НОВЫЕ ИССЛЕДОВАНИЯ

Value-based approach in managing of international high-tech companies

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This paper presents a research dedicated to identification a model of fundamental value of equity estimation which can be applied for high-technology companies. The goal of the research is to develop a value estimation model within the framework of Value-Based Management and based on Residual Earnings model. The paper analyses main value creating characteristics of high-tech companies from the point of view of external investor; such characteristics are: value of intangible assets, growth rate, risks and uncertainty. Research sample is represented by international high-tech companies listed on NYSE and selected from 6 high-tech industries: Software, Hardware, Electronics, Semiconductors, Semiconductor equipment, Telecommunications. The research proved set hypotheses that intangible assets and growth rate significantly influence on market capitalization of high-tech companies; that equity is one of the most important financial indicator which influence on investors decision concerning purchase of shares, and finally that residual earnings become more important when investors decide whether to keep or sell companies' shares. Also possible managerial application of research results was investigated.

Introduction

Significant changes in business environment happened after the forth or contemporary information revolution witch is linked with emergence of digital technology. Economy started to grow with accelerating rates. This change fundamentally reconstructed most organizational processes, initiated new forms of business and attracted attention of researches around the globe to different issues related to high technologies and high-technology companies. Appearance of Internet and different digital appliances triggered not only new forms of businesses as, for example, e-business, but also opened new growth perspectives for existing companies for long time operating in a high-technology sphere. Along with opportunities for business development a number of new risks and challenges appeared. Therefore nowadays high-tech companies are facing such challenges as shortening life-time of new products, increased costs of research and development, increased risks and uncertainty, problems of technology appropriation and intellectual property rights protection. Thus for a high-tech corporation in order to stay competitive and profitable in the modern world questions of how to manage a company in order to create additional value are of a high importance. Answers to this kind of questions can be found in the concept of Value-based management (VBM) which presents a management approach based on the goal of maximization of a company's value (maximizing shareholder value) [Koller et al. 2005; Koller, 1994; Copeland et al. 2005].

Significance of VBM approach was highly evaluated by business community [Ameels et al. 2002]. The main reason to this is that the concept, by means of system of value drivers (factors which influence on value creation) links company's performance and ability to create value for shareholders with decision making processes and actions of a certain person (manager) or group of people (department) in an organization [Volkov, 2006]. The need to orient business on maximizing shareholders value can be explained by the fact that if investors receive less return on investments

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than they can receive in the same kind of business somewhere else, they will reinvest their capital [Koller et al. 2005]. Thus in the system of high mobility of capital the management oriented on creation shareholder value became very important.

VBM concept is very comprehensive: it includes different issues starting from how to create culture which supports wealth creation and ending with issues devoted to development of concrete value drivers and models based on such drivers which can be used to evaluate top management performance and whether additional value for the period was created. This work is dedicated to more concrete questions within the scope of VBM: fundamental value of equity estimation. There were number of well known important researches in scientific environment focused on development of models of fundamental value of equity estimation; quite many researches were dedicated to comparison of such models and analysis of their applicability to business reality. Besides the topic popularity and that a lot of works related to different aspects of VBM were written, still some research gapes exists. In particular there was a research gape in regard of high-tech companies' evaluation. Therefore, taking into account that high-tech companies are different form traditional and that they might have other value creating characteristics, the main purpose of the work was to develop a model which can be used for evaluation of fundamental value of equity of high-tech companies.

In order to create mentioned model the following 2 sub-question must be answered:

- which peculiarities and characteristics have high-technology companies in comparison to traditional companies;
- how identified peculiarities influence on value creating process in high-tech companies.

The paper consists of 5 parts. First part presents the analysis of existing approaches to fundamental value of equity calculation. Second part is dedicated to models of intangible assts valuation, as one of the most important resources for high-technology companies. Third part presents analysis of value creating characteristics of high-tech companies, and research hypothesis developed based on identified characteristics. Fourth part introduced main research results and their possible managerial application. Last 5th part contains summary of the work, conclusions, research limitations and future research directions.

Existing approach to fundamental value of equity estimation

According to Volkov [2006], approaches to fundamental value of equity estimation can be separated based on the following two aspects:

- based on approach: capital approach or operating approach;
- based on flows which create value: cash flows or residual income flows.

Main difference between capital and operating approaches is how the fundamental value of debt is calculated and which assumptions are taken into account. According to operating approach fundamental value of debt is calculated as discounted future outflows associated with a debt; but according to capital approach fundamental value of debt equals to book value of debt.

Figure 1 summarize four approaches of fundamental value of equity estimation.

		Approaches to fundamental value of equity estimation	
		Operating approach	**Capital approach**
Flows which create value	**Cash flows**	***Discounted Cash Flows Models***	
		Discounted Free Cash Flows Model (DFCFM) $V_E^{FCF} = \sum_{j=1}^{\infty} \frac{FCF_j}{(1+k_W)^j} - D_{BV}$ FCF_j is free cash flows in j-year of a forecast, k_W is a weighted average cost of capital, D_{BV} is a book value of debt.	*Dividend Discounted Model (DDM)* $V_E^{DDM} = \sum_{j=1}^{\infty} \frac{d_j}{(1+k_E)^j}$ d_j is dividends in j year of a forecast, k_E is cost of equity.
	Residual Income	***Residual Income Models***	
		Residual Operating Income Model (ReOIM) $V_E^{\mathrm{Re}OIM} = \left[NA_0 + \sum_{j=1}^{\infty} \frac{R_e OI_j}{(1+k_W)^j} \right] - D_0$ NA – net assts, ReOI - residual operating income.	*Residual Earnings Model (REM)* $V_E^{REM} = E_0 + \sum_{j=1}^{\infty} \frac{RE_j}{(1+k_E)^j}$ RE – residual earnings, E – equity.

Figure 1. Classification of fundamental value of equity estimation models [Volkov, 2006, p. 27].

Discounted Cash flow models

"In discounted cash flows valuation, the value of an asset is the present value of the expected cash flows on the asset, discounted back at a rate that reflects the riskiness of these cash flows" [Damodaran, 2006, p. 4]. Thus the value of an asset is a function of discounted cash flows which this asset can generate or is expected to generate in future (Damodaran 2006). In equity valuation investors analyze expected cash flows resulting from equity ownership and discounted at an appropriate rate. There are two different assumptions concerning what represent cash flows from equity ownership: dividends or free cash flows.

According to one of the oldest approach, dividends are considered the only cash flows which the business can generate in future for owners. Thus Basic underling assumption of dividend discounted model is that fair value of share should be equal to discounted future cash inflows expected from share ownership. Advocates of this approach believe that fair value of a share should be equal to discounted amount of cash flows expected from ownership of the share [Damodaran, 2006; Volkov, 2006].

Discounted free cash flow model appeared as a development of dividend discounted model. One of the main limitation of DDM is that it fail to measure fundamental value of equity of companies which pay not all their free cash flows to investors in dividends, therefore possible solution for mentioned problem is to substitute real dividends with possible, in other words to substitute dividends with free cash flows [Damodaran, 2006].

Discounting free cash flow model represent a firm valuation, it is an alternative approach to equity valuation [Damodaran, 2006]. In literature there are different definitions of free cash flows.

In general terms FCF are defined as all cash flows which can be distributed between all capital providers: shareholders and debt providers; in other words FCF is amount of net operational income decreased on the difference in net investments in company's assets [Volkov, 2006].

According to Damodaran [2006] in order to get form firm valuation to equity valuation the value of all non-equity claims should be subtracted form the present value of future FCF which are discounted at cost of capital rate; formula is presented in the figure 1. Non-equity claims in general are presented buy the debt, however can also be in the form of capitalized leases or unfunded pension plan and healthcare obligations [Damodaran, 2006]. While DDM take into account only payments to share owners, DFCFM besides payments to shareholders also takes into account payments to debt capital providers. This lead to different discounting rates used in these two models: cost of equity in DDM and weighted average cost of capital in DFCFM [Volkov, 2006].

Residual income models

Drawbacks of DDM introduced in failure of companies to pay out what they can afford in dividends and also complications involved in cash flows estimation led to appearance of alternative models of fundamental value of equity estimation based on discounting residual income (residual operating income or residual earnings). However it doesn't mean that equity valuation based on residual income is better than valuation based on cash flows. Residual income models (RIM) are different from discounting cash flow models, in respect that they are based on accounting data in calculating fundamental value of equity. Residual income models also have certain limitations and important assumptions.

"Residual income is a measure of accounting income in excess of a normal (required) return on capital employed" [O'Hanlon & Peasnell, 2002, p. 229]. Residual income models use "accounting information to estimate shareholder value" [Lee, 1999, p. 413]. Application of accounting data in equity valuation was a "central theme in the accounting research of the 1990s" [Lee, 1999, p. 413].

According to Residual income model, fundamental value of equity consists of two elements: book value of equity at the point of evaluation and discounted residual income which provide access of fundamental value over book value of equity. Therefore the central idea of RIM is residual income which is defined as a difference between accounting profit for the year and cost of capital employed [Volkov, 2006]. In the most general form residual income can be presented by the following equitation:

$$RI_t = P_t - k * I_{t-1}, \quad (1)$$

where Pt is accounting profit for the year t, k is a cost of capital and It-1 is a book value of investments at the beginning of year t.

Depending on approach to fundamental value of equity estimation (operating/ capital) there are two variations of RIM: Residual operating income model (ReOIM) and Residual earnings model (REM). Thus the difference between RIM variations is in what is considered under investments: book value of equity or book value of all net assets of a company, which include equity and debt capital [Volkov, 2006].

In ReOIM investments are represented by investments in own and debt capital, in other words in all net assets of a company. Thus residual operating income represents a difference between earnings before interest and cost of capital multiplied by book value of all net assets of a company (equation is presented bellow). In REM model under investments are represented investments into own capital or equity. Therefore residual earnings can be calculated by subtracting cost of equity multiplied by book value of equity from net income of a company (equitation is presented bellow) [Volkov, 2006].

$$\mathrm{Re}OI_t = EBI_t - k_w * NA_{t-1} \quad (2)$$

$$RE_t = NI_t - k_E * E_{t-1} \quad (3)$$

One of the most important benefits of RIM if compared to discounted free cash flow models is that it doesn't require additional estimations and complicated measures to calculate the value of input variables in RIM. Accounting data is available and ready to use, because it is obligation for every company to track it performance and for public company also to present financial statements to shareholders. However there is also a week side in using accounting data; the data can be biased or not up to date, what make application of accounting data challenging and may lead to false results. However calculation fundamental value of equity based on DFCFM may be even more deceptive.

Another benefit of RIM is that it use current period accounting numbers, not a forecasts. In fundamental equity valuation models, independent variables are forecasts, what make complications in valuation. Ohlson [1995] solved the problem by introducing "linear information dynamics" (LID), where "value can be expressed in terms of current-period accounting numbers rather than future expected values" [cited in Lee, 1999, p. 417].

In previous researches which were done in the field it was proved that all models of fundamental value of equity estimation are equivalent with application of certain assumptions; mathematical proof of this fact was presented in the book "Theory of Value Based management: Financial and Accounting aspects" [Volkov, 2006]. Conditions of models equivalence (summarized in mentioned book) are as follow [Volkov, 2006]:

- Equivalence of residual operating income model (ReOIM) and discounted free cash flow model (DFCFM) is achieved through application the same discount rate and usage of general assumptions concerning terminal value (EBI – constant, dRONA – constant).
- Equivalence of residual earnings model (REM) and discounted free cash flow model (DFCFM) is achieved upon two conditions: in DFCFM weighted average cost of capital is calculated based on fundamental value of sources of financing; general assumptions concerning terminal value are used.
- Equivalence of residual operating income model (ReOIM) and residual earnings model (REM) is achieved upon the condition when in ReOIM weighted average cost of capital is calculated based on fundamental value of sources of financing.

Despite models were proved to be mathematically equivalent (with certain assumption concerning discount rate and terminal value calculation), they nevertheless provide different results when tested on real companies. In scientific literature different works of well known researchers exist in which they provide empirical evidence in favor of DDM, DFCFM or RIM models. And although they provide quite contradictory results, authors of this paper tend to believe that RIM in certain conditions may have better reliability and explanatory ability (the reasoning is presented bellow).

Among the first empirical studies which compare DCFM and RIM was Penman & Sougiannis [1998]. In their research "they implemented the RIM using ex post realized earnings as a proxy for expected earnings" [cited in Lee, 1999, p. 419]. In the research they used current stock prices to evaluate the explanatory ability of models. Researchers investigated the dependence of models value estimation ability in regard of different terminal value assumption; they focus on analysis of biases which appear when fundamental value of equity is calculated by different models. Penman & Sougiannis [1998, p. 377] concluded that "forecasting accounting earnings facilitates finite horizon analysis better than forecasting cash flows", and accordingly that RIM generally can better estimate value than other models. However they also mentioned that the results can be biased in favor of one model versus another depending on the terminal value assumptions [Penman & Sougiannis, 1998].

Another research was conducted by Francis, Olsson and Oswald [2000] where to compare different models in regard of their explanatory ability researchers used Value Line forecasts of cash flows and earnings. They also identified that accounting models of value estimates "dominate DIV and FCF value estimates in terms of accuracy and explainability" [Francis et al., 2000, p. 57]. According to Francis, Olsson and Oswald [2000, p. 57] possible explanation why RIM outperform DCFM is that "book values resulting from accounting procedures tend to be less biased than

forecasted flows, estimated discount and growth rates". Researchers also investigated whether the results will be different for companies with high R&D spending. High R&D to sales ratio is a common characteristic of high-tech companies, thus Francis, Olsson and Oswald [2000] in their research also tried to find out the model which in general provide better results for evaluating stocks for high R&D spending companies (high-tech companies). Their findings showed that "for High R&D sample, REM value estimates are significantly more accurate and explain more of the valuation in security prices" [Francis et al., 2000, p. 60].

The same kind of studies were done by Courteau, Kao & Richardson [2001] where they confirmed that "RIM outperform DCF when ideal terminal values are not available, however models are empirically equivalent given ideal terminal values" [Courteau et al., 2001, p. 655]. As a proxy of ideal terminal values they "used Value Line terminal stock price forecasts" [Courteau et al., 2001, p. 629].

Taking into account all mentioned above the important part of the work was to select the model which will constitute the bases of the model of high-tech companies' fundamental value estimation. In this research REM was taken as a bases; taking into account empirical evidence that RIM might potentially better explain company value, and in particular evidence form research of Francis, Olsson and Oswald [2000] where they confirmed that for high R&D spending companies correlation between market valuations and fundamental value calculated based on accounting models is greater than calculated based on FCFM.

Methods of intellectual capital valuation

Intangible assets are one of the most important assets in new economy; they supply organizations with competitive advantage and differentiate them from other organizations. For high-tech companies intangible assets are even more critical then for traditional companies. Therefore questions of intellectual capital valuation for high-tech companies are of the a high importance. Valuation of intangible assets is a complicated process, at present moment no one best measure was developed. Different approaches exist, but all of them have significant limitation and there are number of assumptions in the bases of each approach.

Market or value-based approach is one of the simplest approaches in intangible assets valuation. It is based on the assumption that intellectual capital is a difference between company capitalization and net book value of assets, thus intellectual capital is considered as everything in access of book value of net assets [Kok, 2007; Starovic and Marr, n.d.]. Main disadvantage of the approach is that it doesn't take into account external factors which influence on stock prices, among which there are investor's expectation, regulation, media, political influences, competitor's actions.

Tobin's approach of intangible assets calculation is very similar to market-based approach, with the only difference that in market-based approach intangibles are measured as difference between company capitalization and book value of net assets, but in Tobin's approach as difference between market capitalization and replacement cost of assets [Kok, 2007; Starovic and Marr, n.d.]. Tobin's method is more accurate because it uses replacement value of assets, rather then book or historical value. However the main limitation of market-based approach still exists in Tobin's method, because it also operates with stock prices.

Another method of intangible assets valuation relate to matching assets to earnings. The method was developed by Baruch Lev – professor of Stern School of business, New-York University. Lev [2004, p. 114] explains that a company performance "as reflected by operating earnings, is generated by its physical and financial assets, enabled by intangibles". Therefore according to Lev [2004, p. 114] "the value of intangible capital is derived by subtracting from earnings the average contribution of physical and financial assets in the company's industry; what remains is a figure that indicates the contribution of intangible assets to the company's performance and provides the basis for the valuation of intangible capital". Model which matches assets to earnings has certain drawbacks, and the most significant is its complexity and subjectivity involved in return on knowledge capital calculation. The strong side of the model is that, in Lev's model

both earnings and assets are involved in analyses, but in two previously described models only assets were considered as a relevant data for analysis and measurement.

Another approach to intangibles valuation is called value-added intellectual capital coefficient. The main idea of the model is to link part of company gross profit with intellectual capital introduced in labor expenses. "The method calculates the difference between revenue and all inputs (except labor expenses) divided on labor expenses" [Starovic and Marr, n.d. p.18]. High ratio indicates affective usage of intellectual capital, and low on the contrary inefficient usage.

Different approach of intangible assets valuation was introduced by Damodaran in his work "Dealing with intangibles: Valuing Brand Names, Flexibility and Patents" [2006]. In the work Damodaran argue that intangible assets can be valued by conventional discounted cash flow model.

In the research we use method of intellectual capital valuation introduced by Stewart [1995] – Calculated intangible value (CIV). Stewart introduced his valuation model in seven steps which should be done to calculate the value of intangibles. Volkov and Garanina [2008, p. 65] summarized all steps in the following definition how intangible assets can be measured: "intangible value of a company is determined as a difference between the company's value (which, in its turn, is determined by the book value of the company's assets and discounted flow of residual operating income) and the possessed value of its tangible assets (determined by the book value of these assets and discounted flow of residual earnings using the average industrial rate of return)". According to Volkov and Garanina [2008, p. 65] "this difference characterizes the company's capability to use the Intangible Assets in order to "outrun" the competitors in the industry".

In the work "Trying to grasp the intangible" [1995] Stewart introduced the following 7 steps of IC measurement:

- calculation of average EBT for three years;
- calculate average tangible assets for 3 years (based on a balance sheet data);
- calculate return on assets (ROA) by dividing average earnings on average assets;
- find industry average ROA for the same 3 years;
- calculate the "excess return" by multiplying average industry ROA by company average tangible assets. Subtract received amount from the average EBT (calculated in step 1);
- calculate average income tax for 3 years and multiply it by excess return (step 5), then to calculate a premium for intangible assets subtract received amount form excess return;
- calculate net present value of a premium by dividing it on the appropriate discount rate.

Therefore based on mentioned 7 steps, value of intangible assets can be introduced in the following formula:

$$V_i = \frac{BV_{TA} * (ROA - ROA_{ind})(1 - tax)}{k}, \quad (4)$$

were BV_{TA} is an average book value of tangible assets, ROA is an average return on tangible assets, ROA_{ind} is an average industry return on tangible assets, tax is an average tax rate and k is a cost of capital.

Taking into account assumptions introduced in Volkov and Garanina (2008) that book value of intangible assets tend to zero we can write the equation where book value of tangible net assets is equal to total book value of net assets:

$$NA^{BV} = NA_T^{BV}. \quad (5)$$

Based on Stewart model of intangible assets valuation and ReOIM for fundamental value of equity valuation, the formula of intangible assets valuation will be the following [Volkov & Garanina, 2008]:

$$V_i = NA_T^{BV} * \frac{RONA - RONA_{IAVG}}{k_W}, \quad (6)$$

where NA_T^{BV} is a book value of tangible assets, calculated by subtracting accounts payable form total assets; RONA is a return on net asset and k_w a weighted average cost of capital.

Stewart's CIV model has certain strong and weak sides. Advantage of the model is availability of input data about a company; data can be taken from company's financial statements. Stewart model is useful when there is a need to make inter or intra-company comparison. Method has common features with Lev's "matching assets to earnings" model: both models try to calculate part of earnings which is justified by company's intellectual capital not tangible (financial or physical) resources. The difference is that to do this Lev calculate value of IC by subtracting form total earnings part which is justified by tangible resources of a company, thus he based on internal data; but Stewart use external industry average data and calculate value of IC by subtracting earnings calculated based on average industry figures of ROA form real company earnings. The weak side of the model is that it uses subjective average industry data which might be difficult to obtain.

Hypotheses formulation

High-technology companies have certain characteristics, which make them different from traditional companies operating in low or middle technology businesses. There is no universal approach to define high-technology companies or industries. Each approach has certain drawbacks due to complexity of investigated phenomena. In this research the categorization of high-tech companies is based on North American Industrial Classification System (NAICS). Six high-tech industries were selected from classification for the purpose of analysis: Software, Hardware, Electronics, Semiconductors, Semiconductor equipment, Telecommunications.

There are the following differences of high-tech companies from traditional from the point of view of external investor: risk, uncertainty, the degree of intangible assets and growth rate Lianzan, 2005; Fenigstein, n.d.].

Table 1

Comparison of traditional companies with high-tech

Parameter of comparison	***Traditional companies***	***High-tech companies***
Assets	Mostly tangible	Mostly intangible
Level of business risk	Low - middle	High
Level of uncertainty	Middle	High
Growth rates	Low - Middle	High

Mentioned characteristics of high-tech companies have a substantial influence on a process of value creation in such kind of companies.

1. The first mentioned difference is amount of intangible assets or intellectual capital that these companies possess. For high-technology companies intellectual capital plays a key role for competitive advantage and profitability, because companies constantly challenge to innovate and adapt to changing environment and evolving risks. Therefore speed, flexibility of processes and intangible assets like technological capability, intellectual property, network of highly skilled partners, customer relationships are critical for sustainable advantage in this field. It is important to mention that intangible resources nowadays are important for any company, but not only for high-tech companies, the difference is in the difference is in degree of importance.

2. Growth rate is one more characteristic of high-tech, which influence on investors expectations about level and speed of return from their investments. In traditional companies which operate in stable and developed business environment with only incremental changes investors based there expectation on current results (current residual earnings in case of REM), they assume that in future results will be the same thus issues about growth are less important for them then in high-tech sphere. High-technology companies usually operate in a very dynamic environment with constantly evolving technologies; high-tech industries are constantly developing industries, what influence on companies' growth capabilities. Thus companies and industries with good growth

opportunities are much better and attractive investment targets then companies or industries with moderate growth.

Taken into account growth characteristic of high-technology companies, fundamental value of equity of such companies can be calculated with a use of Gordon formula.

$$V_E^{REM} = E_0 + \frac{RE}{k_E - g}, \quad (7)$$

where g is a growth rate, E is value of equity, RE is value of residual earning and k_E is cost of equity. In this research company's growth rate is identified as an average growth rate of an industry where this company operates.

3. Risk higher then in traditional companies is another important characteristic of high-tech companies. When calculating fundamental value of equity risk level is reflected in required rate of return; in case of REM application for fundamental value of equity calculation required rate of return is introduced in cost of capital. However it is interesting to mention, that according to previous researches conducted by Penman and Sougiannis [Peaman & Sougeanis, 1998] and also Volkov and Buhvalov [Buhvalov, Volkov, 2005] required rate of return is not a relevant indicator, which help to estimate correlation between market capitalization and book value of equity and residual earnings [Volkov, 2006]. Thus in the research influence of risk level on market capitalization of high-tech companies wasn't tested in separate hypothesis, but nevertheless was taken into account via calculation cost of capital by CAPM.

Based on analysis of value creating characteristics of high-technology companies the following 2 hypotheses were identified:

H_1 Value of intangible assets significantly influence on market capitalization of high-tech companies.

H_2 In high-technology companies' growth rate significantly influence on their market capitalization.

In the research it was also interesting to analyze the major factors which drive certain investors decisions, thus two additional hypotheses were developed.

H_3 Equity is a major financial indicator which influence on investors decision concerning purchase of companies shares.

H_4 Residual earnings are one of the most important financial indicators which influence on changes of market value of high-tech companies' shares.

Research methodology and data collection

To test first hypothesis that value of intangible assets significantly influence on market capitalization of high-tech companies, 2 regression models were developed:

1. two-factor regression model, where market value of company's shares is explained by book value of equity, residual earnings and industry growth rate;

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + \xi,$$

where $P_{t+\tau}$ - weighted average market price of shares during the time lag τ (second quarter of the year following the analyzed year; need for a certain time lag is explained by the fact that market prices of shares reflect investors' respond to companies' financial results also with some delay), E_{t-1} – book value of equity in period previous to analyzed period, RE_t – residual earnings in analyzed period, k_E – required rate of return on equity, g – industry growth rate, ξ – random component, which characterize factors which are not taken into account in the model. This regression equation was a result of modification of the formula for fundamental value of equity estimation based on REM (presented in the figure 1). Modification was done by means of application Gordon formula in calculation of fundamental value of equity and assumption that residual earnings grow at a constant growth rate g. Growth rate (g) is an average industry growth rate, calculated for 3 years.

Residual earnings were calculated by the following formula:

$$RE_t = NI_t - k_E * E_{t-1}, \quad (8)$$

where NI_t is a net income in the period t.

Cost of equity was calculated with a use of CAPM model (Capital Asset Pricing Model):

$$k_E = R_f + \beta * (R_m - R_f), \quad (9)$$

where R_f is risk free rate (in the research United States T. Bond rate was taken as a risk free rate); β is a coefficient specific for every company, it characterizes the risk of investment in a particular shares; R_m is a risk premium on market. All three variables were taken from <http://pages.stern.nyu.edu/~adamodar/>.

2. three-factor regression model, where market value of company's shares is explained by book value of equity, residual earnings, industry growth rate and value of intangible assets.

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + a_3 V_I + \xi$$

where V_I is fundamental value of intangible assets. V_I was calculated based on modification of Stewart model of intangible assets valuation (was presented in work of Volkov & Garanina 2008):

$$V_i = NA_T^{BV} * \frac{RONA - RONA_{IAVG}}{k_W}, \quad (10)$$

where NA_T^{BV} is a book value of tangible assets, calculated by subtracting accounts payable form total assets; RONA is a return on net asset and k_w is a weighted average cost of capital. RONA and k_w were calculated with a use of following formulas:

$$RONA_t = \frac{EBI_t}{NA_{t-1}} = \frac{NI_t + i_t * (1 - tax_t)}{TA_{t-1} - AP_{t-1}}, \quad (11)$$

where TA_{t-1} and AP_{t-1} are total assets and accounts payable in the year previous to the year of analysis; i_t is interests expenses in analyzed period and tax_t is an effective tax rate in analyzed period.

$$k_w = k_E * \frac{E}{E+D} + k_D * (1 - tax) * \frac{D}{E+D}, \quad (12)$$

where E is book value of equity, D is book value of debt and k_d is cost of debt computed by dividing annual interest expenses on book value of debt.

As explanatory variable in both models (2 and 3 –factor regressions) was chosen relative measure – share price, therefore all variables are counted per share. All calculations of two/ three-factor regression equations were done with application of a statistic computer program "EViews" which calculate parameters of equitation and also statistical data: t-statistic, f-statistic, r-squared and other data needed for analysis of regression equations.

Test of second hypothesis (that growth rate significantly influence on market capitalization of high-tech companies) was based on comparison of already developed 2 and 3 – factor regression equations with their alternatives (where growth rate was removed from fundamental value of equity calculation). Comparison was done based on values of t-statistics and r-squared calculated for each equation. Modified two and three-factor regression models were as follows:

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E} + \xi \quad (13)$$

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E} + a_3 V_I + \xi \quad (14)$$

Proof of third hypothesis that equity is a major financial indicator influencing on investors decision concerning purchase of companies shares was based on calculations needed for the proof of the first hypothesis. To support third hypothesis results of t-statistics were analyzed. In general

good t-statistic confirm the significance of variables included in the model, thus the higher the value of t-statistics of certain variable the greater is importance of this valuable in the model. Therefore to test third hypothesis comparison of t-statistics for each variable within the scope of one equation were done.

Methodology and models which were used to test forth hypothesis (that residual earnings are one of the most important financial indicators which influence on changes of market value of high-tech companies' shares) were similar to those used for the test of first and third hypotheses. The only difference is that forth hypothesis focuses on investigation factors influencing on change of companies' market capitalization, thus all variables were taken in dynamic not static. Models for the test of fourth hypothesis looks as follow (in model, changes of all variables over the financial year were taken):

$$\Delta P = a_0 + a_1 \Delta E + a_2 \frac{\Delta RE}{k_E - g_t} + a_3 \Delta V_I + \xi \quad (15)$$

$$\Delta P = a_0 + a_1 \Delta E + a_2 \frac{\Delta RE}{k_E - g_t} + \xi \quad (16)$$

where ΔP is an annual change of market value of companies shares, ΔE is an annual change of equity, ΔRE is an annual change of residual earnings and ΔV_I is an annual change of value of intangible assets.

Research sample

The research was done for high-tech companies listed on New-York Stock Exchange (NYSE); the sample consisted of 40 companies and 3 years for each company (around 120 company-years, because for some companies information for some years was unavailable); companies were selected from 6 high-tech industries: Software, Hardware, Electronics, Semiconductors, Semiconductor equipment, Telecommunications.

The following criteria were used for company selection:

- company is listed on NYSE more than 4 years (company's Financial Statements are audited and prepared in accordance with GAAP or IFRS);
- company relate to high-tech industry (to one of 6 selected);
- company is international;
- тосompany has one major type of activity or relate to one industry, or all companies' activities are closely related (this justify application of the same industry growth rate to all analyzed companies, which relate to the same industry);
- year end is 31st of December.

Data was collected from open sources of information: stock markets, companies' official web sites and annual financial reports.

Research results and managerial application

By the research all four set hypothesis were proved. Details of results regarding particular hypothesis are presented bellow.

Table 2 summaries results of the first hypothesis test.

Table 2

Coefficients and statistical figures of 2 & 3-factor regression models

Table presents results of 2 and 3 factor regression models analysis:

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + \xi$$

$$P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + a_3 V_I + \xi$$

,

where E is equity, RE – residual earnings, k_E – cost of equity, g – growth rate and V_i – value of intangible assets.

Results are calculated with application of the program "EViews". Table contains coefficients of analyzed regression equitations and statistical data. T-statistics shows significance of variables included in the model (in order to be significant, variable should have t-statistic in absolute term greater than 2). Low F-statistic means that model in general is significant.

	Model 1	***Model 2***
Included observations	103	90
Method	Least squares	Least squares
R-squared	25,69 %	57,12 %
f-Statistic	0,000000	0,000000
Coefficients		
Equity (E)	0,496260	1,220702
RE / (k_E – g)	0,077923	0,175167
Free term	18,30653	11,95522
Value of intangible assets (V_I)	no	0,115574
Standard error		
Equity (E)	0,137139	0,157596
RE / (k_E – g)	0,026510	0,039777
Free term	1,654488	1,665135
Value of intangible assets (V_I)	no	0,055136
t-Statistic		
Equity (E)	3,618649	7,745750
RE / (k_E – g)	2,939386	4,403716
Free term	11,06477	7,179729
Value of intangible assets (V_I)	no	2,096171
Probability		
Equity (E)	0,0005	0,0000
RE / (k_E – g)	0,0041	0,0000
Free term	0,0000	0,0000
Value of intangible assets (V_I)	no	0,0390

Received results are positive: in both regression models value of f-statistic denied the hypothesis of model not significance; at the same time in both regression models results of t-statistic confirm the hypothesis of significance of variables included in the model.

Among two models, tree-factor regression model has a higher explanatory ability, because it has a higher t-statistic for each variable and also higher R-squared (around 57 %). Higher explanatory capability of this model can be explained by implementation in the model additional variable related to value of intangible assets, what in tern support our argument that one of the important differentiating characteristic of high-tech companies from other companies is amount of intellectual capital they posses. Therefore received results confirm our first hypothesis that value of intangible assets significantly influence on market capitalization of high-tech companies.

The highest results of t-statistic in both models has E variable (7.746 and 3.619 for three-factor and two-factor regression models respectively), what means that the book value of equity is

the most important criteria among analyzed criteria, which investors take into account when they make a decision about investments in a certain company. The next important criterion (from analyzed criteria) for investors is residual earnings. Consequently these results proved third hypothesis that equity is one of the most important financial indicators which influence on investors decision concerning purchase of companies shares.

Tables 3 and 4 summarize results of calculation two/ three-factor regressions where fundamental value of equity is calculated with and without application of average industry growth rate.

Table 3

Coefficients and statistical figures calculated for 2 & 3 - factor regression models (with and without growth rate application)

Table presents results of analysis of 2 and 3 factor regression models with and without growth rate application:

Models with growth rate: $P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + \xi$ $P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E - g_t} + a_3 V_I + \xi$

Models without growth rate: $P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E} + \xi$ $P_{t+\tau} = a_0 + a_1 E_{t-1} + a_2 \frac{RE_t}{k_E} + a_3 V_I + \xi$

where E is equity, RE – residual earnings, k_E – cost of equity, g – growth rate and V_i – value of intangible assets.

Results are calculated with application of the program “EViews”. Table contains coefficients of analyzed regression equitations and statistical data. T-statistics shows significance of variables included in the model (in order to be significant, variable should have t-statistic in absolute term greater than 2). Low F-statistic means that model in general is significant.

Variable	***Coefficient***	***Std. Error***	***t-Statistic***	***Probability***
Model with assumption that RE has a constant growth rate g				
Two factor regression model				
E	0.49626	0.137139	3.618649	0.0005
RE / (ke - g)	0.077923	0.02651	2.939386	0.0041
Free term	18.30653	1.654488	11.06477	0.0000
Three factor regression model				
E	1.220702	0.157596	7.74575	0.0000
RE / (ke - g)	0.175167	0.039777	4.403716	0.0000
Vi	0.115574	0.055136	2.096171	0.0390
Free term	11.95522	1.665135	7.179729	0.0000
Model with assumption that RE are constant				
Two factor regression model				
E	0.516242	0.152697	3.380829	0.0010
RE / ke	0.077732	0.046746	1.662845	0.0995
Free term	18.52365	1.747099	10.60252	0.0000
Three factor regression model				
E	1.216095	0.157203	7.735809	0.0000
RE / ke	0.390413	0.087333	4.470411	0.0000
Vi	0.095398	0.057735	1.652337	0.1021
Free term	11.88412	1.662822	7.14696	0.0000

Table 4

R-squared and f-statistics calculated for 2 & 3 factor regression models (with and without growth rate application)

	Model with growth rate (g) application		***Model without growth rate***	
	2-factor	***3-factor***	***2-factorl***	***3-factor***
R-squared	0.256883	0.571272	0.214401	0.573669
Probability (F-statistic)	0.000000	0.000000	0.000006	0.000000
# of observations	103	90	103	90

According to results presented in table 3 and 4 regression equations with growth rate application has greater explanatory ability: variables have lower standard error, greater t-statistic and probability. In general model with growth rate application has better f-statistic and r-squared figures. Based on mentioned facts we can make a conclusion, that model with growth rate application can better explain market value of companies' shares.

To identify which factor or variable from those included in the models (equity, residual earnings or intangible asset) has the major influence on change of companies' share prices, the change of these variables was included in the model. Tables 5 and 6 present result of calculation.

Table 5

Results of 2-factor dynamic regression equation

Table presents results of analysis 2 factor regression models, where variables are taken in dynamics (by annual change):

$$\Delta P = a_0 + a_1 \Delta E + a_2 \frac{\Delta RE}{k_E - g_t} + \xi$$

where E is equity, RE – residual earnings, k_E – cost of equity, g – growth rate.

Results are calculated with application of the program "EViews". Table contains coefficients of analyzed regression equitations and statistical data. T-statistics shows significance of variables included in the model (in order to be significant, variable should have t-statistic in absolute term greater than 2). Low F-statistic means that model in general is significant.

Variable	***Coefficient of regression***	***Std. Error***	***t-Statistic***	***Probability***
Equity	632,9873	442,7126	1,429793	0,1586
Residual earnings	0,104213	0,044082	2.364054	0,0218
Free term	-0,947353	0,857761	-1,104449	0,2744

Table 6

Results of 3-factor dynamic regression equation

Table presents results of analysis 3 factor regression models, where variables are taken in dynamics (by annual change):

$$\Delta P = a_0 + a_1 \Delta E + a_2 \frac{\Delta RE}{k_E - g_t} + a_3 \Delta V_I + \xi$$

where E is equity, RE – residual earnings, k_E – cost of equity, g – growth rate and V_i – value of intangible assets.

Results are calculated with application of the program "EViews". Table contains coefficients of analyzed regression equitations and statistical data. T-statistics shows significance of variables

included in the model (in order to be significant, variable should have t-statistic in absolute term greater than 2). Low F-statistic means that model in general is significant.

Variable	*Coefficient of regression*	*Std. Error*	*t-Statistic*	*Probability*
Equity	91,4244	447,9383	1,543571	0,1288
Residual earnings	0,129868	0,052270	2.484561	0,0162
Intangible assets	-0,031014	0,033828	-0,916809	0,3635
Free term	-0,921135	0,859530	-1,071673	0,2888

According to results of calculation, shown in the table 5 and 6, residual earnings are the only significant variable included in the model (according to peculiarities of statistical program EVeiws, the hypothesis of insignificants of variable included in the model is denied when t-Statistic is in absolute magnitude greater than 2.0). Value of t-statistic for RE amounts to 2,484561 in 3-factor model and 2,364054 in 2-factor model. Low value of t-statistic for other variables included in the model means that they have no significance and ultimately no or low influence on investor decision in regard of keeping or selling company shares. Free term also has t-statistic lower than 2.0 in absolute magnitude, this mean that level of share prices has no influence on investors decisions which follow initial purchase decision.

Therefore residual earnings are the most significant variable among other variable included in the model. This means that when investors decide whether to sell or keep company's shares they first of all pay attention to company's residual earnings and it change over time. Due to market mechanisms investors decision to keep or sell shares influence on fluctuation of share prices what prove the fourth hypothesis that residual earnings is one of the most important factor influencing on change of company's market capitalization. It is important to mention that residual earnings appeared to be the most important financial indicator influencing on change of share prices only among indicators included in the model, however there are a lot of other not less important factors both financial and non-financial which might influence on change of share prices.

Results received during the research, introduced in regression equations are interesting in regard of their managerial application to real business objectives. In particular it is interesting to investigate whether received regression equations can estimate possible IPO price for companies with no listing history. This assumption was tested on 7 high-tech companies which had IPO on NYSE during the period 2005-2007 (details are presented in the table bellow).

Table 7

High-tech companies with IPO in the period 2005 – 2007

Industry / Company	***IPO date***	***Year End***	***Year of FS[3]***	***Date of FS publication***	***IPO date in regard to year end and annual financial results announcement***
Telecommunication service					
Cellcom Israel, Ltd.	6.02.2007	31-Dec	2006	18.03.2007	IPO was between 2006 year end and announcement of annual Financial results of 2006
MetroPCS Communications, Inc.	19.04.2007	31-Dec	2006	30.03.2007	IPO was after the end of 200 and after annual Financial resul of 2006 year announcement
Software					
NetSuite Inc.	20.12.2007	31-Dec	2007	26.03.2008	IPO was 10 days before the 2007 year end
PROS Holdings, Inc.	28.06.2007	31-Dec	2007	22.02.2008	IPO was 6 months before the 2007 year end (annual results of 2006 for calculation fundamental value of equity at the beginning of 2007 are unavailable)
Solera Holdings, Inc.	11.05.2007	30-Jun	2007	17.09.2007	IPO was 1,5 months before the 2007 year end
VMware, Inc.	14.08.2007	31-Dec	2007	29.02.2008	IPO was 4,5 months before the 2007 year end
Hardware					
VeriFone, Inc.	29.04.2005	31-Oct	2005	18.12.2005	IPO was 6 month before the 2005 year end

For identified companies relevant accounting data from published financial statements was obtained (balance sheets and profit and loss statements).

Depending on when was the IPO date if compared to the year end (this information is specified in the last column in the table 7) companies were divided into 2 groups; each group was analyzed separately.

First group: Consist of companies with had IPO date close to the year end.

Table 8 shows the difference between real IPO prices and fundamental share prices calculated based on 2 variants of regression equitation.

[3] Publicly available annual FS which are closest to the IPO date.

Table 8

Difference between IPO prices and fundamental value of shares

Industry / Company	*Calculated fundamental value of a share, USD*		*Market share price at IPO, USD*	*Difference, USD*	
	Model 1	*Model 2*		*Model 1*	*Model 2*
Telecommunication service					
Cellcom Israel, Ltd.	18.74	13.56	19.92	5.91%	31.91%
MetroPCS Communications, Inc.	19.64	17.10	26.25	25.19%	34.84%
Software					
NetSuite Inc.	20.66	18.60	30.75	32.81%	39.50%
Solera Holdings, Inc.	21.09	17.55	17.325	-21.71%	-1.32%

Cellcom Israel had IPO after the year end at 06.02.2007 and one and a half month before official publication of results of 2006 year. Fundamental share prices calculated based on regression equations with and without incorporation value of intangible assets were 18.74 and 13.56 USD per share corresponding. IPO price of Cellcom Israel was 19.92 USD per share. The difference between IPO price and fundamental value of shares was only 5.91% (if fundamental value is calculated based on the Model 1), this means that researched regression equitation might have a good forecasting / estimation ability and also managerial significance. It is interesting to mention, that share prices at the period 19–30 of March after announcement of 2006 year performance results fluctuated in the interval 18.84–18.16 USD/share. These results mean that there was no difference between market value of shares and fundamental value of shares calculated based on regression equitation without incorporation value of intangible assets. Visually situation is presented on the figure 2 (abbreviations used in figure 2: P_f – calculated fundamental value of shares, P_A – market value of shares, P_{IPO} – share prices at initial public offering).

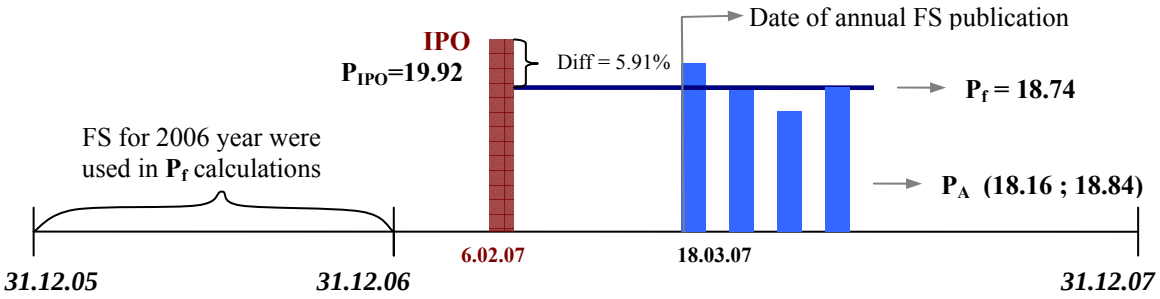

Figure 2. Correlation of fundamental and market valuations for Cellcom Israel

MetroPCS Communications had IPO after the year end and also several days after the annual results announcement. This company is different from previously analyzed, because in this case at the IPO date investors already know about company performance and financial results of 2006 year. Fundamental share prices calculated based on regression equations with and without application value of intangible assets was 19.64 and 17.10 USD per share corresponding. IPO price of MetroPCS Communications was 26.25 USD per share. The difference between fundamental value and historical IPO price was 25.19% and 34.84% depending of the model. These results are also quite significant especially taking into account that other factor also influence on the IPO price: for example, aggressive marketing policy. In this case it is interesting to analyze whether after IPO market prices start to approach fundamental. And we identified that in several months market prices returned to fundamental level.

NetSuite and Solera Holdings companies had IPO several days before the year end; NetSuite 10 days before and Solera Holdings 1,5 months before. Situation with NetSuit is similar to MetroPCS Communications: IPO price was on 32.81% or 39.50% (depending on Model) higher than fundamental, what can be a result of different causes, but it decreased to fundamental level of 20,92 USD/share in 1,5 months after the IPO, and after the year end results, stock prices fluctuated around fundamental level: in the 10 days period (March 26 – April 5 2008) prices vary in the interval from 21.1–23.67 USD per share. Results for Solera Holdings were close to results of Cellcom Israel with the difference that for Solera Holdings Model 2 - regression equitation with application of value of intangible assets appeared to have better estimation ability. For Solera Holdings difference between IPO price and fundamental value of shares calculated based on Model 2 was only 1.32%. Solera Holdings market share prices around the annual results announcement (at 17.09.07) fluctuated at the fundamental level of 17,325 USD/share, and were almost the same as fundamental share prices at the date of annual FS publication.

Four analyzed companies give the evidence that received regression equations might have managerial application and ability to estimate possible IPO price. Identified differences in fundamental level of share prices and IPO price may be a result of different external factors, however in analyzed cases market valuation return to fundamentals after a short time.

Second group: In this group was included remaining 3 companies which had IPO several months before the year end, and there were no available annual reports concerning companies' performance before IPO. For such companies was assumed that comparison of IPO prices with fundamental share prices calculated based on the annual results subsequent to the IPO date may be not meaningful. However such companies can be used to analyze general ability of our regression equations to estimate possible market price at the date of annual financial information disclosure. Table 10 show differences between market prices of shares after the FS announcement and their fundamental valuations.

Table 9

Difference between market prices of shares and their fundamental valuations after the FS announcement

Industry / Company	***Calculated fundamental value of shares, USD***		***Market share price at FS announcement***	***2 weeks after***	***Difference between the fundamental price (of better model) and market share price***	
	Model 1	***Model 2***			***Date of FS announcement***	***2 weeks after announcement***
Software						
PROS Holdings, Inc.	19.21	14.48	14.385	14.975	-1%	3%
VMware, Inc.	28.26	45.16	58.965	44.735	23%	-1%
Hardware						
VeriFone, Inc.	19.94	17.13	23.425	26.6	27%	36%

Based on the results presented in the table 10 we can conclude that analyzed regression equitation have good ability to estimate market value of shares at the point of annual results announcement when investors have full financial information available for the analyses, based on which they can make considered investment decisions.

Conclusions

In the research, high-tech companies were analyzed; and 3 main characteristics of such companies which potentially might have the greatest influence on the process of value creation from the point of view of external investors were distinguished. Therefore the following factors

which usually are higher in high-tech companies than in traditional were identified: value of intangible assets, growth rate, risks and uncertainty. Based on identified distinctive characteristics of high-tech companies two hypotheses (out of 4 tested in the research) were developed, where the first hypothesis was that value of intangible assets significantly influence on market capitalization of high-tech companies and the second was that growth rate significantly influence on market capitalization of high-tech companies. Riskiness characteristic of high-tech companies wasn't tested by a separate hypothesis, but was taken into account in calculation cost of equity by beta coefficient in CAPM model. To test hypotheses, was developed two and three-factor regression models which can be used for evaluation fundamental value of equity of high-tech companies based on Residual Earnings Model of fundamental value of equity estimation, Gordon's growth model and variation of Stewart's CIV model of intellectual capital valuation (introduced in Volkov and Garanina, 2008). Independent variables in regression equations were: book value of equity, year end residual earnings discounted at a certain rate and in 3-factor regression model also value of intangible assets. For test of first hypothesis as a discounting rate for residual earnings cost of equity decreased on average industry growth rate was used; for the test of second hypothesis regression models with growth rate incorporated by Gordon's formula and their variations without growth rate application were compared (thus residual earnings were discounted either at cost of equity rate decreased on growth rate or purely at cost of equity rate). As dependant variable in both equations market value of companies' shares was chosen, thus all independent viable were taken per share value.

To analyze the major factors which drive certain investors decisions third and fourth hypotheses were additionally developed. According to the third hypothesis investors first of all pay attention to the book value of equity while making decision concerning purchase of companies shares, and according to the forth hypothesis residual earnings are one of the most important financial indicators which influence on investors subsequent decisions concerning keeping or selling companies shares.

By the research all four set hypothesis were proved. Proof of first two hypotheses showed that intangible assets and growth rate are important characteristics of high-tech which influence on value creation process in such companies and their market capitalization. Proof of third and fourth hypotheses confirmed that if we consider two important financial indicators book value of equity and residual earnings the first one is more important for investors when they make initial decision concerning purchase of companies shares and residual earnings start to be more important than book value of equity for making following decision concerning keeping or selling shares. It is important to note that despite intangible assets were proved to be an important value creation characteristic of high-tech, they played lower role in investors investment decisions than book value of equity and residual earnings.

To test possibility of managerial application of results received during the research, it was tested whether received regression equations can estimate possible IPO price for companies with no listing history. This assumption was tested on 7 high-tech companies which had IPO on NYSE during the period 2005-2007. Quite significant results were obtained. Possible share price calculated based on 2 and 3 factor regression equations was different from historical IPO price in diapason form 1.32% till 40% depending on the company and the model (2 or 3-factor regression equation). However what was also noticed that real market share price was very close to estimated share price after the year end financial results announcement.

Therefore in general result of the research are significant, however some areas for development exists. The research is done only for around 40 companies and 3 years for each company, companies were selected form 6 high-tech industries; thus to obtain more significant results which can be widely generalized the same kind of research should be done for more high-tech industries and greater amount of companies related to each industry should be included in the research. Results of the research might be increased if average market share prices would be calculated based on trading data during some days after the year end results announcement, but not during the whole second quarter of the year, because during three moths of the whole second

quarter other factors may have a significant influence on share prices beside company annual financial results. Also research results might be better if more accurate and industry specific data is used in regard of risk premium on market which is used for cost of equity calculation. In the research general risk premium on US market was used, however high-tech industries are riskier, so to make research more precise risk premium on certain high-tech market should be applied.

The research gave a start to investigation of different issues related to high-tech companies' valuation based on accounting approach to fundamental value of equity estimation. There are several directions for future research in this field. One possible direction can be a test of developed model on greater amount of companies and inclusion in the test more high-tech industries in order to obtain more scientifically significant results. In the research models were tested on American and European high-tech companies sampled from NYSE. Future research may be dedicated to comparison / benchmark of high-tech industries of different countries in regard of identification similarities and differences in value creating characteristics of high-tech companies in different countries and models of fundamental value of equity estimation which can better explain value of such companies. Also future research questions may be focused on identification other factors which may influence on value creation process in high-tech companies, development of alternative models of fundamental value of equity of high-tech companies estimation (and especially in regard of methods of intellectual capital valuation) and test of their explanatory ability. Another possible research question may be to compare high-tech companies with traditional to identify differences in value creation factors of such companies and models of fundamental value of equity estimation which can better explain value of high-tech and non high-tech companies. Finally future research may also be related to the test of possible managerial application of received models to highlight a link between science and business.

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