue
p_roa	Net income/total assets
p_roe	Net income/equity
p_reta	Retained earnings/total assets
	Other variables:
c_ntan	Non-tangible assets/total assets
c_tech	High-tech industry
c_trem	Total revenue/total number of employees

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