Area of Subject - Technology Management

Title - The Knowledge Creators: Using DEA to Measure the Efficiency of Highly Innovative Companies in the Technology Sector

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Abstract:

In the last few decades, companies have passed through a technological revolution. They become intellectually intensive leading to a transition called the post-capitalist society. Their assets are not tied solely to capital, land and workforce, but also included assets dependent on the knowledge an organization can create, attain and spread. However several questions arise regarding how efficiently companies innovate and create knowledge in this new era.

This current work analyzes the efficiency of highly innovative companies by using Data Envelopment Analysis methodology. More specifically were utilized the CCR model, introduced by Charnes, Cooper & Rhodes (1978), and the Multiplier model, idealized by Farrell (1958). A sample of 27 companies from the technological sector ranked according to U.S. Patent Office 2007 was analyzed in terms of their capacity to develop patents given their total investments in R&D and the marginal contribution of each worker compared to the operational margin.

A view of the sample of data suggests that companies that applied strong efforts to generate knowledge and innovate were not necessarily efficient in overcoming the frontier of innovation. Moreover, the analysis pointed two companies as strongly efficient.

Key-words: Knowledge Economy, Patents, DEA

1. Introduction:

When the management guru Peter Drucker (1994) first introduced the idea the world was getting through the post-capitalist society it wasn't a mere common sense idea, but a matter of fact. According to Drucker (1994), we are no longer living in an industrial society. The innovation cycles are shortening, and for this reason the changes are happening all of a sudden such as when our parents can fancy the world in which our grandparents lived, however, one cannot imagine the world in which his parents previously lived and, probably, his children won't have a clue about the world where he lived.

As the changing cycle speeds up, the post-capitalist society is tailor made for organizations. Organizations will be controlled by managers. Managers are the ones responsible for applying and reusing knowledge. Within this inductive reasoning flow, knowledge techniques help managers to innovate in their organizations. Organizations can gather more information with technologies and, for this reason, to compete. Therefore, only knowledge oriented companies can obtain the fundamentals to survive in the post-capitalist society.

As soon as issues related to knowledge and innovation arise in the organizational context, a debate involving the importance of metrics in knowledge management comes to the forefront discussions. Some might say that actions concerning knowledge in organizations are useless, for once knowledge acquires its tacit form, and it becomes hard to measure (Nonaka, 1991). Others still see that formal actions oriented to keep track of intangibles in an organization is a manner to accomplish knowledge into the cycle of creation, sharing, using and spreading.

This current work has the intention to evaluate the efficiency of highly innovative companies, by using a tool called Data Envelopment Analysis (DEA). This methodology was developed by Farrell (1958) for analyzing technical efficiency of economic units. Since the transformation of DEA into a linear programming problem, its applications have expanded to several fields of study and industries, including health care, hedge funds and non-profit organizations (Cooper, Seiford & Zhu, 2004).

The following section digs deeper into the issue of knowledge of economics in the post-capitalist society. In section 3, introduces the basic concepts concerning DEA utility and restrictions. In section 4, explains the methodology used to analyze the companies under a DEA perspective and section 5 summarizes the analyses and findings collected using this methodology, followed by a conclusion.

2. The Post-Capitalist Society and the Growing Importance of Knowledge

Since the technological evolution began in the organizational environment, information has become a fundamental resource to assure the existence of several companies. Along with these changes, knowledge is the main factor of production to transform information into applicable solutions. This means in addition to the traditional land, workforce and capital, knowledge has become an important factor of production (Drucker, 1994).

As we are going to live in the post-capitalist society, managers will be the ones responsible for constantly applying knowledge in their day to day routines. Two facts can be stressed about this growing importance of knowledge. First, the services sector is gaining importance over agriculture and manufacturing, pointing to an increasing demand for skillful workers and an inversion to an economy in which the intangibles are the main asset traded. Second, the fast growing knowledge-based industries such as the high-technology sectors (computing, space and pharmaceuticals), financial services, insurance companies and services to business are increasing in terms of workforce and becoming more financially representative (Forway, 2004).

Knowledge as a Group Innovation Effort

Adaptability to changes is an important value for companies that want to remain on the main stage of the corporate world. Knowledge acts as a facilitator to recombine factors, to shed light on an unknown answer and to spark creativity. The main outcome of this effort is innovation. The creative destruction is the main virtue that entrepreneurs acquire in developing new products or process improvements and, consequently, in producing extraordinary profits and developing the economic system (Schumpeter, 1934). Under this reasoning flow, it is possible to conclude that knowledge and innovation are correlated concepts, as knowledge launches innovations and innovations motivate the creation of new knowledge.

Innovation can happens in several spheres of an organization. It is related to organizational restructuring, process redesign, technological implementation and product creation. The level of innovation can also pass through several standards, starting with an incremental innovation (usually few organizational changes are noticed) and then reaching upper stages such as the fundamental (the organizational structure is aware of its innovation capability) or the radical innovation (the organization is totally oriented to constantly bringing new concepts and accomplishing a creativity culture).

In a broader view, innovation and invention are different concepts. "Invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to carry it out into practice" (Fagerberg, 2004). This means that the innovation along with the "know-how" and "know-what" are the propulsive factors to launch achievements. When this comes to the organizational context, innovative concepts are an output of the collective-thinking in which the employees keep exchanging their experiences in a social network. This network is not only restricted within the organization, but it can surpass its outside boundaries when the environment provides interesting input to spark innovation, leading us to a conclusion that innovation is a group effort. The consumer goods P&G[1] has a good case study about its open innovation efforts.

Knowledge as an Intangible Asset:

As companies are getting more concerned about generating, codifying and spreading knowledge, the amounts invested to stimulate such projects are also increasing. However, the companies can assess only a few figures to indicate how the intangibles are performing in relation to the amounts invested (Lev, 2001). In a simplistic view, companies can have control only over the expenses being made such as R&D, IT, employee training and customer acquisitions, however, there is not a consolidated tool that indicates the returns on these expenses.

The problem of control over investments expenses in knowledge related programs arises because of the subjectivity of such an issue. Although there is a market to transaction knowledge, for example, when a company invests in corporate training or when it sells a patent, a little is known about the potential

[1] For further information about this case study this website is suggested: www.pgconnectdevelop.com

returns that these knowledge acquisitions can bring to a company's revenues. The reasonable alternative that remains for corporate managers is to rely on, what is known in the financial jargon, as goodwill. Lev (2001) claims that the investment in intangibles might not be monetarily assessed once "it is a claim for future benefits that does not have a physical or financial embodiment." Therefore, the real value of a company intangible assets (those related with its knowledge core) should not be disclosed on its balance sheets, but an effort should be make to evaluate the effectiveness of the knowledge related programs being conducted.

Knowledge and Intellectual Property

As more knowledge is created, the concern to protect it grows. A patent institutes the property rights for the creators of intellectual capital. In other words, it privatizes the utilization of an achievement (Foray, 2004). When the claimer decides to issue a patent, it is believed that he will receive future earnings for his invention, once the patent tries to internalize future spillovers[2] that might come with this new creation. Otherwise, it would be impossible in an unregulated market to benefit from an invention as the competitors could easily steal one's idea and make use of the same outcome. Moreover, a patent registration is a source code for specialists in the same field to share and collaborate on improvements, establishing a common ground for a similar research.

One can point out several benefits brought by patents (Forway, 2004). They can act as an incentive for researchers to reveal their findings that otherwise would stay hidden. As patents contain the source codes of an achievement, more insights and improvements can be made by someone outside the research group, transforming the patents into a powerful tool to connect the patent field-related researchers. Furthermore, patents are an *ex-post facto* reward, as the inventor claims for future benefits of their applications, and they also provide an economic incentive for helping the inventor keep working on further research.

On the other hand, patents raise several issues (Stiglitz, 1999). The royalties' payment for using a patent can create a barrier to further research, retarding the innovation cycles. However, if the time allotted for the expiration of a patent was shortened, the researcher wouldn't have the economic incentive to keep creating more things. Therefore, patents can be a double-edged sword able to diminish the speed of progress.

In the corporate world, a patent represents an asset held. As any other asset, a patent becomes a source of revenue, but especially in this case, it is classified as non-operational revenue. In some sectors, patents play a more important role, such as the intellectual intensive industries (information technology and pharmaceutical) and, consequently, it is in these sectors where one can see the best management practices involving intellectual property tools.

The Ability of Companies to Manage Knowledge

In the post-capitalist society, the way that companies run their businesses will depend largely on how they manage their knowledge. Knowledge management "covers any intentional and systematic process or practice acquiring, capturing, sharing and using productive knowledge, wherever it resides, to enhance

[2] There are clearly two manners the spillover occurs: a researcher can find a new application for the same invention or a researcher can improve, based on the patent code, the invention.

learning and performance in organizations" (Foray, 2004). Two consolidated points concerning this issue can be inferred by this definition. First, knowledge management is about a virtuous cycle that can be stimulated with formal techniques. For example, communities of practice help to acquire knowledge and corporate portals represent an effort to share it. A second point to be stressed regarding this definition is that knowledge resides in different locations. It can be gathered from people or found in books and manuals. Codification and utilization of taxonomies are also examples that perpetuate the virtuous cycle of knowledge.

Knowledge can be represented by two forms: explicit or tacit (Nonaka, 1991.) Explicit knowledge is easily codified and transmitted, and may reside outside people's heads. On the other hand, tacit knowledge is transmitted only directly from people to people through experience, so it resides inside people's heads, and it cannot be codified and shared through formal procedures, including usage of IT tools or manuals. The actions surrounding knowledge management can stimulate either explicit or tacit knowledge. For example, the actual demand for knowledge management software gives stimulus only to *explicit knowledge* and in order to stimulate *the tacit knowledge*, Davenport & Prusak (1998) argue that it is only a matter of hiring good people and letting them talk at the water cooler.

3. The Data Envelopment Analysis:

Data Envelopment Analysis (DEA) is an operational research method used to analyze the efficiency of production in decision making units (DMU's). Farrell (1958) was the first one to study the subject of efficiency within DMU, when analyzing the productivity of agricultural land in the states of U.S. Later on DEA was transformed into a linear programming problem by Charnes, Cooper & Rhodes (1978) when evaluating educational programs for disadvantaged students in public schools all over U.S. Since then, the usages of DEA have been improved, as new computer applications and faster machines were developed, and multiplied into many fields of study, not attaining only to business related researches.

In simple words, DEA tries to calculate the efficiency of DMU's for a given set of inputs and outputs, generating a virtual optimal DMU used as a benchmark. In models using constant returns and absence of economies of scale, the virtual optimal DMU is situated in the isoquant curve known as the efficient frontier of production (Fig. 3.1). DEA handles the problem of efficiency in the DMU's by attributing weights variable to the set of inputs and outputs while maximizing the efficiency equation. This will be represented later on equation (2), when is showed the dual problem. By now, let's define the main terms used in DEA.

The definition of a DMU is not specific (Cooper, Seiford & Zhu, 1999), once its applications have been spreading out in many studies. A characteristic to be highlighted on a DMU is their similarity with their peers units in terms of the technology utilized by each of them. The inputs and outputs are also defined generally. They are treated as variables that present a causality relation, the units presented in their variables aren't considered (DEA is measure in relative numbers) and it is utilized nonparametric techniques to classify them.

On DEA, efficiency is understood as the maximum amount of outputs that can be obtained for a given number of inputs:

$$Efficiency = \frac{Inputs}{Outputs} \quad (1)$$

Considering a scenario of constant returns of scale and two sets of inputs resulting in one output, it is possible to represent a diagram such as in the figure 3.1. In the diagram, the best combination of two inputs for a given output is situated on line “r”. This isoquant line is also known as the efficient frontier of productivity and the virtual DMU is situated on it.

According to figure 3.1, the DMU P presents a lower efficiency than Q as both are producing the same amount of outputs, but P is relatively consuming more inputs. The relation OQ/OP represents the number of times that Q is performing better than P, and it is called the *technical efficiency* (benchmark) of firm P. A reasonable alternative to DMU P improve its efficiency, it would be to consume less input 1 for the given output. This would bring P closer to the efficiency frontier and, in this case, Q wouldn’t be anymore the technical efficiency of DMU P.

This model involving the technical efficiency was proposed by Farrell (1958) and represented a mark on what is studied on DEA. Farrell (1958), divided the concept of efficiency between “price” and “technical”, however further researchers argued that his studies lacked further explanations when analyzing under the influence of economies of scale (DMU’s that needed less unit of inputs as the volume of outputs increased).

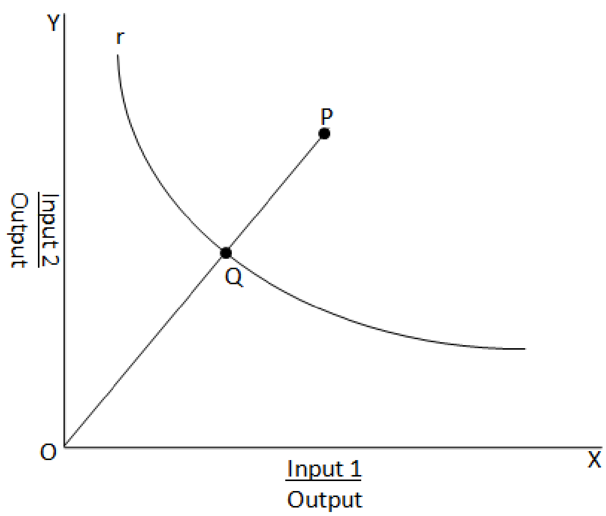


Figure 3.1 - Source: Farrell (1958)

The algorithm proposed by Farrell (1958) is known by the “Multiplier Model”. It finds the optimal solution by maximizing an objective function. From a set of inputs (Y_{ki}) and outputs (X_{ji}), it is calculated through a dual problem the relative weights (v_k, u_i) and for each DMU the efficiency score is generated. This dual problem can be represented as following (Talluri, 2000):

$$\max \sum_{k=1}^{s} v_k \, y_{kp}$$

$$s.t. \sum_{j=1}^{m} u_j x_{jp} = 1$$

$$\sum_{k=1}^{s} v_k y_{ki} - \sum_{j=1}^{m} u_j x_{ji} \leq 0 \quad \forall i$$

$$(2) \qquad \text{and} \quad u_j, v_k \geq 0 \quad \forall k, j$$

In which:

$v, u =$ Relative weights of outputs and inputs, respectively

$x_{ji} =$ ammount of output j utilized by DMU i

$y_{ki} =$ ammount of input k utilized by DMU i

$k = 1 \text{ to } s$

$j = 1 \text{ to } m$

$i = 1 \text{ to } n$

Therefore, this algorithm keeps constant the weighted output and maximizes the weighted input. If a DMU reaches the score 1, it is considered efficient.

As soon as DEA gained popularity, it was transformed into a programming linear problem by Charnes, Cooper & Rhodes (1978) and it became knew as the "Envelopment Model". From equation (2) it is possible to find out the *technical efficiency* (θ) of a DMU by applying a similar algorithm[3].

$$\min \theta$$

$$s.t. \sum_{i=1}^{n} \gamma_i x_{ji} - \theta x_{jp} \leq 0 \quad \forall j$$

$$\sum_{i=1}^{n} \gamma_i y_{ki} - y_{kp} \geq 0 \quad \forall k$$

$$(3) \qquad \gamma_i \geq 0 \quad \forall i$$

In which:

[3] For further details about this transformation, see Cooper, Seiford & Zhu (2004)

$$\theta = efficiency\ score\ and\ \gamma_i = dual\ variables$$

Tracing an analogy with the Farrell model to achieve the technical efficiency, θ on this equation represents the relationship OQ/OP for a given DMU, as in fig.3.1.

The benefits and restrictions of DEA:

DEA is a useful tool to compare efficiency due to its simplicity and practical applications. It makes use of a nonparametric method, in other words, the population analyzed needn't to fit any standardized distribution. Therefore, a few assumptions are required and relatively less input of data are necessary, when compared with another parametric methods such as linear regressions. Also, DEA can compare different types of variables at the same time. With this property, DEA is not attained only to monetary and quantity values as in many economic models, because it uses relative values.

The restrictions of DEA lays on the assumptions concerning:

- The right choice corresponding the causality of inputs over outputs
- The similarity of the DMU's in terms of their technological factors
- The DMU's work with constant returns of scale[4]

Moreover, DEA cannot be used as a predictive tool of efficiency, once it is an *ex-post facto* analyze. This means that DEA analyzes a sample of data that occurred in the past and can only suggest improvements, but it cannot be tested on present or future facts.

4. Methodology:

It was applied the DEA to evaluate the efficiency levels of high innovative companies within the technological sector in terms of quantity of patents issued in the U.S. Patent Office. The sample involved 28 companies to be analyzed and they were all ranked in the annual IFI Top Patents press release of 2007. The companies belonged to the technological sector, but they differed in industry according to the classification adopted by Bloomberg and Google Finance.

Two equivalent application of DEA were used: the Multiplier Model (Farrell, 1957) and the Envelopment Model (Charnes, Cooper & Rhodes, 1978.)

The inputs analyzed were the expenses on R&D over Operational Revenues and the marginal contribution of each worker; and the output utilized was the quantity of patent listed in the U.S. Patent Office Ranking of 2007. The relation of expenses in R&D over operational revenues is understood as the amount of resources destined to finance a company's knowledge and innovation programs. The relative numbers were preferred to facilitate comparisons among big and small companies.

The marginal contribution of each worker was calculated by dividing the operational margin (revenues/ operational profit) over the number of employees. By doing such relationship, one can find out the contribution of each employee over the operations of a company. For the same reason as when

[4] Indeed, the problem of economies of scale arises due to the application of the CCR model (the one explained and used in this work). Other researchers have already proposed better analytical models considering gains of scale, such as the BCC model.

obtaining the ratio R&D/Revenues, the marginal contribution of each worker was also calculated in relative numbers.

All the source of data was obtained through the companies public statements of the year end of 2007. In order to keep the maximum uniformity of the data and numbers, it was used the application Google Finance to obtain the number of employees, and Reuters to obtain the financial statements. In punctual cases those data were obtained on companies' annual report, but a careful attention was paid to the required conversions and standardization.

The software used to analyze the data was Microsoft Excel. The supplement Solver was utilized to calculate the efficiency and the benchmarks.

5. Analysis and findings:

The Multiplier Model and the Envelopment Model were utilized to analyze the sample of companies. The Envelopment Model was achieved by maximizing the weighted level of inputs, while the Envelopment Model was achieved by minimizing the weighted level of outputs. Despite these two different algorithms to calculate the efficiency level of each DMU (as was shown on section 3 of this work), the same result was obtained, revealing the accuracy of the model.

Overview on the Efficiency Levels:

For the given set of DMU, two companies performed at the level of efficiency: Samsung Electronics and Micron Technology. Samsung Electronics occupied the 2nd place as the Top Patent Issuers on 2007 (issuing 2725 patents on that year) and Micron Technology were occupying the 9th place on the same ranking (1476 patents issued). Over these results, it can be inferred that both Samsung Electronics and Micron Technology were companies that could obtain high level of outputs from their inputs, or else, they were innovating more, when creating patents, with less consumption of R&D investments and less employees per operational margin.

The causes of the higher performance among these two top performers are different. When it comes to the R&D expenditures (input 1), Samsung Electronics spent only 3.5% of its revenues, while Micron Technology spent 14% of its revenues. Even though Samsung Electronics spent less than the average on R&D, it still could issue more patents and innovate more. On the other hand, the figures of marginal contribution of the workers (input 2) shows that Samsung Electronics had its workers cooperating at a 0.21% of the operational margin while Micron Technology had its workers cooperating at a 1.13% rate.

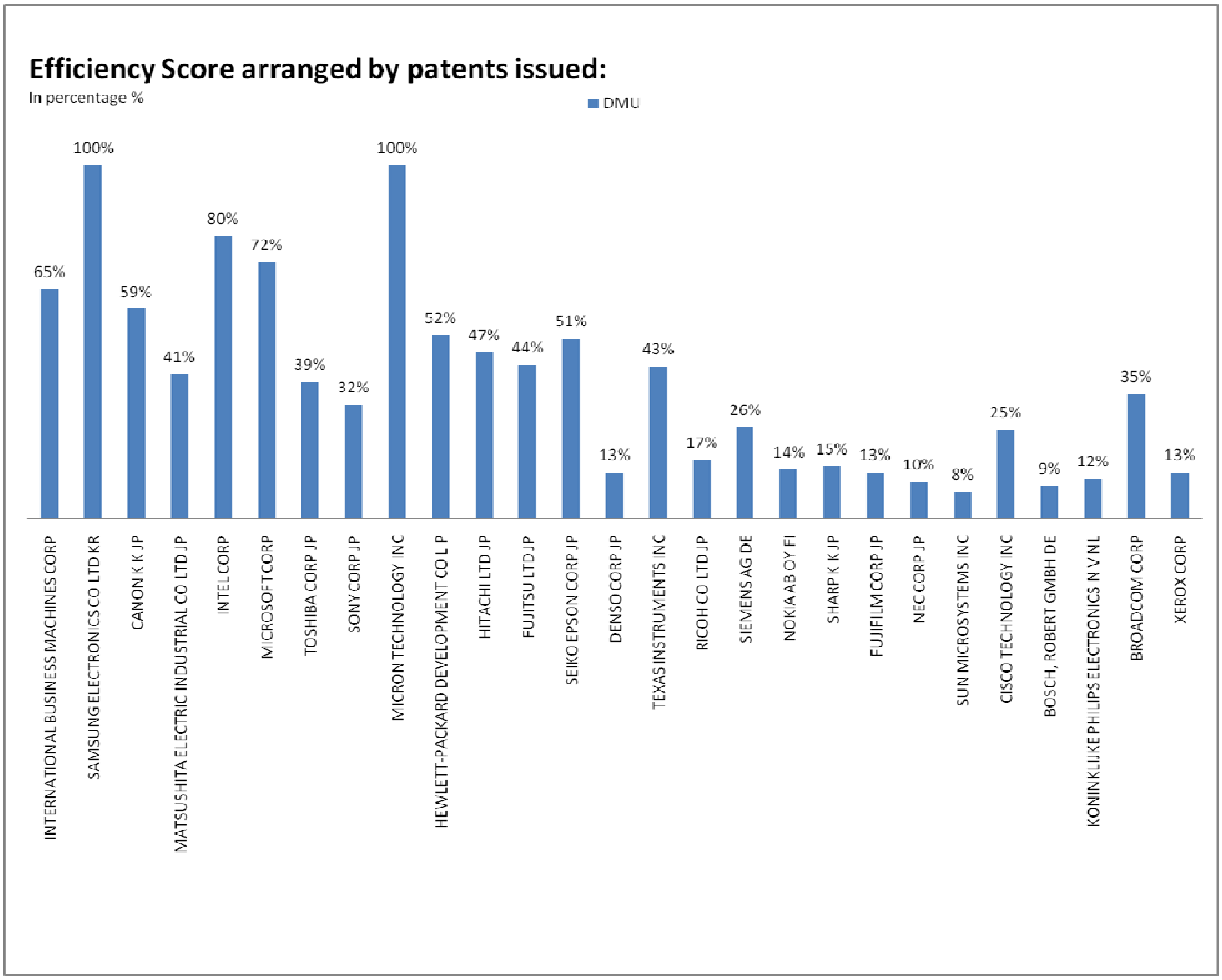
There was a disparity of performance among the companies situated after the median of number of patents issued. On the first half of the sample it can be pointed the two top performers and companies in a level of efficiency of 60%. In the other hand, after the second half of the median, it is situated the poorest performers and an average level of efficiency of 18%. This means that efficient companies are also the ones producing more patents.

The Multiplier Model Perspective:

In order to maximize the objective function, the Multiplier Model distributed different weights between the inputs and output. Therefore, it can be clearly noticed the different roles played by input 1

(Revenues over R&D) and input 2 (Employee contribution to the operational margin). Among DMU's with outstanding level of efficiency, companies such as Epson (V_1=33), Samsung (V_1=29) and Hewlett-Packard (V_1=27) relied on the expenses on R&D (input 1) to innovate. In contrast, companies such as Samsung (V_2=0.0041), Microsoft (V_2=0.0022) and Intel Corp. (V_2=0.0022) relied much more on the contribution of its workers to the operational margin (input 2).

International Business Machine (IBM) was an odd company, due to its big numbers. It was ranked as the first patent issuer on 2007 U.S. Patent Office ranking by releasing 3148 patents and it was also among the biggest companies in number of employees, with 386 thousand workers throughout its divisions. When those numbers are brought to analysis, IBM presented a higher balance on input 1 than on input 2 and its level efficiency was 65%.



Graph 5.1

The Envelopment Model Perspective:

The Envelopment Model is also known as the CCR Model, due to the findings of Charnes, Cooper and Rhodes (1978). It was considered constant returns of scale in the analysis to assure accuracy and simplicity. The main outcomes that this model provided were the benchmarks for each DMU.

The two most efficient companies in the sample, Samsung Electronics and Micron Technology, were pointed as the benchmark DMU. However, 22 companies followed Samsung Electronics as the benchmark company, while only 5 companies followed Micron Technology. In an analogy with the diagram proposed by Farrell (1958) on the efficient frontier, Samsung Electronics can be understood as the DMU that is situated in the isoquant line and forms a line with the origin (O) that should be followed by the other DMU's. Furthermore, Samsung Electronics was the technical efficiency to IBM ($\sum \lambda_i = 1.2$), and Micron Technology didn't present any technical efficiency, being its highest slack Intel Corporation ($\sum \lambda_i = 0.8$).

From the sample of companies analyzed, patents were the main tangible result of application of knowledge. The investments in R&D and the number of employees were comprehended as the efforts that a company applied to innovate and aggregate more knowledge. However, it is reasonable to point out that companies that applied the highest efforts to generate knowledge, investing and hiring, were not the ones to bring up more results; and even some highly innovative companies, despite of the number of patents issued, were not doing it in an effective way.

6. Conclusions:

Knowledge has become an important factor of production in the post-capitalist society. As it gains more importance in the social relations and markets, knowledge also starts to have its impact inside the organizational world. Inside the organizations, knowledge is considered an intangible asset and can be stimulated through efforts in R&D, corporate development, process redesign and so on. Organizations can also issue patents which are the most visible form of knowledge that a company can obtain, and it can also be transformed into a source of revenues as any other asset. Knowledge management programs act in the sense that companies can create, codify and spread the explicit knowledge, and in this context knowledge management have been gained popularity throughout the companies.

However, knowledge may not have its value easily assessed for two main reasons. As an intangible asset, its valuation is embedded of subjectivity, leading to pitfalls such as the one emerged when knowledge is treated as a public good and people can have access to it at zero marginal cost. Second, knowledge is an *ex post-facto* value of benefits, in other words, one cannot know the real utility of knowledge before applying it, otherwise, knowledge would be considered information or raw data.

In order to compare companies in terms of its innovation potential, DEA showed that two companies were considered knowledge creators among the U.S. Pattent Office Ranking of 2007: Samsung Electronics and Micron Technology. They were considered efficient DMU's not so much because of the number of patents issued (which already proves they were innovative) but, due to the number of patents, they generated a right balance between investments in R&D and the number of employees effectively contributing to the companies' results.

Several are the suggestions of future analysis. The application of CCR Model of DEA, involved only 2 inputs and 1 output. More sophisticated methods of DEA, therefore, would be used such as the multiple inputs/outputs orientation. In addition, historical data would be used to evaluate the evolution of DMU's throughout the years; this analysis could be conducted with the DEA Window method.

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Appendix 1: Companies analyzed

Rank USPO	Ticker	Company Name	Patents	R&D/Revenues	Operational Margin	Employees (1000)
1	IBM	INTERNATIONAL BUSINESS MACHINES CORP	3148	0.062	0.1368	386
2	SEO:005930	SAMSUNG ELECTRONICS CO LTD KR	2725	0.035	0.1751	84
3	CAJ	CANON K K JP	1987	0.082	0.2451	131
4	PC	MATSUSHITA ELECTRIC INDUSTRIAL CO LTD JP	1941	0.061	0.0573	313
5	INTC	INTEL CORP	1865	0.150	0.3557	86
6	MSFT	MICROSOFT CORP	1637	0.135	0.3671	91
7	TYO:6502	TOSHIBA CORP JP	1549	0.051	0.0333	205
8	SNE	SONY CORP JP	1481	0.059	0.0911	180
9	MU	MICRON TECHNOLOGY INC	1476	0.140	0.2652	23.5
10	HPQ	HEWLETT-PACKARD DEVELOPMENT CO L P	1470	0.036	0.1099	172
11	HIT	HITACHI LTD JP	1397	0.038	0.0214	360
12	FJTSY	FUJITSU LTD JP	1315	0.049	0.3390	175
13	TYO:6724	SEIKO EPSON CORP JP	1208	0.030	0.0329	92
16	DNZOY	DENSO CORP JP	803	0.077	0.0854	122
17	TXN	TEXAS INSTRUMENTS INC	752	0.156	0.2528	30
18	RICOY	RICOH CO LTD JP	728	0.056	0.0818	87
20	SI	SIEMENS AG DE	700	0.047	0.9298	424
22	NOK	NOKIA AB OY FI	682	0.110	0.1564	123
23	SHCAY	SHARP K K JP	667	0.057	0.0575	54
24	FUJI	FUJIFILM CORP JP	662	0.064	0.0320	78
25	TYO:6701	NEC CORP JP	617	0.075	0.0194	156
26	JAVA	SUN MICROSYSTEMS INC	610	0.145	0.0262	34
27	CSCO	CISCO TECHNOLOGY INC	582	0.129	0.2469	66
28	ZEX.BE	BOSCH, ROBERT GMBH DE	569	0.077	0.0615	258
29	PHG	KONINKLIJKE PHILIPS ELECTRONICS N V NL	560	0.062	0.0450	128
31	BRCM	BROADCOM CORP	533	0.357	0.0663	6
33	XRX	XEROX CORP	517	0.053	0.0832	57