INTELLECTUAL CAPITAL VALUATION USING MONTE CARLO SIMULATION

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We present a simulation model in this paper to determine the value of intellectual capital. In frame of the simulation model we have used the Baruch Lev's intellectual capital valuation modell.We have built in the Baruch Lev model in a two-dimensional Monte Carlo simulation modell. We have determined the intellectual capital in case of some stock exchange company. The calculation are presented in case of a selected company.

Key words intellectual capital valuation, Baruch Lev, Monte Carlo simulation, two dimensional simulation
JEL code G12, G31, C15

1. The importance of intellectual capital

Nowadays an increasingly important factors of the value creation in developed economies are mostly invisible. These assets – staff expertises, process quality, computer programs, patents, brands etc. – are delivering a fast-growing contribution to corporate competitiveness. These invisible assets play a particularly important role in case of research- and knowledge intensive companies.

Thomas A. Stewart in his book "Intellectual Capital" (*1997*) redefined the priorities of businesses, demonstrating that the most important assets owned by the today companies are most often not the tangible goods, equipment, financial capital, or market share, but much rather the intangibles: patents, the knowledge of workers, and the information about customers and channels as well as the past experience that a company has in its institutional memory.

Some authors are referred these assets as intangible assets, others as intangible capital, and others as intellectual capital, however, they all think of the same category of assets. The terms "are widely used – *intangibles* in the accounting literature, *knowledge assets* by economists, and *intellectual capital* in the management and legal literature – but they refer essentially to the same thing: a nonphysical claim to future benefits. (*Lev, 2001*)

In the article „New Math for New Economy" (*Webber, 2007*) we can read: In case of the S&P500 index the market-to-book ratio of the companies constituent the index -- that is, the ratio between the market value and the net-asset value of these companies -- is now greater than 6. This means that the financial report number represents only 15 % to 16 % of the value of these companies. Even if the stock market is inflated, even if you chop 50 % off the market capitalization, you're still talking about a huge difference between value as perceived by those who pay for it day-to-day and value as the company accounts for it.

The beginning of the last century the ratio of intangible business capital to tangible business capital was 30% to 70% which has been changed into its opposite nowadays. In the past several years, there has been a dramatic shift, a transformation, in what the intangibles have became the

major assets of the value creation and growth. Nowadays, the intangibles are fast becoming substitutes for physical assets.
Today, many executives recognize the importance of intellectual capital as a principal driver of firm performance and a core differentiator. But not only enterprises are seeing the value in intellectual capital; governments are also recognizing the importance of it. The European Union, for example, aims for their membership countries to invest a minimum of three percent of their GDP into research and development initiatives in order to grow their intellectual capital and become more competitive in the knowledge economy. (*Joia, 2007*)

2. The intellectual capital statement

An increasing number of firms start to report their corporate intangible aspects even without the force of regulations. This trend is especially observable in Europe with various initiatives by the European Commission (in frame of projects such as METITUM, E*KNOW NET, PRISM). Another example is presented by the Danish Department of Trade and Industry, which produced guidelines of how companies can produce intellectual capital reports. In Austria the government has passed a law that all universities have to report on their intellectual capital, in the UK companies will be forced to produce an Operating and Financial Review outlining many intangible elements of their business, and countries as diverse as Iceland, Germany, and Spain have started their own initiatives. (Mouritsen et al., 2003; Bratianu, 2009)
Intellectual capital statements can serve to structure and assign priorities to knowledge management efforts within the organisation.

- The statement helps the organisation to focus on what it actually does to to develop its knowledge resources and what the effects are of such activities.
- The process of preparing an intellectual capital statement can help to create a culture of knowledge sharing.
- The statement tells the organisation what it must know and what it must excel at, what can be relevant for organisational development.
- The publication of intellectual capital statements can lead to better communication. It can signal the principles of knowledge management practised by a company, to both internal and external stakeholders.
- The intellectual capital statement can also help to attract new employees.
- The intellectual capital statement can also improve the communication between the company and its customers.

3. Methods for evaluation of intellectual capital

An enormous number of the theories, models and methods helping on understanding and measuring of the companies' intellectual capital refer to that there is no generally accepted theoretical model for understanding and measuring of the intellectual capital. (*Petty-Guthrie, 2000*)
There are several methods that can be used to determine the corporate value of the intellectual capital, such as

- Economic Value Added (EVA),
- Market Value Added (MVA),
- Tobin’s Q Ratio,
- Balanced Score Card,
- Skandia’s IC Navigator,
- Intellectual Capital Services’ IC-Index,
- Technology Broker’s IC Audit,

- Sveiby's Intangible Asset Monitor (IAM),
- Real Option Theory.

Baruch Lev said in an interview about the model, which was used to determine the value of company's intellectual capital, the followings: "I've developed a way to measure knowledge assets, intellectual earnings, and knowledge earnings. It's a computation that starts with what I call "normalized earnings" -- a measure that's based on past and future earnings. … My approach looks at the past. Based on those forecasts, I create an average, and I call that average normalized earnings. From those normalized earnings, I then subtract an average return on physical and financial assets, based on the theory that these are substitutable assets. … So when I subtract from the total normalized earnings a reasonable return on the physical and financial assets, I define what remains as the knowledge earnings. Those are the earnings that are created by the knowledge assets." (*Webber, 2007*)

To construct the simulation model we used the Baruch Lev's model. To determine the normalized earnings we used five-year historical data and five-year forecast data. (Table 1)

Table 1: The historical and forecast data to determine the normalized earnings

Title of data	2004	2005	2006	2007	2008
Intangibles	269008	369 644	293 582	296 790	265 753
Fixed assets	1276713	1 179 555	1 066 681	987 611	1 024 243
Long term financial assets	1813964	2 055 525	1 206 779	1 543 117	1 498 149
Equity	6681536	7 252 647	6 987 583	7 351 433	5 590 996
Accounts payable	2600242	2 825 543	2 820 751	2 800 383	4 312 621
Net income	286 438	404 116	173 316	363 850	-1 760 436
Retained earnings	286 438	404 116	173 316	363 850	-1 760 436
Sales	12 508 716	11 801 157	14 013 320	12 194 963	13 893 871
Operating profit	5 352	258 924	-158 480	356 051	11 006
Inflation rate	6,80%	3,60%	3,90%	8,00%	6,10%
ROE	4,29%	5,57%	2,48%	4,95%	-31,49%
Visszaforgatási ráta	100,00%	100,00%	100,00%	100,00%	100,00%
Growth rate	4,29%	5,57%	2,48%	4,95%	-31,49%
Fixed assets/Sales	0,1021	0,1000	0,0761	0,0810	0,0737
Long term financial assets/Sale	0,1450	0,1742	0,0861	0,1265	0,1078
Normalized earnings	**286438**	336 158	281 695	265 330	-711 769
Forecast					
	1	**2**	**3**	**4**	**5**
Inflation rate	**7%**	**6%**	**5%**	**4%**	**4%**
Growth rate	**4,29%**	**5,57%**	**2,48%**	**4,95%**	**-31,49%**
Sales	**13 434 675**	**14 183 253**	**14 535 046**	**15 254 440**	**10 451 277**
Earnings after tax	379448,28	400591,0597	410527,0905	430845,6164	295185,3273
Fixed assets	1 371 222	1 417 651	1 106 394	1 235 383	770 458
Long term financial assets	1 948 243	2 470 438	1 251 708	1 930 255	1 126 941
Normalized earnings	378 682	395 785	412 401	357 339	
EAT/Total assets	8,53%	11,21%	6,75%	12,87%	-63,14%
EAT/Sales	2,29%	3,42%	1,24%	2,98%	-12,67%
EAT/Equity	4,29%	5,57%	2,48%	4,95%	-31,49%
Sales changing		-5,66%	18,75%	-12,98%	13,93%

4. The results of the simulation

A two-dimensional (or second-order) Monte Carlo simulation is useful to estimate the "uncertainty" in the risk estimates stemming from parameter uncertainty. A two-dimensional Monte-Carlo simulation is a Monte-Carlo simulation where the distributions reflecting "variability" and the distributions representing "uncertainty" are sampled separately in the simulation, so that "variability" and "uncertainty" in the output may be estimated separately.

To execute the simulation model we have used the 'mc2d'[366] package of R statistical system.
The statistical results of the simulation are presented in Table 2. The histograms and boxplot diagrams of the net income on the physical, financial and intangible assets are presented in Figures 1-3. The result of the intangible assets' estimation are presented in Figure 4.

Table 2: The results of the simulation

Statistical indicators	Required rate of physical assets	Net income on physical assets (million HUF)	Required rate of financial assets	Net income on financial assets (million HUF)	Net income on intangibles (million HUF)	Intangibles (million HUF)
Minimum	5,54%	61 999	4,35%	72 228	-6 682	-49 783
1st quartile	7,67%	85 893	6,18%	102 492	76 084	750 561
Median	8,92%	99 837	7,11%	117 896	99 723	1 106 770
Mean	9,15%	102 465	7,32%	121 479	98 062	1 165 025
3rd quartile	10,50%	117 513	8,38%	139 039	122 148	1 523 678
Interquartile range	2,83%	31 620	2,20%	36 547	46 064	773 117
Maximum	14,19%	158 908	11,35%	188 374	176 442	2 993 786
Standard deviation	1,88%	21 002	1,48%	24 579	32 244	548 243
Coeff. of variation	20,55%	20,50%	20,22%	20,23%	32,88%	47,06%

[366] Monte-Carlo à Deux Dimensions

Figure 1. Net income on physical assets

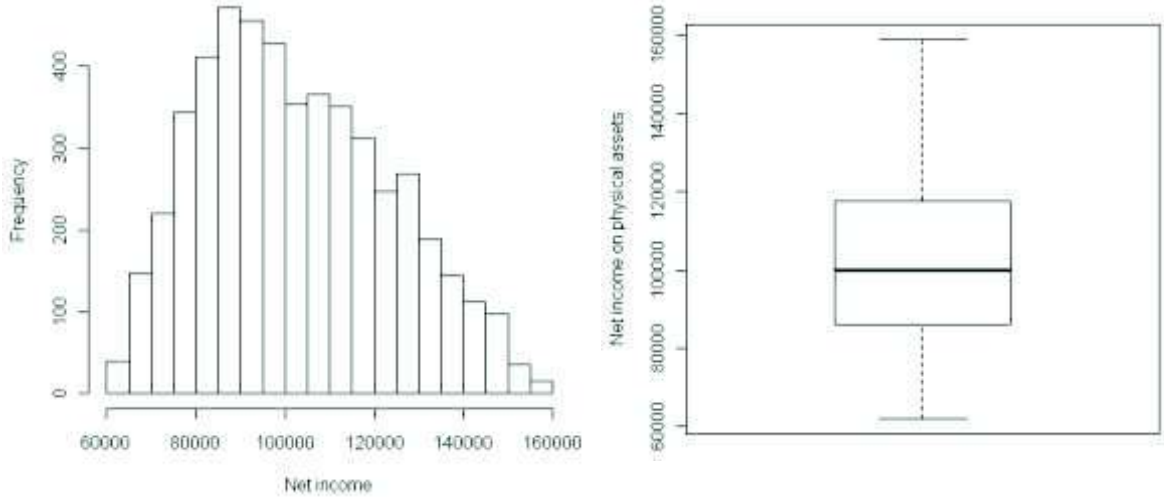


Figure 2. Net income on financial assets

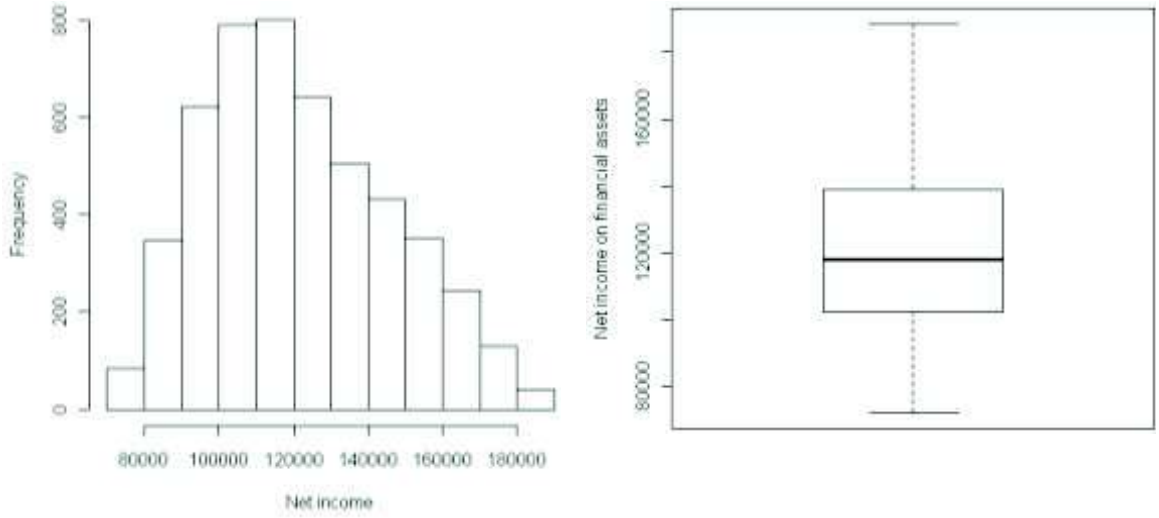


Figure 3. Net income on intangibles

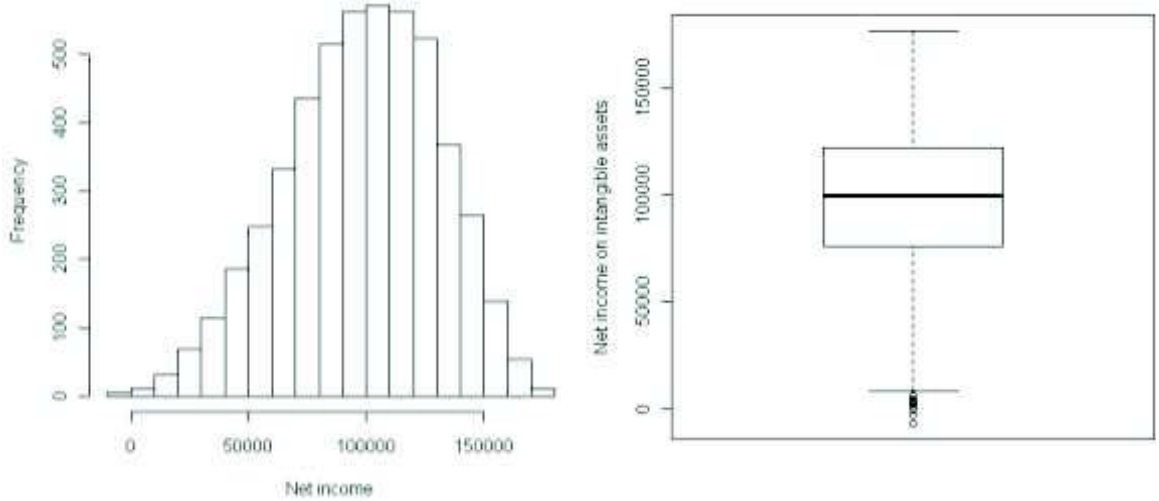
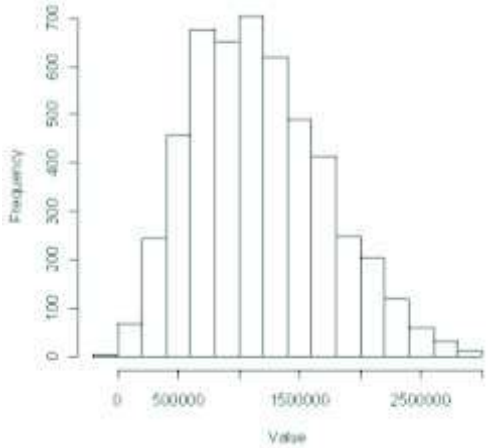
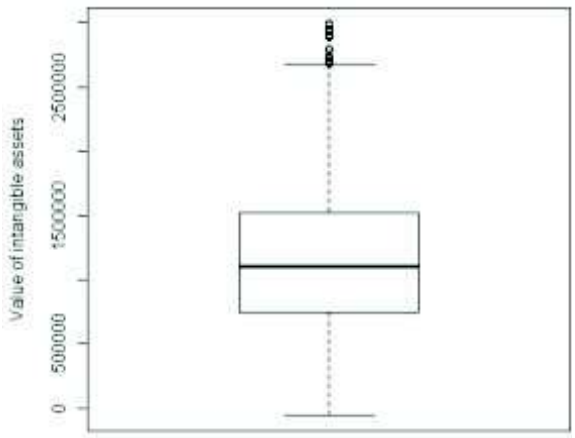


Figure 4. The value of intangibles





The calculation of modell:

net income on intangible assets = Normalized earnings –
(require return on physical assets * value of physical assets) -
(require return on financial assets * value of financial assets)

value of intangible assets = net income on intangible assets / require rate on intangible assets

5 Conclusion

We present a simulation model in this paper to determine the value of intellectual capital. In frame of the simulation model we have used the Baruch Lev's intellectual capital valuation modell.We have built in the Baruch Lev model in a two-dimensional Monte Carlo simulation modell. We have determined the intellectual capital in case of a stock exchange company (Synergon).

To determine a 95% confidence interval for the mean was used the one sample t-test. The result of t-test in case of intangibles' value:

1 149 825 – 1 180 225 million HUF

We can see that the interval has a very small scale. The sample estimate, namely the mean of intangible asset's value is 1 165 025 millioh HUF.

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