Using Data Envelopment Analysis to Evaluate the Influence of Innovation Capital Investments on Operating Performance: Ta

魏嘉伶、邱垂昌

E-mail: 9509795@mail.dyu.edu.tw

ABSTRACT

This study investigated the operation efficiency of Taiwan IC design industry from 2002 to 2004. This study selected innovation capitals investments such as R&D expense, R&D designers and the number of patents and trademarks, to be the inputs items. The outputs items included gross profit, market capitalization, market share and labor productivity. The data envelopment analysis (DEA) is utilized to measure the effectiveness of IC design companies and provide specific suggestions to inefficient distribution centers via slack variable analysis. Then through Tobit regression method, other major factors that will affect the operation performance of IC design companies can be discovered. With this efficiency evaluation result, it can provide an important reference and basis to manager to improve deficiency and to serve as a future operation direction. The result of the actual proof shows that: (1) the average overall efficiency is 59.1%, indicating that there are about 40% inefficiencies. Moreover, the evidence shows that most of the inefficiencies come from pure technical inefficiency.(2) through DEA it can be known that the major reason of causing inefficiency in operation comes from inefficiency in pure technical and most of the decision units (DMU) are in a scale return gradual increase stage. This demonstrates that the operation scales of various IC design companies are too small and increase of scale is required.(3) IC design companies with constant returns to scale have higher efficiencies than those with either increasing returns to scale or decreasing returns to scale.

Keywords : Innovation Capitals, Operating Efficiency, Data Envelopment Analysis, Tobit Model

Table of Contents

REFERENCES

中文部分 王文英，張清福(2004)。智慧資本影響績效模式之探討:我國半導體業之實證研究。會計評論，39，89-117。 王建全、陳厚銘(2000)。政府獎勵措施對廠商績效之影響—LISREL分析方法之應用。臺大管理論叢，10(2)，71-96。 朱博湧，曾國雄，鄧美貞，邱英雄(2004)。市場佔有率、成長率與獲利率相關性之多變量分析—以新竹科學園區廠商為例。中山管理評論，12(3)，507-533。 朱博湧，劉中淵(1992)。我國積體電路廠商競爭策略與績效研究。臺大管理論叢，3(1)，197-217。 江振隆(2003)。台灣光電產業生產效率與影響因子分析。東海大學管理碩士學程在職進修專班碩士論文，未出版，台中市。 吳思華(1998)。知識流通對產業創新的影響。1998第七屆產業管理研討會論文集，頁1-42，政治大學，台北市。 吳思華、黃宛華、賴鈺晶(1999)。智慧資本衡量因素之研究—以我國軟體業為例，1999中華民國科技管理研討會論文集，頁1-14，交通大學，新竹市。 李文雄(1994)。高科技產業發展策略制訂－多元規劃、群體決策模式之探討。1994中華民國科技管理研討會論文集，頁125-137，交通大學，新竹市。 李紀霖(1998)。JIT生產系統提昇半導體產業經營績效與競爭力分析。國立台灣科技大學管理技術研究所碩士論文，未出版，台北市。 李素華(2002)。技術移轉模式-技術引進與技術授權。2005年12月9日，取自 http://stlc.iii.org.tw/04-5.htm 李淑華(2003)。產業價值鏈知識密度與企業績效。國立台灣大學會計研究所博士論文，未出版，台北市。 李朝彬(2003)。台灣資訊硬體廠商投資大陸對生產力影響之初探。國立交通大學經營管理研究所碩士論文，未出版，新竹市。 林灼榮、徐啟升、李智隆(2002)。中華電信市內電話經營效率與影響因子分析。經濟研究，38(2)，203-244。 孫遜(2004)。資料包絡分析法:理論與應用。台北市:揚智文化事業股份有限公司。 徐孟詩(2001)。我國新興科技產業經營績效之研究—以光電產業為例及財務分析之觀點。國立台灣大學國際企業學研究所碩士論文，未出版，台北市。 馬維揚(1995)。我國高科技產業發展之績效評估—以科學工業園區為例。台北銀行月刊，26(2)，29-41。 高強、黃旭男、Sueyoshi, T.(2003)。管理績效評估:資料包絡分析法。台北市:華泰文化事業股份有限公司。 張世其、李宗耀、虞孝成(2003)。我國IC設計上市公司經營效率之分析。產業論壇，5(1)，169-195。 張愛萍(1999)。研究發展與技術引進-上市電子公司panel data 之實證研究。國立中央大學產業經濟研究所碩士論文，未出版，中壢市。 連峻

慶(2000)。主機板廠商經營效率分析及改善之研究。元智大學管理研究所碩士論文，未出版，中壢市。 陳政任(2002)。以資料包絡法探討台灣資訊電子業之核心能力與經營績效。國立成功大學工業管理科學系碩博士班碩士學位論文，未出版，台南市。 陳振遠、李文智、陳魁元、王朝仕(2004)。台灣地區票券金融公司經營效率與最適規模之研究。管理學報，21(6)，777-799。 陳慧瀅(2000)。科學園區主要產業的相對效率之衡量。產業論壇，1(1)，135-146。 曾俊堯(2002)。國內銀行業智慧資本之探討與比較。產業金融季刊，114，35-52。游聲裕(2000)。我國電腦及週邊產業企業經營績效剖析。國立成功大學企業管理學系碩士班碩士學位論文，未出版，台南市。 湯珮妤(2000)，企業類型與研發支出、專利權成效之遞延效益研究。國立中正大學企業管理研究所碩士論文，未出版，嘉義市。 黃宛華(1999)。資訊服務業智慧資本之研究。政治大學科技管理研究所碩士論文，未出版，台北市。 黃金成(2001)。科學園區資源投入產出效率和產業引進策略之研究—以DEA和AHP方法分析。國立成功大學國際企業研究所碩士學位論文，未出版，台南市。 黃雅苓(1999)。研究發展支出與經營績效關係及其費用化之探討-以台灣上市公司之電子業與非電子業為例。國立政治大學會計學研究所碩士論文，未出版，台北市。 楊永嘉(2003)。美國高科技廠商之效率評析—以資料包洛分析法。東吳大學經濟研究所碩士論文，未出版，台北市。 楊志海(1999)。技術來源、創新與生產力。國立中央大學產業經濟研究所博士論文，未出版，中壢市。 楊志海、陳忠榮(2001)。創新活動的投入、產出與效率—科學園區內外高科技產業的比較。臺大管理論叢，11(2)，129-151 詹文男、范錚強、張朝清(2002)。企業智慧資本衡量研究—以資訊硬體產業為例。產業論壇，4(1)，109-137 廖義芳(2002)。專利權與經營績效關係之研究—各項專利權之比較。國立彰化師範大學商業教育學系碩士論文，未出版，彰化市。 劉正田(1997)。研究發展支出之效益及其資本化會計資訊對股票評價攸關性之研究。國立政治大學會計研究所博士論文，未出版，台北市。 劉環(2003)。台灣高科技產業經營績效評估與風險關係之研究—以新竹科學園區為例。東吳大學經濟學系碩士班碩士學位論文，未出版，台北市。 賴奎魁(2002)。台灣IC製造業製程技術能力、專利權與績效關係之研究。國立雲林科技大學企業管理研究所碩士論文，未出版，雲林縣。 謝孟玹(2003)。台灣IC設計服務業之智慧資本與企業策略關係研究。東吳大學國際貿易學系碩士論文，未出版，台北市。 顏旭良(1998)。台灣高科技產業經營績效評估與其資源配置特性之關係研究—以新竹科學工業園區為例。國立成功大學企業管理學系碩士班碩士學位論文，未出版，台南市。 英文部分 Aboody, D. & B. Lev (2001). R&D productivity in the chemical industry. New York University. Unpublished manuscript. Audretsch, D.B. & Z.J. Acs (1991). Innovation and size at the firm level. Southern Economic Journal, 67(3), 739-744. Banker, R. D., Charnes, A., Cooper, W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. Management Science, 30(9), 1078-1092. Bassi, L.J. & Van Buren, M.E.(1999). Valuing Investment in Intellectual Capital. International Journal of Technology Management, 18(5/6/7/8), 414-432. Boussofiane, A., Dyson, R. G., & Thanassoulis, E.(1991). Applied Data Envelopment Analysis. European Journal of Operational Research (Amsterdam), 52(1), 1-15. Boulding, William & Richard Staelin (1990). Environment, market Share, and market power. Management Science, 36(10), 1160-1178. Canto, J. G. D. & Gonzalez, I. S.(1999). A Resource-based Analysis of the Factors Deterrmining a Firm's R&D Activities. Research Policy, 28, 894-905. Chan, S. H., J. D. Martin, & J. W. Kensinger (1990), Corporate research and development expenditures and share value. Journal of Financial Economics 26(2), 255-279. Charnes, A., Clark, C. T., Cooper, W. W., & Golany, B.(1985). A developmental study of data envelopment analysis in measuring the efficiency of maintenance units in the U.S. Air Force. Annals of Operations Research, 2, 95-112. Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the Efficiency of Decision Making Units. European Journal of Operational Research, 2, 429-444. Chen, Tser-yieth (2002), An Assessment of Technical Efficiency and Cross Efficiency in Taiwan's Electricity Distribution Sector. European Journal of Operational Research, 137(2), 421-433. Coelli, T., Rao, D. S. P., & Battese, G. E.(1998). An Introduction to Efficiency and Productivity Analysis. Norwell, MA: Kluwer Academic Publishers. Deng, Z., B. Lev, & F. Narin. (1999). Science and technology as predictors of stock performance. Financial Analysts Journal 55(3), 20-32. Drucker, P.F. (1993). Post-Capitalist Society, Oxford: Butterworth Heinemann. Edvinsson, L. & M. S. Malone. (1997). Intellectual Capital. Harper Collins Publishers, Inc.147-158. Farrell, M. J.(1957). The Measurement of Productive Efficiency. Journal of the Royal Statistical Society- Series A (General), Part3, 253-290. Gambardella, A. & Torrisi, S. (2000). The Economic Value of Knowledge and Inter-firm Technologyical Linnkages: An Investigation of Science-Based Firms. Dynacom TSER Projectt(Contract no. SOE1-CT97-1078). Goss, E. & G.S. Vozidis. (1994). High-tech Manufacturing: Firm Size, Industry and Population Density. Small Business Economics, 6, 291-297 Grabowski, H. G. & Mueller, D. C. (1978). Industrial research and develop, intangible capital stocks, and firm profit rates. The Bell Journal of Economics, 9, 328-343. Griliches, Z. (1990). Patent statistics as economic indicators: A survey. Journal of Economic Literature, 28, 1661-1707. Griliches, Z. (1998). R&D and Productivity: The Econometric Evidence. Chicago, IL:The University of Chicago Press.. Hagedoorn, J. & Schakenraad J.(1990). Interfirm partnerships and cooperative strategies in core technologies, in Freeman & Soete(eds), New explorations to the economics of technical change, Pinter Publishers, London & New York: 3-37. Hall B. H., Jaffe A.& Trajtenberg M. (2000). Market value and patent citations: A First Look, University of California at Berekeley. Department of Economics Working Paper # 00-277, Berkeley, CA. Hansson, B. (1997). Personnel investments and abnormal return: Knowledge- based firms and human resource accounting. Journal of Human Resource Costing and Accounting 2 (2), 9-29. Hill C., W.L. & G.R. Jones. (1998). Strategic Management, 4thEd. Boston: Massachusetts. Hurwitz, J. (2002). The Linkage between Management Practices, Intangible Performances and Stock Returns. Journal of Intellectual Capital, 3(1), 51-61 Hussi, T., & G. Ahonen. (2002). Managing intangible assets-A question of integration and delicate balance. Journal of Intellectual Capital 3(3), 277-286. Jelink, M.& C.B.Schoonhoven. (1993). The lnnovation Marathon: Lessons from High Technology Firms.San Francisco: Jossey-Bass. Kalafut, P.C.& Low,J. (2001). The value creation index: Quantifying intangible value. Strategy & Leadership, 29(5), 9-15 Katrak, H. (1989). Imported technology and R&D in a newly industrializing country: the Indian experience. Journal of Development Economics, 31, 123-139. Kelm, K. & Narayanan, V. K. and Pinches, G. E. (1995). Shareholder value creation during R&D innovation and commercialization stages. Academy of Management Journal, 38, 770-786. Kleinknecht, A. & T.P. Poot. (1992). Do Regions Matter for R&D? Regional Science. 26, 221-232. Kozmetsky G. & Yue P. (1998).

Comparative performance of global semiconductor companies. Omega, 26(2), 153-175 Kwaku A.G. (1996). Differential potency of factors affecting innovation performance in manufacturing and services firms in Australia. Journal of Product Innovation Management, 13, 35-52 Leung, C.K. & C.T. Wu. (1995). Innovation Environments, R&D Linkage and Technology Development in Hong Kong. Regional Studies, 29, 533-546 Lev, B. (2001). Intangibles: Management, Measurement, and Reporting. Brookings Institute Press, Washington, DC Linton, J.D. & Cook, W. D.(1998). Technology implementation: A comparative study of Canadian and U.S factories. INFOR, 36(3), 142-150. Markusen, A., P. Hall & A. Glasmeier. (1986). High Tech America: the What, How, Where, and Why of the Sunrise Industries. Boston: George Allen and Unwin. Narin, F. and Noma, E. & Perry, R. (1987). Patents as indicators of technological strength. Research Policy, 16, 143-155. Pakes, A. (1985). On patents, R&D, and the stock market rate of return. Journal of Political Economy, 93, 390-409. Pelham, Alfred M. (2000). Market orientation and other potential influences on performance in small and medium-sized manufacturing firms. Journal of Small Business Management, 38(1), 48-67. Pfirrmann, O. (1994). The Geography of Innovation in Small and Medium-sized Firms in West Germany. Small Business Economics, 6, 41-54. Pfirrmann, O. (1995). Path Analysis and Regional Development: Factors Affecting R&D in West German Small and Medium Sized Firms. Regional Studies, 29, 605-618. Riahi-Belkaoui, A. (2003). Intellectual capital and firm performance of US multinational firms. Journal of Intellectual Capital 4(3), 215-226. Schoenecker, T. & Swanson, L. (2002), Indicators of Firm Technological Capability: Validity and Performance Implications. IEEE Transactions on Engineering Management, 49(1), Feberuary, 36-44. Schumpeter, J.A. (1934). The Theory of Economic Development. Boston: Harvard Business School Press. Seiford, L. M. (1996). Data Envelopment Analysis: the Evolution of the State of the Art(1978-1995). Journal of Productivity Analysis, 7, 99-137. Shephard, R. W. (1970). Theory of Cost and Production Functions. Princeton University Press, NJ. Siddharthan, N. S. (1992), Transaction costs, technology transfer, and in-house R&D. Journal of Economic Behavior and Organization, 18, 265-271. Souitaris, V. (2002). Firm-specific competencies determining technological innovation: A survey in Greece. R&D Management, 32(1), 61-77. Thore, S., Philips, F., Rufli, T.W., & Yue, P.(1996). DEA and the Management of the Product Cycle: The U.S. Computer Industry. Computers and Operations Research, 23(4), 341-356. Thore, S., Kozmetsky, G., & Philips, F.(1994). DEA of Financial Statement Data: The U.S. Computer Industry. The Journal of Productivity Analysis, 5, 229-248. Van Buren, M.E. (1999). A Yardstick for Knowledge Management. Training and Development, 53(5), 76 Van Dierdonck, R.V., K. Debackere & M.A. Rappa. (1991). An Assesment of Science Park toward a Better Understanding of Their Role in the Diffusion of Technology Knowledge. R&D Management, 21, 109-123. Vickery, S. K., (1992). A Theory of Production Competence Revisited. Decision Science, 22, 635-643. Westhead, P. (1997). R&D Input and Output of Technology-based Firms Located on and off Science Parks. R&D Management, 27(1), 45-62. Woo, C. Y. & G.. Willard. (1983). Performance Representation in Business Research: Discussion and Recommendation. 1983 the 23rd Annual National Meeting, Dallas: Academy of Management.