

*Business Issues, Competition and Entrepreneurship*

# Global Operations Management

Lee R. Hockley  
Editor



NOVA

**BUSINESS ISSUES, COMPETITION AND ENTREPRENEURSHIP**

# **GLOBAL OPERATIONS MANAGEMENT**

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# **GLOBAL OPERATIONS MANAGEMENT**

**LEE R. HOCKLEY**  
**EDITOR**



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**Nova Science Publishers, Inc.**  
*New York*

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#### **LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA**

Global operations management / editors, Lee R. Hockley.

p. cm.

Includes index.

ISBN 978-1-61668-351-1 (eBook)

1. International business enterprises--Management. I. Hockley, Lee R.

HD62.4.G5475 2010

658'.049--dc22

2009054170

*Published by Nova Science Publishers, Inc. ✦ New York*

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## PREFACE

This book provides an overview of some of the fundamentals of global operations functions in an organization. Key issues affecting the global industry are covered, such as operational issues for entrepreneurs in the global context; Sarbanes-Oxley Act and its impact on corporate governance; evaluating country performances with Data Envelopment Analysis (DEA); the ACU (Asian Currency Market) in an optimized world currency basket; warehousing in modern supply chain management; and others. This book also looks at how globalisation is presenting new challenges in operations and the new regulatory environment.

Chapter 1 - Sarbanes-Oxley (SOX) Act was passed by Congress in 2002 after spectacular failures of the once highly respected companies, Enron and WorldCom. Not only is SOX a basic change in law, but it is also a departure in the regulation mode where it introduces a vast array of corporate governance initiatives into federal securities law. Before SOX, the federal regime comprised disclosure requirements instead of substantive corporate governance mandates, which were deemed to be states' area of jurisdiction and accordingly left to state corporate law (Romano 2005). SOX changes this mechanism by making explicit provisions and directions for the SEC. However, many of the governance provisions regulated in SOX are not really innovations to alleviate problems or deficiencies in the business environment. Instead, they are basically recycled ideas that have been proposed by corporate governance entrepreneurs (e.g., more independent directors in the board and prohibition on consulting services to auditing clients by accounting firms).

Practitioners and academics put a high expectation on SOX to revamp unsound governance practices and to embark on enhanced bonding and monitoring mechanisms in corporate governance. Proponents of SOX predict that as corporations improve governance, their operational performance may be enhanced and firm value maximized. However, empirical evidence shows that this may not be the case. A myriad of research has examined SOX, its provisions, and their impact on corporate governance and firm value. This chapter reviews literature on this particular issue and relates SOX to various aspects in corporate finance and market valuation, such as productivity and efficiency of accounting firms; going-public and going-private decisions; small firms; lobbying approach; risk, return, and market reaction; trend in corporate governance; international implications and comparisons; and symptoms and underlying problems. Research findings on SOX and its effects are mixed and less conclusive.

We offer two alternative recommendations. First, if the government is to maintain the "one-mandate-for-all" approach to SOX, it should revise SOX provisions to solve the



underlying problems in corporate governance and accounting fields rather than merely attack the symptoms. As shown by the three-step model, SOX provisions have not dealt with auditors' intellectual ability and diligence to recognize problems and their competencies in catching suspicious transactions. Second, if the government has no immediate interest in revising SOX provisions as suggested by the first recommendation, it should erase SOX provisions' mandatory force and change them into a "comply, otherwise explain" approach. The "one-mandate-for-all" approach currently applied is too costly for certain firms, especially small firms, leading to them avoiding the compliance. Meanwhile, benefits reaped by complying with SOX provisions may stem from stronger governance structures, particularly more aware shareholders and more active market for corporate control in the wake of Enron's demise, rather than from SOX provisions.

Chapter 2 - Since 1999, the International Labor Office (an arm of the UN based in Geneva) has conducted a series of studies of decent work and of the effects of globalization. In 2004, the organization posed the global challenge of tempering the perceived effects of globalization, aiming for A Fair Globalization benefiting men and women in rich and poor countries alike. In earlier studies, two of the present authors rated the performance of some sixty-odd countries from all continents in terms of their achievements of Decent Work, and of A Fair Globalization. The analysis was carried out employing Data Envelopment Analysis (DEA), to assign an "efficiency rating" to each country. Efficiency is assigned the rating of 100 percent. Inefficiency is assigned a rating less than 100 per cent. The present study extends this work in several ways: we interpret the efficiency rating as a measure of effectiveness; we estimate a generalized social preference function that is Cobb-Douglas (rather than the linear utility function of all outputs that is implicit in standard DEA); and we present an extended joined causal structure of nested social preference functions, employing the methods of two-stage DEA.

Chapter 3 - In the past many international transactions have been denominated in US Dollars, even when neither the buyer nor the seller was based in the US. As the US economy has moved from being the dominant world economy to simply the largest economy there has been growing interest in using instead a basket of currencies. Optimization can be used to design such baskets, with a typical objective function being to minimize volatility in the basket's value. Here we slightly extend this idea to consider two partially competing objectives: (1) minimizing volatility and (2) minimizing the number of currencies in the basket. A good basket would be based on a large share of global GDP and have components whose individual movements are not highly correlated, leading to relative stability in the value of the basket. Given recent growth in Asian economies, there is obvious appeal to including them in a world currency basket. However, apart from Japan and China, the individual Asian economies are considerably smaller than the US or euro zone economies. Hence, it is of interest to ask whether it might be useful to include some hypothetical Asian Currency Unit (ACU) in a world currency basket. Here we use optimization to explore how the existence of an ACU might improve the efficient frontier in a two dimensional attribute space considering both volatility and complexity, as proxied by the number of currencies included in a world currency basket.

Chapter 4 - This chapter is a synthesis of survey and case study research undertaken in the area of warehousing. Although warehousing, in one form or another, is present in most supply chains, this tends to be an area that has been under-researched, particularly at the more strategic level. For example, it is generally accepted that markets have become more volatile

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in recent years and this has prompted research on supply chain agility. However, the changing role of warehouses in agile supply chains has been largely assumed up until now with little empirical research on the subject. Similarly, the design and operation of warehouses within this agile environment has been largely ignored. This chapter presents some preliminary research that has addressed these issues and is intended to act as a guide for practitioners, as well as indicating areas of potential further study for researchers. Warehouses are significant investments for many companies and are long term fixed assets by their nature. A company cannot easily change its warehouse network and thus these often become sources of competitive advantage - or disadvantage if they do not meet changing market conditions. Their role and design within the context of modern supply chains therefore need to be fully understood. In the following sections, the roles of warehouses are explored, indicating that a key role is to act as “decoupling points” in supply chains. Other roles, such as cross-docking and production postponement, are also put into context. The need for flexibility is examined, together with how warehouses can be designed and operated to fulfil this need. Finally, the performance measurement of warehouses in dynamic situations is explored, together with a framework for measuring warehouse flexibility.

Chapter 5 - Optimization of network congestion management using pricing setting is investigated in this paper. For a network with equilibrium conditions in trip distribution and network flow, the Wardrop’s first principle is taken into account. The network congestion management problem subject to elastic equilibrium flow can be formulated as a mathematical program with equilibrium constraints. Due to the non-linearity and non-differentiability of the perturbed solutions in equilibrium conditions, a non-linear constrained optimization model is established. A new computationally efficient solution scheme is proposed to solve this network congestion management problem. Numerical calculations are conducted using an example network quantifying computational efficacy and robustness of the proposed approach.

Chapter 6 - This section presents the Customer Complaint problem of Product Usage Life cycle (CCPUL). The motivations, scope, goals, contribution and thesis architecture of this research are also discussed in this section.

Chapter 7 - The article notes the nature and importance of considering operational issues for entrepreneurs in a globalized world. The main focus is on the importance of understanding operational issues from an entrepreneur’s point of view. This approach is relatively novel and unique as most of the extant operational management discussion seems to implicitly take on the lens of established businesses. The commentary also briefly outlines the phenomena of “born global” entrepreneurial firms, global start ups, etc which run counter to the staged model of internationalization that was popular in the past. Global startups highlight the urgency and relevance of effective operations management for entrepreneurial firms in the current times. In addition, the commentary highlights the differences between entrepreneurial and established businesses, the importance of operational management in entrepreneurial businesses, the unique challenges that stem from managing operations from a global context, and new opportunities to address economic and social issues from an operational perspective.

Chapter 8 - International Joint venture with external organizations has been viewed as one of the most efficient and effective way while seeking survival opportunities in the ever spanning of crsss-border economy. Proper partners for an IJV is essential for a venture success. Unfortunately, few if any studies had attempted to include customer as part of

primary consideration in partner selection since 1970s. This research provides an important piece for the puzzle and explains the importance of this additive element in venture performance. Samples are purposely taken from 107 IJVs with various industry background in Taiwan. Using questionnaire as an instrument, this research have successfully collected 321 valid responses with CEO, functional managers. Major findings of this research include identifying and confirming the existence of customer related factors other than task related factors. This paper confirms the importance of customer factor as partner selection criteria in achieving satisfactory venture performance. Partner related factor is the most powerful predictors among all partner selection factors in predicting venture performance, and the customer related factor appears is the second. Task related factor seems irrelevant for the respondents of this research. A market-driven management can assure better performance, selecting partner with customer related factors is the key to assure a market-driven venture business..

Chapter 9 - The aim of this article is to show that, although criticized from new managerial perspectives, Porter and Industrial Organization schemes continue to be essential to the understanding of enterprise competitiveness, in the era of knowledge, and could be connected to the knowledge-based-view. In this vein, our study analyzes Porter and Industrial Organization, and the Resource-Based and Knowledge-Based perspectives to show the importance of these schemes.

In addition, by means of a Delphi study using international experts, and a sample of 189 hospitality firms, our study tries to show and analyze whether, how and why managers have different knowledge of quality of perception of the different environmental competitive forces identified by Porter in the post-Internet context.

Following the application of structural equations models, the managers analyzed in our study hold different quality of perceptions of the various forces. This demonstrates the importance the structural environment has in conforming managerial knowledge or perception, one of the most important resources highlighted in new Resource-Based, and Knowledge Management literature.

*Chapter 1*

# **SARBANES-OXLEY ACT AND ITS IMPACTS ON CORPORATE GOVERNANCE**

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## **ABSTRACT**

Sarbanes-Oxley (SOX) Act was passed by Congress in 2002 after spectacular failures of the once highly respected companies, Enron and WorldCom. Not only is SOX a basic change in law, but it is also a departure in the regulation mode where it introduces a vast array of corporate governance initiatives into federal securities law. Before SOX, the federal regime comprised disclosure requirements instead of substantive corporate governance mandates, which were deemed to be states' area of jurisdiction and accordingly left to state corporate law (Romano 2005). SOX changes this mechanism by making explicit provisions and directions for the SEC. However, many of the governance provisions regulated in SOX are not really innovations to alleviate problems or deficiencies in the business environment. Instead, they are basically recycled ideas that have been proposed by corporate governance entrepreneurs (e.g., more independent directors in the board and prohibition on consulting services to auditing clients by accounting firms).

Practitioners and academics put a high expectation on SOX to revamp unsound governance practices and to embark on enhanced bonding and monitoring mechanisms in corporate governance. Proponents of SOX predict that as corporations improve governance, their operational performance may be enhanced and firm value maximized. However, empirical evidence shows that this may not be the case. A myriad of research has examined SOX, its provisions, and their impact on corporate governance and firm value. This chapter reviews literature on this particular issue and relates SOX to various aspects in corporate finance and market valuation, such as productivity and efficiency of accounting firms; going-public and going-private decisions; small firms; lobbying approach; risk, return, and market reaction; trend in corporate governance; international implications and comparisons; and symptoms and underlying problems. Research findings on SOX and its effects are mixed and less conclusive.

We offer two alternative recommendations. First, if the government is to maintain the “one-mandate-for-all” approach to SOX, it should revise SOX provisions to solve the underlying problems in corporate governance and accounting fields rather than merely attack the symptoms. As shown by the three-step model, SOX provisions have not dealt with auditors’ intellectual ability and diligence to recognize problems and their competencies in catching suspicious transactions. Second, if the government has no immediate interest in revising SOX provisions as suggested by the first recommendation, it should erase SOX provisions’ mandatory force and change them into a “comply, otherwise explain” approach. The “one-mandate-for-all” approach currently applied is too costly for certain firms, especially small firms, leading to them avoiding the compliance. Meanwhile, benefits reaped by complying with SOX provisions may stem from stronger governance structures, particularly more aware shareholders and more active market for corporate control in the wake of Enron’s demise, rather than from SOX provisions.

## 1. INTRODUCTION

Regulatory capitalism basically took off during the Nixon administration as political proponents of neo-liberalism transformed public institutions through deregulation and privatization (Crenson and Ginsberg 2002 in Windsor and Warming-Rasmussen 2009). The regulatory capitalism is underlain by the neoliberal doctrine that efficiency can be attained through competitive free-market mechanisms rather than depending much on the government. Business and corporate transformation, innovation, competition, efficiency, and creativity are hence encouraged to replace the conceptions of fairness, equality, and justice identical to the Keynesian welfare state.

However, continuous corporate wrongdoings have emboldened a renewed interest in corporate governance and accountability, especially in the wake of scandals at Enron, WorldCom, Tyco, Martha Stewart, Citigroup, Arthur Andersen, K-Mart, Global Crossing, etc. These transgressions led to the enactment of Public Company Accounting Reform and Investor Protection Act of 2002, renowned as the Sarbanes-Oxley Act (SOX) of 2002. SOX is basically a combined bill of Senator Paul Sarbanes, Democrat of Maryland, and Representative Michael Oxley, Republican of Ohio. Representative Oxley’s reform bill was introduced on February 13, 2002, passed in Committee on April 16, 2002, and subsequently passed in the House on April 24, 2002. In May 2002, the Sarbanes’ bill was circulated in the Senate Banking Committee, which passed the bill on June 18, 2002. The full debate in Senate began on July 8, 2002, and it passed the bill with an overwhelming support on July 15, 2002. On July 19, 2002, the House and Senate formed a joint committee and began negotiations to merge the two bills. SOX, the joint bill, was enacted by Congress on July 25, 2002 and was signed into law by President George W. Bush on July 30, 2002 (Hochberg 2009). SOX was passed in a commotion of congressional activity close to the mid-term election of 2002 after the implosions of Enron and WorldCom. Simultaneously, the New York Stock Exchange and National Association of Securities Dealers Automated Quotations (NASDAQ) imposed governance changes on listed firms at around the same time.

Regulation is “a law, rule, or other order prescribed by authority, especially to regulate conduct.” (www.dictionary.com as quoted by Hart 2009). According to Romano (2005), SOX as a new regulation is not only a change in law, but also a departure in the mode of regulation.

Before SOX, the federal regime comprised disclosure requirements instead of substantive corporate governance mandates, which were deemed to be states' area of jurisdiction and accordingly left to state corporate law (Romano 2005). In SOX, Congress introduces a vast array of corporate governance initiatives into federal securities laws such that provisions in SOX have overstepped the traditional division between federal and state jurisdiction. Romano (2005) argues that many of the substantive provisions regulated in SOX are not really innovations to solve deficiencies in business environment in which corporations such as Enron and WorldCom have failed; instead, they are merely recycled ideas that have been proposed by corporate governance entrepreneurs.

There is no specific theory of how policy proposals come to the forefront of the legislative agenda, but political science literature identifies shifts in national mood and turnover of elected officials, coupled with focusing events, as key determinants that open policy windows for policy entrepreneurs to link their proposed solutions to a problem (Romano 2005). The failure of Enron provided the event for implementation of corporate governance initiatives already being considered. Hence, corporate governance provisions were not a focus of careful deliberation by Congress. Instead, SOX was an emergency legislation passed with limited debate during media excitement in covering high-profile corporate frauds. Hart (2009) argues that there are several theoretical arguments for regulation: (1) asymmetric information, (2) bounded rationality, (3) judgment-proof problem, (4) moral hazard, (5) changing-taste problem, and (6) political pressure. Of these possible arguments, the best explanation for SOX seems to be the last argument. Pressure from the public, interest groups, and political constituents on politicians to act was so great that intervention was the only option.

Substantive corporate governance mandates in SOX emphasized in this chapter are provisions that require independent audit committees, restrict firms' purchases of non-auditing services from their auditors, prohibit corporate loans to officers, and require executive certification of financial statements. Proponents of SOX argue that it will lead to improved disclosure, transparency, and corporate governance so as to reduce misconduct, perquisite consumption, and mismanagement by insiders, and that these benefits outweigh the costs of compliance (Hochberg et al. 2009). On the other hand, opponents argue that SOX will be ineffective in preventing corporate frauds and/or that any benefits of SOX will be insufficient to outweigh the costs. There have been a vast array of criticisms of SOX; many of them are reminiscent of similar criticisms evoked by the Securities and Securities Exchange Acts of the 1930s, which represented responses to similar deficiencies in business accounting and financial practices believed to have led to the 1929 stock market crash and the subsequent great depression (Chang et al. 2009). Hart (2009) points out that regulation could restrict the feasible set of contracts available to involved parties, and under standard assumptions this would not make them better off.

Jain et al. (2008) suggest that the effects of SOX include: (1) improved corporate governance, (2) enhanced quality, reliability, and transparency of financial information, and (3) strengthened audit effectiveness and credibility. On the other hand, the cost of compliance with SOX can be categorized into: (1) direct costs and (2) indirect costs. Direct costs include accounting and auditing costs, documentation of internal controls, increased need for staff, upgraded software, liability insurance, and consulting fees. Meanwhile, the indirect costs of SOX address a firm's compliance productivity. Executives and directors may spend considerable amount of time dealing with compliance and less time on day to day business

operations. In addition, managers may become more risk-averse, potentially causing companies to miss opportunities to increase shareholder value (DiGabriele 2008).

We organize this chapter as follows. Section 2 details the contents of SOX. Section 3 discusses productivity and efficiency of accounting firms. Section 4 talks about going-public and going-private decisions. Small firms are discussed in Section 5. Afterwards, we explain lobbying approach in Section 6. Subsequently, Section 7 describes risk, return, and market reaction following SOX. Section 8 then discusses trend in corporate governance. International implications and comparisons are analyzed in Section 9. Next, Section 10 deals with symptoms and underlying problems. Finally, Section 11 provides conclusions and recommendations.

## 2. CONTENTS OF SOX

The first sign of a regulatory overhaul was reported on January 16, 2002 when Securities and Exchange Commission (SEC) announced a plan to reform and create an independent regulatory organization. The Bush Administration responded to the Enron scandal in February and March, while Congress moved ahead with several proposals toward accounting reforms (Zhang 2007). Oxley's reform bill, considered business-friendly, was introduced in the House on February 13. Democratic senators proposed bills that went beyond Oxley's proposal. Although Sarbanes' tough reform bill was passed in the Senate Banking Committee on June 18, the media did not expect it to become law at that time (Hilzenrath et al. 2002 in Zhang 2007). However, the WorldCom scandal in late June refueled securities rulemaking activities, which accelerated after President Bush gave a speech regarding accounting reforms on July 9. The Senate embarked on debate on Sarbanes' bill on July 8, and the bill was passed 97 to 0 in the Senate on July 15 (Hilzenrath et al. 2002 in Zhang 2007). The House and Senate then formed a conference committee and started final negotiations to merge the bills on Friday, July 19 (Hilzenrath et al. 2002 in Zhang 2007). The negotiation continued, and the final rule was agreed upon on July 24, passed in Congress on July 25, and signed into law on July 30.

Even though SOX applies to public companies, it is serving as a wake-up call to the non-profit and private sectors (Riotto 2008). Some state attorneys general have proposed that elements of SOX be applicable to non-profit organizations. However, it is observed that an increasing number of small, publicly traded companies are actually going private, or moving to less well-known stock exchanges, or deregistering their stocks to reduce costs and circumvent tougher regulations. SOX has provisions divided in several titles. The following section discusses each title with its emphasized section(s).

### **Title I: Public Company Accounting Oversight Board (PCAOB)**

This title authorizes the SEC to appoint a full-time five-member public company accounting oversight board for a five-year term funded by fees paid by all publicly traded companies. This board has responsibilities for registering auditors and public accounting firms, and setting standards for audits, quality control, ethics, and independence. Foreign

accounting firms that audit a U.S. company must also register with the board (Riotto 2008). The centralized organization was designed to restore public confidence in auditing firms.

There is basically a shift in power to the PCAOB from the audit profession. The combination of a marketized regulatory system, dependence on the self-discipline of auditors' personal ethics, professional economic reliance on the corporate client, and lack of transparency of audit firms have threatened the auditing profession's legitimacy (Windsor and Warming-Rasmussen 2009). Many foreign accounting firms have been objecting to registering with the PCAOB and with a foreign agency (i.e., double registration). Consequently, a compromise was made where the PCAOB agreed to let the foreign agency control inspection and enforcement issues if it believed the relegating agencies were effective (Riotto 2008).

## **Title II: Auditor Independence**

Section 201 prohibits non-audit services to audit clients, except with pre-approval by the PCAOB while Section 203 deals with mandatory auditor rotation every five years. Forbidden services include financial information system design and implementation, internal auditing, investment banking, appraisal or valuation, legal and expert unrelated to the audit, brokerage, and actuarial services (Romano 2005). The reason for the prohibition is that the receipt of high non-audit fees compromises auditor independence by providing auditors with financial incentives to allow managers to be involved in unsound transactions or accounting practices. Enforcement of this title prevents conflicts of interest of accounting firms, and is intended to protect public interest. Exception to the non-audit service pre-approval requirement prevails if the amount provided constitutes less than five percent of the total fees paid to the auditor by the firm.

This provision would surely increase costs and/or reduce revenues as firms may not be able to assist audit clients with non-audit services without authorization. Previous research utilizes fee ratio (the ratio of non-audit to total fees or to audit fees paid to an external auditor) to represent a non-independent auditor whereas audit quality is measured by abnormal accruals, measures of earnings conservatism, earnings surprises, financial statement restatements, and issuance of qualified audit opinions (Romano 2005). A summary of these studies is documented by Romano (2005), who reports that the majority of the studies find no relation between the provision of non-audit services and audit quality. This suggests that SOX's prohibition on the purchase of non-audit services from an auditor does not solve the underlying problems, but merely an exercise in legislating away a non-problem.

## **Title III: Corporate Responsibility**

Section 301 of SOX requires that all listed companies have audit committees that consist entirely of independent directors. The rationale for the rule is that directors are expected to be effective monitors of executives, thereby reducing the possibility of audit fraud since their financial dependence on the company is limited to director salaries. Congress also requires a



disclosure as to whether any of directors are financial expert(s), together with an explanation for firms with no financial expert in the audit committee (Romano 2005).

Although this title, especially Section 301, purports to enhance financial disclosure, critiques in the literature document that independent boards do not necessarily improve performance. Boards with too many outsider directors may have a negative impact on performance. A summary of studies surveyed by Romano (2005) shows that the majority of research has not found any connection between audit committee independence and performance. Specifically, ten of the sixteen studies do not find that complete audit committee independence improves performance. Romano (2005) also documents that several studies have reported that the existence of a director with financial expertise improves performance, and that director independence is less significant than financial expertise with respect to the link between financial statement quality and audit committee composition. Hence, the literature does not support the conjecture that mandating audit committees to be composed entirely of independent directors will improve corporate performance. On the other hand, studies tend to substantiate the proposition that having financial expert(s) in the committee benefits the company as a whole.

Section 302 mandates that annual and interim financial reports include certification that: (1) signing officers (Chief Executive Officer and Chief Financial Officer) have reviewed the financial statements and have not worked for the auditing firm for one year preceding the audit, (2) report is accurate and complete as of the specified date, (3) financial statements present fairly the position of the company, (4) bonuses and any profits are abandoned if financial statements are restated, (5) signing officers are responsible for internal controls and have evaluated and analyzed them within 90 days of the report issuance, (6) shortcomings in the internal control process are identified, (7) it must be intentional and known for liability to transpire, and (8) this title prohibits insider trading during blackout periods (Riotto 2008).

The requirement to certify financial statements makes the CEO and the CFO responsible for fraud prevalent in the firm. This can prevent executive misconducts that happened in Enron and WorldCom. In congressional testimony, Jeffrey Skilling, the CEO of Enron, argued that detailed financial reporting and disclosure was the domain of Enron's accountants and lawyers. Akin to the case of Skilling, Bernie Ebbers, the CEO of WorldCom, maintained that he did not realize his CFO's financial reporting wrongdoing (Bhamornsiri et al. 2009).

This title makes it easier to rectify any shortcomings in developing the reports. Strong internal controls are believed to provide a hindrance to committing a criminal act (Riotto 2008). The cost of complying with this section is considered to be significant, hence companies are calling for assistance to manage the increased costs. Besides, it is particularly disturbing that employees and investors of firms where fraud was committed, and those who had no knowledge of the criminal activities, suffered immensely (e.g., loss of investment or retirement funds, loss of jobs, etc) while the officers of these same firms that initiated the wrongdoings were not appropriately penalized (Riotto 2008).

#### **Title IV: Enhanced Financial Disclosures**

This title requires the disclosure of off-balance-sheet transactions in a clear manner, including but not limited to assets, liabilities, leases, losses, use of special purpose entities,

etc. (Riotto 2008). Section 402(a) prohibits personal loans to officers and directors unless they are given with the same terms and conditions as normal loans offered to the general public. Subsequently, directors, officers, and any 10 percent owner must report selected transactions by the end of the second business day after the transactions are finalized. Section 402(a) was added late in the legislative process, with little congressional discussion of how prohibiting loans to corporate executives would enhance SOX's objective of improving financial reporting and disclosure (Cullinan et al. 2006). The blanket prohibition in Section 402(a) has been concerned by practitioners since it appears to prohibit standard compensation practices that used to be uncontroversial and beneficial, such as the purchase of split-dollar life insurance policies and the arrangement with brokers or other financial institutions for employees' cashless exercise of stock options under incentive compensation plans (Romano 2005). It is extremely difficult to regulate managerial compensation since when one form of compensation is restricted, managers can renegotiate their contracts to make up for the loss, thereby cancelling out the legislative intent. As executive loans tend to increase managerial ownership so as to align the interests of managers and shareholders, the prohibition against executive loans in SOX could be less effective in enhancing corporate governance. However, Cullinan et al. (2006) shed light on this issue by showing evidence that companies that grant loans to executives are more likely to misstate financial statements, indicating that this provision of SOX may enhance the accuracy and reliability of financial reporting.

Subsequently, Section 404 contains a requirement that annual reports incorporate an internal control report that stipulates: (1) management responsibility for establishing and maintaining a robust internal control structure and procedure for financial reporting, (2) management assessment of the effectiveness of the structure and procedure, and (3) attestation by the auditor to management report (Riotto 2008). In addition, firms are required to disclose their senior officers' Code of Ethics and any adjustments made to the Code. The definition of internal controls is "a process designed or supervised by the firm's principal executive and financial officers and supported by the board of directors and management to provide reasonable assurances regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles" (Stoltenberg et al. 2005).

## **Title V: Analyst Conflicts of Interest**

It is required that National Securities Exchanges and registered securities associations adopt conflict of interest rules for analysts recommending equities in research reports (Riotto 2008).

## **Title VI: Commission Resources and Authority**

The SEC will hire additional employees whose primary responsibility is to oversee auditors and audit services. Moreover, the SEC may void the right to practice before the SEC if the person does not have the required qualifications to represent others, or are lacking in integrity, or has willfully breached Federal securities laws (Riotto 2008). The SEC will also

conduct a study on securities professionals found to violate securities laws, and establish standards for lawyers practicing before it.

### **Title VII: Studies and Reports**

The General Accounting Office will conduct a study on the consolidation of public accounting firms since 1989. This study will identify the present and future impacts of these consolidations and any solutions offered (Riotto 2008).

### **Title VIII: Corporate and Criminal Fraud Accountability**

This title stipulates that it is a crime to knowingly destroy or create dossiers to obstruct, hinder, or influence prevailing investigations. Penalties of fines and/or up to 20-year imprisonment can be imposed on this crime. Furthermore, this title requires maintenance of all audit or review papers for a period of five years (Riotto 2008).

### **Title IX: White Collar Crime Penalty Enhancements**

Financial statements filed with the SEC are to be certified by the Chief Executive Officer and the Chief Financial Officer. Penalties by willfully breaching this provision can result in a fine of not more than USD500,000 and/or up to five-year imprisonment (Section 906(a)). Besides, this title imposes an increased penalty for mail and wire fraud to 10 years from five years (Riotto 2008).

### **Title X: Corporate Tax Returns**

This title basically requires that corporate tax return be signed by the Chief Executive Officer (Riotto 2008).

### **Title XI: Corporate Fraud Accountability**

Under this title, it is a crime to interfere with an official proceeding, tamper with a record, or take extraordinary payments. Violators can be fined and/or sentenced to 20-year imprisonment (Riotto 2008).

### 3. PRODUCTIVITY AND EFFICIENCY OF ACCOUNTING FIRMS

Influential accountants have continuously opposed the direct government oversight of audits of public companies. In the past, accountants in the private practice were given the monopoly to perform company audits based on the condition that they abide by a code of ethical conduct mandating auditor independence (Windsor and Warming-Rasmussen 2009). However, the passage of SOX, especially the establishment of PCAOB, has changed this mechanism. Provisions of SOX that affect accounting firms include: (1) Section 101, which establishes the PCAOB; (2) Section 201, which restricts auditors from providing certain consulting services to their audit clients; (3) Section 203, which deals with mandatory audit partner rotation; and (4) Section 404, which requires that company management provide assessments of the effectiveness of internal control systems, and requires auditors to attest to the management assessments (Chang et al. 2009). Of these four sections, Sections 201 and 404 have more direct and specific effects on the services that accounting firms offer and hence on their productivity and efficiency.

Section 404 of SOX requires that company managements evaluate their internal control systems and that auditors attest to these management assessments of the system as part of the overall audit engagement. On the audit services side, these additional audit steps and procedures are charged by audit companies. On the accounting/consulting services side, many companies employ accounting firms other than their own auditors as consultants to document, update, and test their internal control systems (Chang et al. 2009). Hence, performance of these services basically increases revenues of accounting firms. A survey on 217 corporations with revenues of at least USD5 billion reports that in 2004 firms spent an average of USD4.36 million to comply with Section 404, and the additional audit fees paid for these reviews and attestations on average increased 57 percent over the regular audit fees (Chang et al. 2009). With the implementation of Section 404, accounting firms are expected to improve their revenues as well as productivity and efficiency by offering Section 404 compliance services. Furthermore, with knowledge spillover, audit firms have a willingness to share cost savings with their clients, and charge a lower rate for their services.

Recent research indeed shows an increase in audit fees due to the internal control reporting requirements of SOX, based in part on the increase in billable hours (Patterson and Smith 2007). The increase in fees is contributed by start-up costs, unanticipated inefficiencies, and additional litigation risk faced by auditors. Patterson and Smith (2007) find that economic efficiencies can arise if required internal control testing under SOX is not too large; otherwise, audit fees will increase.

Conducting research on 62 public accounting firms, Chang et al. (2009) find that U.S. accounting firms on average experienced approximately 14.5 percent increase in productivity after SOX. They attribute the gain to an improvement in efficiency with which the firms operated. Specifically, efficiency increased by 15.3 percent while technical change increased by only 0.5 percent. However, the mean value of productivity change as measured by the Malmquist index decreased slightly for the big-four public accounting firms, which is about 2 percent, whereas it increased dramatically for non-big-four public accounting firms, which is about 15.6 percent.

On the other hand, an interesting finding is provided by Windsor and Warming-Rasmussen (2009). They document that auditors' independence judgments are inconsistent as

auditors' personal characteristics interact with client financial condition, which is an element that affects all decision-making groups. Windsor and Warming-Rasmussen (2009) report that when the client financial condition is good, auditors tend to become less independent. Similarly, when an audit is tendered, auditors are more likely to acquiesce, suggesting that tendering increases the client's economic influence. The ability to maintain auditor independence is a human process, integral to the whole person's life experiences and personal predispositions, and accordingly not just a state of mind that can be exercised from the auditor's life experiences as described in the code of ethics. Hence, merely prescribing more rules in the professional code of ethics may not be able to achieve actual auditor independence.

Bhamornsiri et al.'s (2009) study reports that the total cost of audit fees increased by an average amount of USD3,201,258, an increase of 66.4 percent, from 2003 to 2004. The results indicate that 446 (94 percent) of the 473 firms in their sample exhibited an increase in their audit fees during this period. Subsequently, audit fees soared by an average amount of USD707,310 or 0.9 percent in the period of 2004-2005. These findings imply that compliance with SOX (especially Section 404) causes soaring audit fees during the first year of compliance, but these costs then decline in the second year. In addition, they find that the implementation of SOX's external audit requirements has an insignificant effect when compared to revenues (<0.05 percent), and results in an average decrease in pre-tax income of only 0.5 percent. With respect to control systems, Patterson and Smith (2007) document that dishonest managers choose a stronger control system and commit less fraud. Auditors would perform less control testing after SOX. However, the amount of control testing increases if its amount before SOX is less than the minimum required to report under Section 404. Meanwhile, it is also reported by their study that audit risk, which is the probability of undetected fraud, increases with Sarbanes-Oxley despite the decreasing expected fraud.

#### **4. GOING-PUBLIC AND GOING-PRIVATE DECISIONS**

SOX provisions are also intended to improve the transparency of firms that go public and to reduce uncertainty surrounding their valuations. In particular, SOX mandates that firms have audit committees and internal controls in place at least one year before going public (Johnston and Madura 2009). Their chief executive officers and chief financial officers must be involved and accountable for the internal controls process. The firms must establish an audit committee of independent directors, and one of the members must be a financial expert, who has experience in auditing or analyzing financial reports. Subsequently, a quality control process must be set up, and a process for internal communications of information is also required. Since it is a legal requirement that IPO firms have internal controls and procedures in place, there is more legal compliance to ensure that the documentation satisfies the law. There are other issues such as a Code of Ethics that must be fulfilled. In the post-SOX period, firms are subject to more scrutiny and therefore faced with more barriers to conducting IPOs.

Provisions in SOX may help IPO firms in the following ways. First, the provisions on the disclosure of financial information are more complete due to SOX. Second, the requirement to establish internal controls and a quality control process can enhance the credibility of an issuer. Third, the CEOs and CFOs are held accountable for reporting and internal controls,

which can improve the quality of information. Fourth, the provisions can raise the credibility of auditing process, which can reduce uncertainty. Fifth, the provisions of SOX can alleviate the potential conflicts of interest between underwriters and analysts (Johnston and Madura 2009). To the extent that SOX may reduce the asymmetric information of firms going public, it should reduce the uncertainty surrounding valuations, and therefore reduce the degree of underpricing. Theoretically, firms that satisfy SOX guidelines leave less money on the table. A small but growing body of research suggests that SOX and its provisions have increased the scrutiny that public firms face, and thus have provided several positive effects.

SOX can also influence the performance of IPOs in the period following the initial return. To the extent that SOX can enhance transparency and alleviate investors' overexpectations, it may reduce the initial returns and therefore prevent an aftermarket correction. Consequently, the aftermarket performance of IPOs could be more favorable (or less unfavorable) after SOX. Johnston and Madura (2009) find that initial returns of IPOs of U.S. firms are lower in the post-SOX period than in the pre-SOX period, while the initial returns of Canadian IPOs (not subject to SOX) are not lower in the post-SOX period. The mean initial return is 25.5 percent in the pre-SOX period versus 10.6 percent in the post-SOX period. This finding substantiates the hypothesis that the degree of IPO underpricing is lower after SOX. Moreover, they find that one-year abnormal returns following IPOs in the post-SOX period are significantly higher than those in the pre-SOX period. The mean one-year abnormal return following the IPOs is -8.5 percent during the pre-SOX period whereas the mean one-year abnormal return in the post-SOX period is 5.1 percent and not significant. The results support the hypothesis that the aftermarket performance of IPOs is less negative following SOX.

In another setting, Engel et al. (2007) conduct research on going-private decisions and argue differently on this issue. For legislation such as SOX to work, privately chosen levels of disclosure must differ from socially optimal levels. They reveal that if private contracts cannot impose sufficient penalties for frauds, government-mandated disclosure should lead to better outcomes. However, if entrepreneurs can fully internalize the benefits of disclosure, then the need for government mandates for disclosure are questionable. One concern with respect to increases in the regulatory burden on public companies is that SOX may deter firms from seeking financing in equity markets. While increased disclosure requirements and heavier penalties for corporate malfeasance may lead to greater transparency, the costs of complying with SOX may dwarf the benefits for smaller firms. If these firms are then forced to fund operations with higher cost of capital, profitable investment projects will be foregone, thereby undermining economic efficiency. Engel et al. (2007) finds that SOX has affected firms' going-private decisions where there is a significant increase in the number of firms undertaking going-private transactions in the post-SOX period compared to that in the pre-SOX period. They also report that average abnormal returns around events that increase the possibility of SOX passage are negative, but these abnormal returns are positively related to firm size and share turnover, indicating that SOX compliance costs are more burdensome for smaller and less liquid firms.

Although factors predicting the decision to go private do not change from pre-SOX to post-SOX periods, smaller firms with greater inside ownership enjoy higher going-private announcement returns in the post-SOX period than those in the pre-SOX period (Engel et al. 2007). It is possible that these small firms with large managerial and director ownership interests are more likely to be well governed even prior to SOX. In addition, one important objective of SOX is to make insiders' shareholdings less liquid; if small firms' large inside

ownership is largely illiquid prior to SOX, then the benefits of the regulation are smaller for shareholders of these firms. This finding supports the proposition that going private in the post-SOX period should be most attractive to small firms and firms where managerial and director ownership stakes are least liquid.

On the other hand, Leuz (2007) argues that the increase in going-private decisions per quarter is no longer significant once firms that continue trading in the Pink Sheets (going dark) are removed from their sample. Therefore, there is likely an alternative interpretation; for instance, the net value of being public is negative possibly due to some unresolved agency problems between controlling insiders and minority shareholders. This being the case, the positive announcement return on going private not only reflects compliance costs avoided but also any value that can be unlocked by going private. In other words, going private may provide benefits to minority shareholders, such as by alleviating unresolved agency problems. From this perspective, it will be a benefit if SOX induces some firms to go private (Leuz 2007).

Likewise, DiGabriele (2008) provides two arguments as to why SOX may have been detrimental to private companies, particularly in the context of acquisitions. First, more rigorous due diligence process post-SOX is disproportionately burdensome for private companies as information is less transparent. After completing the acquisition, corporate officers of a publicly held acquirer will be required to personally certify the accuracy of the private targets operating results. A materially incorrect certification can lead to fines and criminal penalties. Hence, a private company target may be less attractive to a public acquirer as the target has not complied with SOX. Second, compliance with SOX indicates that the potential target has overcome the hurdles associated with SOX, thus sending a positive signal to potential acquirers since. DiGrabriele's (2008) research supports the presence of a private company discount, and also finds that the private company discount increases following SOX. Coefficients on the independent variable "acquired firm is a public company" are positive and significant, meaning that acquisition premium will be higher if the acquired firm is a public firm.

## 5. SMALL FIRMS

Securities Exchange Act of 1934 exempts small firms from particular filing requirements, and the SEC expands these exemptions in implementing SOX (Gao et al. 2009). Researchers document that SOX can undesirably reduce management risk-taking incentives, impede the flow of internal information, distort corporate disclosure, and reduce firms' ability to attract qualified executives and directors. Some empirical evidence suggests that SOX imposes net costs on shareholders and bondholders, and especially high costs on small firms (Gao et al. 2009). Hence, small filers may fear that the costs of SOX are disproportionate to the benefits, especially due to the fixed component in compliance costs.

SOX directs the SEC to develop rules to implement Section 404 regarding internal controls. The SEC has differential reporting requirements for "small business issuers" (USD25 million in revenues and public float or less), "accelerated filers" (public float in excess of USD75 million), and "large accelerated filers" (public float of more than USD700 million). The first proposal of the SEC required that all public firms comply with Section 404

for fiscal years ending on or after September 15, 2003. However, Section 404 and the SEC rule in September 2003 did not contain procedural guidance for implementing Section 404. An accelerated filer is defined as a firm that: (1) as of the last business day of the most recently completed second fiscal quarter has a public float of at least USD75 million, (2) has been subject to the reporting requirements of the Securities Exchange Act of 1934 (Section 13(a) or 15(d)) for at least one year as of fiscal year-end, (3) has filed at least one annual report under the Exchange Act, and (4) is not eligible to file abbreviated reports on forms 10-KSB and 10-QSB (Gao et al. 2009). Once a firm becomes an accelerated filer, it remains an accelerated filer regardless of whether it continues to have a public float of USD75 million or more, except that if the firm subsequently becomes eligible to use forms 10-KSB and 10-QSB. Widely cited statistics from the American Electronics Association suggests that Section 404 costs the average multibillion-dollar company about 0.5 percent of revenues and as much as 3 percent for small companies (Gao et al. 2009). The indirect costs of Section 404 for small companies are also relatively large. Small firms have more Section 404 implementation problems since they are inclined to have less well-defined internal control processes and less clear segregation of duties. In addition, they also have to compete with large firms for the post-SOX limited supply of auditors, and face a soaring audit cost.

In response to the concerns expressed by small firms, the SEC on May 27, 2003 deferred accelerated filers' compliance with Section 404 to fiscal years ending on or after June 15, 2004, and for non-accelerated filers to fiscal years ending on or after April 15, 2005 (Gao et al. 2009). The extension per se raises expectations of even more extensions and the possible eventual exemption to complying with Section 404 for non-accelerated filers. Gao et al. (2009) in their timeline analysis note that on February 24, 2004, the SEC extended the compliance dates for accelerated filers to fiscal year ending on or after November 15, 2004, and for non-accelerated filers and foreign issuers to fiscal year ending on or after July 15, 2005; on March 2, 2005, the SEC again postponed the compliance dates for non-accelerated filers and foreign issuers to fiscal year ending on or after July 15, 2006; subsequently, the SEC voted on September 21, 2005 to propose another extension of the compliance date for non-accelerated filers to fiscal year ending on or after July 15, 2007; on December 21, 2005, the SEC issued a rule that a company might exit the accelerated filer status when its public dropped below USD50 million; on August 9, 2006, the compliance date was further extended to fiscal year ending on or after December 15, 2007 whereas the compliance date to submit an auditor's attestation report on interval control was extended to fiscal year ending on or after December 15, 2008; finally, on June 20, 2008, the SEC approved an additional extension for smaller public firms to meet the auditor attestation requirement to fiscal year ending on or after December 15, 2009. At least two alternative reasons can motivate managers to retain their firm's non-accelerated filer status: (1) they believe that complying with Section 404 reduces shareholder value and/or (2) they believe that Section 404 reduces their private control benefits (Gao et al. 2009).

Gao et al. (2009) compares non-accelerated filers with a control sample of accelerated filers. The control sample comprises firms with market capitalizations below USD150 million to avoid including, as control firms, large companies that might be vastly different from non-accelerated filers. The event period spans from June 1, 2003 (following the first postponement of the Section 404 compliance deadline for non-accelerated filers) to December 31, 2005 (immediately after the SEC issued the new exit rule for accelerated filers) while the control period is from January 1, 1999 to September 1, 2001, right before the legislative



activities leading to SOX and before the SEC introduced the “accelerated” and “non-accelerated filers” distinction.

Gao et al. (2009) find that post-SOX non-accelerated filers commit regulatory dialectics intertwined with various corporate policies to stay small by: (1) reducing net investment in fixed assets, intangibles, and acquisitions; (2) paying out more cash to shareholders; and (3) decreasing the number of stocks held by non-affiliates. They also document various techniques adopted by non-accelerated filers post-SOX to press down share prices before testing their filing status: (1) disclosing more bad news in the second fiscal quarter and (2) reporting lower accounting income in the second fiscal quarter.

Subsequently, no evidence of poor governance is found in firms that remain small. With respect to board governance, the stayers of non-accelerated filers go from having larger boards pre-SOX (6.94 vs. 6.07 for the crossers) to having smaller boards post-SOX (6.77 vs. 6.95 for the crossers). The percentage of independent directors increases substantially for both groups from below 60 percent pre-SOX to over 70 percent post-SOX. The evidence, therefore, does not support the preservation of insider private control benefits as a motivation for staying small. The evidence indicates that when regulations require large costs for small businesses, one of the unintended consequences of these exemptions is that some firms have incentives to do regulatory dialectics by remaining below the threshold. The results also show that SOX also alters their incentives to grow. This is dangerous as lower growth has social welfare implications if it affects employment, real investment, and wealth creation.

Research in a different setting by Zhang (2007) also finds that small firms that obtain a longer extension period experience significantly higher abnormal returns than other firms around the announcement. Hence, the evidence suggests that investors consider the postponement good news and the compliance costs of Section 404 are very significant for small firms. The cost saving of delaying compliance for one more year is about 1.26 percent of the market value of an average firm in the non-accelerated filers group. Meanwhile, Bhamornsiri et al. (2009) point out a different perspective, and show that there is an inverse relation of firm size to the percentage increase in audit fees. They confirm the conjecture that smaller firms have weaker internal control structure and procedure, thus requiring additional audit analysis.

Research on small-cap firms is also conducted by Switzer (2007), who finds that mandatory compliance with SOX for small firms has net benefits that exceed the costs. According to this study, an incremental market valuation gain from SOX ranges from 15.7 percent to 34 percent for affected firms, based on market-capitalization-weighted Tobin Q's and depending on the measure of board independence used. Cross-listing premiums in the period following SOX suggest that the costs of enhanced disclosure and compliance are exceeded by their benefits. Another finding shows that debt is a costly control mechanism for small-cap firms although the market for corporate control functions as a positive disciplining factor.

## **6. LOBBYING APPROACH**

Hochberg et al. (2009) evaluates the effect of SOX on shareholder value by classifying the nature of the comment letters submitted to the SEC by individual investors and investor

groups. They document that individual investors, based on their letters to the SEC, overwhelmingly support the implementation of SOX. Lobbying by investor groups such as labor unions and pension funds, supposed to be more sophisticated than individual investors, is also supportive. 79 percent of letters from individuals and 83 percent of letters from investor groups are in favor of the rule commented on. These findings suggest that SOX is considered to be worthwhile by individual investors and investor groups. On the other hand, an overwhelming majority of insiders in lobbying companies oppose the strict implementation of SOX and argue strongly for delays, exemptions, and loopholes in its implementation. Across all rules, 81 percent of letters written by firms (corporate managers or directors) and 73 percent of letters written by non-investor groups argue against the rule they comment on.

It is then found by Hochberg et al. (2009) that firms most likely to lobby are firms in mature industries with high profitability, relatively low earnings growth, and poor governance. These are firms with traditional Jensen's (1986) free cash-flow problems. Meanwhile, with respect to audit fees, they find that lobbying companies are less likely to be those expecting a large increase in compliance costs. Instead, lobbyists on average have lower audit fees relative to market value in the pre-SOX period, and their audit fees relative to size increase by less than those of non-lobbying firms in the post-SOX period. They also find that there is no obvious market reaction to the submission of the letter, meaning that market participants are not surprised to see which firms lobby (and thus, which firms are more likely to be more affected by SOX). Subsequently, their portfolio analysis finds that during the period leading toward the enactment of SOX, cumulative returns for firms whose insiders lobbied against one or more of the "enhanced disclosure" (Title 4) provisions were approximately seven percentage points higher than those for non-lobbying firms with similar size, book-to-market, and industry characteristics. On the contrary, they find no significant proof of higher cumulative returns for firms whose insiders lobbied against the "corporate responsibility" (Title 3) provisions or the "auditor independence" (Title 2) provisions than those for comparable non-lobbying firms. This suggests that while investors do not disapprove of the "corporate responsibility" or "auditor independence" provisions, the market expects SOX to benefit mainly the firms most affected by provisions related to "enhanced disclosure".

Hochberg et al. (2009) overall find that: (1) investors expect SOX to more closely align interests of insiders and shareholders; (2) lobbying firms are indeed those more likely to suffer from agency issues; (3) relative returns during the period preceding SOX passage are consistent with the views of investors; (4) investors' positive expectations of firms most affected by SOX (as they may benefit most from SOX) may have been warranted, based on returns in the post-SOX period; (5) in the eyes of public company shareholders, the most important and effective provisions in SOX are the "enhanced disclosure" provisions rather than "corporate responsibility" and "auditor independence" provisions; and (6) there is a positive relationship between lobbying the SEC and the likelihood of a subsequent corporate scandal.

## 7. RISK, RETURN AND MARKET REACTION

The quality of accounting information and the systems that produce the information influence a firm's cost of capital in two ways: (1) direct effects, where higher quality accounting information does not affect firm cash flows, but affects market participants' assessments of the risk of a firm's cash flows and the covariance of the firm's cash flows with aggregate market cash flows; (2) indirect effects, where higher quality information and better internal controls affect real decisions within the firm, including the quality of operating decisions as well as the amount of firm resources that managers appropriate for themselves (Ashbaugh-Skaife et al. 2009).

According to Ashbaugh-Skaife et al. (2009), internal control deficiency (ICD) may affect firms' information quality in two principal ways. First, random or unintentional misstatements due to the lack of adequate policies, training, or diligence by company employees. Examples include, inventory counting and pricing errors that misreport inventory on hand and related cost of sales, omission of items such as failure to record credit purchases, etc. Second, intentional misrepresentations or omissions by employees or by management. These non-random misstatements basically overstate earnings for current period, but "big bath write-offs" can result in opportunistic understatement of current earnings as well. For instance, management's exercise of discretion in accounting choices allows financial misrepresentation through manipulation of accruals for recording important accounting estimates such as warranty liabilities, reserves for sales returns, and allowance for uncollectible receivables (Ashbaugh-Skaife et al. 2009). Besides, employee fraud is made possible by inadequate segregation of internal control duties, which can trigger misappropriation of assets and alteration of recorded amounts by employees since the firm has inadequate staff for monitoring.

Research conducted by Ashbaugh-Skaife et al. (2009) shows that firms reporting ICDs exhibit significantly higher unsystematic risk, betas, and cost of equity compared to those that do not report ICDs. Their results also indicate that ICD firms enjoy a statistically significant increase of 93 basis points in market-adjusted cost of equity around the first disclosure of ICDs. Their analysis further finds that ICD firms that subsequently receive unqualified SOX 404 opinions suffer from a decrease of 151 basis points in market-adjusted cost of equity around the unveiling of the opinions. In contrast, ICD firms that then receive adverse SOX 404 audit opinions experience a slight but insignificant increase in cost of equity around the opinions release. No significant change in cost of equity is found for companies least possible to report an ICD, but there is a significant decrease in the market-adjusted cost of equity on average around the release of unqualified SOX 404 opinions for companies most expected to report ICDs. Overall, Ashbaugh-Skaife et al. (2009) conclude that firms with effective internal control or those that remedy ICDs previously reported are rewarded with significantly lower cost of equity.

Many concurrent studies have tested the consequences of SOX, but there is no agreement on how SOX changes business practices, nor whether the changes are value increasing for firms. Although the compliance costs are considered substantial, the indirect opportunity costs imposed by SOX are likely even greater. Some critiques argue that SOX has increased the difficulty of finding qualified directors, compensating directors, and paying directors' and officers' insurance policies. Besides, tightening shareholder controls may reduce

management's flexibility in decision making and encourage managers to behave in a less risk-averse manner to shun the consequences of lower-tail outcomes of good projects. Examining the value creation impacts of SOX, Zhang (2007) finds that the market responded negatively to events that signaled increases in the likelihood of enacting tough regulations and positively to events revealing that no further costs would be imposed. The cumulative abnormal returns over the key SOX events are significantly negative. Specifically, she documents that the cumulative value-weighted (equal-weighted) raw returns of the U.S. market are -15.35 percent (-12.53 percent) around the key SOX events. It is also reported that SOX-complying foreign firms on average experience a negative cumulative abnormal return (-18.46 percent) around key SOX rulemaking events, lower than the cumulative raw return of the U.S. market and that of foreign markets. Foreign private issuers on average witness a negative abnormal return of -9.71 percent around the four key SOX events, indicating that U.S.-listed foreign firms underperform non-U.S.-traded foreign firms in their home country market around key SOX events. Zhang (2007) also provides evidence that firms' cumulative abnormal returns around the significant legislative events decrease with their purchase of non-audit services. Firms with foreign operations or transactions incur significantly greater costs. Furthermore, firms with weak shareholder rights relative to their industry peers experience more negative abnormal returns in the SOX rulemaking period. The results suggest that SOX imposes significant net costs on complying firms. However, Leuz (2007) reminds readers that Zhang's (2007) main conclusion and the sign of the cumulative return are sensitive to the choice of event dates. Two competing studies by Rezaee and Jain and Li et al. (Leuz 2007) choose slightly different event days surrounding SOX and find that the cumulative event return is significantly positive.

Other evidence of market reaction to SOX is provided by Akhigbe and Martin (2006). This research indicates that before SOX, financial services firms had less favorable governance structures, such as less independent audit committee, no financial expert in the audit committee, less financial statement footnote disclosures, and less involved CEOs when they were smaller. They find that wealth effects of non-compliant firms are significantly lower than compliant firms, and the variation across the group is explained by disclosure and governance measures. In general, the adoption of SOX produces favorable effects for the portfolio of all financial services firms, suggesting that investors value the strong governance and disclosure of the compliant firms, that they recognize greater compliance costs to offset any expected benefits for non-compliant firms. Subsequently, with respect to risk, Akhigbe and Martin (2008) find that shorter-term risk shifts are significantly positive, on average, for the full sample of 768 U.S. financial services firms as well as across segments within the industry. The increased risk is logical as the mandatory nature of disclosure and governance provisions within the legislation may produce the expectation that some firms would disclose unfavorable information that had previously been withheld or hidden. Financial services firms with stronger disclosure and stronger governance are found to experience smaller increases in the shorter-term risk. In contrast, they find that longer-term total and unsystematic risk shifts are negative and significant. The decreased risk over the longer-term period reflects reductions in investor uncertainty as firms become more transparent. Firms that experience larger decreases in longer-term total and unsystematic risks are also those with stronger disclosure and governance. In addition, CEO involvement is negatively related to the shorter-term total risk shift, but positively associated with the longer-term risk shifts. It seems that the financial market perceives firms with more involved CEOs to initially warrant reductions in

risk as there is an immediate need for certifying financial statements, but over a longer period of time these firms are associated with high levels of risk.

Corroborating their previous study, Akhigbe et al. (2009) find that capital market risk measures increase in the more immediate period following the passage of SOX, which does not support the idea that the legislation helped calm investor fears. However, they again find that total risk and unsystematic risk measures decrease over a longer-term period of time, suggesting a reduction in investor uncertainty. Stock price volatility is reduced in the longer horizon since disclosure may mitigate uncertainty, alleviate asymmetric information, and reduce heterogeneity of beliefs about the value of the firm. They also report that more uncertain firms, i.e., firms with larger bid-ask spreads, are associated with smaller decreases in risk. On the other hand, firms with better governance (smaller GIM index) and thus less uncertain experience a greater decrease in risk. Foreign firms deemed to be less uncertain at the time of SOX passage experience the greatest risk reductions in the post-SOX period. Similarly, Choi et al. (2008) do not find a positive reaction to the passage of SOX for firms with strong shareholder rights or good governance structures. Instead, firms with weak shareholder rights or high managerial power show a strong positive reaction to the passage of SOX. This suggests that the market does not anticipate that SOX would provide significant additional benefits to shareholders of firms with stronger governance structures. However, an inexistence of negative reaction also implies that the market does not perceive excessive costs for strong shareholder rights firms. Meanwhile, firms with weak shareholder rights exhibit a positive risk shift following SOX, while firms with strong shareholder rights do not alter their risk.

Surprisingly, Choi et al. (2008) report that firms with strong shareholder rights tend to weaken their shareholder rights following SOX. This may indicate that firms with strong shareholder rights before SOX perceive the required changes as redundant monitoring such that less shareholder protections might be necessary following the passage of SOX. On the other hand, there is little change in shareholder protection levels by firms with weak shareholder rights after SOX. This study also concludes that greater investor protection lowers the optimum level of perquisites consumption and increases managerial risk-taking.

Market liquidity is also influenced by the passage of SOX. The functioning of efficient capital markets depends on the quality, reliability and transparency of financial information disseminated to the markets (Jain et al. 2008). Heflin, Shaw and Wild (2002 in Jain et al. 2008) find that high-quality disclosures improve market liquidity by reducing asymmetric information. Using large public companies that reported revenues of greater than USD1.2 billion and certified their financial statements, Jain et al. (2008) find that average quoted and effective spreads increase by seven and five basis points, respectively, in the scandal window compared with the benchmark window. The adverse selection component share of spreads increases by 3.31 percent in the scandal window, indicating that deterioration in the information environment is a key driver of decline in liquidity. Moreover, there is a statistically significant reduction of eight basis points in quoted spread and three basis points in average effective spread (indicating improvements in liquidity) after the passage of SOX. However, dollar depths also decline, leaving no statistically significant change in the liquidity index. An explanation for this mixed result is that the capital markets are still negatively influenced by a wave of financial scandals such that the passage of SOX does not have an immediate impact. The implementation of SOX provisions indeed leads to improved liquidity

measures. Quoted and effective spreads decrease by seven and four basis points, respectively, from their levels after the financial scandals.

## 8. TREND IN CORPORATE GOVERNANCE

As discussed above, Congress passed SOX in July 2002 as a response to emergency circumstances caused by high-profile corporate scandals. The major objective of SOX is to improve the quality of financial reporting and increase personal responsibility for inappropriate reporting. It is expected that the mandated provisions in SOX and the stock exchange rules would lead to great changes in management behavior, corporate governance, and the business environment. Key accountability provisions of SOX with respect to top executives are: (1) Section 302 requires CEOs and CFOs to certify the fairness of the presentation of financial statements; (2) Section 304 requires that CEOs and CFOs disgorge any bonuses or stock market gains that result from misstated earnings; (3) Section 906 imposes on the CEO and the CFO potential criminal sanctions for misstated financial statements (Collins et al. 2008).

SOX focuses its attention on corporate governance and roles that management and directors play; consequently, SOX may change the relationship between boards and CEOs by holding board members more accountable (Wang and Davidson 2009). For instance, SOX could impact the length of time that boards will tolerate ineffective management. However, differences in firms may cause a firm to deviate from its optimal governance structure because no corporate governance is universally optimal to all firms, and consequently, may hurt shareholders in some firms (Hermalin 2005). Jensen and Meckling (1976) argue that the board of directors should represent the first line of defense for the shareholders in disciplining top executives. When internal control mechanisms do not function properly, the external market for corporate control (such as corporate takeover) is another potential disciplining mechanism. Besides, external financial and job markets also represent potential disciplining mechanisms (Collins et al. 2008).

SOX may significantly enhance the monitoring function of corporate boards. Changes in corporate boards have been reported by empirical research, such as an increased board size, more outside directors, more audit committees meetings, more financial experts, and fewer CEO/Chair dualities. SOX also empowers the audit committee with the appointment, supervision, and compensation of any public accounting firm employed by the company. The registered public accounting firms have to report directly to the audit committee, and the audit committee has the authority to engage in independent counsel and other advising to carry out its duties (Wang and Davidson 2009). Boards that meet more often are more likely to perform their duties as the representatives of shareholders (Xie, Davidson, and DaDalt, 2003). However, board meeting frequency might be just the byproduct of the increased board size. This being the case, more board meetings may not improve the effectiveness of monitoring. Multiple monitoring system, extra individual responsibilities placed on management, and mandatory requirements of compliance by SOX may distract board directors' and CEOs' attention from business operations and make them spend more time and resources to meet the legal requirements.

While the legal authority of the board of directors is relatively broad, empirical evidence indicates that the board plays a significant role in only a few corporate decisions. Among those in which the board plays a significant role, the most common and important are decisions pertaining to the selection, monitoring, and retention (or dismissal) of CEO (Hermalin 2005). The board's choice of the CEO is between an internal candidate and an external one. The difference between these candidates is that the external candidate is less known such that his or her ability is estimated with less precision than the ability of internal candidate.

A trend toward greater board diligence should yield a corresponding trend toward more frequent external hires as CEOs. Greater diligence will increase the option value of a new CEO and make boards be more willing to give up a higher estimated ability in exchange for greater uncertainty about ability (Hermalin 2005). Given that hired CEOs are of lower average quality due to the uncertainty about ability, their tenure should be correspondingly lower on average as well. Similarly, Dalton and Dalton (2008) report that this may also be the case for directors. In 2001, the turnover rate for independent directors was 5 percent; for the first three years post-SOX (2002–2005), the annual turnover rate increased to 11.3 percent, and the turnover rate in 2006 for independent directors was a 35.7 percent annually. On the other hand, a greater board diligence with respect to monitoring should increase the CEO's effort. This higher level of effort should lead to a trend toward greater CEO compensation (Hermalin 2005). This prediction about the correlation between board diligence and executive compensation would seem at odds with the view expressed, for instance, by Bebchuk and Fried (2003), that it is weak boards that tend to overpay their CEOs.

Fraud is believed to be a contributing factor to executive changes since it decreases firm value, sends negative signals, and destroys reputations. Previous research does not find strong evidence supporting that fraud scandals trigger management replacement. Nevertheless, transparent disclosure under SOX may reduce the probability that investors make decisions based on inaccurate information. Wang and Davidson (2009) conduct research and find that 50.6 percent of their sample experience CEO turnovers after the passage of SOX, and there are more forced turnovers (104 vs. 86), fewer dualities (248 vs. 254), and more financial restatements (52 vs. 25) in the post-SOX period than in the pre-SOX period. Meanwhile, average board size, audit committee size, number of board meetings, and CEO tenure do not differ significantly for the two periods although the average proportion of independent outside directors on boards and audit committees have significantly increased from 71 percent to 75 percent and from 95 percent to 98 percent, respectively. On average, institutional ownership has significantly increased from 49 percent in the pre-SOX period to 60 percent in the post-SOX period. In addition, they find that audit committees have become more active in the post-SOX period. On average, the audit committee meetings increase to 7.15 times in the post-SOX period from only 3.88 times in the pre-SOX period.

In their regression analysis, Wang and Davidson (2009) do not find evidence of a significantly direct effect of SOX on CEO tenure. However, the finding of significant impact of outside directors on CEO tenure provides some evidence that supports the hypothesis that forced CEO turnover is more likely in the post-SOX era than in the pre-SOX period. Four of the five intensified monitoring proxy variables: CEO/Chair duality, the proportion of institutional ownership, number of negative news, and shareholder governance proposal, are found to be significantly related to the odds ratio for forced turnover.

Other research by Collins et al. (2008) is focused on CFO instead of CEO. Observing 167 (196) firms in the pre-SOX (post-SOX) periods that restated earnings downward and matching each restatement firm with a control firm based on year, industry, size, and age, they find higher turnover rates of CFOs after restatements in both the pre- and post-SOX periods. This suggests that governance mechanism is capable of disciplining CFOs involved in restatements in both periods. Surprisingly, they find little evidence that the passage of SOX has influenced CFO turnover rates. They also report that job market appears to impose heavy penalties. For instance, former restatement firms' CFOs are less able to find new jobs comparable to their previous CFO posts, less likely to find employment in public companies, and less possible to find comparable jobs with the same salary levels in public firms. In several cases, the penalties are severe, such as penalties that would hinder the individual's ability to function as a CFO (e.g., loss of certified public accountant certificate, barred from acting as an officer in a publicly traded firm), penalties involving criminal charges and legal issues, and financial penalties. Moreover, it is documented that executives dismissed in the post-SOX period experience greater reputational and job market penalties than those in the pre-SOX period, indicating that firms are less willing to hire a former CFO with a bad reputation in the post-SOX period.

Dalton and Dalton (2008) focus their research on compensation practices after SOX. Compensation Disclosure and Analysis (CD&A) discusses compensation matters intended to provide investors with a clearer and more complete overview of the compensation earned by the CEO, the CFO, three other of its highest paid executive officers, and directors. Although public and regulators pay a close attention to compensation disclosure and analysis (CD&A), CEOs of the 500 largest U.S. firms received a collective 38 percent increase in their 2006 pay (Dalton and Dalton 2008), which substantiates the finding of Hermalin (2005) discussed above.

Another issue in corporate governance is earnings management. Cohen et al. (2008) report that pre-SOX period was characterized by increasing accrual-based earnings management. The accrual-based earnings management got larger in financial scandal period, but real earnings management declined in this period. After the passage of SOX, accrual-based earnings management decreased significantly while real earnings management increased significantly. At the same time, option-based compensation decreased. This suggests that firms switched to managing earnings using real approach possibly because these techniques are likely to be harder to detect (Cohen et al. 2008). They also reveal that increasing accrual-based earnings management in the financial scandal period was related to an increase in option-based compensation. Option-based compensation offers two opposing incentives regarding current stock price. On the one hand, managers have an incentive to lower stock price around stock option award. On the other hand, managers have an incentive to increase stock price as they possess unexercised options (Cohen et al. 2008). They indeed find that while new options granted are negatively associated with income-increasing discretionary accruals, unexercised options are positively related to income-increasing discretionary accruals. The relationship between income-increasing discretionary accruals and unexercised options declined in the post-SOX period. This proposition is corroborated by Cullinan et al. (2006), who find that CEOs of misstatement companies receive smaller cash salaries and bonuses but larger amount of options than do their peers. In addition, they find evidence that firms with more option-based, and less cash-based, compensation schemes are more susceptible to misstatement.



## 9. INTERNATIONAL IMPLICATIONS AND COMPARISONS

The legal bonding motivation for foreign listing decisions postulates that high quality firms from countries with weak institutions list their shares abroad to credibly subject themselves to the host country's stricter legal and regulatory requirements (Piotroski and Srinivasan 2008). They argue that this process may create a commitment to adopting stronger corporate governance practices, and separates the listing firm from other firms in its home market, thereby resulting in higher market valuation and lower cost of capital. After years of cooperation, Europeans were surprised to see the U.S. change from an international approach toward foreign issuers to a unilateralist approach by passing SOX in 2002. This has caused debates in Europe, even one of the European Commission (EC) Directors complained that SOX was "passed without the slightest regard to third countries and with no consultation," (Stoltenberg et al. 2005). The European companies listed on the American exchanges, and thus subject to SOX, have been particularly vocal in their complaints that the newly implemented requirements of SOX Section 404 are expensive, oppressive, and difficult to implement (Akhigbe et al. 2009). Some European companies have even moved to delist their securities from U.S. stock exchanges.

SOX and its SEC implementing rules include foreign issuers among the regulated entities. The most controversial provisions that have been widely debated are the requirements in Sections 302 and 906 that CEOs and CFOs must personally certify their companies' quarterly and annual financial reports filed with the SEC, and Section 404 that mandate management and auditors to assess the effectiveness of internal control over financial reporting (Stoltenberg et al. 2005). On April 16, 2003, the PCAOB designated the AICPA's Statements on Standards for Attestation Engagements as the temporary standard for attestation to the effectiveness of internal control. One of the controversial characteristics of Section 404 is that its benefits, such as a fraud that does not occur or the increased confidence of investors in the U.S. capital markets, are difficult to measure, while the costs of compliance are immediate and easy to identify (Stoltenberg et al. 2005). However, some observers have concluded that the overall impact of SOX is beneficial as a consequence of improved transparency and disclosure and better control of agency costs. A governance metrics international survey (GMI) claims that U.S. companies have stepped up to the top of a global comparison of corporate governance standards, overtaking the U.K. and Canada (Switzer 2007).

When European companies are struggling to cope with complex new international accounting standards, the additional rigorous demands of Sarbanes-Oxley may make the costs of a U.S. listing outweigh the benefits. Large German companies estimate that it costs from EUR30 to 80 million to maintain their U.S. listings. Meanwhile, the cost incurred by U.K. businesses for Section 404 compliance is estimated at between GBP122 and 457 million in the first year alone. Another contributing factor to the Europeans' reassessment of their U.S. listings is the increasing number of U.S. institutional investors investing outside their home market. The birth of the Eurozone has also created a deep European equity market such that many European companies no longer need public offerings in the U.S. (Stoltenberg et al. 2005). There is evidence that no new cross listings have occurred since the adoption of SOX, but delisting is extant. Several foreign companies have decided to delist from U.S. stock exchanges to avoid complying with SOX (Bhamornsiri et al. 2009). However, delisted

companies still have to comply with SOX disclosure rules if they have more than 300 U.S. investors. Besides, even if they cancel their U.S. listings, they may still be faced with tightening requirements at home as U.S. and European standards converge.

At the time that the Enron fraud was unveiled, Europeans were absolutely astonished and seemed to think that Enron was an instance of American tendency toward greed, thereby believing that European corporate ethical standards and the prevalent accounting systems would have prevented such fraud from occurring in Europe (Stoltenberg et al. 2005). Europeans were still complacent until December 2003 when high-scale bookkeeping irregularities were unveiled in Parmalat, the Tanzi family-owned business in Italy. The EC began on May 21, 2003 by setting ten priorities to improve quality and protect investors in the audit of company accounts (Stoltenberg et al. 2005). The Parmalat fraud became an important factor in emboldening the EC to quickly propose an amendment to the Eighth Company Directive on statutory audit in March 2004. Under the provisions of the Directive, rotation of auditors is required, with an option to either replace the key audit partner every five years if the same audit firm maintains the work (internal rotation) or otherwise to replace the audit firm every seven years (external rotation) (Stoltenberg et al. 2005). Independence of auditors from the management of the audited company is enhanced by requiring listed companies to establish an audit committee (or its equivalent) with clear functions to perform. There is also a requirement for the application of the International Standards of Auditing (ISA) in all statutory audits conducted in the EU.

Traditionally, corporate governance regulations in Europe have been on a "comply or explain" basis rather than by legislation, while the U.S. has chosen the latter (Stoltenberg et al. 2005). In contrast to the U.S. approach where sanctions follow non-compliance, the E.U. law operates when a company has decided not to comply and not to explain. Another difference between Europe and the U.S. with respect to securities violations is that Europe does not have a central securities regulatory agency comparable to the SEC. The Committee of European Securities Regulators (CESR) comprises regulators from all 25 E.U. Member States. Furthermore, in the US and UK, there is a more dispersed share ownership while publicly traded continental European companies is more concentrated. The European view is associated with the rights of the community in relation to the corporation itself. These wider stakeholders' interests have influenced the development of corporate governance policy in the EU, and this is contrasted with the hardcore pursuit of shareholder value maximization associated with U.S. corporations. For any capital market, the challenge is to stay sufficiently free of regulation to remain competitive while at the same time building on levels of principle and ethical behavior to make the market worth investing in (Stoltenberg et al. 2005).

Reduced fraud risk, better risk management, strengthened governance, and enhanced controls as a result of SOX implementation are expected to improve investor confidence, which will in turn influence U.S. and world economies positively (Bhamornsiri et al. 2009). However, a survey by the Financial Executives Institute estimates that the total costs of compliance with SOX reach USD4.6 million in the first year (Financial Executive 2005 in Bhamornsiri et al. 2009). Likewise, a study by McKinsey shows that globally the U. S. is losing between four and seven percent of its financial market share and has only attracted one-third of the share of the IPO market values it obtained in 2001 (Bhamornsiri et al. 2009). Critiques blame the excessive regulations, including SOX, which debilitate new economic activities.

Specific research on international implications of SOX is also done by Piotroski and Srinivasan (2008). This research finds that foreign firms are more likely to choose an exchange with greater liquidity and higher market valuation. U.S. exchanges typically attract larger firms and firms that raise equity in the host market, and are less likely to attract firms from countries with relatively weaker governance. Controlling for firm characteristics and other economic factors, their study draws two main conclusions with respect to SOX. First, among large foreign firms choosing between a U.S. exchange and the London Stock Exchange's (LSE) Main Market, listing preferences do not change following SOX. In addition, there is a marginal increase in the likelihood of a U.S. listing for firms choosing between the LSE's Main Market and the NASDAQ. Second, for smaller foreign firms eligible to choose between the LSE's AIM and the NASDAQ, they find that the probability of a U.S. listing declines after SOX. The finding of a negative SOX effect among smaller, NASDAQ-eligible foreign firms is consistent with the argument that small, less profitable firms are less capable of absorbing the incremental costs associated with SOX compliance (Piotroski and Srinivasan 2008).

## **10. SOLVING THE PROBLEMS OR HEALING THE SYMPTOMS?**

As discussed throughout this chapter, SOX is enacted to strengthen audit process by transferring professional disciplinary authority from the principle professional association to the PCAOB and by producing provisions that prohibit certain types of consulting services. In detecting misstatements and report problems, auditors follow a three-step model (Cullinan, 2004). First, they become aware of problem transactions. Second, they recognize a transaction as a problem and finally if management does not fix the problem, they modify their opinion.

The first step is selecting a "problem" transaction for examination (Cullinan 2004). If the problematic transaction occurs outside the auditor's sample, the auditor will not have the opportunity to identify the transaction as a problem. The probability of identifying a problematic transaction may have diminished as a result of audit reengineering for the sake of greater audit efficiency (Cullinan 2004). The possibility that an auditor is unaware of a transaction is also an important aspect of the expectation gap between the auditor's perception of his or her responsibility and the public's expectation of the audit.

The second step is the auditor's recognition that the transaction actually represents a problem (Cullinan 2004). Awareness of the transaction does not necessarily lead to recognition of the problem. An auditor can be unable to recognize a selected transaction as a problem due to two possible rationales: (1) management intent and (2) auditor deficiency (Cullinan 2004). Examples of management intent include the creation of fictitious underlying documentation by management or collusion with third parties. Instances of auditor deficiency include lack of care in gathering evidence about a transaction, reliance on evidence provided by management during audit, and incompetence to recognize a problem transaction (Cullinan 2004).

The final step for an auditor to appropriately prevent misstated financial statements from reaching the investing public is to be willing to give management a qualified or adverse audit opinion (Cullinan 2004). Unfortunately, the auditor or the audit firm may not require a client to modify misstated financial statements due to a close clientele relationship or because the

audit firm receives huge revenues from the client by providing both audit and non-audit services.

Various financial scandals or frauds have been unveiled and analyzed. Five of the large scale scandals include the cases of Sunbeam, Cendant, Waste, Enron, and WorldCom. While this chapter is not focused on the stories financial scandals, these frauds can epitomize the application of the three-step model to detecting failure. Failure to be aware of a suspicious transaction (Step 1) is believed to be the problem that causes the fraud in Cendant. Meanwhile, failure to recognize the transaction as a problem (Step 2) seems to be the main cause for Sunbeam, Cendant, Enron, and WorldCom cases. Finally, failure to disclose the problem (Step 3) is considered the major cause for the cases of Sunbeam, Waste Management, and Enron (Cullinan 2004). As Steps 2 and 3 seem to contribute most to those frauds, it is understandable as to why regulatory framework is so focused on dealing with these problems. However, we should note that the prevalence of problems in Steps 2 and 3 is only possible if auditors do not catch the potential problem earlier in Step 1.

Now we will discuss SOX in relation to the enhancement of the three-step model. One of the two main provisions of SOX is the creation of the PCAOB whose main functions are to create standards on auditing, quality control, and ethics, and to investigate and discipline public accounting firms and public accountants (Windsor and Warming-Rasmussen 2009). In audit standard selection, the PCAOB may decide either to adopt standards set by professional bodies or to create their own standards. If the PCAOB decides to adopt existing U.S. professional standards, the first component of the misstatement detection model may not improve (Cullinan 2004). Recent Statement of Accounting Standard on fraud detection limits an auditor's responsibilities for busting upper management fraud (Paltrow 2002 in Cullinan 2004). Many frauds indeed come from the upper management level, hence this responsibility limitation may dwarf SOX's main objective.

The other principal provision of SOX is the independence provisions. These provisions restrict an auditor from providing certain non-audit services, although they do not explicitly prohibit auditors from providing training for their client's audit committee members (Windsor and Warming-Rasmussen 2009). It is believed that if an auditor becomes more independent, the auditor will have an enhanced capability of recognizing problems as he or she will be viewing the processes and assumptions used to create the financial statements with greater objectivity (Cullinan 2004). These provisions also require audit partner rotation at least once every five years as a response to a concern that audit partners may become too familiar with their clients so as to limit their willingness to stand up to the client due to reduced objectivity. Another provision prevents auditors from auditing financial statements of a client whose main accounting or management officers were previous employees of the accounting firm during the year preceding the audit. All of these provisions, unfortunately, have no direct impact on enhancing the intellectual capacity of auditors to recognize problematic transactions. The concern emphasizes the idea that an auditor may be less willing to confront a former colleague with respect to a detected misstatement (Cullinan 2004).

Hence, SOX actually has provisions that can help reduce problems of misstatement detection and reporting. These provisions primarily deal with Step 3 (disclosure of problem) and partially Step 2 (recognition of problem). SOX has yet to create provisions designed to enhance the intellectual ability and diligence of auditors to recognize problems (part of Step 2). In addition, SOX offers no provision to improve the first step of misstatement detection,

which is the awareness of transaction. This being the case, SOX is probably less effective at its current stage in dealing with future financial scandals or frauds.

The limited effectiveness of SOX stems from its focus on specific aspects of the Enron case. Policy entrepreneurs, by opportunistically coupling their corporate governance proposals to Enron's collapse, offer symptomatic remedies for future "Enrons" that probably have minimum or no relation to the underlying cause of implosion (Romano 2005). Most of the legislative remedies are designed to deal with particular concerns in the Enron case (Cullinan 2004). In conclusion, the U.S. Congress may have attacked the symptoms of the audit problem. However, it has not provided more serious efforts to identify and repair the underlying problem of an inadequate emphasis on audit competence in the accounting profession's culture and a lack of a sense of public duty (Cullinan 2004).

## **11. CONCLUSION AND RECOMMENDATIONS**

SEC Commissioner, Harvey Goldschmid, referred to SOX as the "most sweeping reform since the Depression-era Securities Laws", and President Bush called SOX "the most far-reaching reforms of American business practice since the time of Franklin Delano Roosevelt" (Choi et al. 2008). There are three ways through which SOX may increase shareholder value. First, SOX may directly improve the operating performance of the firm through the elimination of management incompetence and complacency, or through lessons learned during the internal control review. Second, SOX may improve operating performance through the elimination of actual expropriation or perquisites. Third, SOX may lead to a lower cost of capital via an increase in stockholder confidence (Hochberg et al. 2009).

A myriad of research has examined SOX, its provisions and their impacts on corporate governance and firm value. This chapter reviews literature on this particular issue and relates SOX to various aspects in corporate finance and market valuation. Research findings on SOX and its effects are mixed and less conclusive. Productivity and efficiency of accounting firms are found to be enhancing following SOX, especially after the establishment of the PCAOB. With respect to going-public or going-private decisions, some evidence shows that firms undergoing IPOs in the post-SOX period gain higher abnormal returns but other evidence indicates that firms that go private after SOX experience higher abnormal returns. This less conclusive result if combined with the small-firm analysis may provide a brighter clarity. Small firms are inclined to have weaker corporate governance structures and less ability to absorb compliance costs brought by SOX. Consequently, these small firms are more willing to go private (or at least go dark). On the other hand, large firms are more equipped with stronger governance structures and funds availability to comply with SOX provisions. Firms that are reluctant to comply with SOX provisions (e.g., firms with weak shareholder right or companies with heavy management control) use a lobbying approach to delaying the effective compliance date. Meanwhile, small firms have their own way of regulatory dialectics, which is to stay small as non-accelerated filers.

In international setting, SOX has a less apparent impact on foreign firms cross-listing on U.S. exchanges. The interest in listing on U.S. exchanges mainly comes from large companies from weaker governance countries, and this interest does not change after the passage of SOX. However, small firms do change their exchange choices; they tend to prefer the LSE's

AIM to NASDAQ in the wake of SOX enactment. With respect to risk, return, and value, research shows that risk increases in the short run immediately after the passage of SOX, but then decreases in the longer horizon. Similarly, research findings on market value indicate a value creation by SOX provisions in the long run. Overall, the trend in corporate governance shifts in line with the objectives of SOX.

However, there are a vast array of concerns about SOX. Regulations basically purport to repair or solve remaining problems that cannot be fixed by free-market mechanism. In the field of corporate governance, market mechanisms include internal governance (board monitoring), market for corporate control, and job market. Research findings have provided evidence that large firms actually have the most complete governance structures as well as funds. These firms technically can rely on the market mechanism to solve governance problems, but because market mechanism is imperfect, these firms are also the most dangerous entities that can harness the imperfection and benefit from it. Cases of Enron, WorldCom, and other scandals epitomize this problem. Even after the passage of SOX, large companies may still possess high-caliber techniques to circumvent the regulations. For instance, research finding that companies shift from accrual-based earnings management to real earnings management must carefully inspected. On the other hand, small firms most likely have weaker governance structures but they are also companies that less likely commit large-scale financial frauds. As SOX is focused on large-scale fraud prevention, small firms do not perceive an urgent need for or benefit from complying with SOX compared to the huge increase in compliance costs. This leads to another regulatory dialectics, which to stay small as non-accelerated filers that can delay the compliance with Section 404. Subsequently, the biggest problem with SOX provisions is that they have only attacked the symptoms of the audit problem, but have not provided more serious efforts to identify and repair the underlying problem of an inadequate emphasis on audit competence in the accounting profession's culture and a lack of a sense of public duty (Cullinan 2004). Since they are focused on the Enron case and how to prevent this large-scale financial fraud in the future, only Step 3 (disclosure of problem) and partially Step 2 (recognition of problem) in the three-step model are improved. SOX has yet to create provisions designed to enhance the intellectual ability and diligence of auditors to recognize problems (part of Step 2), and offers no provision to improve the first step of misstatement detection, which is the awareness of transaction.

We offer two alternative recommendations. First, if the government is to maintain the "one-mandate-for-all" approach to SOX, it should revise SOX provisions to solve the underlying problems in corporate governance and accounting fields rather than merely attack the symptoms. As shown by the three-step model, SOX provisions have not dealt with auditors' intellectual ability and diligence to recognize problems and their competencies in catching suspicious transactions. Second, if the government has no immediate interest in revising SOX provisions as suggested by the first recommendation, it should erase SOX provisions' mandatory force and change them into a "comply, otherwise explain" approach. The "one-mandate-for-all" approach currently applied is too costly for certain firms, especially small firms, leading to them avoiding the compliance. Meanwhile, benefits reaped by complying with SOX provisions may stem from stronger governance structures, particularly more aware shareholders and more active market for corporate control in the wake of Enron's demise, rather than from SOX provisions.

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## APPENDIX: RESEARCH FINDINGS ON SOX

Researcher		Hochberg et al.	Hochberg et al.	Hochberg et al.	Zhang	Akhigbe et al.
Year		2009	2009	2009	2007	2009
Dependent Variable		Lobbied against Enhanced Disclosure and PCAOB	Lobbied against Corporate Responsibility	Lobbied against Auditor Independence	CAR (US) Cumulative Abnormal Returns	$\Delta$ Total risk
Independent Variables	Size	+***	+***	+***	-	+***
	ROA	+***	+***	+**	-***	
	Long-term earnings growth forecast (%)	-***	-***	-***		
	Governance index	+*	+*	+	-*	-*
	Non-audit (calculated as non-audit fees minus fees paid for tax-related services, deflated by the market value of equity of each firm at the end of 2001)				-***	
	Busi_lines (equals the number of four-digit SIC industries of each firm)				-**	
	Foreign = one if foreign currency adjustment is non-zero, zero otherwise.				-***	

Researcher		Hochberg et al.	Hochberg et al.	Hochberg et al.	Zhang	Akhigbe et al.
Year		2009	2009	2009	2007	2009
Dependent Variable		Lobbied against Enhanced Disclosure and PCAOB	Lobbied against Corporate Responsibility	Lobbied against Auditor Independence	CAR (US) Cumulative Abnormal Returns	ΔTotal risk
Independent Variables	Incentive (equals the ratio of incentive pay to total compensation of the CEO less the industry median ratio)				-	
	Accr (measures abnormal accruals, computed as residuals from the modified Jones model estimated using 2001 data for each two-digit SIC industry)				-***	
	Shumway (captures the likelihood of bankruptcy)				-	
	Acq (equals one if a firm is subsequently acquired and de-listed in 2003)				+*	
	MTB (denotes the market-to-book ratio, evaluated at the end of 2001)				+***	-

Researcher		Hochberg et al.	Hochberg et al.	Hochberg et al.	Zhang	Akhigbe et al.
Year		2009	2009	2009	2007	2009
Dependent Variable		Lobbied against Enhanced Disclosure and PCAOB	Lobbied against Corporate Responsibility	Lobbied against Auditor Independence	CAR (US) Cumulative Abnormal Returns	ΔTotal risk
Independent Variables	Spread					+****
	Trading volume					-**
	Developing country					-
	Tax Haven Country					+
	Financial leverage					+
	Operating return					+

Researcher		Wang and Davidson	Wang and Davidson	Engel et al.	Cullinan et al.	Switzer
Year		2009	2009	2007	2006	2007
Dependent Variable		CEO tenure	CEO turnover	cumulative abnormal return measured in the (-1, +1) window around going-private announcement	misstatement (0, 1) estimate ( $p > x^2$ )	Tobin's Q
Independent Variable	Constant	-	+***			
	Tech firm dummy	+	-*			
	Post-sox	-	+*	-		
	Percent of outside directors on the board	-.***	-			
	Percent of outside directors on the AC	-	+			
	Industry adjusted ROA (Year -1)	+				
	Financial restatement	-	+			
	Number of negative news	-	+***			
	Proportion of institutional ownership	-	+*			
	CEO age	+***	-.***			
	CEO/Chair Duality	+***	-.***		-	-
	Staggered board	-.**	-			
	Board size	-	-		-	
	Number of board meetings	-	+			
	Number of audit meetings	-				
	Post-SOX * % of outsiders	+*	+			
	Lagged CEO tenure		-.***			
Pre-turnover Industry adjusted ROA		-*				
Pre-turnover debt ratio		+				

Researcher		Wang and Davidson	Wang and Davidson	Engel et al.	Cullinan et al.	Switzer
Year		2009	2009	2007	2006	2007
Dependent Variable		CEO tenure	CEO turnover	cumulative abnormal return measured in the (-1, +1) window around going-private announcement	misstatement (0, 1) estimate ( $p > x^2$ )	Tobin's Q
Independent Variables	Post-SOX* percent of outsiders on the AC		-*			
	Number of AC meetings		-			
	Shareholder governance proposal		-.**			

	MGR =1 if transaction type is merger, third-party tender offer, or self tender offer; 0 if reverse stock split or small shareholder purchase offer			+***		
	LogMV (log of firm market value)			-		
	PostSOX*LogMV			-.**		
	MgrDirOwn <sub>p</sub> (manager, director ownership percentage prior to going-private announcement)			-		
	PostSOX* MgrDirOwn <sub>p</sub>			+		
	LogMV* MgrDirOwn <sub>p</sub>			+		
	PostSOX*LogMV* MgrDirOwn <sub>p</sub>			-.**		
	SalesGr <sub>p</sub> (prior year sales growth)			+		

Researcher	Wang and Davidson	Wang and Davidson	Engel et al.	Cullinan et al.	Switzer
Year	2009	2009	2007	2006	2007
Dependent Variable	CEO tenure	CEO turnover	cumulative abnormal return measured in the (-1, +1) window around going-private announcement	misstatement (0, 1) estimate ( $p > \chi^2$ )	Tobin's Q
Independent Variables	PostSOX* SalesGr <sub>p</sub>			+	
	FCF <sub>p</sub> operating income before depreciation income tax expense + deferred taxes - dividends to preferred and common assets			-	
	PostSOX* FCF <sub>p</sub>			+***	
	Dollar amount of loans outstanding			+***	
	CEO Salary			.*	
	CEO Bonus			-.**	
	Options owned			+**	
	% of shares owned			+	
	Audit committee independence			-	
	Nominating committee			-.**	
	Percent independent directors			+	
	Leverage			+	
	Loss			-	

Researcher		Wang and Davidson	Wang and Davidson	Engel et al.	Cullinan et al.	Switzer
Year		2009	2009	2007	2006	2007
Dependent Variable		CEO tenure	CEO turnover	cumulative abnormal return measured in the (-1, +1) window around going-private announcement	misstatement (0, 1) estimate ( $p > x^2$ )	Tobin's Q
Independent Variables	BIND (Degree of Board Independence)					+
	DBVAL (Total long-term debt/total assets)					***
	PAY (Jensen–Murphy pay-performance sensitivity)					-
	OWN (Percentage of the firm's outstanding shares owned by the CEO at the fiscal year end)					-
	BFSIZE (Total number of board members)					+
	QUEBEC (Quebec headquartered firms: dummy variable equal to 1 if the firm is headquartered in Quebec, and 0 otherwise)					***

Researcher		Wang and Davidson	Wang and Davidson	Engel et al.	Cullinan et al.	Switzer
Year		2009	2009	2007	2006	2007
Dependent Variable		CEO tenure	CEO turnover	cumulative abnormal return measured in the (-1, +1) window around going-private announcement	misstatement (0, 1) estimate ( $p > x^2$ )	Tobin's Q
Independent Variables	LISTING (Cross-listing: dummy variable equal to 1 if the firm is also listed on a U.S. stock exchange, and 0 otherwise)					+

	SHRRTS (Shareholder rights: dummy variable equal to 1 if the firm has a single class share structure, and 0 otherwise)				-
	PACQ (5-year corporate control activity)				+**
	SOXLEY (Dummy variable for post-SOX time period, equal to 1 for post-2002 observations, and 0 otherwise)				+
	USSOXLEY (Interactive variable, equal to SOXLEY* LISTING)				+***

Researcher		Johnston and Madura	Johnston and Madura	Cohen et al.	Cohen et al.
Year		2009	2009	2008	2008
Dependent Variable		Initial return	one-year market-adjusted buy-and-hold return	<i>ABS_DA</i> (the absolute value of discretionary accruals)	<i>R_CFO</i> represents the level of abnormal cash flows from operations
Independent Variables	SOX	_-***	+***	_-***	+**
	UP (the Carter-Manaster rank)	-	+***		
	VC (a dummy variable equal to one if the firm had VC investment)	+***	-		
	Size (the log of the gross proceeds raised in the IPO)	+***	_-***		
	HOT (the average initial return for IPOs in the previous 30 days)	+***	_-***		
	Bubble (a dummy variable equal to one if the IPO occurred during 1999–2000)	+***	+		
AP (a dummy variable equal to one if the auditor is one of the Big 4+)		_-***	+	_-***	-

Researcher		Johnston and Madura	Johnston and Madura	Cohen et al.	Cohen et al.
Year		2009	2009	2008	2008
Dependent Variable		Initial return	one-year market-adjusted buy-and-hold return	<i>ABS_DA</i> (the absolute value of discretionary accruals)	<i>R_CFO</i> represents the level of abnormal cash flows from operations
Independent Variables	Industry (a dummy variable equal to one if the firm is in an emerging industry (determined by SIC code))	+***	-.***		
	Age (the log of the number of days from founding to offer date)	-.***	+		
	Sales (the log of sales from the year prior to the offer date)	+	+***		
	OH (the number of shares retained divided by the number of shares offered)	+***	+***		
	Uses (the number of uses of gross proceeds)	-.*	-.***		
	DCACC (represents discretionary current accruals, which is measured by the Jones model)	-	-		

7.5		Johnston and Madura	Johnston and Madura	Cohen et al.	Cohen et al.
Year		2009	2009	2008	2008
Dependent Variable		Initial return	one-year market-adjusted buy-and-hold return	<i>ABS_DA</i> (the absolute value of discretionary accruals)	<i>R_CFO</i> represents the level of abnormal cash flows from operations
Independent Variables	<i>ΔGDP</i> (percent change in the real gross domestic product from previous year)			-.***	-.***
	<i>MKTVAL</i> (market value of equity)			-.***	+**
	<i>Time</i> (a trend variable equal to the difference between the current year of observation and 1987)			+***	-.**
	<i>SCA</i> (a dummy variable equal to 1 if the year of observation is in 2000 or 2001)			-	-.*

Researcher		Johnston and Madura	Johnston and Madura	Cohen et al.	Cohen et al.
Year		2009	2009	2008	2008
Dependent Variable		Initial return	one-year market-adjusted buy-and-hold return	<i>ABS_DA</i> (the absolute value of discretionary accruals)	<i>R_CFO</i> represents the level of abnormal cash flows from operations
Independent Variables	<i>BONUS</i> (the average bonus compensation as a proportion of total compensation received by the CEO and CFO of the firm)			+	-.***
	<i>BONUS</i> x <i>SCA</i>			-	+
	<i>BONUS</i> x <i>SOX</i>			+	+*
	<i>UN_OPTION</i> (the number of unexercised options (excluding options grants in the current period) that the executive held at year-end that had not vested scaled by total outstanding shares of the firm)			+***	-.***
	<i>UN_OPTION</i> x <i>SCA</i>			-.*	+**
	<i>UN_OPTION</i> x <i>SOX</i>			-.***	+***
	<i>GRNT_OPTION</i> (new option grants made during the current period scaled by total outstanding shares of the firm)			+***	+
	<i>GRNT_OPTION</i> x <i>SCA</i>			-	+*



Researcher		Johnston and Madura	Johnston and Madura	Cohen et al.	Cohen et al.
Year		2009	2009	2008	2008
Dependent Variable		Initial return	one-year market-adjusted buy-and-hold return	<i>ABS_DA</i> (the absolute value of discretionary accruals)	<i>R_CFO</i> represents the level of abnormal cash flows from operations
Independent Variables	<i>GRNT_OPTION</i> x <i>SOX</i>			_-***	+
	<i>EX_OPTION</i> (the number of unexercised options that the executive held at year-end that were vested scaled by total outstanding shares of the firm)			+*	-*
	<i>EX_OPTION</i> x <i>SCA</i>			-	-
	<i>EX_OPTION</i> x <i>SOX</i>			_-*	+
	<i>OWNER</i> (the sum of restricted stock grants in the current period and the aggregate number of shares held by the executive at year-end (excluding stock options) scaled by total outstanding shares of the firm)			+***	-***
	<i>OWNER</i> x <i>SCA</i>			+	+***
	<i>OWNER</i> x <i>SOX</i>			_-***	+***
	<i>ABS_DA</i>				_-***

Researcher		Gao et al.	Gao et al.	Gao et al.	Gao et al.
Year		2009	2009	2009	2009
Dependent Variable		$\Pr(Less75_{t+1} = 1)$	$Chinv_t$	$\Pr(Cashpay_t = 1)$	$\Delta \ln(NonAffl_t)$
Independent Variables	$NA_t$ (non-accelerated filers measured at time 1)	-	+***	+**	-
	$Event_t$ (the value of one if year $t$ is post-SOX (June 1, 2003 to December 31, 2005) and zero if year $t$ is pre-SOX (January 1, 1999 to September 1, 2001))	-***	+**	-	+***
	$Event_t * NA_t$ (the difference in the likelihood of staying small between non-accelerated filers and accelerated filers during the event period)	+***	-	+*	-
	$Mkt\_Rf_t$	-***			
	$SMB_t$	-***			
	$HML_t$	-***			
	$MOM_t$ (the momentum factor)	-***			
	$Indret_t$ (industry returns ( $t$ ) during firm-year $t$ (from time 1 to time 2))	-***			

Researcher		Gao et al.	Gao et al.	Gao et al.	Gao et al.
Year		2009	2009	2009	2009
Dependent Variable		$\Pr(Les_{s75t+1} = 1)$	$Chinv_t$	$\Pr(Cashpay_t = 1)$	$\Delta \ln(NonAffl_t)$
Independent Variables	$NALrg_t$ (indicator variable for larger non-accelerated filers)		***	-	+
	$Event_t * NALrg_t$ (the difference in the differences between the large and small non-accelerated filers over the two time periods)		***	***	**
	$ROA_{t-1}$ (return on assets)		***	***	***
	$MB_{t-1}$ (market-to-book ratio)		**	***	***
	$Sales_{t-1}$		***	+	***
	$FCFs_{t-1}$ (free cash flows)		+	+	***
	$Leverage_{t-1}$		-	**	***
	$Older_{t-1}$ indicator for older firms		+	***	***
	$Stdret_{t-1}$ stock return standard deviation		-	***	***
$lag(dependent\ variable)$			***	***	***

Researcher		H. Chang et al.	H. Chang et al.	H. Chang et al.
Year		2009	2009	2009
Dependent Variable		Productivity change	Efficiency change	Technical change
Independent Variables	A&A% (proportion of accounting & auditing services (A&A) revenue)	+	+	-
	MAS% (proportion of management advisory services (MAS) revenue)	+	+	-
	$\Delta A\&A\%$ (the change in percentage revenues from A&A services between the pre-SOX and the post-SOX period)	+	+	+
	$\Delta MAS\%$ (the change in percentage revenues from MAS % between the pre-SOX period and the post-SOX period)	+	+	+
	BIG 4 (a dummy variable for big 4 firms)	+	+	+

Researcher		Hochberg et al.	Hochberg et al.
Year		2009	2009
Dependent Variable		Cumulative Weekly Excess Return over the Riskless Rate during the Lead-Up Period	Cumulative Weekly Excess Return over the Riskless Rate during the Post-passage Period
Independent Variables	Lobbied against Enhanced Disclosure and PCAOB	+***	-
	Lobbied against Corporate Responsibility	-	-
	Lobbied against Auditor Independence	+	-

Researcher		Ashbaugh-Skaife et al.	Ashbaugh-Skaife et al.	Akhigbe & Martin
Year		2009	2009	2008
Dependent Variable		<i>I_RISK</i> Idiosyncratic Risk	<i>CC</i> cost of equity	Total risk shift, $\Delta \sigma_F^2$
Independent Variables	<i>ICD</i> internal control problem	+**	+**	
	<i>STD_CFO</i> (standard deviation of cash flow from operations defined as cash flows from operations divided by total assets calculated using 2004 and the prior four fiscal years, requiring a minimum of three years of data)	+***		
	<i>LEV</i> (total debt divided by total assets)	-***		+***
	<i>CFO</i> (cash flow from operations divided by total assets at the firm's 2004 fiscal year-end)	-		

Researcher		Ashbaugh-Skaife et al.	Ashbaugh-Skaife et al.	Akhigbe & Martin
Year		2009	2009	2008
Dependent Variable		<i>I_RISK</i> Idiosyncratic Risk	<i>CC</i> cost of equity	Total risk shift, $\Delta \sigma_r^2$
Independent Variables	<i>BM</i> (book value of equity divided by market value of equity at the firm's 2004 fiscal year-end)	-***	+***	
	<i>SIZE</i> (natural log of market value of equity at the 2004 fiscal year-end)	-***	-**	
	<i>DIVPAYER</i> = 1 if the firm pays dividends in its 2004 fiscal year, and 0 otherwise	-***		
	<i>RET</i> (buy-and-hold return over the firm's fiscal year)	+***		
	<i>SEGMENTS</i> (number of reported business segments)	-**	-	
	<i>FOREIGN_SALES</i> =1 if the firm reports foreign sales, and 0 otherwise	-	-*	
<i>M&amp;A</i> = 1 if the firm has a merger or acquisition from 2001 to 2003, and 0 otherwise		+**	-*	

Researcher		Ashbaugh-Skaife et al.	Ashbaugh-Skaife et al.	Akhigbe & Martin
Year		2009	2009	2008
Dependent Variable		<i>I_RISK</i> Idiosyncratic Risk	<i>CC</i> cost of equity	Total risk shift, $\Delta \sigma_r^2$
Independent Variables	<i>RESTRUCTURE</i> = 1 if the firm restructures as indicated by a nonzero amount in any of the Compustat data items #376, 377, 378, or 379 from 2001 to 2003, and 0 otherwise	+***	-	
	<i>RGROWTH</i> (decile rank of average sales growth rate from 2001 to 2003)	+***	+***	
	<i>INVENTORY</i> (average of inventory to total assets from 2001 to 2003)	-	+	
	<i>%LOSS</i> (proportion of years from 2001 to 2003 that the firm reports negative earnings)	+***	+***	
	<i>RZSCORE</i> (decile rank of Altman [1980] z-score)	-***	-***	
	<i>AUDITOR_RESIGN</i> = 1 if the auditor resigns in 2003, and 0 otherwise (8-K filings)	+	+	

Researcher		Ashbaugh-Skaife et al.	Ashbaugh-Skaife et al.	Akhigbe & Martin
Year		2009	2009	2008
Dependent Variable		<i>I_RISK</i> Idiosyncratic Risk	<i>CC</i> cost of equity	Total risk shift, $\Delta \sigma_r^2$
Independent Variables	<i>RESTATEMENT</i> = 1 if the firm has a restatement or an SEC Auditing Enforcement Release from 2001 to 2003, and 0 otherwise	+	-	
	<i>AUDITOR</i> = 1 if firm's auditor for 2003 (Compustat #149) is Price waterhouse Coopers, Deloitte & Touche, Ernst & Young, KPMG, Grant Thornton, or BDO Seidman, and 0 otherwise	-	-	
	<i>INST_CON</i> = (percentage of shares held by institutional investors divided by the number of institutions owning its stock (Thomson Financial Securities data) multiplied by 100)	-.***	-.*	
	<i>LITIGATION</i> = 1 if the firm is in a litigious industry, and 0 otherwise.	+.***	+.***	

Researcher		Ashbaugh-Skaife et al.	Ashbaugh-Skaife et al.	Akhigbe & Martin
Year		2009	2009	2008
Dependent Variable		<i>I_RISK</i> Idiosyncratic Risk	<i>CC</i> cost of equity	Total risk shift, $\Delta \sigma_r^2$
Independent Variables	<i>BETA</i>		+.***	
	<i>I_RISK</i>		+.***	
	<i>Disclosure</i>			-.***
	<i>Board Monitoring</i>			-
	<i>Ownership</i>			+.*
	<i>CEO Involvement</i>			+
	ROE (EBIT to common equity ratio)			-
	LNSIZE (natural log of equity market value)			-
	MVBV (equity market value to book value ratio)			+.***

Researcher		Collins et al.	Piotroski and Srinivasan	DiGabriele
Year		2008	2008	2008
Dependent Variable		CFO turnover	Prob(U.S. Listing = 1)	Price
Independent Variables	<i>RESTATE</i> (a categorical variable coded 1 if it is a restate-ment firm, 0 if a control firm)	+		
	<i>POST</i> (a dummy variable coded 1 in the post-SOX period (2002–2003), 0 otherwise)	-	-***	
	<i>RESTATE* POST</i>	+		
	<i>CEOTURNOVER</i> (coded 1 if the CEO was terminated twenty-four months after the restatement announcement date, 0 otherwise)	+		
	<i>BANKRUPT</i> (a dummy varia-ble coded 1 if the firm files for chapter 11 within twenty-four months after the restatement, 0 otherwise)	+		
	<i>MERGER</i> (a dummy variable coded 1 if the firm is involved in a merger or acquisition within twenty-four months after the restatement)	+		

Researcher		Collins et al.	Piotroski and Srinivasan	DiGabriele
Year		2008	2008	2008
Dependent Variable		CFO turnover	Prob(U.S. Listing = 1)	Price
Independent Variables	BHAR12PRIOR (market-adjusted buy and hold returns estimated over months -12 to -1 relative to the restatement month)	-		
	BHAR12AFTER (market-adjusted buy and hold returns estimated over months +1 to +12 relative to the restatement month)	-		
	<i>ROA</i>	-	+	
	<i>CFOAGE</i>	+		

	(the age of the CFO)			
	<i>CFOTENURE</i> (the number of years the CFO has been in office)	-		
	<i>Canada</i>		+***	
	<i>Ireland</i>		-***	
	<i>Israel</i>		+***	
	<i>EU</i>		+	
	<i>Emerging</i> = one if the firm's host country is not classified as a developed economy by the World Bank		-***	
	<i>CodeLaw</i>		-***	
	<i>Socialist</i>		-	

Researcher		Collins et al.	Piotroski and Srinivasan	DiGabriele
Year		2008	2008	2008
Dependent Variable		CFO turnover	Prob(U.S. Listing = 1)	Price
Independent Variables	<i>Diff_Liquidity</i> (measured as the value of shares traded (scaled by the exchange's market capitalization))		+	
	<i>Diff_IndexReturn</i> (the difference in <i>IndexReturn</i> , between a given U.S. exchange and the corresponding U.K. alternative)		-	
	<i>Diff_P/E_Index</i> (the relative difference in pricing premium, as implied by the exchange's current pricing multiple <i>P/E_Index<sub>t</sub></i> , between a U.S. exchange and the corresponding U.K. exchange.		+	
	<i>Diff_DomesticList</i> , (measured as the difference in the number of new domestic firms listing on a specific U.S. and U.K. exchange ( <i>DomesticList<sub>t</sub></i> ) in the month of the foreign listing)		+***	



Researcher		Collins et al.	Piotroski and Srinivasan	DiGabriele
Year		2008	2008	2008
Dependent Variable		CFO turnover	Prob(U.S. Listing = 1)	Price
Independent Variables	<i>NonExchUSList</i> , (which is measured as the number of foreign firms listing in the United States via a level I (OTC listings) or level IV (private placements) ADR listing in the month of the listing event)		+**	
	<i>Big5</i> (to capture whether the firm employed a Big 5 auditor around the time of the listing)		+***	
	<i>Issuance_Home</i> (to capture the firm raised equity capital in their home, respectively, in the one-month period surrounding the foreign listing)		-	
	<i>Issuance_Host</i> (to capture the firm raised equity capital in their host market, respectively, in the one-month period surrounding the foreign listing)		+***	

Researcher		Collins et al.	Piotroski and Srinivasan	DiGabriele
Year		2008	2008	2008
Dependent Variable		CFO turnover	Prob(U.S. Listing = 1)	Price
Independent Variables	<i>Diff_Trade</i> (measured as the sum of imports and exports between the home country and the United States minus the sum of imports and exports between the home country and the United Kingdom, scaled by the home country's gross domestic product (GDP), in the year of listing)		+*	
	<i>Log(Assets)</i>		+***	+***
	<i>Log(1+BTM)</i>		-	
	Acquired firm public, pre-SOX			+***
	Acquired firm public, post-SOX			+***
	Buyer public			+
	Stock			+***
	Risk premium			-*

Researcher		Choi et al	Choi et al
Year		2008	2008
Dependent Variable		$R_{pr}$ (Weak shareholder rights)	$R_{pr}$ (Strong shareholder rights)
Independent Variables	$\beta_0$ (the intercept term)	-	+
	$\beta_1$ (measures the systematic risk of the portfolio)	+***	+***
	$\beta_2$ (the coefficient on the lagged CRSP market index)	-	+
	D1 (2/14/02)	+	+
	D2 (2/28/02)	-	+
	D3 (3/08/02)	+	-
	D4 (4/24/02)	+	+***
	D5 (6/18/02)	+	+
	D6 (6/20/02)	+	-
	D7 (6/25/02)	-	+
	D8 (6/27/02)	+	_**
	D9 (7/15/02)	-	_***
	D10 (7/16/02)	_**	_***
	D11 (7/19/02)	_*	-
D12 (7/24/02)	+	+	
D13 (7/25/02)	+***	+	

Researcher		Jain et al.
Year		2008
Dependent Variable		Log depth (\$) to spread (%) ratio (direct liquidity measure)
Independent Variables	Financial scandals	_***
	Sarbanes-Oxley (SOX) Act legislation	_***
	SEC rules implementation	+***
	Inverse of price midpoint	_***
	Price volatility	_*
	Log of dollar volume	+***
	Log of market capitalization	-

Researcher		Akhigbe and Martin
Year		2006
Dependent Variable		$R_{pt}$ (the portfolio return)
Independent Variables	$\beta_0$ (the intercept)	-.***
	$\beta_1$ (the portfolio's beta)	+***
	$\lambda_1$ (coefficient measuring the abnormal return for event 1)	-
	$\lambda_2$ (coefficient measuring the abnormal return for event 2)	+
	$\lambda_3$ (coefficient measuring the abnormal return for event 3)	+**
	$\lambda_4$ (coefficient measuring the abnormal return for event 4)	-
	$\lambda_5$ (coefficient measuring the abnormal return for event 5)	+***
	$\lambda_6$ (coefficient measuring the abnormal return for event 6)	+***
	$\beta_2$ (shift in systematic risk in the post-SOX period)	+***

\*\*\* significant at 1% level, \*\*significant at 5% level, \* significant at 10% level

Sources: research surveyed by the authors of this chapter

*Chapter 2*

## **A UTILITY FUNCTION APPROACH FOR EVALUATING COUNTRY PERFORMANCES WITH DEA – THE TWIN GOALS OF DECENT WORK AND A FAIR GLOBALIZATION**

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### **ABSTRACT**

Since 1999, the International Labor Office (an arm of the UN based in Geneva) has conducted a series of studies of decent work and of the effects of globalization. In 2004, the organization posed the global challenge of tempering the perceived effects of globalization, aiming for A Fair Globalization benefiting men and women in rich and poor countries alike. In earlier studies, two of the present authors rated the performance of some sixty-odd countries from all continents in terms of their achievements of Decent Work, and of A Fair Globalization. The analysis was carried out employing Data Envelopment Analysis (DEA), to assign an “efficiency rating” to each country. Efficiency is assigned the rating of 100 percent. Inefficiency is assigned a rating less than 100 per cent. The present study extends this work in several ways: we interpret the efficiency rating as a measure of effectiveness; we estimate a generalized social preference function that is Cobb-Douglas (rather than the linear utility function of all outputs that is implicit in standard DEA); and we present an extended joined causal structure of nested social preference functions, employing the methods of two-stage DEA.

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## 1. BACKGROUND AND THE TASK AHEAD

The term “Decent work” was coined by the International Labor Organization, Geneva, to describe a desirable mix of conditions in national labor markets, including the availability of employment and the demographic makeup of those employed. In an earlier study (Thore and Tarverdyan, 2009), a social preference function of the various dimensions of Decent Work was estimated for 61 countries from all continents. The calculations took the form of estimating a generalized input-output relationship, employing Decent Work as the outputs and a set of factors measuring the effects of globalization and economic and social policy parameters as inputs.

In an accompanying piece of work (Thore and Tarverdyan, 2008), a related data base was used to estimate “A Fair Globalization” as another social preference function, blending aspects of the open and unrestricted economy with measures of social protection. This time data for 58 countries were employed, again estimating the frontier of a generalized input-output function, using the dimensions of a fair globalization as outputs. The inputs listed a set of factors measuring the degree of receptivity of the winds of globalization of each country.

As the first wave of anti-globalization demonstrations now seems to have faded, most people seem to accept that the trend towards greater interconnectedness between the world’s major economies is unlikely to be reversed. Instead, there is an increased focus on the resulting winners and losers, and the various ways that power is being transferred and redistributed in our ever more connected global polity. The rankings presented in the two papers mentioned above go some way toward assessing these matters numerically. The “winner” countries are assessed an efficiency rating or index of 100 per cent; the “loser” countries are rated at less than 100 per cent, indicating a less than optimal policy regime.

The statistical estimations in both papers drew on a frontier technique called data envelopment analysis or DEA, for short. It fits a piecewise linear envelope or frontier to the given data (for comprehensive treatments, see [5], [7] and [8]). The basic idea is easy to explain. Given a collection of points in a multidimensional space (each point representing the input and output observations of a single country), DEA calculates its upper convex hull or “envelope”. The frontier indicates a normative ideal. Countries located at the frontier are optimally adjusted. They are Pareto efficient. Countries below the frontier are inefficient.

DEA also introduced a measure of effectiveness which is defined as follows:

*Definition of effectiveness:* Effectiveness consists of

1. Ability to state goals
2. Ability to achieve the stated goals.

This is in contrast to the definition of efficiency which is as follows:

*Definition of efficiency:* Efficiency relates to

1. Benefits realized
2. Resources used.

See Cooper, Seiford and Tone (2006) for a detailed discussion.

The Decent Work rankings and the rankings of A Fair Globalization both featured financial, social and economic policy variables as outputs (=goals). In each case, and for each country, the implied social preference function was obtained as the virtual value of all output, using the virtual multipliers supplied by DEA as prices. The implied social preference function or goal function was linear. For instance, using both the openness of trade and the evenness of the vertical income distribution as indices of A Fair Globalization, a given increase of income inequality could then always be offset by a fixed amount of boosted exports or foreign investments.

The reality, of course, is that in any country the scope for trade-offs between income inequality and foreign trade is quite limited. To the extent that trade-offs exist at all, they are political, not economic. They reflect the willingness of the political body to accept a temporary buildup of profits in the export industries and an influx of foreign capital as long as there remains a reasonable expectation that increased incomes eventually will “trickle down” to the income earners at large. As demonstrated by vociferous demonstrations by anti-globalization campaigners world-wide, however, wage-earners and their protagonists easily run out of patience. To model such attitudes, a much more realistic assumption would be to assume that the marginal rate of substitution between the economic performance in conventional terms and income inequality is rapidly increasing .

Seen in a more general perspective, then, our present effort amounts to rediscovering the interpretation of the DEA measures in terms of effectiveness rather than just efficiency. To accomplish this, one obviously needs a more general class of utility functions (read: goal functions of the outputs, or social preference functions) than additive ones. In Section 2 we demonstrate the use of the Cobb Douglas utility function for this purpose. That is, we will write the goal function or social preference function as Cobb Douglas in the goals or social indicators. Just as in the original Charnes, Cooper, Rhodes (1978) paper, the DEA model is thereupon developed as a case of fractional programming (maximizing effectiveness).

As we shall see, this brings us to a variant of the well-known multiplicative model of DEA, which essentially involves running the standard DEA calculations with all variables expressed in their logarithms.

Applying the techniques of DEA to the field of social and economic policy, one moves beyond the simple interpretation of a conventional production function. In particular, the list of inputs and outputs now becomes very much a matter of model design, reflecting the ambitions of the model builder. For earlier applications of DEA assessing the economic and social performance of entire nations, some key references are Golany and Thore [9], [10], [11] , cf. also [15] and [16].

Causal mechanisms in social and policy areas are often entangled, involving clusters of variables interacting in many different ways. In our case, many output characteristics of a Fair Globalization can be seen as inputs into Decent Work. So, what we are facing in this instance is a case of two *nested social preference functions* and two nested calculations of effectiveness. Fortunately, such cascading arrangements are well-known in the literature on hybrid DEA models. Our calculations in Section 3 take the form of two-stage DEA, employing a multiplicative formulation at each stage. Two successive DEA frontiers will be fitted to the statistical observations, with the economic and social indicators of A Fair Globalization being the output variables of the first-stage frontier, at the same time some of them serving as inputs into the second-stage frontier fitted to Decent Work. More precisely,

the preference function for A Fair Globalization includes two characteristics of the openness of trade (exports and foreign direct investments), mirroring the globalization-induced transfers of wealth between nations. The very same data on the openness of trade are used as inputs determining Decent Work.

For a survey of the two-stage DEA model and other hybrid models, see e.g. [5] pages 432- 434 and [1]. The two steps or “stages” are sequential or cumulative in the sense that (some of) the outputs from the first stage are fed as inputs into the second stage. From a causal point of view, the two-stage DEA model joins together two separate cause-and-effect mechanisms into a larger comprehensive causal process. But this integrated interpretation is only conceptual: in terms of actual computations, the two-stage model collapses into two consecutive conventional models of one-stage DEA.

Section 4 discusses whether the goals of A Fair Globalization and Decent Work are compatible with each other, or whether they are inherently contradictory. Our calculations are reported in Section 5. Some final comments are offered in Section 6.

## **2. ESTIMATING A COBB-DOUGLAS GENERALIZED SOCIAL UTILITY FUNCTION BY DEA**

Since the works of Tinbergen on economic policy [19], [20] -- see also the review article [2] -- it has been a commonplace in the economics literature to postulate the presence of a social welfare function expressed as a function of an array of suitable economic goals. These would include aims such as international peace, maximum real expenditure per capital, and the distribution of income over social groups and countries. Tinbergen suggested maximizing social welfare subject to constraints imposed by technology, resources and to some extent political feasibility.

The obvious difficulty with such sweeping generalizations is that it becomes next to impossible to carry out such maximization in empirical terms; to this day, Tinbergen’s ideas have remained a lofty but unattained ideal of calculation. In the pages to follow, we shall present a set of numerical calculations that attempt to breathe empirical life into the constrained programming problem suggested by Tinbergen. In so doing, we shall select a set of goals for economic and social policy relating to labor markets, globalization and social conditions in developed and less developed countries alike. In brief, we intend to assemble a social preference function featuring dimensions that reflect the working program of the ILO and its efforts in promoting Decent Work and A Fair Globalization. As causal variables (“instruments” in Tinbergen’s parlance) we employ a range of economic and social policy variables. Collecting data for the goals and the instruments in an array of countries from all continents, we estimate an inter-country Cobb-Douglas generalized welfare function.

To put our work in perspective, we would also like to mention many “Quality of Life” studies sponsored and supported by the U.S. National Science Foundation. For instance, Terleckyj (see [18]) employed variables like crime rates and the chance of an individual income falling by more than 2 ranks (as a measure of “income stability”), GDP per capita, etc. At the time, the U.S. Government picked up on this with a series of reports on social indicators (for a brief discussion see the definition of “social accounting” in [6]).

Following up on Tinbergen's original intentions, we shall indeed maximize a generalized welfare function subject to constraints, drawing on the techniques of Data Envelopment Analysis (DEA). The calculations will be made for each one of a set of countries brought from all continents. Furthermore, and breaking with the received doctrines of economic equilibrium, DEA permits for some decision-makers (here: countries) to fall short of the maximization of social preference; optimization and the attainment of the optimal equilibrium point is thus not assumed but rather considered as a matter that needs to be investigated empirically. As it turns out, some countries are indeed successful in maximizing social preference, but others fall short of optimum. Extending the standard approach of DEA to the calculation of a social utility (welfare) function and to the whole realm of social accounting, quality of life measurements etc., we shall show how it is possible to take the step from "efficiency" to "effectiveness". Pareto efficiency in economics is concerned only with efficiency, i.e., the application of resources to alternative possible uses. As previously noted, effectiveness is concerned with the attainment of explicitly stated goals. In our case the goals are stated by the ILO and its subsidiary organizations. We are concerned with the extent to which these goals (usually multiple goals) are attained or exceeded.

In order to accomplish what has now been indicated, denote the social utility function  $V(Y)$  where  $Y$  is a column vector of welfare indicators. Let the indicators be causally related to a set of policy parameters ("instruments") which are collected in the column vector  $X$ . Furthermore, we shall associate each choice of the policy parameters  $X$  with an attendant virtual social cost written  $U(X)$ . Assume that  $U(X)$  and  $V(Y)$  are both Cobb-Douglas,

$$(1a) \log U(X) = v \log X$$

$$(1b) \log V(Y) = \mu \log Y$$

where  $v$  and  $\mu$  row vectors of virtual weights or "multipliers", as obtained from DEA. (The notations  $\log X$  and  $\log Y$  mean the column vectors of the logarithms of the individual elements.) The interpretation of  $U(X)$  will become evident shortly.

Let there be  $i = 1, 2, \dots, n$  countries to be programmed. For each country let  $i = 0$  be the country being evaluated, for which we pose the Cobb-Douglas fractional programming problem

$$(2) \max \mu \log Y_0 / v \log X_0$$

subject to

$$\mu \log Y_i / v \log X_i \leq 1, \quad i = 1, 2, \dots, n$$

$$\mu \log Y_0 = 1$$

$$\mu, v > 0$$

(For simplicity, we use the notation  $\mu, v > 0$  as a shorthand expression of the standard requirements featured in the DEA calculations that the two unknowns are not to exceed some suitable non-Archimedean infinitesimally small quantity.)

In words, one wants to determine the virtual weights  $\mu$  and  $v$  so that the virtual effectiveness ratio  $\mu \log Y_0 / v \log X_0$  for the country currently evaluated becomes as large as possible, while seeing to it that, using the same weights to calculate the effectiveness ratio of every other country, none of these ratios can exceed 1. Furthermore, using the so-called



”output-oriented” version of DEA, as we shall do here, the weights of the policy instruments are normalized to meet the condition  $\mu \log Y_0 = 1$ . Using the theory of fractional programming as given in Charnes, Cooper and Rhodes [4], a linear programming equivalent is then immediately obtained as

$$\begin{aligned}
 (3) \quad & \min v \log X_0 \\
 & \text{subject to} \\
 & -\mu \log Y_i + v \log X_i \geq 0, \quad i = 1, 2, \dots, n \\
 & \mu \log Y_0 = 1 \\
 & \mu, v > 0
 \end{aligned}$$

Program (3) is identical to “the output-oriented CCR dual” listed in [5], page 39 with the given observations replaced by their logarithms. It is not the same as the “invariant multiplicative dual” listed on page 29 in the same reference which starts out from the “additive” version of DEA. Many multiplicative versions of DEA are possible; our own choice was dictated by two considerations: we wanted to re-establish contact with the effectiveness interpretation in [4] originally derived from engineering considerations, and we wanted a social welfare function with non-constant rates of marginal substitution between the various indicators employed.

Any CCR model exhibits constant returns to scale. So, does program (3). That is, increasing each input  $\log X_i$  by 1 percent, the logarithm of the optimal output vector  $\log Y_i$  increases also by 1 percent. Note, however, that there is no immediate interpretation of this property in terms of the inputs and the outputs themselves.

The dual program to (3) is

$$\begin{aligned}
 (4) \quad & \max \Phi \\
 & \text{subject to} \\
 & \Phi \log Y_0 - \sum_i (\log Y_i) \lambda_i \leq 0 \\
 & \sum_i (\log X_i) \lambda_i \leq \log X_0 \\
 & \lambda \geq 0
 \end{aligned}$$

Here  $\Phi$  is derived from the input norming condition  $\mu \log Y_0 = 1$  and in the common fashion the  $\lambda_i$  are the weights of the peers of the current observation  $(\log X_0, \log Y_0)$ . According to the dual theorem of linear programming,  $\min v \log X_0 = \max \Phi$ .

Decent work is held to be the converging focus of the objectives of the ILO: the promotion of rights at work, employment, social protection, and social dialogue (see [12] and [13]). The UN Millennium Declaration set out a series of millennium development goals (MDGs) that include poverty reduction, full and productive employment and decent work for all, educational goals, health goals, the environment and so on. At the 2005 World Summit, the heads of states, reviewing the progress on the Millennium Declaration, stated their strong support to fair globalization and the need “to make the goals of full and productive employment and decent work for all, including women and young people” a central objective of national and international policies [23]. These constitute the goals we use to determine our measure of effectiveness in accordance with the definitions given in Section 1.

The important role of employment policy in national development strategies is now well recognized. Improving the levels and conditions of employment has been identified as one of

the most effective means of achieving the MDGs. Commitment to this objective was further endorsed during the 8<sup>th</sup> session of the UN Committee for Development Policy and the 2006 session of the UN Economic and Social Council (see ref. [24]) and has mainstreamed the concept of decent work into the regular activities of relevant UN agencies.

In subsequent sections, we shall treat Decent Work as a social utility function. In Thore and Tarverdyan (2009), the following three causal indicators were employed

$$(5) \quad (EMP, NOPOV, WOM)$$

where

- EMP represents the total gainful employment in a country
- NOPOV is a measure of social protection
- WOM is a measure of gender equality

More precisely, the indicators were defined as follows: EMP equals 1 minus the percentage unemployment rate, NOPOV is 100 minus the percentage of the population with an income below US \$2 per day, and WOM is measured as the percentage of the working population who are women.

Where unemployment is low, low-quality low-income work often takes its place. Also, large numbers of workers - - usually women -- are excluded from the statistics. However, gender is a ubiquitous source of labor market inequality and women form the majority of unpaid, atypical or discouraged workers. (See [12] pp. 21 and 28).

We now form the Cobb-Douglas generalized social utility function

$$(6) \quad A EMP^{\mu_1} NOPOV^{\mu_2} WOM^{\mu_3}$$

Here,  $A$  is a constant to be estimated. The coefficients  $\mu_1, \mu_2, \mu_3$  are the elasticities of  $U$  with respect to the three causative factors. If  $\mu_1 + \mu_2 + \mu_3 = 1$  the function exhibits constant returns to scale. If at an optimum  $\mu_1 + \mu_2 + \mu_3 < 1$  there are decreasing returns to scale in the country being evaluated, and if  $\mu_1 + \mu_2 + \mu_3 > 1$  there are increasing returns to scale, see [7], p.49 for the theorem and proof. Taking logarithms

$$(7) \quad \log A + \mu_1 \log EMP + \mu_2 \log NOPOV + \mu_3 \log WOM$$

Turning to the causal background, we list four causal indicators

$$(8) \quad (EXP, FDI, TARIFF, SUB)$$

where

- EXP is exports of goods and services, as a percentage proportion of GDP
- FDI is net foreign direct investment, as a percentage proportion of GDP
- TARIFF represents taxes on international trade, as a percentage proportion of total government revenue
- SUB denotes subsidies and other transfers, as a proportion of total government expenditure

SUB represent subsidies and other government transfers and constitute a powerful and immediate control variable of central governments (the figures that we employ includes all unrequited, non-repayable transfers on current account to private and public enterprises, social security, social assistance benefits and employer social benefits in cash and in kind, also grants to foreign governments and international organizations.)

These factors were chosen to illustrate both the treatment of conventional macroeconomic variables and national and international policy parameters. Exports and FDI are two core reference indicators of economic globalization defined by OECD (see [17]). Trade and investment liberalization can be a powerful force for fostering job creation and poverty reduction. But tariffs may also be used to protect local agriculture and industry, shielding domestic workers from foreign competition. If structured wisely, subsidies could support not only domestic employment but also the quality of work.

Our task is not only to uncover statistical covariability, but to point to the possible design of economic and social policy. The challenge is to identify the best, or optimal, levels of protection/liberalization that will enable countries to integrate into the world economy without compromising the fulfillment of their national sustainable development goals.

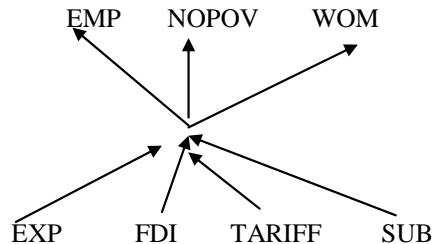


Figure 1. Decent Work, causes and effects.

Figure 1, above traces the causal relations between the variables explaining Decent Work. The effects are the indicators of decent work.

The indicators are collected into the generalized social policy cost function

$$(9) B EXP^{v_1} FDI^{v_2} TARIFF^{v_3} SUB^{v_4}$$

where  $B$  is a constant and  $v_1$ ,  $v_2$ ,  $v_3$  and  $v_4$  are the elasticities with respect to the four causative factors. Taking logarithms

$$(10) \log A + v_1 \log EXP + v_2 \log FDI + v_3 \log TARIFF + v_4 \log SUB$$

The optimal ratio *between expressions (7) and (10)* is the desired measure of the effectiveness of Decent Work policy for the country currently rated.

### **3. DISENTANGLING THE CAUSAL STRUCTURE: A HIERARCHY OF NESTED SOCIAL UTILITY FUNCTIONS AND TWO-STAGE DEA**

Any meaningful discussion of Decent Work needs to relate conditions in labor markets to the effects of globalization. Indeed, after having presented his two initial reports on Decent Work and the Decent Work Deficit in 1999 and 2001 respectively ([13] and [14]), the Director-General of the ILO three years later submitted the report *A Fair Globalization: the Role of the ILO* ([15]). At some length this publication develops the theme that “in order to achieve a Fair Globalization that creates opportunities for all, Decent Work should become a global goal to be pursued by every country and the international community” (*ibid.*, p. 3.)

What is a “fair globalization”? To the World Commission on the Social Dimension of Globalization (see [27]) it blends aspects of the openness of a country to international trade and to international capital markets with indicators of social fairness. The Commission devoted an entire chapter to the subject matter of how countries can introduce fairer rules of competition, redressing inequities in terms of market access in international trade. In the present paper we shall put the equality or skewness of the vertical income distribution in focus. We define a fair globalization for a given country as the maximal level of openness and international competition that is compatible with some given and ruling skewness of the income distribution.

Following Thore and Tarverdyan [21], we shall here employ two factors to measure the openness of an economy,

- Exports of goods and services, as a percentage proportion of GDP (EXP)
- Net foreign direct investment, as a percentage proportion of gross capital formation (FDI).

As an index of social fairness, we select a well-known measure of the equality of the vertical income distribution, viz.

- 100 % minus the Gini index (1-GINI)

The number  $1-GINI = 0$  represents perfect inequality (i.e. one person has all the income) and the number  $1-GINI = 100$  represents perfect equality (all persons have the same income).

Clearly, no fast and robust conclusions can be drawn regarding the net effects of globalization on the Gini index. An increased openness of an economy builds profits and expands employment in the export industries. There will be increased profits, increased dividends, and increased wages being paid in the expanding sectors. But other sectors of the economy that are shielded from competition from abroad may experience little change. Even in the intermediate run, the net effect will then typically be an increased inequality of the vertical income distribution. An important goal of the fairness of globalization must therefore be to establish some kind of trade-off between the positive factors of globalization (EXP and FDI) and the negative ones (the Gini index).

To sum up, to characterize A Fair Globalization we shall use the following (column) vector of indicators

$$(11) (EXP, FDI, 1-GINI)$$

and employ the Cobb-Douglas generalized social utility function

$$(12) A EXP^{\mu_1} FDI^{\mu_2} (1-GINI)^{\mu_3}$$

(For simplicity, we have here used the same notation for the Cobb-Douglas parameters as in (6). No misunderstanding should be possible.) Taking logarithms

$$(13) \log A + \mu_1 \log EXP + \mu_2 \log FDI + \mu_3 \log(1-GINI)$$

Turning to the causal background, we list three causal indicators:

$$(14) (GROWTH, FORMAL, 1-TARIFF)$$

where

- The annual growth of GDP (GROWTH) is a proxy for the degree of modernization of a country,
- The degree of monetization of the economy is measured as 1 minus the informal economy as a percentage of GDP (FORMAL)
- The degree of trade liberalization is measured as 1 minus the proportion of GDP collected as trade duties (1– TARIFF).

The three factors illustrate the impact of conventional macroeconomic variables (GROWTH), social conditions (FORMAL), and national and international policy parameters (1– TARIFF). The same list of factors was used in Thore and Tarverdyan [21].

Figure 2 illustrates the causal tree determining a Fair Globalization.

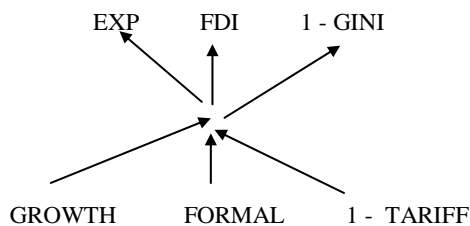


Figure 2. A Fair Globalization, causes and effects

The indicators are collected into the generalized social policy cost function

$$(15) B GROWTH^{v_1} FORMAL^{v_2} (1-TARIFF)^{v_3}$$

where  $B$  is a constant and  $v_1$ ,  $v_2$ , and  $v_3$  are the elasticities with respect to the three causative factors. Taking logarithms

$$(16) \quad \log B + v_1 \log GROWTH + v_2 \log FORMAL + v_3 \log(1-TARIFF)$$

The optimal ratio between expressions (13) and (16) is the desired measure of the effectiveness of Fair Globalization policy for the country being rated.

The two variables EXP and FDI serve as causes in Figure 1 and as effects in Figure 2. Figure 2 thus digs deeper than Figure 1, searching for an explanation of the factors earlier used to determine Decent Work.

The variable TARIFF in Figures 1 and 2 plays an interconnected role in the causal system. On the one hand, *lower* tariffs encourage globalization and with it a more open economy (Figure 2). An open economy creates more domestic jobs in the export sector. On the other hand, *higher* tariffs may be used to shield domestic workers from foreign competition and would thus promote decent work (Figure 1). So, are higher tariffs good or bad?

To illustrate the dilemma, we present a causal schema encompassing the two mechanisms of Figure 1 and 2, bringing together the entire causal structure described so far. The result takes the form of a causal hierarchical system or, simply, a causality map, see Figure 3. The directed links indicate causal relationships (from cause to effect). The top part shows the causal determination of the indicators of Decent Work. The lower part illustrates the causal determination of A Fair Globalization.

Large and complex causality structures are well known features of *multi-criteria analysis* (for a brief introduction, see e.g. [3]). The causality map in Figure 3 is an example of *cognitive mapping*, highlighting the structure between the various variables of the decision context. The field of investigation may often feature causal trains involving a very large number of variables. See the multi-hierarchical cognitive maps indicated in earlier studies (Figure 2 in [21] and Figure 1 in [22]). Multi-criteria analysis proceeds by building one or several *value functions*, measuring the attractiveness of groups of variables. But there are usually no objectively given value functions. Instead, it is up to the analyst to search for a reasonable chain of causality, building utility via a step-wise synthesizing process.

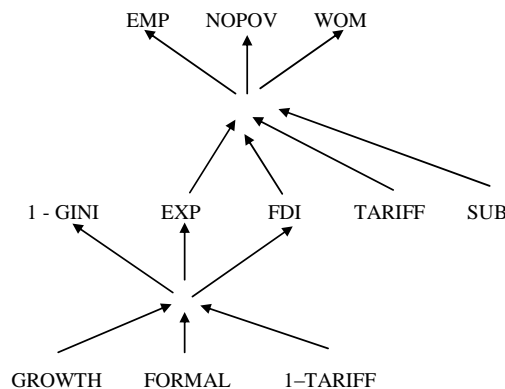


Figure 3. Decent Work and a Fair Globalization; the causal tree of two-stage DEA

The hierarchy in Figure 3 implies the presence of two *nested social utility functions*. The top-layer value function would be the utility function (6), describing Decent Work as a trade-

off between employment, social protection and the participation of women in the labor force. The second-layer value function represents the variables in utility function (12), describing A Fair Globalization as a trade-off between exports, foreign direct investments, and income equality.

As illustrated in Figure 3, a first and limited investigation of Decent Work would only encompass the top tiers of the hierarchy. In order to dig deeper, one would also invoke the variables of A Fair Globalization as causal factors.

To portray this cascading causal mechanism, we shall here have recourse to the procedures of a hybrid DEA model usually referred to as *two-stage* DEA (for references, see Section 1 above). This model accomplishes what is presently required, joining together two successive causal sub-hierarchies into an extended causal process. As we shall see, this integrated approach delivers much more forceful empirical results than the two isolated DEA models were able to produce by themselves. For each country, we shall now obtain not one effectiveness rating but two: the effectiveness of the country in reaching the idealized conditions of A Fair Globalization, and its effectiveness in reaching the idealized goal of Decent Work.

#### 4. IS A RECONCILIATION OF THE TWIN GOALS POSSIBLE?

In many countries, the prevailing systems for decision-making tend to separate economic, social and environmental factors at policy, planning and management levels. This has led to a widening of inequality, both at global and national levels. Making globalization serve all economic actors calls for careful sequencing of trade/investment liberalization reforms and the need to make social tradeoffs where necessary. A strong political commitment and institutional capacity may be needed to redistribute the benefits of globalization.

International organizations such as the UN, the OECD, the World Trade Organization, and the World Health Organization regularly stress the importance of achieving acceptable work conditions (decent work) and shielding vulnerable sectors of the economy from negative effects of globalization. For instance, the Director-General of the WTO in January 2006 called for creation of a new “Geneva consensus” (see ref. [27]):

*We need to “reform globalization” with a clear view to enhancing the development of social, economic and ecological aspects of humanity. This is also in line with the millennium development goals that can be achieved through a “reform of globalization” from within and for development.*

In the same vein, WHO on its internet site (ref. [26]) states that

*We are working to ensure that trade and globalization work to improve the health of the poor and disadvantaged populations. The overall goal is to achieve greater coherence between international trade and health policy so that international and multilateral trade rules maximize health benefits and minimize health risks especially for poor and vulnerable populations.*

While the principles of policy development may be common across countries, the achievement of social-economic goals will depend on national situations and political priorities attached to individual policies. The Director-General of the ILO has stated (in [13] p. 37)

*Each country has different deficits and needs, but there is a common idea that they need to be addressed with a package of mutually reinforcing action.*

A 2004 report by World Commission on the Social Dimension of Globalization (see [27]) expressed the hope that it would be possible to bend the market forces of globalization to generate some degree of fairness, and to deliver "unprecedented material progress, generate more productive and better jobs for all and contribute significantly to reducing world poverty" (*ibid.*, p.X ). This, in its turn, would hopefully open the door for the possibility of creating more "decent work". But the authors also recognized that (*ibid.*)

*the current process of globalization is generating unbalanced outcomes, both between and within countries. Wealth is being created, but too many countries and people are not sharing in its benefits.*

The quotations given here all express the well-meaning wish that some kind of reconciliation between the twin goals of a Fair Globalization and Decent Work can be worked out. This may indeed be possible sometimes, but, as we shall now see, the two goals can in some instances be at loggerheads with each other, being competing rather than supporting each other. This may be referred to as the "classical dilemma of trade policy."

## 5. NUMERICAL RESULTS

The calculations to be reported here all start out from the programming model (3). For the *first stage* of the two-stage DEA model the vector  $X$  is given by (11) and  $Y$  is given by (14). This stage solves for the Fair Globalization score. The *second stage* is given by the same model (3) with  $X$  given by (5) and  $Y$  by (8). This last stage solves for the Decent Work score.

To facilitate comparisons with the two earlier works Thore and Tarverdyan [21] and [22], we made the calculations for a list of 52 countries that were featured in both of these earlier studies. (The present list is thus the intersection of those two earlier lists.) These countries all present data of acceptable quality and with no data missing, and all data positive. For the purpose of the present calculations, all data were converted from percentage points into *pro mille* points instead; as it happens, this strategem produces positive values of all logarithms<sup>1</sup>.

The calculations were made employing software written in GAMS (General Algebraic Modeling System). A copy of the software may be obtained from the present corresponding author.

*A Fair Globalization.* The thirteen countries listed in Table 1 are located on the first stage frontier. Their effectiveness score is 100 percent and the observed data coincide with the frontier values. A few observations:

<sup>1</sup> One exception: The GROWTH of Uruguay was only 0.11 %.



- Many entries for the frontier EMP and NOPOV are entered as 100 %. This value was imposed as a separate upper bound each time we solved the mathematical program (4).
- Panama and Thailand may alternatively be considered as outliers, as they do not serve as peers to anybody.

**Table 1. List of 13 countries that are efficient at the first DEA stage (a fair globalization), and their inputs and outputs**

	Observed inputs, in %			Observed outputs, in %		
	FDI	EXP	GDP	FORMAL	1-TARIFF	1-GINI
Bangladesh	0.43	14.61	3.31	64.4	70.33	68.21
Belgium	31.85	81.61	1.66	76.8	99.41	67.03
Bulgaria	7.01	53.55	5.49	63.1	97.3	74.56
CzechRep	7.55	62.5	2.88	80.9	98.75	74.18
Ethiopia	3.62	13.75	1.93	59.7	73.36	70
Georgia	5.87	28.16	6.71	32.7	93.29	61.43
Hungary	5.6	66.65	4.68	74.9	97.81	73.75
Jamaica	6.55	39.7	0.41	63.6	92.37	59.38
Netherlnds	8.67	63.38	1.36	87	99.32	69.1
Panama	5.83	68.96	2.42	35.9	91.43	43.5
Thailand	2.95	65.47	2.03	47.4	90.94	57.28
Ukraine	2.06	55.36	6.23	47.8	95.41	71.64
Uruguay	1.73	21.82	0.11	48.9	95.94	55.24

The results for the remaining 39 countries are listed in Table 2. The first column displays the effectiveness score as determined by program (3). The following three columns exhibit the observed output data; the final three columns the corresponding frontier values (i.e. the values of these variables that are needed to make these countries 100 % effective). A few countries score in the low 90s. Among them are Brazil, Chile, Colombia and Mexico. At the frontier they would all be able to improve their FDI, EXP and their income evenness quite considerably. South Africa should be able to increase its FDI by almost tenfold. (Presumably, this result reflects the lack of internationalization of the South African economy). The US is also located quite far from its effectiveness frontier. In particular, there is a large gap between its current income distribution and the frontier distribution – the frontier value of the variable 1-GINI is 94 per cent, the largest value in the table. (Such a high value has of course never been recorded in a real economy, and reflects the uneven income distribution in the US economy. To compensate for the very strong forces of globalization in the US economy, a huge dose of "fairness" – increased income equality - - would be required.)

**Table 2. List of 39 countries that are inefficient at the first DEA stage (a fair globalization), their standardized effectiveness score ( $1/\Phi$ ), observed and frontier outputs**

	score	FDI	EXP	1-GINI	FDI	EXP	1-GINI
		observed outputs, in %			frontier outputs, in %		
Algeria	98.8	1.29	36.18	64.67	4.9	38.98	70.19
Argentina	96.8	3.06	17.22	47.78	3.43	23.21	58.8
Austria	99.1	2.19	46.48	70.85	13.51	49.12	75.16
Brazil	92.8	3.98	14.25	41.17	5.31	30.75	65.93
Canada	98.0	3.58	42.66	67.44	7.83	48.39	77.24
Chile	92.0	6.87	34.26	42.63	10.37	56.88	72.14
Colombia	93.4	2.65	19.9	41.26	4.05	28.94	63.19
CostaRica	95.5	3.45	47.05	51.42	10.75	62.98	69.12
Croatia	99.2	5.81	46.02	70.41	5.99	48.23	74.03
Dominican	99.3	4.77	43.88	48.31	5.53	45.75	50.41
Finland	98.5	4.81	38.87	73.12	5.46	42.61	80.94
France	97.0	2.73	26.84	67.26	6.76	31.96	82.41
Greece	95.8	0.65	21.89	65.73	2.25	27.78	87.55
Guatemala	96.0	1.32	17.92	48.02	2.63	22.19	61.94
Italy	97.1	0.97	26.86	63.97	6.19	31.77	77.66
Kazakhstan	99.6	8.75	47.18	67.4	8.89	48.25	69.02
KoreaRep	98.3	1.2	40.16	68.41	4.97	44.61	76.7
Latvia	97.1	3.93	41.61	63.35	4.38	49.76	76.72
Lithuania	97.8	4.18	48.61	66.26	4.54	55.8	76.58
Mexico	93.6	2.85	29.25	47.67	9.73	43.18	72.77
Moldova	99.1	5.14	51.11	64.94	5.34	54.22	69.05
Mongolia	99.9	5.47	63.05	69.73	7.65	63.51	70.25
Morocco	98.4	1.17	32.01	60.54	7.5	35.15	67.17
NewZealand	97.0	2.74	32.23	63.83	8.85	38.59	78.07
Nicaragua	97.1	5.87	23.59	56.4	6.62	29.81	68.03
Norway	99.7	2.02	42.24	74.21	9.3	43.01	75.69
Pakistan	98.1	0.8	15.47	68.63	3.87	17.05	77.84
Poland	96.8	3.64	30.12	66.25	4.1	36.43	82.27
Portugal	96.9	3.09	30.48	61.55	7.73	36.63	75.66
Romania	97.9	3.75	32.7	69.29	4.06	37.07	79.84
RussianFed	97.2	1.37	36.94	56.57	1.98	43.92	68.11
SthAfrica	91.6	1.4	27.82	42.23	11.27	46.6	73.49
Spain	96.4	3.85	27.1	65.34	6.46	33.47	83.42
SriLanka	98.6	1.16	36.31	63.31	3.71	39.39	69.21
Sweden	99.3	7.49	44.48	75	7.74	46.57	78.84
Switzerlnd	99.2	3.96	43.49	66.32	7.22	45.77	70.05
Turkey	95.8	0.84	27.28	58.17	5.4	34.99	77.16
US	93.3	1.78	10.4	59.19	4.23	17.22	93.78
Zambia	97.5	4.2	22.16	54.99	4.63	25.51	64.83

*Decent Work.* Twelve countries are located on the second stage frontier. They are listed in Table 3, together with their inputs and outputs (coinciding with optimal inputs and optimal outputs).

**Table 3. List of 12 countries that at the second DEA stage (decent work) turn out to be located on the frontier, together with their inputs and outputs.**

	FDI	EXP	SUB	TARIFF	EMP	NOPOV	WOM
	Observed inputs, in %				Observed outputs, in %		
Bangladesh	0.43	14.4	27.44	29.67	96.7	17.2	23.18
Belgium	31.85	81.61	72.87	0.59	92.47	100	44.13
Colombia	2.65	19.36	7.31	5.73	83.32	82.24	44.34
Finland	4.81	38.87	66.26	0.04	90.34	100	50.22
France	2.73	26.84	58.6		89.89	100	46.78
Greece	0.65	21.89	40.17		89.54	100	39.61
Jamaica	6.55	39.7	1.14	7.63	85.96	86.72	45.66
Mexico	2.86	29.23	1.53	4.22	97.54	79.63	34.43
Norway	2.02	42.24	67.34	0.24	96.3	100	48.59
Portugal	3.09	30.48	43.56		94.91	100	46.26
Sweden	7.49	44.48	62.84	0.06	93.76	100	50.46
US	1.78	10.4	61.16	1.08	95.04	100	47.21

Note that

- Sweden may alternatively be considered as an outlier, as it does not serve as a peer to anybody.
- Seven additional countries reached the score of 100 per cent but are located behind the frontier rather than on the frontier (positive slacks). They are Austria, Canada, Italy, the Netherlands, New Zealand, Spain and Switzerland.

The results for the sub-frontier countries are listed in Table 4. Overall, the effectiveness scores here are quite a bit larger than in Table 2. The lowest decent work scores are obtained by South Africa (96.8) and by Argentina and Mongolia (both at 97.5). But these are fairly respectable results in any case. So, judging from these results, it appears that decent work is a goal easier to reach than a fair globalization.<sup>2</sup>

*Tariffs and trade restrictions.* Comparing the DEA results from the two stages, only three countries are located on both frontiers: Bangladesh, Belgium, and Jamaica. Several countries that are doing well in terms of a fair globalization, obtain quite low scores for decent work. Conversely, a number of countries that are doing well in terms of decent work got quite low scores at the preceding globalization stage. The case of the US is particularly instructive: the US received one of the lowest scores at the globalization stage, but is 100% effective in terms of decent work. It demonstrates the possibility that even a quite unfair globalization can still entail decent work.

<sup>2</sup> The observed values of the inputs (FDI,EXP,SUB and TARIFF) were listed in the publication [22].

**Table 4. List of 40 countries that are inefficient at the second DEA stage (decent work), their standardized effectiveness score ( $1/\Phi$ ), observed and frontier outputs**

	score	Observed outputs, in %			Frontier outputs, in %		
		EMP	NOPOV	WOM	EMP	NOPOV	WOM
Algeria	99.7	71.47	98	14.03	100	100	43.45
Argentina	97.5	84.25	77.01	43.53	100	91.2	50.81
Austria	100.0	95.97	100	44.82	95.97	100	48.68
Brazil	98.6	90.66	78.85	43.74	100	100	48.95
Bulgaria	99.1	84.45	93.89	48.97	100	100	51.85
Canada	100.0	92.5	100	47.19	100	100	47.19
Chile	98.8	92.08	90.42	35.79	100	100	45.28
CostaRica	99.1	94.02	92.48	34.76	100	98.35	47.04
Croatia	99.7	85.75	98	46.23	100	100	47.07
CzechRep	99.7	92.07	98	46.45	100	100	47.29
Dominican	98.3	85.1	89	41.61	100	100	46.15
Ethiopia	98.8	91.8	22.2	36.85	100	100	45.33
Georgia	98.1	87.6	74.71	48.34	100	100	54.55
Guatemala	99.7	98.03	68.11	30.94	100	86.89	41.24
Hungary	99.7	93.61	98	48.01	100	100	48.89
Italy	100.0	90.17	100	40.73	90.89	100	41.22
Kazakhstan	98.3	88.68	83.96	45.7	100	100	50.93
KoreaRep	99.7	95.54	98	40.62	100	100	43.88
Latvia	99.3	87.07	95.29	49.64	100	100	51.86
Lithuania	98.8	85.37	92.19	51.76	100	100	55.76
Moldova	98.7	91.53	36.3	50.92	100	100	55.21
Mongolia	97.5	84.15	25.09	49.84	100	100	58.42
Morocco	97.9	86.66	85.67	22.67	100	100	40.53
Netherlnds	100.0	96.47	100	43.9	100	100	50.82
NewZealand	100.0	94.4	100	48.84	100	100	49.2
Nicaragua	98.3	89.12	20.07	41.98	100	100	50.04
Pakistan	99.3	93.12	26.42	11.88	98.03	32.33	28.96
Panama	97.9	86.38	82.87	39.52	100	100	46.19
Poland	99.7	83.43	98	46.73	100	100	50.6
Romania	98.9	92.97	87.07	44.29	100	93.59	47.26
RussianFed	98.5	89.2	87.86	48.74	100	97.36	53.53
SthAfrica	96.8	72.82	65.93	43.67	100	96.86	53.36
Spain	100.0	86.81	100	8.92	92.97	100	43.78
SriLanka	98.7	91.48	58.41	33.03	100	94.63	43.93
Switzerlnd	100.0	96.69	100	44.55	96.69	100	48.72
Thailand	99.7	97.69	74.85	44.06	100	99.27	44.98
Turkey	98.7	91.33	81.27	19.97	100	88.85	40
Ukraine	99.3	89.61	95.06	48.88	100	100	51.17
Uruguay	99.2	86.02	94.27	45.28	98.15	100	47.73
Zambia	98.2	88	5.87	22.81	100	100	50.06

The classical dilemma of trade policy as earlier described amounts to understanding the role of the variable TARIFF as it affects the calculations at the two DEA stages (see Figure 3). TARIFF serves as a link between globalization and decent work. The variable  $1-TARIFF$  is an input into the first stage DEA calculation (free trade stimulates globalization), and TARIFF is an input into the second stage (protection promotes the possibility of decent work).

In order to spell out numerically this role of the variable TARIFF, we now demonstrate a novel application of two-stage DEA, confronting the results from the first stage calculations directly with the results from the second stage. Switch the DEA calculations at both stages

from an output formulation to an input-oriented one. The first stage will then reveal the scope for reducing 1-TARIFF and still reach the frontier of optimal fair globalization. And the second stage will reveal the scope for reducing TARIFF while still reaching the frontier of optimal decent work. In other words, the calculations for each country will deliver an interval: a maximal TARIFF for which a fair globalization would obtain and at the same time a minimal TARIFF for which optimal decent work would obtain. If the gap is zero, both DEA stages deliver optimality.

As is well known, switching from an input-oriented version to an output-oriented one – or vice versa – leaves the efficiency frontier unchanged. A country will be characterized as efficient with an output formulation (i.e. located on the frontier) if and only if it is characterized as efficient with an input formulation. But for an inefficient country, the projection onto the frontier can be different under the two formulations. The "peers" of the country (i.e. the set of corner points of the facet in which the projection is located) will then also typically be different. The prescription for a possible improvement of current performance will then be different.

Presenting now the results of the calculations, the countries can be divided into four categories as listed below.

- (i) The three countries Bangladesh, Belgium and Jamaica are frontier corner points at both stages. For each of these countries, the observed TARIFF coincides with the optimal TARIFF and the observed 1-TARIFF coincides with the optimal 1-TARIFF. For these countries, then, fair globalization policy and decent work policy work hand in hand.
- (ii) Ten countries are frontier corner points at the fair globalization stage, but are off the frontier estimating decent work. They are listed in Table 5a below together with the observed TARIFF data and an interval of possible TARIFF reduction. The interval ranges from the optimal TARIFF at the second stage (the lower bound) to the optimal TARIFF at the first stage (the upper bound, coinciding with the observed TARIFF).

**Table 5a. Output oriented DEA calculations.**  
For "interval", see the main text

Country	TARIFF, observed data	Interval
Bulgaria	2.70	(1.55, 2.70)
Czech Republic	1.25	(0.79, 1.25)
Ethiopia	26.64	(1.36, 26.64)
Georgia	6.71	(2.36, 6.71)
Hungary	2.19	(1.23, 2.19)
Netherlands	0.68	(0.49, 0.68)
Panama	8.57	(2.82, 8.57)
Thailand	9.06	(2.90, 9.06)
Ukraine 4	59	(1.02, 4.59)
Uruguay	4.06	(0.94, 4.06)

These countries are all efficient at the first stage (a fair globalization) so that they deliver optimal values of the variable 1-TARIFF. But they are inefficient at the

second stage (decent work) and it would be possible to reduce the TARIFF variable for these countries and yet preserve the same outputs (decent work).

To illustrate using an extreme case: Ethiopia severely curtails contacts with the outside world, imposing a protective regimen involving a TARIFF level of more than 25 %. This level also happens to coincide with the frontier level for the first stage, meaning that no reduction is possible while maintaining the current level of globalization. However, the very same high TARIFF rate is quite excessive in terms of decent work, and it should be possible to lower it to just 1.36 % and yet maintain the same level of decent work. Such a lowering of the trade barriers would at the same time stimulate the forces of globalization. To sum up, there is a strong argument for lowering TARIFF, and there is no contradiction between globalization policy and decent work policy.

In the same manner a moderate amount of trade liberalization would be helpful for all these ten countries. Such a policy would enhance the level of fair globalization, while maintaining the level of decent work already established. Conclusion: no dilemma, no contradiction between globalization and decent work.

- (iii) Next, turning to the opposite case, consider the countries that are 100 % effective at the second stage (decent work) but ineffective at the first stage (globalization). For these countries it would be possible to reduce the 1-TARIFF variable - - that is to increase TARIFF - - and yet preserve the same outputs (a fair globalization). See Table 5b below. This time the "interval" ranges from the optimal TARIFF at the second stage (lower bound, coinciding with the observed TARIFF) to the optimal TARIFF at the first stage (upper bound). The variable 1-TARIFF in general is assumed to enhance globalization, but for these countries it is actually excessive (TARIFF falls short of the optimal value).

**Table 5b. Output oriented DEA calculations**

Country	TARIFF, observed data	Interval
Colombia	5.73	(5.73, 40.05)
Mexico	4.22	(4.22, 38.35)
US	1.08	(1.08, 37.79)

The extreme case is represented by the US. The US is a quite open economy, and the observed TARIFF rate was only 1.08%. This is also the optimal rate at the second stage of the calculations (decent work). But the US turns out to be off-frontier during the first stage. Hence, it should be possible to reduce the input variable 1-TARIFF while still securing the same level of globalization - - that is, it should be possible to *increase* TARIFF; as shown in the table the TARIFF variable could be increased all the way to 37.79 %. (This of course only serves to point to the direction of change that could be called for.) To sum up, there is no contradiction between globalization policy and decent work for these three countries either. A moderate amount of trade restrictions would be helpful on both accounts.

**Table 5c. Output oriented DEA calculations. Cases of "classical dilemma of trade policy". See main text**

	Observed TARIFF	Frontier values	
		TARIFF 1 <sup>st</sup> stage A fair globalization	TARIFF 2 <sup>nd</sup> stage Decent work
Algeria	12.65	19.74	0.3
Argentina	15.3	31.98	1.76
Austria	0	5.98	0.1
Brazil	2.98	41.09	1.14
Canada	1.23	14.19	0.86
Chile	3.72	44.4	1.54
CostaRica	5.38	30.61	1.58
Croatia	4.78	9.6	2.17
Dominican	33.62	36.5	2.64
Finland	0.04	9.99	0.1
France	0	18.86	0.1
Greece	0	25.35	0.1
Guatemala	11.68	32.48	1.97
Italy	0	18.23	0.1
Kazakhstan	5.62	7.94	2.72
KoreaRep	4.23	14.91	0.26
Latvia	1.16	18.97	0.86
Lithuania	0.91	14.75	0.72
Moldova	5.59	11.47	2.77
Mongolia	5.66	6.39	2.85
Morocco	16.04	24.59	0.34
NewZealand	3.01	21.21	1.9
Nicaragua	6.11	22.87	1.77
Norway	0.24	2.27	0.1
Pakistan	11.43	22.33	10.68
Poland	1.49	20.95	1.07
Portugal	0	19.36	0.1
Romania	2.54	15.78	1.66
RussianFed	13.52	28.65	0.7
SthAfrica	2.73	45.41	0.89
Spain	0.01	22.2	0.1
SriLanka	12.61	20.32	1.49
Sweden	0.06	5.09	0.1
Switzerlnd	1.03	6.57	0.72
Turkey	1.7	26.65	0.32
Zambia	12.41	26.27	1.81

- (iv) It remains to discuss all the other countries, being off-frontier at both DEA stages. There are 36 such countries listed in Table 5c; unfortunately they all present the "classical dilemma of trade policy". It is not necessary to discuss the details here. Suffice it to say that for most of these countries the observed TARIFF level is located inside the interval ranging from the globalization optimum to the decent work optimum. Hence any lowering of TARIFF while being helpful to globalization would be detrimental to the level of decent work obtained. Conversely, any increase of TARIFF while helpful to decent work would be detrimental to the pace of globalization.

## 6. CONCLUDING REMARKS

The purpose of the present inquiry has been an attempt to measure the achievements of nations in reaching the twin goals of a fair globalization and decent work. In a report entitled "Reducing the Decent Work Deficit: A Global Challenge (see reference [13]) the Director-General of the ILO called for international studies of decent work and for the calculation of the decent work deficit in different countries. Similarly, one may pose the task of calculating the fair globalization deficit.

Clearly, decent work is a multi-dimensional concept - - it embodies aspects of employment, workers' rights, social protection, and dialogue between employers' and workers' organizations. Similarly, a fair globalization is multi-dimensional: joining free trade, foreign direct investments, cross-border flows of information, technology and financial instruments with fairer rules of competition and redressing iniquities in trade and in the distribution of income and capital.

How does one compare and rank the performance of decision-making units (like countries) when there exists no single measure of their achievements, but rather an entire vector of goals? Standard DEA estimates an "efficiency frontier" in the sense of Walras, and each observation is compared with its projection on the frontier. In this manner it is possible, as we have shown, to calculate a "decent work deficit" and a "fair globalization deficit" of a given country.

Striking out in a new direction, however, we here no longer limit the analysis to Walras efficiency but actually calculate a measure of effectiveness for each decision-making unit. Drawing on ideas originally presented in Charnes, Cooper and Rhodes [4], this measure is calculated by solving a fractional programming problem. Rather than employing linear production functions, we have here postulated a Cobb-Douglas functional form for both achievements (outputs) and costs (inputs). The result was a cardinal Cobb-Douglas utility function of the policy aims of each country. The abstract theory of economic policy, as developed by Tinbergen and others in the 1950s, then turns into an empirical tool.

In two earlier works, conventional DEA runs were presented for a fair globalization (see [21]) and for decent work ([22]). The present investigation, while using the same data, goes beyond these introductory studies, developing a two-stage DEA format. We were thus able to determine a fair globalization (the first stage) and decent work (the second stage). This made it possible to compare the achievements of countries with respect to both these goals at the same time. A common causal factor ties the two stages together in trade policy and the openness of a country.

Obviously, only a few countries would reach optimum at both stages. Others will reach optimum at the first stage (a fair globalization) but fall short of the optimal frontier at the second stage (decent work). A typical case turns out to be the US where a moderate increase in tariffs would then be called for. Others again reach optima at the second stage (decent work) but fail to reach optimum at the first stage (globalization). Ethiopia is surrounded by high tariff walls and a reduction of tariffs is then called for. The majority of countries, however, face what we have termed "the classical dilemma of trade policy": open trade policy would be helpful to promote globalization, but can be detrimental to decent work.



*Caveats.* DEA is a mathematical programming technique enabling the researcher to address real world problems. The inputs and the outputs are chosen to mirror the policy interests of actual governments. But as a non-parametric technique, DEA does not provide specific information on the causal relationship between inputs and outputs (policies and performance variables). While the results presented here should indicate the potential of analyzing concepts like a fair globalization and decent work as frontiers of a generalized input–output (production) relationship, the computer runs should be taken as those of only an exploratory study and our numerical results must await confirmation from further research. To define the right set of inputs and output variables to be used is a difficult task considering, in particular, different local and cultural particularities existing under various structural and institutional regimes. DEA does not by itself tell the researcher whether the choice of inputs and outputs were wise or unwise decisions and whether there exist variables that more adequately should have been included in the analysis.

Hence, caution need to be exercised regarding the interpretation of the model findings. Drawing policy conclusions at the country level is difficult since a large number of factors not captured by the model may be important for the outcome. It will therefore be a future task to incorporate into the modeling framework additional relevant performance or policy variables. In view of the above, our results are certainly not ready to be used for drawing hard policy conclusions and recommendations at the country level. However, they do provide an opening and a path to follow for future research and use.

## DISCLAIMER

The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the International Labor Office.

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*Chapter 3*

## **BENEFITS OF INCLUDING AN ASIAN CURRENCY UNIT (ACU) IN AN OPTIMIZED WORLD CURRENCY BASKET**

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### **ABSTRACT**

In the past many international transactions have been denominated in US Dollars, even when neither the buyer nor the seller was based in the US. As the US economy has moved from being the dominant world economy to simply the largest economy there has been growing interest in using instead a basket of currencies. Optimization can be used to design such baskets, with a typical objective function being to minimize volatility in the basket's value. Here we slightly extend this idea to consider two partially competing objectives: (1) minimizing volatility and (2) minimizing the number of currencies in the basket. A good basket would be based on a large share of global GDP and have components whose individual movements are not highly correlated, leading to relative stability in the value of the basket. Given recent growth in Asian economies, there is obvious appeal to including them in a world currency basket. However, apart from Japan and China, the individual Asian economies are considerably smaller than the US or euro zone economies. Hence, it is of interest to ask whether it might be useful to include some hypothetical Asian Currency Unit (ACU) in a world currency basket. Here we use optimization to explore how the existence of an ACU might improve the efficient frontier in a two dimensional attribute space considering both volatility and complexity, as proxied by the number of currencies included in a world currency basket.

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## 1. INTRODUCTION

In the past many international transactions have been denominated in US dollars, even when neither the buyer nor the seller was based in the US. There were various incentives for this practice, notably a desire to insulate against currency fluctuations. Suppose a firm in Country A agreed to sell its products in Country B for a fixed number of Country B's currency units. Then if Country B's currency devalued, the firm in Country A would effectively receive much less compensation – in the sense of purchasing power – than it expected. Of course there was also always a risk that the US Dollar would devalue, but the firm in Country A could protect itself from this with currency hedges and/or by purchasing supplies via contracts that were also denominated in dollars.

At one time the US played a dominant role in the global economy, but it is now simply the single largest economy. Furthermore, the US dollar has at various times appreciated and depreciated relative to many other global currencies, with greater than normal volatility in recent years. Hence, suggestions have been made for using not the US dollar alone, but rather a basket of major currencies. For example, both Williamson (1999) and Pontines (2007) look at baskets comprised of Euros, US Dollars, and Yen, three currencies covering three of the largest pieces of the world economy.

Over time, various Asian economies besides Japan have grown in importance, most notably but not exclusively the Chinese economy. Hence, one might wish to extend the world currency basket to include the Chinese renminbi and/or other Asian currencies. However, the other Asian economies besides China are relatively smaller, so including enough of them to encompass most of Asia's GDP would involve a perhaps unwieldy number of currencies. In recent years there have been various proposals to create an Asian Currency Unit (ACU) (Kawasaki and Ogawa, 2003; Williamson, 2005; Moon, Rhee, and Yoon, 2006; Kawasaki and Ogawa, 2006; Adams and Chow, 2007; Pontines, 2007; Pontines and Rajan, 2008). Hence, we consider here whether the existence of a hypothetical Asian Currency Unit (ACU) might allow for a "better" world currency basket in the sense of yielding lower volatility while covering a larger share of world GDP without having to include too many separate currencies in the basket.

We frame this question as a multi-objective optimization problem and ask how the option of including an ACU might improve the efficient frontier of this multi-dimensional problem. In particular, using the method proposed by Hovanov, Kolari, and Sokolov (2004) we create a minimum volatility currency basket comprising of euros, US dollars, and yen plus an ACU – that either includes or excludes the Chinese renminbi. We assess a basket's volatility by calculating the standard deviation of the various global currencies (adjusted to remove the impact of currency exchange rate and base period selection) for each of the methods separately. The roadmap of the paper is as follows. Section 2 lays out the inherent concepts used in the paper as well as the empirical methods employed. Section 3 presents the empirical results. Section 4 concludes.

## 2. METHODS

### 2.1. Currency Exchange Rates and Currency Baskets

A currency basket is simply a weighted sum of various currencies. By custom we let  $q_i$  denote the number of units of currency  $i$  included in the basket, reserving  $w_i$  for the weight or importance of currency  $i$  in the basket. The distinction arises because if currency  $i$  has a small (large) value, then its weight in the basket may be modest (large) relative to the number of units of the currency that the basket contains. For example, in a basket comprising one euro, one US dollar, and one Japanese Yen, the euro would have the greatest weight and the Yen the least, even though  $q_1 = q_2 = q_3 = 1$  because, at least at the time of this writing, a euro is worth more than a US dollar, which in turn is worth more than a yen.

Making this more precise requires defining the value of a currency. The relative value of a currency in exchange for another currency is defined by  $c_{ij}$  = number of units of currency  $j$  that can be purchased with one unit of currency  $i$ . So, for example, if we wanted to define the weights of each currency in the above example in terms of British pounds, we could set  $w_i = q_i c_{i,GBP}$  (perhaps then normalizing the  $w_i$ 's so they all sum to 1.0).

If transitivity in exchange rates holds, so  $c_{ik} = c_{ij} * c_{jk}$ , for all  $i, j$ , and  $k$ , then it does not matter which currency is used to define the weights. Had a currency  $k$  other than the British pound been used, then the weights would have all been  $w_i' = q_i c_{ik} = q_i c_{i,GBP} c_{GBP,k} = w_i c_{GBP,k}$ , for the fixed constant  $c_{GBP,k}$ . That is, the  $w_i$ 's would be just scaled versions of the  $w_i$ 's when weights were computed using the British pound. Hence, for determining the normalized  $w_i$ 's in a currency basket, the base currency is irrelevant.

If we let  $VAL_i(t)$  denote the value of currency  $i$  at time  $t$ , without worrying at the moment about the base with respect to which the currency is valued, we can construct the currency baskets by first estimating the contribution,  $w_i$  of the  $i^{\text{th}}$  currency at base time period  $t_0$ . Using  $w_i$ , the quantity  $q_i$  of the  $i^{\text{th}}$  currency in the basket is given by  $w_i/VAL_i(t_0)$ . Therefore, we can calculate the contribution of the  $i^{\text{th}}$  currency at time  $t$  as  $q_i VAL_i(t) = w_i (VAL_i(t)/VAL_i(t_0))$ . We call  $VAL_i(t)/VAL_i(t_0)$  the reduced value of the  $i^{\text{th}}$  currency at time  $t$  and denote it using  $RVAL_i(t)$ . The total value of the basket at time  $t$  is given by

$$V(t) = \sum_{i=1}^n w_i RVAL_i(t). \quad (1)$$

### 2.2. Normalized Measures of Currency Exchange Rate Trends and Volatility

Although  $VAL_i(t)$  of a currency or a basket can be calculated based on a single currency such as USD, as Hovanov et al. (2004) point out, the trend analysis in volatility based on a single currency is sensitive to choice of the base currency. Hence, a somewhat more sophisticated approach is needed when thinking about currency basket values and volatility.

To see why this is true, consider the following contrived example involving two currency baskets. The first basket is comprised of 100 US dollars and 1 Euro. The second is comprised of 1 US dollar and 100 Euros. The first tracks closely the value of the US dollar; the second tracks closely the value of the euro. Finally, suppose that over some fixed period of time the

dollar appreciated against the euro by a considerable amount, but with the appreciation occurring in bursts at irregular intervals, not steadily.

If we measured the value of both baskets relative to the US dollar, we would conclude that over this period of time the first basket depreciated slightly but with very little volatility, whereas the second basket depreciated a lot and was highly volatile. In contrast, if we measured both baskets relative to the euro, we would conclude that the first basket was more volatile, not the second. So we can speak about the volatility of a currency basket relative to a single currency, but it is not so easy to measure volatility in any global or absolute sense.

We would prefer to assess the value and volatility of a currency basket relative to a “neutral” currency. Hovanov et al. (2004) propose for such a neutral currency the geometric mean of the currency’s exchange rates over a broad set of other currencies. That is, they define the normalized value,  $NVAL_i(t)$  of currency  $i$ , as the geometric mean of the quantities of all currencies within a set  $\{1, \dots, n\}$  that can be obtained for one unit of that currency. In symbols, this is given as follows:

$$NVAL_i(t) = \sqrt[n]{\prod_{j=1}^n c_{ij}(t)}. \quad (2)$$

We use both this measure and a slightly more general measure where the exchange rates  $c_{ij}(t)$  are weighted by pre-determined non-negative exponents  $\beta_j$  such that  $\sum \beta_j = 1$ , rather than having all  $\beta_j = 1/n$ . In particular, we set  $\beta_j$  proportional to country  $j$ ’s share of international trade (imports plus exports) as reported in the CIA Factbook (2007). The countries we use together with their weights are listed in Table 1. Similar measures are used by the Bank of England (Bank of England, 1999). We call this the trade-weighted normalized value,  $NVAL_i^\beta(t)$ .

$$NVAL_i^\beta(t) = \prod_{j=1}^n \left( c_{ij}(t) \right)^{\beta_j}. \quad (3)$$

The Hovanov et al. (2004) series  $NVAL_i(t)$  is a special case of  $NVAL_i^\beta(t)$ , where the weights  $\beta_j$  are all equal to  $1/n$ . In either case, the series can then be reduced (normalized in the other sense of the term) so that its initial value at time  $t = t_0$  is 1 by setting  $RNVAL_i(t) = NVAL_i(t) / NVAL_i(t_0)$ , or  $RNVAL_i^\beta(t) = NVAL_i^\beta(t) / NVAL_i^\beta(t_0)$ . The standard deviation of the resulting  $RNVAL_i(t)$  or  $RNVAL_i^\beta(t)$  series can be used as a measure of volatility.

The same idea applies to valuing currency baskets, not just individual currencies. The only change is that the terms  $c_{ij}(t)$  become the number of units of currency  $j$  can be purchased at time  $t$  with one unit of the currency basket  $i$ , rather than an individual currency  $i$ .

**Table 1. Weights in Equation 3, Assigned Based on Total Trade of a Country**

Country	Total Trade	Weight
(j)	US\$ Million	( $\beta_j$ )
United States	\$3,116,000	0.235
European Union	\$2,796,000	0.211
China	\$2,124,600	0.161
Japan	\$1,251,400	0.095
Canada	\$817,500	0.062
Korea, South	\$728,600	0.055
Hong Kong	\$711,500	0.054
Russia	\$578,900	0.044
Singapore	\$554,700	0.042
Mexico	\$553,800	0.042
<b>Total</b>	<b>\$13,233,000</b>	<b>1</b>

### 2.3. Methods for Creating Currency Baskets or Composite Currencies

There are various ways of creating a currency basket or composite currency. Two prominent alternatives are (1) weighting the currencies by some measure of the sizes of the economies of their corresponding countries and (2) adjusting the weights of currencies using an optimization procedure to obtain a minimum variance basket.

As an example of the first, Moon, Rhee, and Yoon (2006) evaluated various ACUs using the method used to calculate the ECU (predecessor of euro) under the European Monetary System. In this method the weights assigned to various currencies in the basket reflect the economic importance of the currencies.

Although there are a number of ways to determine the economic importance of a country (e.g., nominal GDP, purchasing power parity adjusted GDP or GDP-PPP, intra-regional trade, bilateral swap arrangements of Chiang Mai Initiative (CMI) and combinations of these), we use the GDP-PPP here as it takes into account the relative cost of living and inflation rates between countries. We calculate the normalized weight of currency  $i$ ,  $w_i$  using the following formula:

$$w_i = \frac{\text{GDP}_i(t')}{\sum_1^n \text{GDP}_i(t')} , \quad (4)$$

where  $t'$  is a fixed year.

The second method was pioneered by Hovanov et al. (2004). Its basket is created by minimizing the variance of a weighted sum of the values of currencies normalized to a base year when those currencies are valued in terms of a “neutral” currency, as described above.

In particular, Hovanov et al. (2004) proposed that the  $w_i$  should be selected to minimize the variance of  $V(t)$ , the value of the currency basket, i.e., to minimize



$$Var(V(t)) = \sum_{i,j=1}^n w_i w_j cov(i,j) = \sum_{i=1}^n w_i^2 s_i^2 + 2 \sum_{\substack{i,j=1 \\ i < j}}^n w_i w_j cov(i,j). \quad (5)$$

The values  $s_i$  denoting variance of  $RNVAL_i(t)$  and  $cov(i,j)$  denoting covariance of  $RNVAL_i(t)$  may be calculated from historical data of currencies over a fixed interval, and the above expression may be minimized using a non-linear optimizer subject to constraints  $\sum w_i = 1$  and  $w_i \geq 0$ . Here we use monthly currency valuations over the period January 2000 to December 2007 from the Pacific Exchange Rate Service (accessed at <http://fx.sauder.ubc.ca/>).

Many factors can come into play with regional currencies and/or currency baskets. However, as a point of departure, we assume that for a hypothetical ACU, size and political power as proxied by the GDP-PPP would predominate. For example, for a minimum variance composite currency built from the ASEAN-5 countries plus China, the Philippine peso would get a greater weight (18%) than the Chinese renminbi (14%), even though China's economy (\$7.1 trillion) is almost twenty-five times larger than that of the Philippines (\$0.3 trillion). That does not seem credible. Even Hovanov et al. (2004) acknowledged that political and economic factors will play a role in the formation of regional currencies.

However, matters of sovereignty and national pride may matter much less for currency baskets, as opposed to actual regional currencies, particularly when those baskets are only going to be used behind the scenes by businesses, not by the citizenry generally. In those circumstances, minimizing risk in terms of currency basket volatility may be the primary objective.

Hence, when we ask whether the existence of an ACU might facilitate the creation of better world currency baskets, we assume the world currency basket is created by the Hovanov et al. (2004) optimization method, but the ACU that might or might not enter into such a basket is itself a GDP-PPP-weighted composite of the currencies of the countries participating in that hypothetical ACU (using GDP-PPP data from the World Bank (2008)).

### 3. RESULTS

#### 3.1. Does the Addition of an ACU Result in a Better Global Currency Basket?

The first question we ask is whether including an Asian Currency Unit (ACU) in a global currency basket can improve the basket in the sense of being less volatile. Since various ACU have been proposed, to answer our question, we first have to define what such a hypothetical ACU might look like.

Table 2 defines eight possible ACU's, labeled ACU1, ACU2, ..., ACU8, by giving the GDP-PPP based weights of each country in that ACU. We reserve the label "ACU0" to stand for the null case of no ACU at all being added to the other currencies that make up the global currency basket. Our base case ("ACU1") includes the ASEAN-5 countries (Indonesia, Malaysia, Singapore, Thailand, and the Philippines). We progress from our base case (ACU1)

by including one or more of the additional countries examined in Pontines and Rajan (2008), specifically, China, South Korea, India, Australia, and New Zealand. We did not consider an ACU that includes the Japanese yen since it is already on its own a part of the global currency basket.

Next, we use the minimum variance method to construct global currency baskets containing the US dollar, euro, Japanese yen and one of the ACUs obtained in the previous step. The first global currency basket we construct contains only the US dollar, euro, and Japanese yen (i.e., “ACU0”). Tables 3 and 4 list the global currency baskets, the weights on these currencies, and the volatility of the basket as measured by the standard deviation of its value over time measured using Hovanov et al.’s (2004) geometric mean valuation (Equation 2) and the trade-weighted valuation (Equation 3), respectively.

Creating a world currency basket that includes not only the US dollar (USD), euro (EUR), and Japanese yen (JPY), but also an ACU produces a world currency basket with lower volatility. In particular using geometric mean valuation (Equation 2), adding an ACU based on the ASEAN-5 countries (i.e., “ACU1”) reduces the standard deviation of the value of the resulting currency basket by about 17% from 0.0224 to 0.0185 (See Table 4, first two rows).

**Table 2. Weights Assigned to Each Country in the Various Hypothetical ACU**

Country	ACU1	ACU2	ACU3	ACU4	ACU5	ACU6	ACU7	ACU8
ASEAN-5								
Indonesia	0.37	0.09	0.08	0.06	0.06	0.24	0.13	0.11
Malaysia	0.16	0.04	0.03	0.03	0.02	0.10	0.05	0.05
Singapore	0.10	0.02	0.02	0.02	0.02	0.07	0.04	0.03
Philippines	0.13	0.03	0.03	0.02	0.02	0.09	0.05	0.04
Thailand	0.23	0.06	0.05	0.04	0.04	0.15	0.08	0.07
Other Countries								
China		0.76	0.67	0.52	0.49			
Korea			0.11	0.09	0.08	0.35	0.18	0.16
India				0.23	0.21		0.47	0.42
Australia					0.05			0.10
New Zealand					0.01			0.01
<b>Total</b>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

**Table 3. Currency Baskets based on Geometric Mean Valuation**

Global Currency Baskets	US	EU	JP	ACU	Standard Deviation
USD, EUR, JPY, ACU0	0.67	0.24	0.09		0.02241369
USD, EUR, JPY, ACU1	0.47	0.19	0.04	0.30	0.01849819
USD, EUR, JPY, ACU2	0.00	0.14	0.15	0.70	0.01333311
USD, EUR, JPY, ACU3	0.00	0.11	0.15	0.74	0.00997002
USD, EUR, JPY, ACU4	0.05	0.11	0.11	0.74	0.01012593
USD, EUR, JPY, ACU5	0.09	0.07	0.09	0.75	0.00987770
USD, EUR, JPY, ACU6	0.43	0.12	0.03	0.41	0.01255652
USD, EUR, JPY, ACU7	0.35	0.12	0.00	0.53	0.01136388
USD, EUR, JPY, ACU8	0.39	0.06	0.00	0.55	0.01119596

Using the trade-weighted valuation benchmark (Equation 3), the reduction is comparable in percentage terms, from 0.0126 to 0.0104 (See Table 5, first two rows). The ACU's weight in these currency baskets is considerable (0.30 and 0.17, respectively) and comes at the expense of reduced weight on all three of the other global currencies.

**Table 4. Global Currency Baskets Based on Trade-Weighted Valuation**

Global Currency Baskets	US	EU	JP	ACU	Standard Deviation
USD, EUR, JPY, ACU0	0.63	0.30	0.07		0.01262755
USD, EUR, JPY, ACU1	0.52	0.27	0.04	0.17	0.01040409
USD, EUR, JPY, ACU2	0.20	0.23	0.12	0.45	0.00720299
USD, EUR, JPY, ACU3	0.24	0.21	0.11	0.44	0.00527669
USD, EUR, JPY, ACU4	0.27	0.22	0.08	0.43	0.00548748
USD, EUR, JPY, ACU5	0.29	0.19	0.07	0.44	0.00535943
USD, EUR, JPY, ACU6	0.50	0.23	0.04	0.24	0.00696257
USD, EUR, JPY, ACU7	0.45	0.22	0.02	0.31	0.00634852
USD, EUR, JPY, ACU8	0.47	0.19	0.02	0.32	0.00627063

Hence, the immediate answer to our question is, “Yes, the existence of an ACU could allow for the creation of world currency baskets that are better, in the sense of being less volatile.” There is no guarantee, however, that if an ACU were created it would cover just the ASEAN-5. So we replicated this analysis by considering seven other possible sets of countries in the Asia-Pacific region that might be in an ACU, specifically the sets listed in Table 2 (labeled ACU2-ACU8). The results are in Tables 3 and 4, rows three to nine.

Including either China or Korea in addition to the ASEAN-5 in the ACU substantially reduces the standard deviation of the global currency basket by almost another 30 %. In particular, including China (moving from ACU1 to ACU2) reduces the geometric mean valuation's standard deviation from 0.0185 to 0.01333 and the trade-weighted valuation's standard deviation from 0.0104 to 0.0072. The declines in standard deviation when adding South Korea (moving from ACU1 to ACU6) are slightly greater, down to 0.01256 for the geometric mean valuation and 0.00696 for the trade-weighted valuation.

Adding still more currencies to the ACU (i.e. more than the ASEAN-5 and China or Korea) produces some additional reduction in the standard deviations but not in all cases. For example, adding India to an ACU that already included the ASEAN-5 + China + Korea (moving from ACU3 to ACU4) slightly increases the volatility of the resulting world currency basket.

### 3.2. Effect of Adding an ACU on Relative Weights of USD, Euro and Yen in Global Currency Basket

As can be seen in Tables 3 and 4, in a global currency basket consisting only of the USD, EUR, and JPY the three currencies have weights of (67%, 24%, 9%) and (63%, 30%, 7%) using the geometric mean valuation and trade-weighted valuation, respectively. When we move to our base case of including the ACU1 into the global currency basket, the relative

proportions of the usual three global currencies are not substantially altered. For example, using a trade-weighted valuation, the weights of USD, Euro, and Yen in the global currency basket with ACU1 are (52%, 27%, 4%), which are almost in proportion with the weights in the global currency basket without any other currency. However, once the Chinese renminbi is included in the ACU, the relative weight of the USD falls substantially. For instance, in basket containing the USD, EUR, JPY, and ACU2 the respective weights of the USD, EUR, and JPY are (20%, 23%, 12%). The weight of the US dollar is now less than that of the euro, and the yen has a higher weight than before. The decline in the weight of the US dollar is even greater with the geometric mean valuation.

This behavior occurs because the renminbi is strongly correlated with the US dollar (the correlation between the corresponding RNVALS is 0.82 with a geometric mean valuation and 0.86 with a trade-weighted valuation) and also less volatile than the USD. As a result of the high correlation with the USD and lower volatility, in any minimum variance basket, the renminbi replaces the USD to a large extent, without affecting the other currencies as much. Nonetheless, in the case of the trade-weighted valuation, there is a higher representation of USD in the base, so the variance of US dollar RIVAL is less, and hence its displacement by the ACU is also less.

### **3.3. Comparing a Currency Basket with an ACU vis a vis a Basket with Other Popular Currencies**

As mentioned, minimizing the volatility of the global currency basket is not the only consideration. Otherwise one would include every currency in the world in the basket, since the more decision variables there are in the optimization, the better the optimized objective function value would be. However, all other things equal, one would also like the world currency basket to have fewer currencies, both to constrain complexity and associated administrative costs and also to minimize the extent of over-fitting to historical data that may not provide comparably low volatility in the future. In that sense, adding the ACU to a global currency basket improved one attribute (volatility) but harmed another (complexity embodied in the number of elements in the basket).

Hence, it would be fairer to compare a four-currency basket that includes an ACU to another basket with four currencies. We do this by comparing baskets created with the USD, EUR, JPY and an ACU with baskets that combined the original three currencies (USD, EUR, and JPY) with another existing currency. We consider as candidates for this fourth currency the next top five currencies in terms of foreign exchange turnover after USD, EUR and JPY as published by the Bank for International Settlements (BIS) for 2007. These are the British pound, Swiss franc, Australian dollar, Canadian collar, and Swedish krona. Tables 5 and 6 summarize the results using geometric mean and trade-weighted valuations, respectively. Though the absolute values of the resulting standard deviations in Tables 5 and 6 differ, the relative changes are very similar.

**Table 5. Comparison of Currency Basket with ACU and other Popular Currencies (Geometric Mean)**

Other Popular Currencies	USD	EUR	JPY	OTHER	Standard Deviation
Great Britain pound (GBP)	0.57	0.00	0.06	0.37	0.019203085
Swiss francs (CHF)	0.67	0.24	0.09	0.00	0.022412613
Australian dollar (AUD)	0.72	0.00	0.02	0.26	0.017505699
Canadian dollar (CAD)	0.56	0.00	0.14	0.30	0.009699914
Swedish krona (SEK)	0.71	0.01	0.00	0.28	0.021337300

**Table 6. Comparison of Currency Basket with ACU and other Popular Currencies (Trade-Weighted)**

Other Popular Currencies	USD	EUR	JPY	OTHER	Standard Deviation
Great Britain pound (GBP)	0.56	0.13	0.05	0.26	0.010948342
Swiss francs (CHF)	0.63	0.30	0.07	0.00	0.012626255
Australian dollar (AUD)	0.67	0.10	0.02	0.20	0.00971941
Canadian dollar (CAD)	0.57	0.15	0.10	0.18	0.005404899
Swedish krona (SEK)	0.67	0.15	0.01	0.17	0.012524128

Comparing Tables 3 and 4 with Tables 5 and 6, we observe that in general the standard deviation of the global currency basket built with an ACU is lower than that of a global currency incorporating one of the other popular currencies. In the case of a global currency consisting of either the Australian dollar or the Canadian dollar the standard deviation is slightly less than a global currency consisting of an ACU made up of just the ASEAN-5. However, the GDP-PPP of the ASEAN-5 (\$2.75 trillion) exceeds that of either Canada (\$1.27 trillion) or Australia (\$0.77 trillion), so the global currency basket with the ASEAN-5 based ACU might still be preferred. Furthermore, as the number of currencies comprising the ACU increases, the standard deviation of the resulting global currency baskets falls further, below that of the global currency baskets created with existing currencies considered in Tables 5 and 6.

## 4. CONCLUSIONS

We explored the effects of adding a hypothetical Asian Currency Unit (ACU) to a global currency basket containing the US dollar, the European euro, and the Japanese yen. In particular, we examined the impact on the standard deviation over time of the value in trade of the currency basket and on the weights of the currencies in the global currency basket.

In short, being able to add an ACU to a world currency basket can appreciably reduce the volatility of that basket. That is true when the ACU is based on just the ASEAN-5 countries. The reduction in volatility is even greater if the ACU is extended to also include China or

South Korea. When the Chinese renminbi is part of the hypothetical ACU, the ACU tends to displace the US dollar in the world currency basket.

Generally speaking, the more currencies that are included in a world currency basket, the lower the volatility of that basket's value can be. However, we found that the reduction in volatility from adding an ACU to the basket was generally greater than the reduction achieved by adding one of five other popular existing currencies, such as the British pound.

There are many arguments for and against the creation of an ACU, and the self-interest of the countries involved will ultimately determine whether such a union occurs. The analysis here suggests, however, that the creation of an ACU may have an unexpected additional benefit for international business and trade, namely enhanced ability to create world currency baskets with low volatility.

From a methodological perspective, we would note that elementary nonlinear optimization proves to be a valuable tool not only for designing currency baskets, but also for exploring financial implications of an array of plausible policy scenarios in advance. Thereby it can help inform policy deliberations and negotiations.

## ACKNOWLEDGMENTS

This work was funded in part by the Qatar Foundation.

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*Chapter 4*

## **THE ROLE AND DESIGN OF WAREHOUSES IN MODERN SUPPLY CHAINS**

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### **ABSTRACT**

This chapter is a synthesis of survey and case study research undertaken in the area of warehousing. Although warehousing, in one form or another, is present in most supply chains, this tends to be an area that has been under-researched, particularly at the more strategic level. For example, it is generally accepted that markets have become more volatile in recent years and this has prompted research on supply chain agility. However, the changing role of warehouses in agile supply chains has been largely assumed up until now with little empirical research on the subject. Similarly, the design and operation of warehouses within this agile environment has been largely ignored. This chapter presents some preliminary research that has addressed these issues and is intended to act as a guide for practitioners, as well as indicating areas of potential further study for researchers. Warehouses are significant investments for many companies and are long term fixed assets by their nature. A company cannot easily change its warehouse network and thus these often become sources of competitive advantage - or disadvantage if they do not meet changing market conditions. Their role and design within the context of modern supply chains therefore need to be fully understood. In the following sections, the roles of warehouses are explored, indicating that a key role is to act as “decoupling points” in supply chains. Other roles, such as cross-docking and production postponement, are also put into context. The need for flexibility is examined, together with how warehouses can be designed and operated to fulfil this need. Finally, the performance measurement of warehouses in dynamic situations is explored, together with a framework for measuring warehouse flexibility.

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## INTRODUCTION

Warehouses<sup>1</sup> are important components of modern supply chains, both in terms of cost and service. It has been estimated in a recent survey that warehouses account for 20% of logistics costs while the inventory within them adds a further 19% (Establish, 2008). As regards service, warehouses are often the last despatch point to the customer and therefore are critical to the provision of high service levels. They often determine the success or failure of many supply chains (Frazelle, 2002b), with failings potentially affecting on-shelf availability, market share and profitability (Sainsbury, 2004) or resulting in damaging publicity as in the case of Toys-R-Us when they were unable to fulfil all their Christmas delivery promises (Kover, 2000). On the other hand, warehouses can be a source of competitive advantage, as for example when Wal-Mart introduced cross-docking techniques in their warehouses (Stalk *et al.*, 1992).

However, in spite of this importance, there is relatively little research on the subject of warehousing at the supply chain management level. In fact, there appears to be somewhat of a disconnect between the two areas of literature. Du (2003) found that only 2 out of the 32 supply chain strategy publications he examined mentioned warehousing in passing and that none covered the subject in any depth. Similarly, only 6 out of the 36 warehousing publications he examined mentioned supply chain strategy and again none addressed that subject in any detail. Most warehouse research tends to be at the operational level (e.g. automated crane algorithms and pick route optimisation) while most supply chain strategy literature largely ignores warehousing.

## THE ROLE OF INVENTORY

The traditional role of warehouses has been for storage and indeed this role goes back many centuries to their use by ancient civilisations for storing grain and other foodstuffs. In order to understand the role of warehouses, it is therefore necessary to examine the role of inventory in modern supply chains.

A key role of inventory is to act as a buffer between demand and supply. With increasing globalisation, supply lead times have been lengthening and, by conventional inventory control theory, this results in a higher level of safety stock to maintain the same service levels (Waters, 2002). In addition, cycle stocks may increase due to the preference to ship in full load, rather than part load, containers for cost and security reasons. Other pressures that have tended towards holding higher inventories have been increasing market volatility (Weber, 2002) and product range proliferation.

There has been considerable concern about tendencies to hold inventory. This has partly been due to the realisation of the true costs of inventory holding, including for example the costs of working capital, storage, deterioration, insurance, obsolescence, damage and shrinkage (Christopher, 2005). In lean supply chain thinking, inventory is regarded as one of

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<sup>1</sup> For the purposes of this chapter, the term warehouse is used in its wider sense (e.g. as per Frazelle, 2002a) and thus includes for example raw material warehouses, finished goods warehouses, distribution centres, transshipment centres, fulfilment centres, local warehouses, value-added service warehouses and returns centres.

the seven wastes (or *muda*) that should be reduced or eliminated (Womack & Jones, 1996). Similarly, in agile supply chain thinking, inventory is viewed as an important constraint on responsiveness (Etienne, 2005).

Owing to these disadvantages, there have been various techniques proposed to try to reduce the amount of inventory in supply chains, including:

Shorter manufacturing set-up times and smaller production runs (Harrison & van Hoek, 2008).

Production postponement whereby final assembly takes place at the last possible moment, thus replacing the inventory holding of multiple finished goods with a smaller number of common components (van Hoek, 1998).

Total cycle time compression, in both information and material flows (Mason-Jones & Towill, 1999).

Visibility of end consumer demand, as well as supply chain inventory, to all participants (Christopher, 2005).

Centralisation of inventory, reducing inventory holding in accordance with the “square root” law (Maister, 1976).

Virtual warehousing, whereby inventory is regarded as common stock across a number of sites, and transferred as required between them (Landers *et al.*, 2000).

Cross-docking (i.e. moving goods directly from goods-in to goods-out in a warehouse, without putting away to storage) in order to increase supply chain velocity (Apte & Viswanathan, 2000).

However, in spite of this range of suggestions on how to reduce stockholding, inventory is seen as playing a key role in terms of acting as “decoupling points” in supply chains. Within this concept, strategic inventory is held as a buffer to separate upstream lean operations from downstream agile responses to the market (Christopher & Towill, 2001). Goods tend to flow through to decoupling points based on forecasts and are then pulled from there by individual customer orders. In addition to this decoupling role, supply chain risk literature views inventory as one possible risk mitigation technique (e.g. Chopra & Sodhi, 2004, and Christopher & Peck, 2004).

The literature thus tends to have an ambivalent view on the subject of inventory. Traditional inventory control literature has been based on identifying the “optimum” level of inventory in a supply chain, given specific demand and supply parameters. More recently, there has been a significant amount of literature based on a wider supply chain perspective which implies that inventory should be avoided or eliminated altogether. However, within this latter literature there is a recognition that inventory is required for decoupling purposes and, in some instances, as a risk mitigation technique. These views need to be consolidated into a wider approach which recognises the circumstances in which inventory is required and identifies where and how much inventory should be held in a supply chain. An outline framework for this is proposed later in this chapter.

## THE ROLE OF WAREHOUSES

Warehouses may be used at many stages of a supply chain as indicated by the roles set out by Frazelle (2002a):

- Raw material and component warehouses
- Work-in-process warehouses
- Finished goods warehouses
- Distribution warehouses / centres
- Fulfilment warehouses / centres
- Local warehouses
- Value-added service warehouses

As well as fulfilling the traditional purpose of storage, warehouses in modern supply chains also undertake roles associated with many of the techniques now employed to minimise the level of inventory. Thus, Higginson & Bookbinder (2005) expand on the above list of roles to specify those undertaken specifically by distribution centres:

- Make-bulk / break-bulk consolidation centre
- Cross-dock
- Transshipment facility
- Assembly facility
- Product-fulfilment centre
- Returned goods
- Miscellaneous other roles

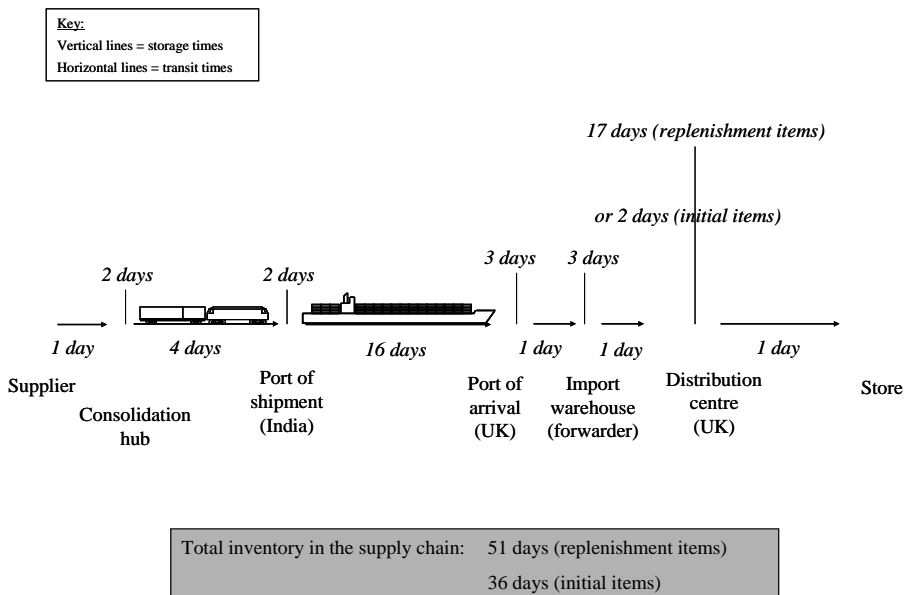
For example, an assembly facility at a warehouse may be performing production postponement, while a cross-dock facility may be facilitating time compression in the supply chain.

Although warehouses in modern supply chains may be undertaking a wide range of roles, it is interesting to note that the traditional role of storing goods is still very significant. A survey in the United Kingdom found that on average about 7 weeks of inventory is held in warehouses (Baker & Perotti, 2008), with the figure ranging from zero to 26 weeks. Although cross-docking is practised, about 80% of the warehouses in the survey cross-dock 10% or less of their throughput. Most of the throughput of a typical warehouse is thus derived from its own inventory holding. This is very much in line with the concept of “decoupling points”, outlined above. These decoupling points often hold a wide range of products in order to service customer orders. For example, in the survey mentioned above, an average of 23,000 different stock keeping units (SKUs) was stored in large warehouses<sup>2</sup>. Goods are thus typically picked from this inventory, consolidated and despatched to the customers. Customer lead times tend to be short with 47% of warehouses in the survey picking and delivering either the same day as, or the next day after, the receipt of order. Warehouses thus tend to provide high customer service levels based on their own inventory holdings.

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<sup>2</sup> In the survey, a large warehouse was classified as being over 10,000 square metres, or 107,640 square feet, in area.

Although storage, and the associated consolidation of goods, is still the prime role of warehouses, cross-docking is used in appropriate circumstances. For example, a clothing supply chain from India to the UK is shown in Figure 1. In this, the initial shipments of a new fashion garment are pushed directly out to stores only staying on average for two days at the UK distribution centre. Goods are sorted on the receiving dock and transferred immediately to the marshalling areas in the goods-out area, only waiting there until the next scheduled vehicle leaves for a store. This type of cross-docking activity is very common for fashion goods as well as for many fresh and short shelf-life products. In the case of the supply chain depicted in Figure 1, subsequent shipments of goods are stored at a decoupling point (i.e. the UK distribution centre) until they are required by stores to replenish sold items. In this example, items are held there for 17 days on average before they are called forward. Even with replenishment items, the goods may pass through various nodes (or warehouses) in the supply chain both upstream and downstream of the decoupling point where they may be cross-docked.



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Source: Baker, 2007.

Figure 1. Supply chain pipeline map of a UK fashion retail company

Although production postponement activities do take place in warehouses, these tend to be generally minor in nature (e.g. language labelling at the last moment for specific markets). In a UK survey, it was found that although value added activities occurred in 71% of warehouses, only 5% of floor area was typically given over to these activities (Baker, 2004). These activities thus tend to be conducted as part of the pick / pack / despatch operations rather than the warehouses acting as production assembly points. In fact, 50% of the floor area is typically given over to storage, 19% to picking and packing, and 16% to goods in/out, reflecting the prime role of warehouses as decoupling points for inventory holding and order consolidation (Baker & Perotti, 2008).

## **FRAMEWORK FOR IDENTIFYING THE ROLES OF WAREHOUSES**

The starting point for identifying the appropriate roles for a warehouse stem from the business model adopted. In general, inventory is necessary if both of the following conditions hold:

- the customer lead time is shorter than the supply lead time (otherwise, goods could be made-to-order), and
- the goods need to be available continuously to customers (otherwise, goods could be pushed directly to points of sale, as in the case of new fashion garments).

For example, if the business model is “make-to-order”, as in the case of Dell when they entered the personal computer market, then no finished goods inventory is necessary. Similarly, if the business model is to introduce new lines on a continuing basis, as in the case of Zara’s “fast fashion” ranges, then goods can be cross-docked directly to the stores without the need for a decoupling point of finished goods inventory.

Having determined whether inventory is necessary under the business model being applied, then it is suggested that the possible inventory reduction techniques outlined earlier in this chapter can be applied (e.g. production postponement, visibility, cycle time compression and inventory centralisation). At the same time, the organisation’s supply chain risk strategies need to be determined, as inventories may play a role within these. Supply chain trade-offs should then be calculated taking into account the full cost of inventory (including obsolescence, etc). These may trade-off inventory against such factors as purchasing discounts, long production runs and full load container transport. At this point, conventional inventory control theory can then be applied to calculate optimum inventory levels for the agreed service levels. The exact role and size of warehouses can then be determined. In general, the decoupling point should be as far upstream as customer service levels allow, thus centralising inventory, postponing distribution and taking advantage of lower inventory costs, whilst permitting customer lead times to be fully met. Cross-docking can take place both upstream and downstream of the decoupling point to increase the velocity of goods in the supply chain through those nodes. The overall framework for determining inventory and warehousing policy is shown in Figure 2.

The role of warehouses can be positioned within the context of the taxonomy of supply chain strategies described by Christopher *et al.* (2006). This taxonomy is based on demand characteristics (i.e. predictable or unpredictable demand) and supply characteristics (i.e. short or long lead times), as per Figure 3. Where demand tends to be predictable, a fairly lean supply chain would be appropriate, probably with cross-docking downstream from a small finished goods decoupling point where supply lead times are short, but with the decoupling point increasing in size as lead times lengthen. With unpredictable demand, then a more agile supply chain is needed

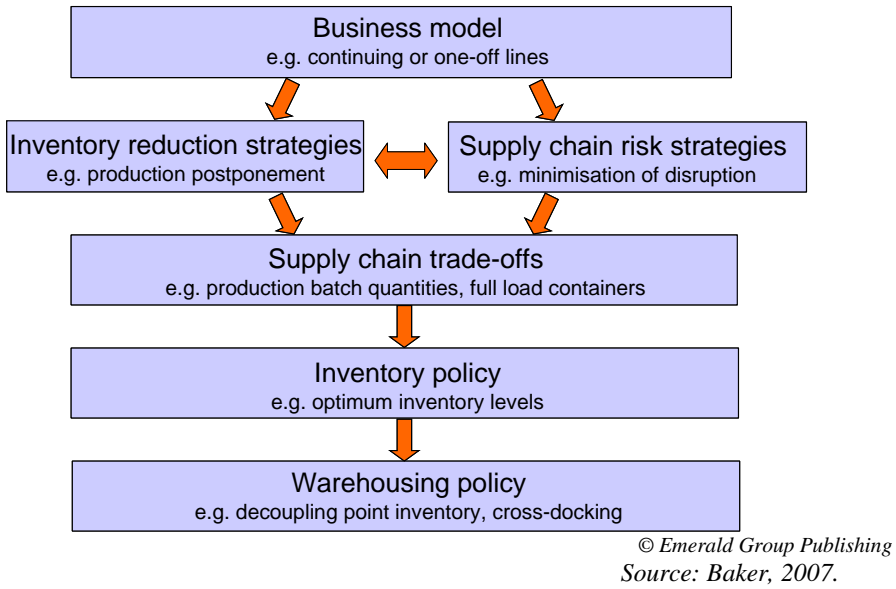


Figure 2. Framework for determining inventory and warehousing policies

. The cross docking of locally manufactured fashion lines would for example fit within the short lead time quadrant (e.g. as per Zara: Ferdows *et al.*, 2002), while a leagile production postponement strategy with a component decoupling point may be suited to long supply lead times. If postponement, or other inventory reduction, strategies are not possible in the latter scenario, then the unpredictable demand and long lead times would tend to result in the need for substantial inventory holdings of finished goods at the decoupling point. These quadrants are of course a continuum, as demand is never perfectly predictable.

<b>Supply</b>	Long lead time	<b>Lean:</b> Finished goods decoupling point	<b>Leagile:</b> Component decoupling point
	Short lead time	<b>Lean:</b> Cross-dock from small finished goods decoupling point	<b>Agile:</b> Cross-dock fashion lines
		Predictable	Unpredictable

**Demand**

(developed from Christopher *et al.*, 2006)

Figure 3. Taxonomy of supply chain strategies and associated warehouse roles

## DESIGN OF FLEXIBLE WAREHOUSES

It is generally recognised that markets are becoming increasingly volatile (Christopher, 2000) and therefore warehouses need to be able to respond to this. As seen from the 2008 “credit crunch”, this flexibility needs to be in a downward as well as an upward direction. Most large organisations have a network of warehouses and therefore the commitments agreed are critical to this flexibility e.g. in terms of rentals or third party logistics (3PL) contracts. However, many warehouses are dedicated to a particular company’s operations (Baker, 2004) whether they are own operated or operated by a 3PL. There is therefore often a commitment of reasonable length to the warehouse, as these are by their nature long term fixed assets (with warehouses often being depreciated over 25 years or more). It is often expensive and difficult to replace a warehouse or a complete network of warehouses. Therefore, within the resource based view of the firm, a warehouse network may constitute a competitive advantage, as it may be valuable, rare, inimitable and non-substitutable (Barney, 1991). Similarly, inappropriate warehouses may represent a competitive disadvantage.

The correct design of warehouses is therefore extremely important and yet various researchers have concluded that there is not a sound theoretical and science-based methodology for warehouse design (e.g. Rouwenhorst *et al.*, 2000, and Goetschalckx *et al.*, 2002). Most studies have approached this problem by proposing a series of steps that designers should follow, for example as per Baker & Canessa (2009):

- Define requirement
- Define and obtain data
- Analyse data
- Establish unit loads to be used
- Determine operating procedures and methods
- Consider possible equipment types and characteristics
- Calculate equipment capacities and quantities
- Define services and ancillary operations
- Prepare possible layouts
- Evaluate and assess
- Identify the preferred design

Flexibility needs to be incorporated into these design steps by undertaking scenario planning (e.g. as per Sodhi, 2003) in step “i”, as well as by evaluating different flexible approaches and equipment in steps “v” and “vi”.

Manufacturing flexibility literature states that a company needs to know in which way a facility may need to be flexible in the future, as it is unhelpful just to stipulate that “flexibility” is required (Upton, 1994). For warehousing, the following types of flexibility have been identified (van Hoek, 2001 and Baker, 2006):

- volume (e.g. demand variations)
- time (e.g. rush orders)
- unit quantity (e.g. item, as well as case, picking)
- presentation (e.g. different height pallets)

information (e.g. customised labelling)

Case study research into how companies respond to these different flexibility requirements indicate that solutions can be formulated at different levels (Baker, 2008). Thus companies may respond at a combination of supply chain levels:

- external integration (e.g. agreeing more frequent deliveries from suppliers at peak periods)
- internal integration (e.g. planning the scheduling of seasonal promotions with marketing)
- distribution network (e.g. changing the flow of goods: direct deliveries to customers at peak throughputs, etc)
- warehouse (e.g. changing from batch to pick-by-order for large customers at peak periods)

At the warehouse level, the types of responses can be grouped as follows:

- extra capacity (e.g. sufficient sorter capacity for absolute peak)
- additional resources when needed (e.g. hiring in temporary staff)
- flexible resources (e.g. “combi” narrow aisle trucks that can be used for pallet handling or order picking)

These responses can in turn be related to the basic components of a warehouse namely: land / buildings, equipment, staffing and systems / processes, so that alternative designs can be evaluated. This combination of options can be shown diagrammatically as in Figure 4.

Each of these possible responses will have different implications in terms of how quickly they can be implemented, the range of flexibility that can be accommodated, capital and operating costs, and service level provision. These classifications are analogous to those used in manufacturing flexibility literature (Upton, 1994). Based on these characteristics a methodology, such as that shown in Figure 5, can be used to determine the most appropriate design solution. Under this methodology, the flexibility, or agility, requirements are first stipulated. For example, this may be that the warehouse must be able to handle throughputs 25% above planned peak levels, with three months notice, and be able to maintain agreed customer service levels.

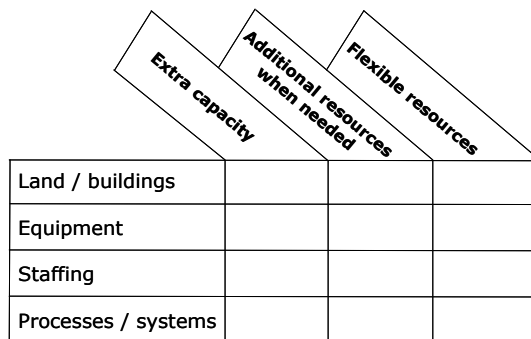


Figure 4. Warehouse flexibility option framework



The matrix in Figure 4 can then be used as an aid to identify possible resource options and flexibility approaches (e.g. install mezzanine and hire extra staff). These options will have different implications that can be related to the requirements. Feasible approaches that meet the requirements can then be evaluated in relation to their capital and operating costs.

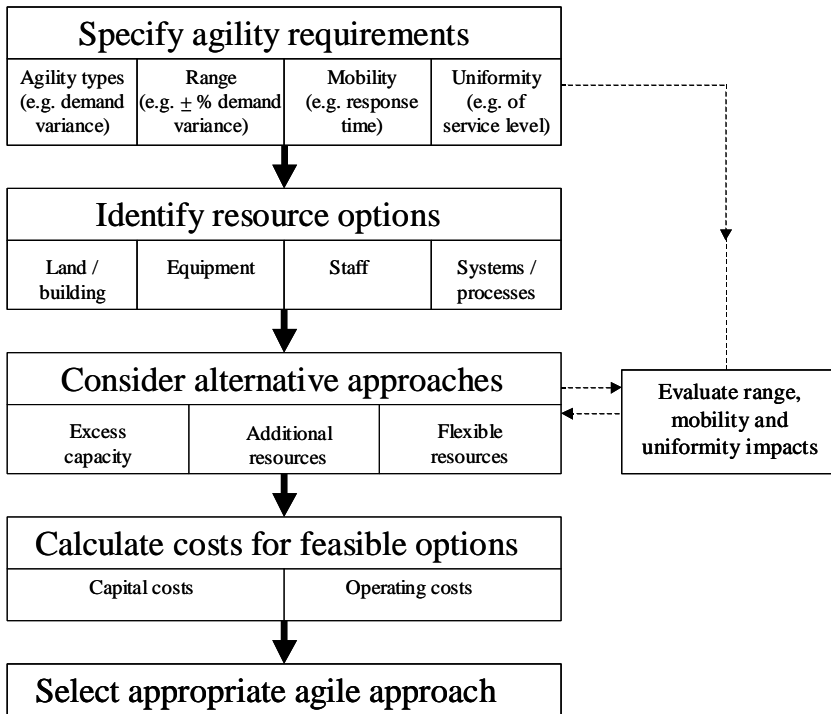


Figure 5. Methodology for selecting the appropriate agile approach to warehouse design

In selecting a flexible approach to warehouse design, automated equipment (e.g. automated storage and retrieval systems, A-frame dispensers, conveyors and sorters) is often regarded as being inflexible by its very nature. In addition, implementation timescales for automation can be lengthy (on average almost two years from planning to completed “ramp up”) and there is a danger of a “service level dip” immediately after commissioning (Baker & Halim, 2007). However, automation may be necessary to contain costs as scale increases (Pfohl *et al.*, 1992) and inflexibility can be minimised by proper scenario planning.

## PERFORMANCE MEASUREMENT OF FLEXIBLE WAREHOUSES

Conventional measures of warehouse performance are static in nature and normally measure input and output ratios (e.g. cost per case and picks per hour). These ratio measures have been called into question for comparative purposes, as they are greatly influenced by different operating circumstances (e.g. items per line and lines per order). Hackman *et al.* (2001) have proposed data envelopment analysis (DEA) as one possible solution. This

method compares various inputs and outputs and relates the results to similar facilities within the sample being examined. However, a very large sample of warehouses is required if a reasonable range of inputs and outputs are to be included.

Given these difficulties with static performance measures, it is understandable that there has been little attention given to dynamic performance measures that monitor flexibility. However, the attributes mentioned in the previous section can be used for this purpose:

*Range:* the number of flexibility types (i.e. quantity, time, etc) and the percentage change that can be accommodated.

*Mobility:* how quickly a change can be accommodated and to what extent the unit cost of storing / handling differs.

*Uniformity:* to what extent target service levels can be maintained during the change.

Thus, a perfectly flexible warehouse would be one that can accommodate every type of flexibility, to vast changes in magnitude, immediately, with no increase in unit cost and while maintaining target customer service levels. This would certainly represent utopia for warehouse managers!

## CONCLUSION

Warehouses are key components of many modern supply chains. Their role has been changing and this is demonstrated by some of their current names, such as sequencing centres, fulfilment factories and customer service centres. They are important both in terms of cost and service. They are long term fixed assets and cannot easily be changed, even though the markets they serve are increasing in volatility. This is a major challenge for practitioners. Outsourcing may play a part in the required flexibility but many large warehouses are dedicated to specific end users, whether they are own-operated or managed by a 3PL. They therefore often represent a long term commitment.

A key role of warehouses is to act as decoupling points, separating upstream lean manufacturing operations (often driven by forecasts) from the fulfilment of customer orders in volatile markets. This role implies the holding of inventory. In addition, warehouses often conduct a multitude of other roles, such as cross-docking, production postponement and handling returns. The circumstances when each of these roles is appropriate need to be understood more clearly. For example, in this chapter it is suggested that inventory needs to be held when supply lead times are longer than demand lead times and when products need to be made available continuously to customers. Cross-docking can be undertaken throughout the supply chain when these conditions do not exist and can also take place upstream and downstream of the decoupling point when they do exist. Further research is required into understanding such circumstances more fully.

In volatile markets, warehouses need to be designed and operated so that they can respond in a flexible manner. This chapter has provided some frameworks to assist in this respect, but again this is an area where further research would be beneficial so that

practitioners can be guided more clearly. It is hoped that the research summarised in this chapter will provide an impetus to such further research.

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*Chapter 5*

# **OPTIMIZATION FOR NETWORK CONGESTION MANAGEMENT WITH ELASTIC EQUILIBRIUM FLOWS**

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## **ABSTRACT**

Optimization of network congestion management using pricing setting is investigated in this paper. For a network with equilibrium conditions in trip distribution and network flow, the Wardrop's first principle is taken into account. The network congestion management problem subject to elastic equilibrium flow can be formulated as a mathematical program with equilibrium constraints. Due to the non-linearity and non-differentiability of the perturbed solutions in equilibrium conditions, a non-linear constrained optimization model is established. A new computationally efficient solution scheme is proposed to solve this network congestion management problem. Numerical calculations are conducted using an example network quantifying computational efficacy and robustness of the proposed approach.

## **1. INTRODUCTION**

Optimization of congestion management in a road network with elastic equilibrium flows is considered in this paper. The problem of congestion management for general networks has been well researched in past decades (Chiou, 2007; Shim et al, 2008; Talmor and Mahale, 2007; Ou et al, 2006; Kelly et al. 1998). For example, ways in dealing with the problems of traffic congestion management in transportation network and telecommunication networks have been widely discussed (see Ou et al, 2006; Chiou, 2007). For a network when the

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equilibrium conditions accounting for users' behaviour of trip and route choice are taken into account, for instance, a mathematical program with equilibrium constraints is often regarded as one of the most useful tools to formulate such optimization problem. In this paper we take a road network for example where users' trip and route choices are supposed to follow the Wardrop's first principle, i.e. the equilibrium principle. For a congested road network one of the effective ways to reduce traffic congestion is to implement an effective network pricing policy on the most congested links. Such a network congestion management problem can be formulated as a mathematical program with equilibrium constraints and has been well researched (see Ferrari, 1995; Yang and Lam, 1996; Bergendorff et al, 1997; Lawphongpanich and Hearn, 2004; Yildirim and Hearn, 2005).

Regarding the decision-making behaviour of multiple users in a general network, Sinha and Sinha (2004) proposed a linear programming approach for multi-level decentralized programming problems along with solution methods. For a road network with uncertain transportation costs and demands, Mudchanatongsuk et al (2008) presented an optimization-based formulation for the network design problem. For a global signal setting problem with user equilibrium network flows, Cipriani and Fusco (2004) presented an algorithm applying Armijo step length to general projected gradient algorithm. Investigations on the shape of the objective function together with algorithm properties are also conducted via numerical calculations on a small test network. Cascetta et al (2006) discussed models and algorithms for the optimization of urban signal settings with stochastic traffic assignments where numerical tests are reported. Chiou (2007) also presented a variety of sensitivity-based network optimization models for general networks with equilibrium conditions and computationally tested them on several example networks where numerical results have shown the preliminary performance of the proposed methods. Because of the non-linearity of the road network system in equilibrium constraints, solution algorithms mentioned above for general network optimization with equilibrium constraints can simply solve these non-linear inequality constrained problems only locally.

The network congestion management problem (NCM for short) using pricing settings can be conceptually categorized into the first-best and second-best congestion pricing setting problems according to the set of congested links. For the first-best congestion pricing setting problem, every congested link is tolled. For the second-best congestion pricing setting problem some congested links are not allowed to be tolled. Because the congestion tolls with this restriction do not obtain the maximum benefit possible, they are referred as the 'second-best' congestion pricing. In order to achieve optimal utilization of congested road networks, economists usually recommended the marginal social cost pricing (MSCP for short) policy imposed on road users for which the prices of goods and services are at their full cost to society. The MSCP policy is generally regarded as one of the first-best congestion pricing settings because they achieve the optimal utilization of road network on the basis of system optimum. As compared to the MSCP, a recent new minimum revenue tolling framework (MINSYS for short, Hearn and Ramana, 1998) is presented for finding a cheaper and efficient implementation procedure. In this minimum revenue approach, road users are assumed to behave on the basis of minimizing their travel cost, e.g. the travel cost from the point of entry to the point of exit plus the tolls on the congested links. For the second-best congestion pricing problem, it is to find a minimum toll revenue for a restricted set of congested links in a road network, which are penalized for congestion as defined by decision makers. This network congestion control problem can be also formulated as a bi-level mathematical

program (Shi and Xia, 1997). From a viewpoint of bi-level multi-objective decision-making problem (BMDMP for short) of the leader-follower Stackelberg game, Shi and Xia presented a two-person bi-level multi-objective decision-making model and an interactive algorithm to approximately solve the problem. This interactive algorithm simplifies a BMDMP by transforming it into separate multi-objective decision-making problems at the upper- and lower-levels, therefore avoiding the difficulty associated with non-convex mathematical programming to arrive at an optimal solution. Yang and Lam (1996) also presented a sensitivity analysis based method (SAB for short) to heuristically solve this network congestion pricing problem. Using a linear approximation for the flows in equilibrium to simplify the relationships of flow and the congestion pricing settings, Yang and Lam only obtained local optimal solutions for the network congestion pricing setting problem. Due to the non-differentiability of the decision variables in equilibrium constraints, solution algorithms for the bi-level programming problem can simply solve these problems only approximately.

In this paper, we formulate this NCM problem as a mathematical program with equilibrium constraints (MPEC for short) which is a generalization of the bi-level programming program. As it has been widely indicated, the equilibrium flows and travel costs in a congested network are strongly influenced by the operations of pricing settings. In our problem the sum of collected network congestion pricings is to be minimized. According to Wardrop's first principle, an elastic user equilibrium traffic assignment taking account of both users' trip and route choices is considered as the constraint set for the pricing setting problem. Due to the non-linearity and non-differentiability of perturbed pricing settings in equilibrium trip distribution and network flow, we utilize a non-smooth approach to solve this non-linear NCM problem subject to elastic equilibrium flows. We propose a computationally efficient novel algorithm: a contractive subgradient projection method to solve this NCM problem with global convergence.

The organization of this paper is as follows. In next section, a NCM problem with elastic equilibrium flow can be formulated as a MPEC program. Due to the non-differentiability of the perturbed congestion pricing settings in equilibrium trip distribution and flows, the first-order sensitivity analysis of the NCM problem can be conducted. In section 3, a new solution scheme is proposed to efficiently solve the NCM problem with global convergence. In section 4 numerical calculations are performed using an example road network to quantify the effectiveness of the proposed method. Conclusions and further work are summarized in the section 5.

## 2. PROBLEM FORMULATION

In this section, a NCM problem with elastic equilibrium flow can be formulated as a MPEC programme. Due to the non-linearity and non-differentiability of the perturbed solutions in equilibrium conditions, the first-order sensitivity analysis is conducted for which the generalized gradient and directional derivatives of variable of interests can be derived.



## 2.1. Notation

$G(N, L)$  denotes a directed network, where  $N$  is the set of nodes and  $L$  is the set of links.

$\beta$  denotes a set of link tolls.

$W$  denotes a set of origin-destination (OD) pairs.

$q$  denotes a vector of travel demand.

$R_w$  denotes a set of paths between OD pair  $w$ ,  $\forall w \in W$ .

$p$  denotes a vector of path flow.

$f$  denotes a vector of link flow.

$\Lambda$  denotes the link-path incidence matrix.

$\Gamma$  denotes the origin-destination-path incidence matrix.

$c$  denotes a vector of link flow travel cost.

$\pi$  denotes a vector of minimum travel cost.

$C$  denotes a vector of path flow travel cost.

$\rho$  denotes the travel demand inverse function.

## 2.2. An Elastic User Equilibrium Traffic Assignment

According to Wardrop's first principle, an elastic user equilibrium traffic assignment which takes account of both users' trip and route choices can be expressed by the following variational inequality: introduce

$$K = \{(f, q) : f = \Lambda p, \Gamma p = q, p \geq 0\}$$

To find values  $(f, q) \in K$  such that

$$c^t(f)(\bar{f} - f) - \rho^t(q)(\bar{q} - q) \geq 0 \quad (1)$$

for all  $(\bar{f}, \bar{q}) \in K$  where the superscript  $t$  denotes matrix transpose.

## 2.3. A MPEC Programme

Let  $\Pi$  define the constraints for pricing setting variables, and  $S(\cdot)$  denote the solution set for elastic equilibrium flow. A NCM problem with elastic equilibrium flow can be formulated in the following way:

$$\begin{aligned} & \underset{\beta, f, q}{\text{Min}} \quad \Theta_1(\beta, f, q) & (2) \\ & \text{subject to } \beta \in \Pi, (f, q) \in S(\beta) \end{aligned}$$

According to Wardrop's first principle, the solution set  $S(\cdot)$  for elastic equilibrium flows can be solved in the following manner: introduce

$$K(\beta) = \{(f, q) : f(\beta) = \Lambda p(\beta), \Gamma p(\beta) = q(\beta), p(\beta) \geq 0\}$$

find values  $(f, q) \in K(\beta)$  such that

$$c^t(\beta, f)(\bar{f} - f(\beta)) - \rho^t(\beta, q)(\bar{q} - q(\beta)) \geq 0 \quad (3)$$

for all  $(\bar{f}, \bar{q}) \in K(\beta)$ .

## 2.4. Sensitivity Analysis by Directional Derivatives

Suppose the solution set  $S(\cdot)$  defined in (2) is *locally Lipschitz*. Following the results developed by Qiu and Magnanti (1989), the first-order sensitivity analysis of (3) can be established in the following way. Given an arbitrary path flow  $p^*$  together with the corresponding equilibrium flow and trip distribution  $(f^*, q^*)$  and travel times  $\pi^*$  at current congestion pricing settings  $\beta^*$ , let the changes in link or path flow with respect to the changes in variables denoted by  $g_{f(\beta^*)}$  or  $g_{p(\beta^*)}$ . The changes in travel demand with respect to the changes in variables denoted by  $g_{q(\beta^*)}$ . The subgradients  $(g_f, g_q)$  of (3) can be obtained by solving the following affine variational inequality. Introduce

$$g_{K(\beta)} = \left\{ (g_f, g_q) : \exists g_{p(\beta)} \text{ such that } g_{f(\beta)} = \Lambda g_{p(\beta)}, \Gamma g_{p(\beta)} = g_{q(\beta)}, \text{ and } g_{p(\beta)} \in g_{K_0(\beta)} \right\} \quad (4)$$

where

$$g_{K_0} = \left\{ g_{p(\beta^*)} : \begin{array}{l} (i). g_{p_v(\beta^*)} \text{ free,} \quad \text{if } p_v^* > 0 \\ (ii). g_{p_v(\beta^*)} \geq 0, \quad \text{if } p_v^* = 0, \text{ and } C_v^* = \pi_w^*, \forall v \in R_w, w \in W \\ (iii). g_{p_v(\beta^*)} = 0, \quad \text{if } p_v^* = 0, \text{ and } C_v^* > \pi_w^* \end{array} \right\}$$

Find subgradients  $(g_f, g_q) \in g_{K(\beta)}$  such that

$$(\nabla_{\beta} c(\beta^*, f^*) g_{\beta} + \nabla_f c(\beta^*, f^*) g_f)(\bar{f} - g_f) - (\nabla_{\beta} \rho(\beta^*, q^*) g_{\beta} + \nabla_q \rho(\beta^*, q^*) g_q)(\bar{q} - g_q) \geq 0 \quad (5)$$

for all subgradients  $(\bar{f}, \bar{q}) \in g_{K(\beta)}$  where  $\nabla_{\beta} c, \nabla_f c, \nabla_{\beta} \rho$  and  $\nabla_q \rho$  are gradients evaluated at  $(\beta^*, f^*, q^*)$  when the changes in congestion pricing settings are specified. According to Rademacher's theorem (Clarke, 1983), the solution set  $S(\cdot)$  is differentiable almost everywhere. Thus, the generalized gradient for  $S(\cdot)$  can be denoted as follows.

$$\partial S(\beta^*) = co \left\{ \begin{pmatrix} g_{f(\beta^*)} \\ g_{q(\beta^*)} \end{pmatrix} = \lim_{k \rightarrow \infty} \begin{pmatrix} \nabla f(\beta^k) \\ \nabla q(\beta^k) \end{pmatrix} : \beta^k \rightarrow \beta^*, \begin{pmatrix} \nabla f(\beta^k) \\ \nabla q(\beta^k) \end{pmatrix} \text{exists} \right\} \quad (6)$$

where *co* denotes the convex hull.

## 2.5. A Non-Linear Inequality Constrained Optimization Problem

According to the generalized gradient in (6), the MPEC problem given in (2) for a NCM problem with elastic equilibrium flow can be expressed in the following manner: suppose the solution set  $S(\cdot)$  is *locally Lipschitz*, a non-linear inequality constrained optimization problem of (2) is to

$$\underset{\beta}{Min} \quad \Theta(\beta) \quad (7)$$

subject to  $\beta \in \Pi$

Because the solution set of trip distribution and equilibrium flow  $S(\cdot)$  in (2) may not be explicitly expressed as a closed form, as it seen obviously from Demp (2002),  $\Theta(\cdot)$  function in (7) is a non-smooth and non-convex function with respect to the pricing setting variables.

## 3. A NOVEL SOLUTION SCHEME

Due to the non-linearity and non-differentiability of the solution set  $S(\cdot)$  for trip distribution and equilibrium flows given in (2),  $\Theta(\cdot)$  in (7) is non-smooth. In this section, we propose a novel solution scheme: a contractive subgradient projection method (CSP for short) to efficiently solve the non-linear inequality constrained optimization problem (7). In the following, we suppose the objective function  $\Theta(\cdot)$  is *semi-smooth* (Mifflin, 1977) and *locally Lipschitz* on the domain set. The directional derivatives of  $\Theta(\cdot)$  can be characterized by its generalized gradient.

### 3.1. Characteristics of the Non-Linear Inequality Constrained Optimization Problem

**Definition 1.** We say that  $\Theta(\cdot)$  in problem (7) is *semi-smooth* on set  $\Pi$  if  $\Theta(\cdot)$  is *locally Lipschitz* and the limit

$$\lim_{g \in \partial \Theta(\beta + \lambda d'), d' \rightarrow d, \lambda \downarrow 0} \{g^t d'\} \quad (8)$$

exists for all  $d' \in \Pi$ .  $\Upsilon$

**Theorem 2** <Directional derivatives for semi-smooth functions> Suppose that  $\Theta(\cdot)$  in (7) is a locally Lipschitzian function and the directional derivative  $\Theta'(\beta; d)$  exists for any direction  $d$  at  $\beta$ . Then

- (1).  $\Theta'(\cdot; d)$  is Lipschitzian;
- (2). For any direction  $d$ , there exists a  $g \in \partial\Theta(\beta)$  such that

$$\Theta'(\beta; d) = g^t d \quad (9)$$

**Proof.** See Qui and Sun (1993).

The generalized gradient of  $\Theta(\cdot)$  is as follows.

$$\partial\Theta(\beta^*) = \text{co} \left\{ \lim_{k \rightarrow \infty} \nabla\Theta(\beta^k) : \beta^k \rightarrow \beta^*, \nabla\Theta(\beta^k) \text{ exists} \right\} \quad (10)$$

According to Clarke (1983), the generalized gradient is a convex hull of all points of the form  $\lim \nabla\Theta(\beta^k)$  where the subsequence  $\{\beta^k\}$  converges to the limit value  $\beta^*$ . And the gradients in (10) can be expressed as follows.

$$\nabla\Theta(\beta^k) = \nabla_{\beta} \Theta_1(\beta^k, f^k, q^k) + \nabla_f \Theta_1(\beta^k, f^k, q^k) f'(\beta^k) + \nabla_q \Theta_1(\beta^k, f^k, q^k) q'(\beta^k) \quad (11)$$

where the subgradients  $f'(\beta^k)$  and  $q'(\beta^k)$  can be obtained from (5).

### 3.2. A Contractive Subgradient Projection Method

With regard to the solutions for the non-linear inequality constrained optimization problem (7), in this section, we present a computationally efficient novel algorithm: contractive subgradient projection method to solve the problem (7). In the following, a number of mathematical propositions are established first. Let  $\text{Pr}_{\Pi}(x) \in \Pi$  denote the projection of  $x$  on set  $\Pi$ .

**Proposition 3.** For given solutions  $x$  in (7), let  $\Pi(\beta)$  denote the feasible solution set for problem (7) then for each  $x \in \Pi(\beta)$  there exists  $y \in \Pi(\beta)$  such that

$$\|x - y\| \leq \|x - z\|, \quad \forall z \in \Pi(\beta) \quad (12)$$

and  $y$  is known as the projection of  $x$  on the set  $\Pi(\beta)$  with respect to the Euclidean norm, i.e.

$$y = \text{Pr}_{\Pi(\beta)}(x) = \arg \min_{z \in \Pi(\beta)} \|x - z\| \quad (13)$$

**Proposition 4.** For given solutions  $x$  in (7), let  $\Pi(\beta)$  denote the feasible solution set for problem (7), then  $y = \text{Pr}_{\Pi(\beta)}(x)$  if and only if the following inequality holds.

$$y^t(z - y) \geq x^t(z - y), \quad \forall z \in \Pi(\beta) \quad (14)$$

In problem (7), for any  $x \in \Pi(\beta)$  let  $e(x; \Pi)$  denote an error bound in which a given pair point  $x$  fails to satisfy equality (13), which can be expressed as

$$e(x; \Pi) = x - \text{Pr}_{\Pi(\beta)}(x) \quad (15)$$

the *Proposition 4* can be re-expressed as follows.

**Proposition 5.** For given solutions  $x$  in (7), let  $\Pi(\beta)$  denote the feasible solution set for problem (7), then  $y = \text{Pr}_{\Pi(\beta)}(x)$  that is,

$$e(x; \Pi) = 0, \quad \forall x \in \Pi(\beta) \quad (16)$$

if and only if the following inequality holds.

$$(x - z)^t e(x; \Pi) \geq \|e(x; \Pi)\|^2, \quad \forall z \in \Pi(\beta) \quad (17)$$

**Theorem 6 (A fixed point map)** For given solutions  $x$  in (7), let  $\Pi(\beta)$  denote the feasible solution set for problem (7), and  $0 \in d + \partial\Theta(\beta)$ , then  $x^* \in \Pi(\beta)$  is a solution of the problem (7) if and only if  $x^*$  is a fixed point of the map

$$\text{Pr}_{\Pi(\beta)}(I + d) : \Pi(\beta) \mapsto \Pi(\beta) \quad (18)$$

that is,

$$x^* = \text{Pr}_{\Pi(\beta)}(x^* + d) \quad (19)$$

or

$$e(x^*; \Pi) = 0, \quad \forall x^* \in \Pi(\beta) \quad (20)$$

**Proof.** Suppose that  $x^* \in \Pi(\beta)$  is a solution of the problem (7) given by a known set of network pricing  $\beta$ , that is,

$$-d^t(z - x^*) \geq 0, \quad \forall z \in \Pi(\beta) \quad (21)$$

Adding  $x^{*t}(z - x^*)$  to both sides of (21), one obtains

$$x^{*t} (z - x^*) \geq (x^* + d)^t (z - x^*), \quad \forall z \in \Pi(\beta) \quad (22)$$

From *Proposition 4* one concludes that

$$x^* = \Pr_{\Pi(\beta)}(x^* + d)$$

Also by *Proposition 5* one has

$$e(x^*; \Pi) = 0$$

Conversely, if  $x^* = \Pr_{\Pi(\beta)}(x^* + d)$  then

$$x^{*t} (z - x^*) \geq (x^* + d)^t (z - x^*), \quad \forall z \in \Pi(\beta)$$

and therefore,

$$-d^t (z - x^*) \geq 0, \quad \forall z \in \Pi(\beta)$$

which concludes this proof.  $\square$

According to *Theorem 6*, the projection inequality (14) can be re-expressed in the following manner:

$$(x - \Pr_{\Pi(\beta)}(x))^t (\Pr_{\Pi(\beta)}(x) - z) \geq 0 \quad \forall z \in \Pi(\beta) \quad (23)$$

Using the mapping form in (18), let

$$x = \beta + d \quad (24)$$

The inequality (23) becomes

$$(\beta + d - \Pr_{\Pi(\beta)}(\beta + d))^t (\Pr_{\Pi(\beta)}(\beta + d) - z) \geq 0 \quad (25)$$

Because in (24), the error bound function for (24) is

$$e(\beta; \Pi) = \beta - \Pr_{\Pi(\beta)}(\beta + d) \quad (26)$$

Thus in (25) it becomes

$$(e(\beta; \Pi) + d)^t (\beta - z - e(\beta; \Pi)) \geq 0 \quad (27)$$

Let  $z = \beta^*$ , it implies

$$(\beta - \beta^*)^t (e(\beta; \Pi) + d) \geq e(\beta; \Pi)(e(\beta; \Pi) + d) \quad (28)$$

Let

$$\tilde{d} = e(\beta; \Pi) + d \quad (29)$$

We have the following from (28):

$$\begin{aligned}
(\beta - \beta^*)^t \tilde{d} &\geq e(\beta; \Pi) \tilde{d} \\
&= \|e(\beta; \Pi)\|^2 + e(\beta; \Pi) d
\end{aligned} \tag{30}$$

Assume that there exists a  $\mu > 1$  such that

$$e(\beta; \Pi) d \geq (\mu - 1) \|e(\beta; \Pi)\|^2 \tag{31}$$

Thus in (30) we have

$$(\beta - \beta^*)^t \tilde{d} \geq e(\beta; \Pi) \tilde{d} \geq \mu \|e(\beta; \Pi)\|^2 \tag{32}$$

with  $\mu > 1$ .

**Theorem 7. (A contractive subgradient projection method)** Let  $l \in (0, 2)$  be a constant. Given an arbitrary iterate  $\beta^1 \in \Pi(\beta)$  for problem (7), for  $k = 1, 2, \dots$ , if  $\beta^k \notin \Pi(\beta^*)$  then

$$\beta^{k+1} = \beta^k - l\gamma(\beta^k) \tilde{d} \tag{33}$$

with

$$\gamma(\beta^k) = \frac{e(\beta^k; \Pi) \tilde{d}}{\|\tilde{d}\|^2} \tag{34}$$

where search direction  $\tilde{d}$  is defined in (29). The sequence  $\{\beta^k\}$  generated by the contractive subgradient projection method satisfies

$$\|\beta^{k+1} - \beta^*\|^2 \leq \|\beta^k - \beta^*\|^2 - l(2-l)\gamma(\beta^k)e(\beta^k; \Pi)\tilde{d} \tag{35}$$

for all  $\beta^* \in \Pi$ .

**Proof.** By definition,

$$\begin{aligned}
\|\beta^{k+1} - \beta^*\|^2 &= \|\beta^k - l\gamma(\beta^k) \tilde{d} - \beta^*\|^2 \\
&= \|\beta^k - \beta^*\|^2 - 2l\gamma(\beta^k) \tilde{d} (\beta^k - \beta^*) + l^2 \gamma(\beta^k) \gamma(\beta^k) \|\tilde{d}\|^2 \\
&= \|\beta^k - \beta^*\|^2 - 2l\gamma(\beta^k) \tilde{d} (\beta^k - \beta^*) + l^2 \gamma(\beta^k) e(\beta^k; \Pi) \tilde{d}
\end{aligned} \tag{36}$$

From (30), (36) becomes

$$\|\beta^{k+1} - \beta^*\|^2 \leq \|\beta^k - \beta^*\|^2 - 2l\gamma(\beta^k) e(\beta^k; \Pi) \tilde{d} + l^2 \gamma(\beta^k) e(\beta^k; \Pi) \tilde{d}$$

$$= \|\beta^k - \beta^*\|^2 - l(2-l)\gamma(\beta^k)e(\beta^k; \Pi)\tilde{d} \quad \Upsilon$$

**Theorem 8 (Convergence of the method)** If the solution set  $\Pi(\beta^*)$  for problem (7) is nonempty, then the proposed solution scheme is globally convergent, i.e.

$$\lim_{k \rightarrow \infty} \|\beta^k - \beta^*\|^2 = 0 \quad \forall \beta^* \in \Pi(\beta^*) \quad (37)$$

**Proof.** For all  $\beta^* \in \Pi(\beta^*)$ , it is easy to check that every sequence  $\{\beta^k\}$  generated by the solution scheme is bounded. We proof this theorem by contradiction. Suppose

$$\lim_{k \rightarrow \infty} \|\beta^k - \beta^*\|^2 = \varepsilon > 0 \quad (38)$$

We introduce a set

$$\Sigma = \left\{ \beta : \varepsilon \leq \|\beta - \beta^*\|^2, \|\beta - \beta^*\|^2 \leq \|\beta^1 - \beta^*\|^2, \forall \beta^* \right\}$$

then

$$\{\beta^k\} \subset \Sigma \quad (39)$$

and  $\Sigma$  is a closed bounded set.

From (34) and (35) in *Theorem 7*, we have

$$\|\beta^{k+1} - \beta^*\|^2 \leq \|\beta^k - \beta^*\|^2 - l(2-l)\|e(\beta^k; \Pi)\|^2 \quad (40)$$

Because  $\Sigma \cap \Pi(\beta^*) = \emptyset$ , then on set  $\Sigma$  we let

$$\Psi(\beta) = l(2-l)\|e(\beta^k; \Pi)\|^2 \quad (41)$$

Since  $\Psi(\beta)$  is *Lipschitz continuous* on set  $\Sigma$ , we have

$$\inf_{\beta \in \Sigma} \Psi(\beta) = \nu \quad (42)$$

From (38), there is a  $\zeta > 0$  such that for all  $k > \zeta$ ,

$$\|\beta^k - \beta^*\|^2 < \varepsilon + \frac{\nu}{2} \quad (43)$$

On the other hand, from (40) and (42),



$$\|\beta^{k+1} - \beta^*\|^2 \leq \|\beta^k - \beta^*\|^2 < \varepsilon - \frac{\nu}{2} \quad (44)$$

This contradicts (38) and completes this proof.  $\square$

### 3.3. A Novel Solution Scheme

Consider the solution for problem (7), a new solution scheme can be established in the following steps.

#### *Step 1.0. (Set initial data)*

- 1.1. Set parameter  $l \in (0,2)$  and termination threshold  $\nu$ .
- 1.2. Start with  $\beta^k$  and set index  $k = 1$ .

#### *Step 2.0. (Compute subgradients)*

- 2.1. Solve an elastic user equilibrium traffic assignment problem with pricing setting variables  $\beta^k$  in (3).
- 2.2. Obtain the subgradients  $(g_f, g_q)$  associated with the changes in the equilibrium flow and trip distribution with respect to the changes in pricing settings  $\beta^k$  by solving affine variational inequality (5).
- 2.3. Compute the generalized gradients  $\partial\Theta(\beta^k)$ .

#### *Step 3.0. (Compute the subgradient projection)*

- 3.1. Compute the subgradient projection  $\text{Pr}_{\Pi(\beta)}(\beta^k + d_k)$  along with the search direction  $d_k$ .
- 3.2. Compute an error bound function  $e(\beta^k; \Pi)$  in (26).
- 3.3. Determine a modified search direction  $\tilde{d}^k$  via (29).

#### *Step 4.0. (Conduct the contractive subgradient projection method)*

- 4.1. Determine  $\gamma(\beta^k)$  via (34).
- 4.2. Compute the  $\Psi(\beta^k)$  value via (41).
- 4.3. If  $\Psi(\beta^k) \leq \nu$  then stop; otherwise continue.
- 4.4. Find new iterate  $\beta^{k+1}$  via (33) and increase index  $k$  by 1. Then go to Step 2.0.

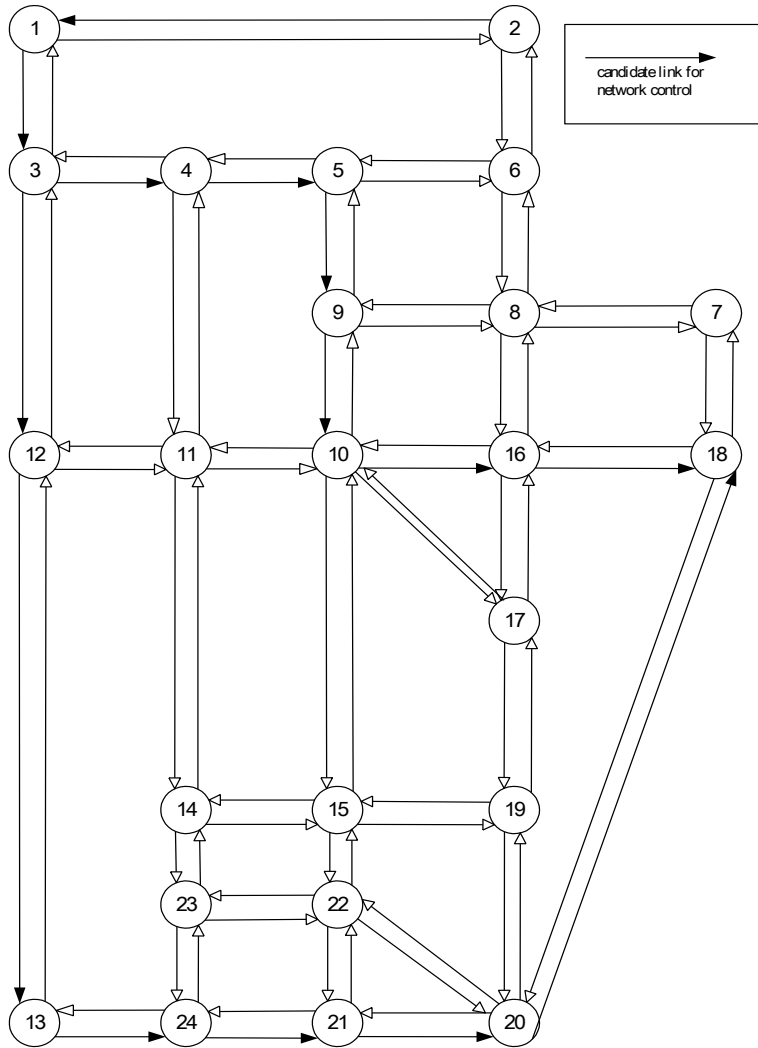


Figure 1. Sioux Falls city network.

#### 4. NUMERICAL CALCULATIONS

In this section, numerical experiments are conducted using a real data Sioux Falls city network (Chiou, 2007; Abdulaal and LeBlanc, 1979) with 14 tolled links for network congestion management as shown in Figure 1 to quantify and demonstrate the effectiveness and computational efficacy of the proposed method. The proposed method: CSP, the marginal social cost pricing (MSCP for short) policy, the sensitivity analysis based (SAB for short) method (Yang and Lam, 1996) and recent new proposed methods: the minimum revenue tolling framework (MINSYS for short) and the genetic algorithm (GA for short, Ceylan and Bell, 2004) are conducted with three distinct sets of initial data for non-linear inequality constrained NCM problem. The following elastic travel demand inverse function is used. For

any origin-destination pair  $w$ , let  $m_w$  denote a travel time coefficient associated with the trip distribution  $q_w$  where  $m_w \in [1,10]$ , and let  $t_w$  denote the travel demand inverse function  $\rho_w$  intercept for origin-destination  $w$ ,  $\forall w \in W$ , where  $t_w \in [10,100]$ .

$$\rho_w = -m_w q_w + t_w, \quad \forall w \in W \quad (45)$$

The objective function of the NCM problem is to pursue minimal travel cost and can be specified as follows.

$$\begin{aligned} & \underset{\beta}{\text{Min}} \quad \sum_{a \in L} c_a(\beta_a, f_a) f_a & (46) \\ & \text{subject to } \beta \geq 0 \text{ and } (f, q) \in S(\beta) \end{aligned}$$

The corresponding results are summarized in Tables 1-3. Implementations for carrying out the following solution methods were made on SUN SPARC SUNW, 900 MHZ processor with 4GB RAM under Unix SunOS 5.8 using C++ compiler. The stopping criterion is set when the relative difference in the objective function value is less than 0.1%.

Computational results are shown in Tables 1-3 where travel costs are expressed in terms of monetary values. As it is observed in Tables 1-3, due to the non-convexity and non-linearity of the NCM problem, multiple local optima exist and evidently each method leads to a different solution. For the first initial data set of pricing setting variables, as it is seen in Table 1, the proposed CSP achieved the minimum travel cost with the value of \$209, which greatly improved travel cost of the NCM problem by 61.58%. Conventional methods like MSCP and SAB respectively improved travel costs by 60.11% and 61.03%. The recently proposed methods: MINSYS and GA also improved travel costs nearly by 60%. With respect to computational efficacy in solving the NCM problem, the proposed CSP only took 28% and 40% CPU times of those did by the MSCP and SAB. Furthermore, in comparison with two recently proposed methods, the proposed CSP took only 21% CPU times of those did by the GA and MINSYS.

**Table 1. Computational results for 1<sup>st</sup> set initial data**

	MSCP	SAB	MINSYS	GA	CSP
Initial data of $\beta$	1.0	1.0	1.0	1.0	1.0
$\beta_{(1,3)}$	4.6	4.0	4.5	4.0	4.2
$\beta_{(2,1)}$	4.5	4.2	4.5	4.0	4.0
$\beta_{(3,4)}$	4.5	3.8	4.5	4.2	4.0
$\beta_{(3,12)}$	5.0	3.7	4.9	3.9	3.5
$\beta_{(4,5)}$	4.0	4.3	4.1	4.3	4.5

$\beta_{(5,9)}$	4.2	4.1	4.2	4.5	4.0
$\beta_{(9,10)}$	4.8	3.9	4.8	3.7	4.0
$\beta_{(10,16)}$	5.1	3.5	5.1	4.0	3.6
$\beta_{(12,13)}$	3.9	4.5	3.9	4.2	4.4
$\beta_{(13,24)}$	4.0	4.5	4.0	3.6	4.6
$\beta_{(16,18)}$	5.0	3.5	5.0	4.6	3.4
$\beta_{(20,18)}$	5.1	4.4	5.1	5.0	4.5
$\beta_{(21,20)}$	3.9	3.6	3.9	3.2	3.5
$\beta_{(24,21)}$	4.2	4.1	4.2	3.6	4.1
Initial cost (in \$)	544	544	544	544	544
Minimum cost (in \$)	217	212	220	219	209
CPU (in s)	786	544	1012	1055	217

**Table 2. Computational results for 2<sup>nd</sup> set initial data**

	MSCP	SAB	MINSYS	GA	CSP
Initial data of $\beta$	5.0	5.0	5.0	5.0	5.0
$\beta_{(1,3)}$	3.6	2.4	1.5	3.0	2.2
$\beta_{(2,1)}$	4.5	1.9	1.5	2.0	3.0
$\beta_{(3,4)}$	4.3	3.8	4.2	1.2	1.5
$\beta_{(3,12)}$	5.1	3.5	3.9	3.9	3.2
$\beta_{(4,5)}$	3.8	4.5	2.1	4.3	4.4
$\beta_{(5,9)}$	4.2	3.1	4.2	4.5	3.6
$\beta_{(9,10)}$	4.5	3.6	4.8	3.7	4.2
$\beta_{(10,16)}$	5.1	3.5	5.5	4.2	3.6
$\beta_{(12,13)}$	3.9	4.2	3.6	4.6	4.4
$\beta_{(13,24)}$	4.2	3.5	4.0	5.6	2.6
$\beta_{(16,18)}$	5.1	2.5	5.0	2.6	1.4
$\beta_{(20,18)}$	5.2	2.4	5.2	5.1	4.5
$\beta_{(21,20)}$	3.7	3.8	3.9	3.2	3.5
$\beta_{(24,21)}$	4.2	4.5	3.2	4.6	4.1
Initial cost (in \$)	447	447	447	447	447
Minimum cost (in \$)	225	219	223	221	209

CPU (in s)	785	544	1010	1050	220
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**Table 3. Computational results for 3<sup>rd</sup> set initial data.**

	MSCP	SAB	MINSYS	GA	CSP
Initial data of $\beta$	10.0	10.0	10.0	10.0	10.0
$\beta_{(1,3)}$	9.6	12.4	11.5	10.5	9.2
$\beta_{(2,1)}$	10.5	11.9	10.8	9.6	11.6
$\beta_{(3,4)}$	12.3	8.8	9.2	1.2	10.5
$\beta_{(3,12)}$	8.1	10.5	7.9	3.9	9.9
$\beta_{(4,5)}$	8.8	4.5	12.1	4.3	7.4
$\beta_{(5,9)}$	5.2	3.1	8.2	4.5	3.6
$\beta_{(9,10)}$	2.5	3.6	3.8	3.7	4.2
$\beta_{(10,16)}$	5.1	7.5	5.5	9.2	3.6
$\beta_{(12,13)}$	3.9	4.2	3.6	4.6	8.4
$\beta_{(13,24)}$	4.2	8.7	8.5	5.6	12.6
$\beta_{(16,18)}$	9.5	12.5	5.9	2.6	11.4
$\beta_{(20,18)}$	5.2	9.4	5.2	5.1	4.5
$\beta_{(21,20)}$	3.7	3.8	7.9	3.2	3.5
$\beta_{(24,21)}$	4.2	4.5	3.2	4.6	9.1
Initial cost (in \$)	687	687	687	687	687
Minimum cost (in \$)	325	291	355	253	211
CPU (in s)	819	589	1210	1158	221

For the second initial data set of pricing setting variables, as it is seen in Table 2, again the proposed CSP achieved the minimum cost with the value of \$209, which greatly improved travel costs of the NCM problem by 53.24%. Conventional methods like MSCP and SAB respectively improved travel costs nearly by 50% and 51%. The recently proposed methods: MINSYS and GA also respectively improved travel costs by 50.11% and 50.56%. With respect to the computational efficacy in solving the NCM problem, again, the proposed CSP took 28% and 40% CPU times of those did by the MSCP and SAB. Also, in comparison with two recently proposed methods, the proposed CSP took only 22% and 21% CPU times of those did by the MINSYS and GA.

For the third initial data set of pricing setting variables, as it is seen in Table 3, the proposed CSP achieved the minimum cost with the value of \$211, which appreciably improved travel cost of the NCM problem nearly by 70%. Conventional methods like MSCP and SAB also improved travel costs by 53% and 58%. The recently proposed methods: MINSYS and GA respectively improved travel costs by 48.3% and 63.2%. With respect to the computational efficacy in solving the NCM problem, again, the proposed CSP took 27%

and 38% CPU times of those did by the MSCP and SAB. Also, in comparison with two recently proposed methods, the proposed CSP respectively took 18% and 19% CPU times of those did by the MINSYS and GA.

## 5. CONCLUSION AND FUTURE WORK

This paper addressed a new optimal scheme for a network congestion management problem using the pricing setting variables. Such a network congestion management problem with equilibrium conditions in trip and equilibrium flows can be expressed as a MPEC program. A contractive subgradient projection method is proposed to efficiently solve this NCM problem with global convergence. Computational tests are conducted using a real data Sioux Falls city network demonstrating and quantifying the effectiveness and computational efficacy of the proposed method in solving the non-linear inequality constrained NCM problem. The proposed method has been also computationally compared to two well-known conventional methods and two recently proposed methods. As it can be seen from numerical results, the proposed method has shown significant improvements in travel cost reduction with far less computational overheads when compared to other alternatives. Further issues like solving a non-linear inequality constrained NCM problem with time-varying delays are being taken into account. We will discuss this issue in a subsequent paper.

## ACKNOWLEDGMENTS

Special thanks to Taiwan National Science Council for financial support via grants NSC 96-2416-H-259-010-MY2 and 98-2410-H-259-009-MY3.

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## *Chapter 6*

# **ARCHITECTURE OF CCPUL**

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This section presents the Customer Complaint problem of Product Usage Life cycle (CCPUL). The motivations, scope, goals, contribution and thesis architecture of this research are also discussed in this section.

## **1.1 RESEARCH MOTIVATION AND GOAL**

The development and design for a product is the most important thing in a competitive market. The forward design is the key on the R&D department. Which a new product is successful or fail, is related to the customer complaint about product problems. So we can track the problem and clarify the responsibility for efficient performance management. We can accumulate experience and feedback to design origin so that mechanisms such as design guidelines/checklist can be developed to prevent problem reoccurrences in the future. This is a thought which establish a reverse design by reverse thinking (Youngsup & Russell, 1995; Sheu & Chen, 2006). The customer complaint users here may be extended to mean manufacturers, channels, ODM customers, and end users.

When a product occur problems, it is usually a user brings up the problem and gives the product to the buying source to handle. Normally, the product will be sent to the original buying sales agent or the sales agent which is a chain retail store, and then the sales agent will send it to the proxy agent to recondition. If the proxy agent doesn't have a qualified technician, it will be sent to the maintenance center of the manufacturer of origin to recondition.

The process is a long, complicated and not efficient. Because a proxy agent may not have these service experience and capability, it has to rely on the product technique archives to supply easy maintenance service for customers. Because which a manufacturer face is proxy agent, not a downstream sales agent or customers, when a customer encounters problems, the



first thing he demands is the after sales service from the store / sales agent from where the product is bought from.

However, in the complicated and longwinded flow path, they usually don't have an efficient way to utilize the past information well. So that when the problem occurs next time, they will spend much time on the investigation and analysis for the problem again. Besides, analyze and investigate over and over not necessarily can find out the genuine cause of the quality problem. In addition, in the complicated and large information, the person in charge of the quality problem usually can not promptly and properly detect the extraordinary cause which may lead to the bad product quality by his professional knowledge and experience. He leans to instincts and random variable to work.

From the above description, we can make a little question and discussion: how to maintain properly and promptly the customer complaint, in order to respond to the customer as soon as possible, avoid occurring mistakes again, and feed back to R&D for product improvement.

## **1.2. PROBLEM STATEMENT**

Traditionally, the customer complaints have only been processed by the RMA department, where identification of problem is vague and thus can not prevent problem reoccurrences in future from the upstream.

Two problems were identified from the above statements. First problem was a reformulation of the backward design from customer's complaint with the consideration of all the downstream relational attributes such as product design, manufacturing, sales, and so on.

As timely new product development becomes critical due to shorter product life cycle, the respond time from the customer complaint to product design must be shorter than ever.

For this purpose, the concept of design for X (DFX) plays a key role by considering the most important X item constraints synchronously in the design stage and integrates process through feedback relationships for new product development.

More recently, for manufacturing, quality, maintainability, reliability, and assembly, researchers have focused their key point on design for X item. Beside this, a comprehensive information management system was necessary to implement these two key functions: design for manufacturability and manufacturing information feedback to design.

Since the 1990s, also speed and flexibility in the new product development had received increased priority. Although the above literature is widely distributed over many different disciplines, most studies had concentrated on a specific "X" topic such as DFM, etc and manufacturing information feedback to design.

Two issues which usually present the problem:

- 1) DFX only focus on a specific "X" item such as DFM, etc. This has meant that do not consider other process multi-attributes simultaneously, and do not capture enough structured and relational information feedback through product formation and usage life cycle.
- 2) Customer's complaint usually does not connect with seamless operations of the downstream functions. Some researchers demonstrated that the formation of inter-

firm new product development networks was linked to both internal organizational and external factors. This means that the product problems do not map the cause and responsibility, of department relationship.

To address the first problems, this section proposed an integrated framework for product forming and usage life cycle which includes:

(1).The section will provide an integrated framework for customers and downstream organization or individuals such as end users, ODM/OEM customers, manufacturing, logistics, etc., to feedback knowledge seamless and relationship in the product forming and usage life cycle.

(2).The section will build and store a many to many relationships from product problems to mapping the cause and responsibility department relationships.

Second problem was automated mapping cognitive uncertainties attributes with differential process stage thinking and perception, which involved in classification problems were explicitly measured, analyzed, and tracked into the knowledge induction process.

Product problems submitted by customer maybe observation error, uncertainty, subjective judgments, and so on, many data occurring in real world was presented in fuzzy description. Fuzzy sets and membership function allow the modeling of uncertainties, while providing a symbolic method for knowledge comprehensibility.

Another, product problems usually occur at downstream stages of the product forming and usage cycle, so there are no classified attributes felt by new product development. There is no incentive for product design to apply the priority on others' relational attributes. Decision trees are one of the most useful approaches for learning and classified from feature-based examples, but they do not undergo a number of alterations to deal with perception vagueness and measurement uncertainties. Accordingly, fuzzy decision tree representation is becoming increasingly approach in dealing classification with problems of uncertainty, and inexact data. One issue is usually present about literature in this problem:

(1). Most of existing algorithms for constructing fuzzy decision trees focus on the selection of the attributes. They attempt to improve the classification accuracy for unknown cases. But, an important point is how to identify suitable for the attributes.

To address the second problems, this section proposed a database base fuzzy decision tree with multi-attributes.

Our fuzzy decision tree differs from traditional fuzzy decision trees. It let identification more suitability usage cause of past validation result by continue learning.

### **1.3. RESULT AND CONTRIBUTION**

- (1). Establish an integrated feedback framework for the product usage life cycle.
- (2). Propose an automatic cause identification methodology for product problems with fuzzy symptoms by using the fuzzy decision tree method.
- (3). Establish an intelligent diagnose system of product problems.

## 1.4. SCOPE OF CCPUL

### 1.4.1. Scope

Reference Figure 1-1, this study is from customer complaint acceptance, analysis, and cause attribution to the problem resolving and the responsible department, and then responds to customers and attributes the causes for the R&D reference. According to the Cooper's study (1994), the forward design of a new product development process is divided to seven steps, such as an idea beginning of a product, early estimation, a concept design, product development, product test, pile run, and mass production. At this section, the backward feedback means starting at users, and feedback to market, R&D, origin, manufacture, channels etc. six areas in the enterprise function process. These become a trace process for product problems.

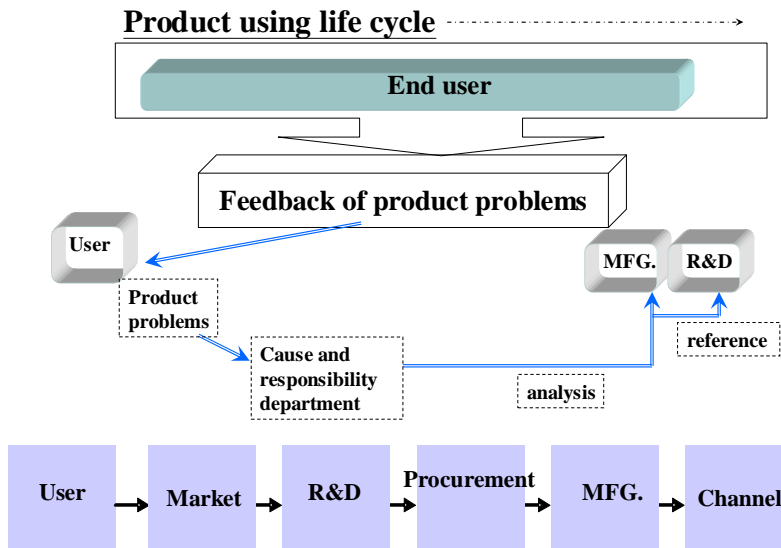


Figure 1-1 Research scope.

### 1.4.2. Thesis Position

Literature review has contain both product usage life cycle and design for life cycle in the Figure 1-2. Generally speaking, it could be divided in two areas. One is traditional product life cycle management system. It includes the knowledge system of the single product manufacture function(S.K.Padhy,1991), the dynamic analysis of the product life cycle(Bayus,B.L1998), coordination product development by design knowledge(Amrit Tiwana , Balasubramaniam Ramesh,2001), web-based knowledge sharing system(Sang Bong Yoo, Yeongho Kim,2002), knowledge data warehouse(Hamid R. Nemati , David M. Steiger,

Lakshmi S. Iyer, Richard T. Herschel,2002), and web-based coordination product development(Zhan, H.F. & Lee W.B. & Cheung C.F. & Kwok S.K. & Gu, X.J.,2003) etc.. The other is considering the product life cycle and feedback of the product design. It is considered about the design for single manufacture function (S.G.Shina, 1991), the product life cycle (Alting 1991) (Ishii, K., Lee, B.H. & Eubanks, C.F. 1995), the manufacture experience feedback of product design (Youngsup, & Russell, 1995) etc. Different from the above traditional literatures, this section is centered on considering the knowledge feedback analysis and diagnosing system in the design. It is obvious different in the integration, range, knowledge types, and DFX in the Table 1-1. Six volumes are chosen as Table 1-2 for the references.

**Table 1-1.Traditional product usage life cycle vs. intelligent product usage life cycle**

Items	Traditional product usage life cycle	Intelligent product usage life cycle
Scope	Feedback to R&D with single function	Feedback to R&D with product usage life cycle
Knowledge	Crisp Knowledge	Fuzzy knowledge
DFX	DFX	DFX + Feedback + Multi-attributes

**Table 1-2. Thesis position with literature**

Paper name	Integrated product and process design through feedback of manufacturing experience		journal	Computers industry engineering		
	Author	issue		points	Methodology	contribution
Young sup & Russell, 1995	DFM system are unpredictable variations in manufacturing environment	formal feedback information process procedures with PCBA manufacturing problems from design rule updating system to manufacturing process and product parameters	Design rule updating based on logistic regression model	An information feedback system from manufacturing to design that helps to avert previous manufacturing problems is critical to an effective concurrent engineering approach.	Feedback to R&D with single function	Feedback

Figure (Continued)

Paper name	Reliability in a time driven product development process		journal	Quality and reliability engineering		
Author	issue	points	Methodology	Contribution	Comment	Related with thesis
Yuan, 1999	the customers also expect a high reliability of these complex and sometimes expensive products	demonstrate by use of a case study how quality and reliability can be managed in a time-driven product development process (PDP).	MIR (Maturity index on reliability)	understand the non-linear behaviors of time and cost during the PDP.	Do not consider all factors of the product using life cycle	Reliability for feedback system of the product using life cycle

Paper name	The building bricks of product quality: An overview of some basic concepts		journal	Product economics		
Author	issue	points	Methodology	Contribution	Comment	Related with thesis
Berden, 2000	Concurrent engineering do not consider upstream problem feedback.	The MIR concept provides a method to analyze the nature of information flows in actual companies	feed-forward and feedback	Established mechanism of the quality information with flow feed-forward and feedback	Do only consider single attributes	Feedback with multi-attributes

Figure (Continued)

Paper name	Why do quality and reliability feedback loops not always work in practice: a case study		journal	Reliability engineering & system safety		
Author	issue	points	Methodology	Contribution	Comment	Related with thesis
Molenaar, 2002	Product design do not avoid problem of old problem	Design information flow		Management of the information in this process becomes more transparent and can be improved	Do not consider feedback of MIR	Feedback from information to knowledge

Paper name	Knowledge warehouse: an architectural integration of knowledge management, decision support, artificial intelligence and data warehousing		journal	Decision Support Systems		
Author	issue	points	Methodology	Contribution	Comment	Related with thesis
Hamid, 2002	a data warehouse does not necessarily provide adequate support for knowledge intensive queries in an organization	The goal of KW is to provide the decision maker with an intelligent analysis platform that enhances all phases of the knowledge management process.	knowledge warehouse	a knowledge warehouse (KW) architecture that will facilitate the capturing and coding of knowledge organization.	Do not consider fuzzy data	Fuzzy data of knowledge warehouse

Figure (Continued)

Paper name	Application of data warehouse and Decision Support System in construction management		journal	Automation in Construction		
	Author	issue		points	Methodology	Contribution
Chaua, 2002	How to make decision more efficiently without interrupting the daily work of an On-Line Transaction Processing (OLTP) system	The integration of a data warehouse and a Decision Support System (DSS) seems to be efficient.	The concepts of the data warehouse, On-Line Analysis Processing (OLAP) and DSS.	Construction Management Decision Support System (CMDSS) developed in this study.	Do not consider feedback in the decision-making	Feed back to R&D process

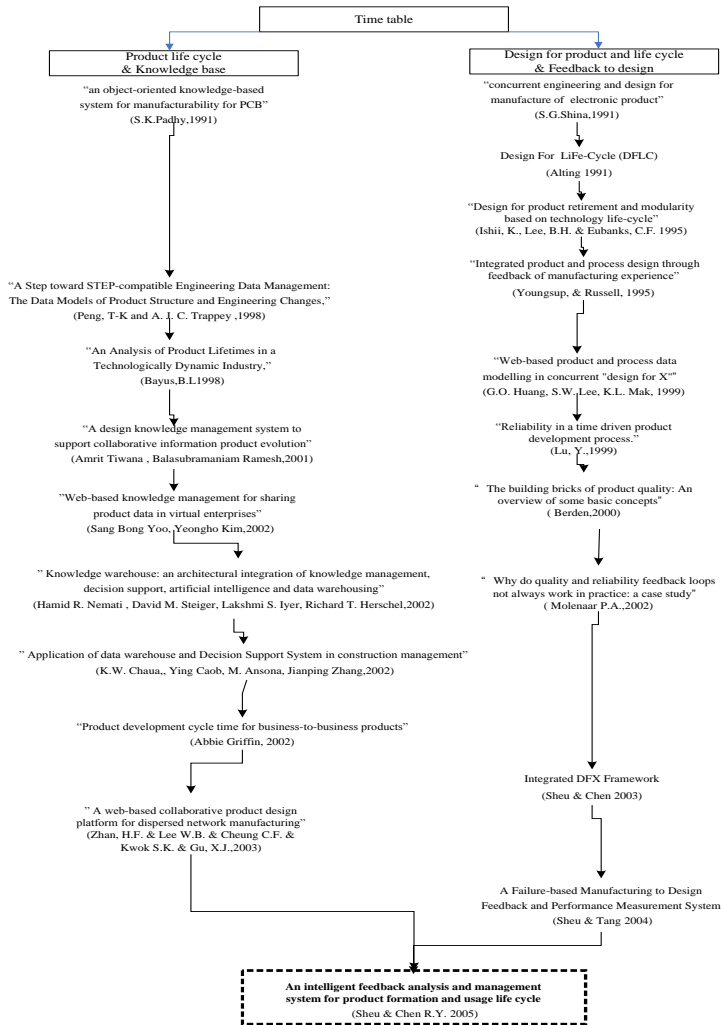


Figure 1-2. Time-based literature review .

## 1.5. ARCHITECTURE OF CCPUL

### 1.5.1. Architecture

The structure of this section is that the downstream customer users bring up the problems of product. These problems are via the interface of the product problem feedback tracing system and it will be via two ways. One way, if the product problem is a new problem, it will be classified automatically to the upstream unit and the responsible department, and store the attributions into the knowledge warehouse for the fuzzy data storage model. These can avoid happening again and to be the guild line reference to the product development in the R&D department. The other way, we can get the cause reason from the upstream and the responsible department to respond to the customers instantly and to solve problems, and to reward or punish. The product problem feedback is from the downstream, and could include the customer users, also may include the manufactures, channels, and providers. The downstream feedback to the upstream will form a product using problem feedback cycle structure to relate the product problems, reason, responsible unit, and feedback. In order to respond and handle the complicated process, it needs a software agent with memory and relative data to instead of the artificial process. In the Figure 1-3, we can see the software agent execute the feedback from the product using cycle problems and store the diagnoses in the knowledge data warehouse. Above sayings are the diagnosis architecture and the feedback analysis for the product using cycle problem. It also is the research method approach on this section.

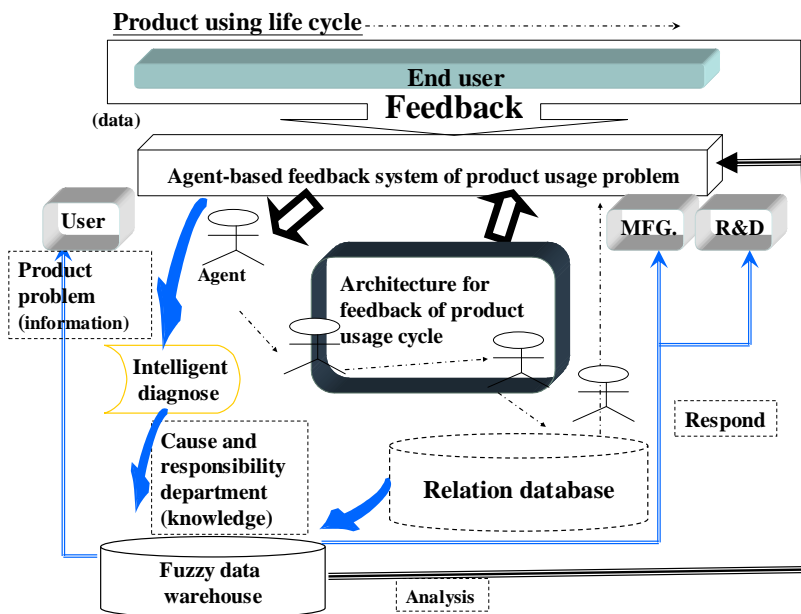


Figure 1-3. Architecture of CCPUL.



## 1.5.2. Architecture for Feedback of Product Usage Cycle

According to the above problem statements, this section will describe an integrated framework for formalizing such a customer's complaint problem feedback process USAGE object-oriented relation database through the product forming and usage life cycle. Networks are often seen as models of organizational flexibility, the section submits the relationship of innovative firms on both internal and external networks to facilitate a complex feedback of product forming and usage life cycle.

More recently, researcher divided new product development process into seven procedures. Another researcher proposes a study to identify the methods used for collaborative works in the supply chain and focuses on some of its areas, as between a company and its suppliers and its customers, and also the integration of product information in the value chain.

This section presents a backward design process from customer's complaint problem through product forming and usage life cycle.

Some researcher provided strong evidence that customer orientation in innovation projects had a positive influence on NPD success and that the impact increased with the degree of product innovativeness using regression analysis. Some study collected performance assessments from both the customer and the supplier of a new product or process and compared their perceptions of the importance of several critical success factors. This section will describe an integrated framework through the product usage life cycle in the Figure 1-4.

Generally, the process of the customer complaint for a product problem is started at the service after sales department. Then, it is handled by the original manufacturer or the maintenance department. And it is the end for all the process of the customer complaint. It is less to make a further inquiry into the problem and cause classification and the responsibility to which upstream department and rarely to feedback to the design rule of R&D for reference. In such a case, it will make an influence on such as mentioned above for could not respond to customer promptly. So this section will expand the cycle of the customer complaint process for a product into the cycle of the entire product formed and used to build up a framework of integrated product problem feedback to link all the process and which is build up as follows:

First, the cycle of the product formed and used is divided according to user, market, procurement, manufacturing, and channel six stages. And each stage is downward defined the industry function process, and then according to the industry organization department to be as an attribution unit. It is referenced as the right part of the figure 1-4.

Then, it defined the happening location of each problem according to the different user as a participation role, such as manufacturer, channel, user and supplier etc., and which is corresponded with the cause of the problem. And map the cause to the department of the organization to clarify the responsible unit for attribution. It is referenced as the left part of the Figure 1-4.

Moreover, fast and correctly map the problem characteristic to the department which cause the problem and to the six stages of the product formed and use cycle. For the Figure 1-4, it is known that some problem may not be caused by single cause (for example: the cause which the problem A is high probability in the sales department. It is higher than the probability in the material department)

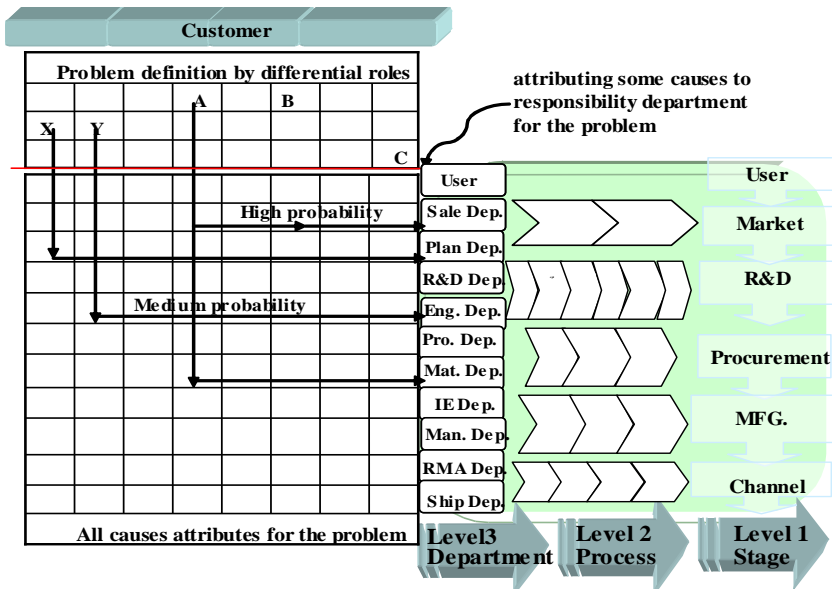


Figure 1-4 the integrated framework.

A customer's complaint problem feedback process is very complex and many-to-many relationships; it must be built by structured multi-level One-to-Many relation in order to deal with such as complex's product forming and usage life cycle. The section will use relation database to connect all cycle process seamlessly. The integrated framework focuses on analyzing and feeding the problem-causes to appropriate department(s) for further evaluation and actions. The organization's responses to the problem-causes can be learned and response performance evaluated for incentive or penalties.

According the above problem formation, the section would present problem formulations using object-orient base fuzzy decision tree. Most recently, information technology (IT) using fuzzy linear regression is the acquisition, processing, and storage and dissemination capability of representing vague knowledge. Some researchers focus on the knowledge component to propose learning strategies that are based on the similarity between the inefficient firms. Some researcher analysis and design is based on Object-oriented design and implementation of a web-enabled beer game for illustrating the bullwhip effect in supply chains. One of main objectives of object-orient base fuzzy decision tree is to attribute cause to responsibility department with high accuracy of classification for feedback, tracking, analysis through product forming and usage life cycle.

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*Chapter 7*

## **OPERATIONAL ISSUES FOR ENTREPRENEURS IN THE GLOBAL CONTEXT**

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### **ABSTRACT**

The article notes the nature and importance of considering operational issues for entrepreneurs in a globalized world. The main focus is on the importance of understanding operational issues from an entrepreneur's point of view. This approach is relatively novel and unique as most of the extant operational management discussion seems to implicitly take on the lens of established businesses. The commentary also briefly outlines the phenomena of "born global" entrepreneurial firms, global start ups, etc which run counter to the staged model of internationalization that was popular in the past. Global startups highlight the urgency and relevance of effective operations management for entrepreneurial firms in the current times. In addition, the commentary highlights the differences between entrepreneurial and established businesses, the importance of operational management in entrepreneurial businesses, the unique challenges that stem from managing operations from a global context, and new opportunities to address economic and social issues from an operational perspective.

### **INTRODUCTION**

Most of the research on global operations management is centered primarily on large and established businesses (Prater & Ghosh, 2006). The domain of textbooks on global operations is likewise focused on large and established businesses, with minimal (if any) attention being paid to entrepreneurial businesses. Clearly, effective operational management is fundamental to the success of any business, from the large, established businesses to the new, small entrepreneurial firms as well as all the other medium range businesses that fall between these two extremes.

What are entrepreneurial businesses and why do they matter? Entrepreneurial firms are fairly young, small in size, innovative, with the founders actively involved in the management, ownership, and governance of the firm (Salimath, Cullen & Umesh, 2008). Entrepreneurs recognize and exploit opportunities, and establish firms to bring new or adapted products and services to the marketplace. Thus they serve to fulfill important gaps in consumer needs that were unmet by established firms. Often entrepreneurs create new markets where none existed before (e.g., the market for cell phones was non-existent prior to the invention of this telecommunication product) and thereby benefit from the rewards and profits of such vision and enterprise. The innovations brought to market by entrepreneurs benefit society by creating continuous improvements in the quality and standard of life.

Entrepreneurs also matter from an economic standpoint because they impact the economic well being of the communities, regions, and nations in which they are embedded. Small businesses and entrepreneurial firms contribute to wealth creation and gross domestic product of nations by virtue of employment and production of goods and services in the economy. Understanding their importance, governments at the regional and national level actively provide incentives, grants, loans, and other attractive terms to encourage entrepreneurial activity. Among the more aggressive side, it is not uncommon to find state governments competing to attract new ventures to set up their operations in their areas by the provision of free land, technical expertise, tax holidays, and substantial grants.

Typically, entrepreneurial firms tend to operate under conditions of scarce resources, especially during the initial launch of the new venture. Operational efficiencies thus are a critical factor in their success at the start up phase. However the need to maintain operational efficiencies continues to be an important factor in the entrepreneurial firm's success at later stages of growth and development. As entrepreneurial businesses succeed and grow, their operations necessarily have to expand in a similar fashion. The success of a new product brings demands for greater production as well as the efficient procurement of inputs and the distribution of outputs to an increasing market. Managing expanded operational requirements effectively becomes a central issue for the sustenance of entrepreneurial businesses.

Yet another aspect of operating under constraints or without slack, is that entrepreneurial businesses rarely have the luxury of being able to outsource their operational management to skilled professionals or agencies. Instead, entrepreneurs work in bootstrap mode, trying to manage all aspects of operational management by themselves, as they usually lack the cash reserves to hire additional people during the initial stages. Entrepreneurs therefore tend to be their own supply chain and operations managers, particularly during start up phases of the new venture. As firms grow and become successful however, there is greater tendency to hire professional help in managing operations. As such, the knowledge and ability to manage operations effectively becomes a critical asset for entrepreneurs at various stages fo the life cycle of the firm.

It is interesting to note that prior to the advances in information technologies and the world wide web, international operations tended to be relevant to the concerns of large and established businesses only. This was due to the fact that international expansion required significant investment of resources in the form of financial capital, human capital and expertise, which was rarely available in small, entrepreneurial businesses. Those firms that intended to eventually become internationalized in their operations could do so by taking small incremental steps. For example, the staged model of internationalization (Johanson & Vahlne, 1977) suggests that firms gradually move from exporting to licensing to foreign

direct investment, gradually gaining experience and minimizing risk by investing financial capital in small increments. Consequently, full scale international operations tended to coincide with larger and more established firms. Perhaps this is one of the reasons why most textbooks seem to assume that internationalization (and accompanying global operational issues) primarily concerned larger firms.

With the evolution of technology and globalization, internationalization has become a core factor in entrepreneurial and small businesses as well. The rapid development of internet capabilities in the information technology sector has made it very easy and inexpensive to market and advertise on a worldwide basis. Advances in financial institutions has enabled seamless transactions in international currency and ensured security of online payments, increasing confidence from both the suppliers and consumers. Similar advances in physical delivery and transportation has assisted overseas shipment of goods and services. International agreements and trade blocs have eased governmental restrictions on cross border business activity. Due to these multiple forces, international business activity has increased significantly over the last two decades. Many businesses can no longer afford to ignore international competitors who are seeking worldwide markets. To remain competitive in such an international arena, businesses are often forced to consider internationalization as a means of survival.

In direct contrast to the staged model of internationalization, the phenomena of “born globals” or global start ups (Knight. & Cavusgil, 1996) has shown that relatively new, small, entrepreneurial firms can have global operations from their birth, instead of waiting several years to acquire financial resources and experience prior to venturing in the international arena. The born globals leverage the internet and worldwide delivery systems to sell and source their products and services with minimal cost additions. Consequently, global operations become particularly relevant to entrepreneurial and small businesses.

A significant number of entrepreneurial firms either compete or want to compete in global markets (Ernst & Young, 1995). Oviatt and McDougal (1994) classify four types of supply chain activities that are salient to new ventures, i.e., sourcing, production, sales and marketing and service activities. Additionally global supply chain activities may be carried out at different levels, i.e., local, international or global levels. International expansion requires, at the minimum, a consideration of cost, unique global resources, and network factors in order to be successful.

From a strategic perspective, among the global operational issues that are pertinent to entrepreneurial business, efficiencies in procurement, production, and distribution are especially important. Recognizing opportunities that arise from the sharing of knowledge and techniques is another critical issue. The concern over the commercialization and protection of innovation that emerges from the sharing of knowledge is another area where global entrepreneurial firms face challenges. Maintaining high levels of quality, customer service and risk management are other factors that are relevant to entrepreneurial global startups. Entrepreneurial firms, therefore, need to be cautious about erosions or threats to their competitive advantage that stem from these operational inefficiencies.

In recent times fundamental transformations in technology have also resulted in the creation of new organizational forms such as virtual organizations. With rapid globalization, new startups have begun to explore and exploit opportunities that exist in subsistence markets around the world. These subsistence economies bring a unique set of challenges that may run counter to conventional approaches to marketing, distribution and other operational logistics



(Madhubalan, . Gajendiran & Venkatesan, 2008). Additionally, recognition of social and ethical issues in business has led to the emergence of social entrepreneurial firms and start ups that are seeking to service those at the bottom of the economic pyramid (Prahalad, 2006). Widespread entrepreneurship applied to all aspects of the firm's operations is a key route to success in these subsistence markets, and in serving less affluent consumers in the world (Salimath, 2010).

Likewise, issues of sustainability and green business models have started to become important ways to evaluate business performance in the eyes of various stakeholders. For example, the Dow Jones Sustainability Index (DJSI) tracks the performance of the leading sustainability-driven companies worldwide, based on long term economic, environmental and social criteria. Sustainable practices, ecologically sound operations, and green supply and distribution chains are some of the opportunities that may be considered by visionary and proactive entrepreneurial firms when designing their globally networked operations.

The future holds many exciting avenues for entrepreneurs to utilize and create innovative business models and techniques to address key economic and social issues in their global operations. Such innovations may include ways to reduce carbon imprint of products, eliminating waste produced by packaging, reducing inventory time and amounts, decreasing time to market, and eco friendly products, marketing and distribution. Operational issues therefore, present opportunities for entrepreneurial firms to create new ways to facilitate the achievement of economic and social goals in the global context.

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*Chapter 8*

## **ON PARTNER SELECTION FACTORS AND VENTURES PERFORMANCE OF INTERNATIONAL ALLIANCE**

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### **ABSTRACT**

International Joint venture with external organizations has been viewed as one of the most efficient and effective way while seeking survival opportunities in the ever spanning of crsss-border economy. Proper partners for an IJV is essential for a venture success. Unfortunately, few if any studies had attempted to include customer as part of primary consideration in partner selection since 1970s. This research provides an important piece for the puzzle and explains the importance of this additive element in venture performance. Samples are purposely taken from 107 IJVs with various industry background in Taiwan. Using questionnaire as an instrument, this research have successfully collected 321 valid responses with CEO, functional managers. Major findings of this research include identifying and confirming the existence of customer related factors other than task related factors. This paper confirms the importance of customer factor as partner selection criteria in achieving satisfactory venture performance. Partner related factor is the most powerful predictors among all partner selection factors in predicting venture performance, and the customer related factor appears is the second. Task related factor seems irrelevant for the respondents of this research. A market-driven management can assure better performance, selecting partner with customer related factors is the key to assure a market-driven venture business..

### **1. INTRODUCTION**

Scholars from resource-based theory advocate that rationale behind firms collaborating with external organizations is to seek complementary resources and capabilities that currently

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absent in its resource stock for competition (e.g. Wernerfelt, 1995; Eisenhardt & Martin, 2000; and many others). Compare to resource internality, such a resource leveraging is preferable in terms of cost-effectiveness (Hagedoorn & Schakenraad, 1994; Coviello & Munro, 1997). Contrast to foreign direct investment, collaboration is particularly a preferred alternative in the globalizing environment (Acs, Morck, Shaver & Yeung, 1997; Eden, Levitas & Martinez, 1997), especially for small and medium size enterprises that marketing knowledge is particularly important and inaccessible (Park, Whitelock & Giroud, 2009).

Cross-border joint venturing provides multinational enterprises (MNE) opportunities to gain local expertise and market access as well as local knowledge in a relative lower cost (Makino & Delios, 1996), thus has become one of major strategic alternatives for cross-border expansion (Contractor & Lorange, 1988; Osland & Cavusgil, 1996; Hennart & Reddy, 1997). Selecting cooperating partner is one of the critical issues associated with international joint venture in both academician studies and practitioner cases (Buono, 1997; Cavusgil & Evirgen, 1997; Glaister & Buckley, 1997; Fey & Beamish, 2000). Studies generally agreed that proper venturing partner is the key to the success of cross-border venture (Littler & Leverick, 1995; Dacin, Hitt & Levitas, 1997), and formal and rigorous partner selection has positive effects in finding appropriate partner as well as better performance (Njissen, Douglas & Galis, 1999), no matter where or what industry an IJV attempts to form.

Studies on the consideration factors associate with the partner-selection roughly have two broad scopes, of which generally follow the Geringer's categorization. One focus on criteria that relate with the potential partners' capabilities or complementary ability, for example, strategic fit (Lasserre, 1984; Harrigan, 1988) for value creation that unable to achieve by conventional trading (Beamish, 1987; Kanter, 1994) for mutual benefit (Brouthers, Brouthers & Wilkinson, 1995). These factors are partner-related factors (PRF) for they concern more on what partner's characteristics could be beneficial to a venture. Another focus on specific capabilities and competences that required for particular tasks the MNE seeks in that market, as earlier studies mostly follow. For example, particular local asset (Tomlinson, 1970), complementary technology and marketing system (Adler & Hlavacek, 1976), financial related factors (Luo, 1998), human and physical asset resources (Hitt, Levitas, Arregle & Borza, 2000), and other resources that contributable to the ventures (Awadzi, 1987). These are task-related factors (TRF) for they concern mainly on partner's capabilities toward certain tasks (Geringer, 1991; Arino & Abramov, 1997; Al-Khalifa & Peterson, 1998) rather than the others..

As numerous studies have witnessed, customer is increasing important to MNE in that numerous calls to include this into management studies (Brief & Bazerman, 2003), and practically industrial cases have experienced to fail or loss because of ignoring this vital element (Deloitte Haskins & Sells International, 1989; Stickler, 2001). In the other hand, marketing scholars have also evidenced strong linkages between market oriented operation and market performance (Slater & Narver, 1994a; Slater & Narver, 1994b; Kohli, Jaworski & Kumar, 1993; Pelham, 1997; Hurley & Hult, 1998; Cano, Carrillat & Jaramillo, 2004; Kirca et al., 2005). Ironically, few studies place customer as the primary consideration in the studies on international cooperative activities. Taking the works collected in the Social Science Citation Index (SSCI) as the example. There are 28 articles or less than 2 % of 1,528 works on alliance or cooperation between years of 1999 and 2003 had included customer or consumer as part of their work (Pan, 2004a). This reveals that past studies had substantially

ignored the importance of customers in the international cooperation, thus leave the role customers play as a puzzle in the studies on MNE's venturing (Pan, 2004b) for us to bridge.

The customer capital, along with the human capital and structural capital, as knowledge-based view advocates, are the three core resources firms needed for mission accomplishment (Petrash, 1996). Past studies on partner selection have extensively explored the first two groups. Base on the customer-based knowledge perspective, this research attempts to reveal the importance of customer factors in the partner selection by exploring its effects on joint venture performance. Research is conducted in Taiwan, in which has attracted tremendous foreign investments from the TRIAD (Ohmae, 1985).

## 2. LITERATURE REVIEW AND HYPOTHESES

This research reviews the literature by including carefully examining theories were used for explaining the phenomenon of IJV partner selection, and past studies in the partner selection. This research further discusses the literature on customer-based knowledge, of which to be used as the theoretical background for the study. Several hypotheses were then concluded at the end of each discussion.

### 2.1. Theories on Partner Selection

Although no single theory is able to fully interpreting this complicated partner selection issue (Varis & Conn, 2002), we may categorize these attempts into two distinctive scopes as economic rationality and social perspectives. Theories used include transactional cost theory, resource-based view, organizational learning perspective, and resource dependency theory. We further explore the knowledge-based view, of which result in our major argument for customer related factors in partner selection

#### 2.1.1. *Economic and social perspectives*

The economic rationality as the transaction cost theory advocates confines the decisions associated with asset internalizations (Williamson, 1975; 1979; Hoskisson, Eden, Lau & Wright, 2000) or externalizations (i.e. cooperatives including joint ventures) by assessing the level of transactional costs (Coase, 1937). Transactional cost theory emphasizes solely on the cost, ignores the value creation that one of the major outcomes joint venture aim to achieve (Alexander & Young, 1996; Lin, 2006).

In the other hand, the resource-based theories suggest firms possessing tangible and intangible resources (Wernerfelt, 1995) to build core competences through fostering sustainable and hardly copiable capabilities (Barney, 1991). Linking external organizations for those heterogeneous resources (Eisenhardt & Martin, 2000) to stay competitive becomes primary rationale behind partner selection. Thus, partner selection criteria vary along with different environment associated with specific tasks. Heterogeneous resources needed are context-specific for joint-ventured firm, whereas venture partners should be united prior to a contextual difficulty of such venture appears. Customer-related knowledge is the most notably heterogeneous resources for MNE in host country (Tanriverdi & Venkatraman,

2005). Firms that not include acquiring such customer-based knowledge as part of selection criteria may expose themselves to the risks of losing local customer acceptance (Jaworski, Kohli & Sahay, 2000; Harris & Cai, 2002). This means a complementarity of physical and human resources might be useful to shorten the list of partner candidates, yet it is not sufficient in selecting a customer-oriented partner (Lyles & Salk, 1996; Gibbert, Leibold & Probst, 2002) in IJV studies.

Either single loop learning within organization or double loop learning from including external organizations for valuable knowledge, as the of the organizational learning perspective proposes for directing high performance operation (Argyris, 1977; Powell, Koput & Smith-Doerr, 1996), the key to performance is the learning capability or readiness a firm possessed toward the new knowledge that partners brought to the ventures (Shenkar & Li, 1999; Parise & Henderson, 2001). In the other hand, outcomes of any learning are largely depending on the knowledge givers' 'learnability' (Brush & Licata, 1983; Turbin, 1993). Codifiable or explicit knowledge could be easily transferred and learned between partners, yet customer knowledge that pertains to consumer behaviors such as personal relationship, reputation, experience is hardly codifiable for a intangible constraint established by the nature of context-specific (Ruigrok & Wagner 2003; Uhlenbruck, Meyer & Hitt, 2003). Unfortunately, knowledge on customer's reaction in a context-specific scenarios is nothing but vital to the success of almost all cross-cultural ventures (Rodriguez, Perez & del Val, 2003), in which an acceptance of local market is essential. Lacking focus on customer knowledge prevents the learning perspective from proper interpreting on the partner selection process. Besides, the level of learning capabilities of knowledge seekers as well as the learnability of a knowledge owner and so as the compatibility of 'teacher' and 'student' are significant in differentiating the outcomes of knowledge transfer in the learning perspective. This means the organizational learning perspective would be useful in explaining a need on finding the particular type of partner to learn, but not the criteria a firm shall hold for a partner to joint venture.

Resource dependency theorists argued that organizations will survive through their ability of effective accessing and maintaining linkages with needed resources from the network the organizations embedded (Pfeffer & Salancik, 1978). Contingent to the context, management of the firm thus continuously modifies decisions regarding any potential parties to collaborate, and continuously amend the firm's magnitude of commitment toward current and possible collaborations. This implicitly means the management is more concern on the environment monitoring (Pfeffer & Salancik, 1977) rather than the characteristics of particular partner in an international joint venture. Although resource dependence theory is good in explaining and predicting whether certain cooperations will survive or not, it is short in providing explanations for cross-border partner selection, of which often occurs before a real joint venture.

### ***2.1.2. Knowledge-based view***

It stems from resource-based view and organizational learning, knowledge-based view (KBV) suggests that amount of knowledge as well as capabilities in exploring and exploiting current and new knowledge jointly contribute to firm's competitiveness by creating value for customers (Nonaka, 1994). Contrast to property-based resource, knowledge-based resource is more intangible and tacit in nature (Das & Teng, 2000), of which is unique and is highly isolated from competitor's imitating intent (Barney, 1991; Miller & Shamsie, 1996).

As important capital to firm, knowledge includes resources of human, structural (Edvinsson & Sullivan, 1996), and customer (Stewart, 1998; Petrash, 1996; Edvinsson & Malone, 1997; Reid, Bussiere & Greenaway, 2001). Human capital refers to individual employee's techniques, experiences, routines, and instincts; whereas structural capital refers to those organization-based technologies, data, patents, innovations, and processes, etc. Past studies on partner selection tend to limit their concern on the need of these two kinds of capital. As a result, the literature categorized selection criteria as task and partner related factors, and ignored the customer related factors pertain to customer capital.

Petrash (1996) is one of the pioneer research that first reminds us our ignorance toward customers in knowledge studies, though customer capital in this study is confined as perceived value after transaction (Petrash, 1996, p.366) and not other factors affecting such a perception. As a matter of fact, customer knowledge shall include that information that affecting or shaping customer's purchasing behaviors, of which hardly could obtain through market or market agency (i.e. advertising agencies). For MNE as an outsider of a market, best approach to be tuned with such information is to explore and exploit immensely within a certain institution (Simonin, 1997; Parise & Henderson, 2001).

To my best knowledge, few if nay studies on partner selection factors have involved market knowledge as part of selection criteria. Knowledge-based resources, as knowledge-based view advocated as the major source of competitiveness included market knowledge in a host country. Knowledge of this kind is generally the outcomes of market-based and marketing support resources, and is highly tacit and culture-specific. Knowledge-based view is one of the first theories identifies market and customer knowledge as independent and critical factors in helping company's competitive advantage. However, this theory focus only on customer perceived value in representing customer capital, and not extending to consumer-related market knowledge (Petrash, 1996). This is part of major reasons to explain why the importance of customer related factors was uncovered in past studies. This research advocates that customer-based knowledge asset shall include knowledge on customers' value perception as well as knowledge regarding activities that produce such a value perception.

## 2.2. Literature on IJV Partner Selection

Tomlinson (1970) is one of the leading studies that systematically research into the partner selection for international joint venture. Geringer (1991) summarizes studies after Tomlinson (1970) and simplifies the list of partner selection factor as partner related and task related factors. This categorization is then become main stream in discussing IJV partner selection process (Glaister & Buckley, 1997; Al-Khalifa & Peterson, 1998).

Literature on this important issue could be traced back to the studies of Tomlinson (1970) in India and Pakistan. This study concludes six major criteria associated with the subsidiary's tasks and missions. Adler & Hlavacek (1976) suggests distribution system, technology improvement, or complementarity as additional criteria. The literature in 1980s and later focus on the benefit contribution of each partner could make to the joint venture as major attributes of an ideal partner. For example, complementary mission, resource capabilities, and other 'strategic fit' attribute (Lasserre, 1984; Harrigan, 1988; Brouthers et al., 1995). Majority of the literature agreed that a good joint venture would bring firms unique values that could

not be achieved by individual firm alone (Beamish, 1987; Bleeke & Ernst, 1991; Dyer & Singy, 1998).

Evidences that past studies provided have directly or indirectly confirmed that proper (Devlin & Bleakley, 1988) partners who possessed strengths that complementary to firm's capabilities, especially to the core market or core techniques (Hoffmann & Schlosser, 2001), will significantly impact the performance of international joint ventures (Tomlinson, 1970; Cavusgil & Evirgen, 1997). A correct partner selection decision may not guarantee success (Inkpen & Ross, 2001), yet improper decision will jeopardize a venture (Deloitte Haskins & Sells International, 1989). Although making good decision on partner decision may not almighty, it is vital for venture success.

Joint venturing with external organizations to reach complementary resources means additional transactional costs and power sharing (Harrigan, 1988). As a result, firms need to offset or exceed such costs with benefits from joint venture (Beamish & Banks, 1987; Gulati & Singh, 1998). Although partners could contribute strengths in any stages of value chain, the ultimate goal of any value chain is to supply value to it's' customers (Porter, 1985). In sum, partners' potentiality of becoming venture partner will be judged by assessing its contribution to customer value instead of firm's value (Madhok & Tallman, 1998). This implicitly reveals that customer related factors should be sufficiently considered in selection decision.

Partner related factors are organization-specific (Geringer, 1991; Al-Khalifa & Peterson, 1997; Varis & Conn, 2002). Selection criteria of this kind may contingent with organizational characteristics, cultures, and probably other emotional background. In the other hand, task related factors are task-specific. Criteria are more subjective and may contingent with emerging tasks and missions. It is thus possible to present a list of factors for an ideal partner, yet means nothing to either the academician or the practitioners (Geringer, 1991; Varis & Conn, 2002). By identifying the serious short of customer in the partner selection studies, this research proposes customer related factors as additional and critical factor beyond conventional partner and task factors. This is not to add the length of the list but to remind the importance of customer and to bridge the gap between current studies and reality this market-oriented or customer-centered age (Brief & Bazeran, 2003; Ricci, 2003; Kirca et al., 2005). This research believes more attention on customer will bring international joint venture more successful in either jointed business or for parent firms. The conceptual framework is shown as figure 1.

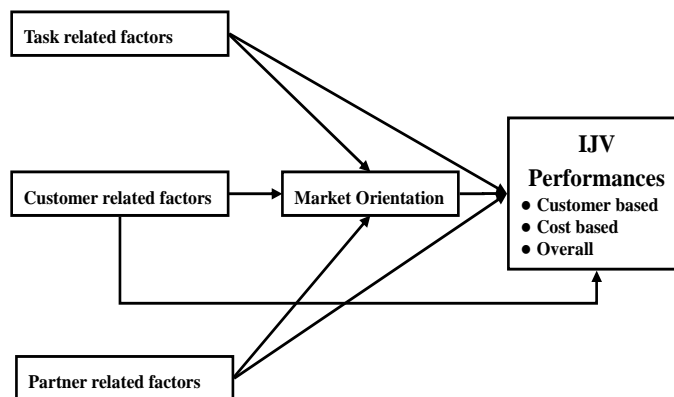


Figure 1. Conceptual framework for selection factors and IJV performances

### 2.3. Customer-Based Knowledge

Creating customer value is essential for any organizational decision (Mascarenhas, Kesavan & Bernacchi, 2004). Ironically, customer acceptance to a partner to be joint-ventured for certain business have few or never been assessed as a primary concern (Geringer, 1991; Glaister & Buckley, 1997). This research highlights the importance of customer-based knowledge in business operations and argue how such knowledge could be used to help identifying a proper partner for customer values in subsequent sections of this paper.

Customer satisfaction generates company's profits (Blackwell, Milliard & Engel, 2006). As a customer-centric organization, firms will make endless efforts to explore, design, develop, and manufacture what customers need to produce profit by carefully detecting factors that attract or distract customers' preference (Esteban, Millan, Molina & Martin-Consuegra, 2002). Although technology convergence, income parity, and advertising converge have comprehensively adopted in attempt to unify consumer behavior (de Mooji & Hofstede, 2002), the ever increasing heterogeneous customers demands indeed place serious challenges to modern companies. For example, nationalism (Huddleson, Good & Stoel, 2001) or ethnocentrism (Shimp & Sharma, 1987; Durvasula, Andrews & Netemeyer, 1997), and animosity, (Klein, Ettenson & Morris, 1998) within the national cultural context has manifested its impacts on the quality, image, and preference of imported products in varied way (Lastovica, Bettencourt, Hughner & Kuntze, 1999; Kaynak & Kara, 2002). Firms attempt to penetrate to a foreign market generally encounter dual difficulties. One is the difficulty in understanding the consumer behavior, of which is context-specific and hardly generalizable between distinctive cultures (Suh & Kwon, 2002; Laroche, Kalamas & Cleveland, 2005; Rawwas, 2001; Chung & Pysarchik, 2000; Reisinger & Turner, 1999; Wee, 1999; Wells, 1994; Money, Gilly & Graham, 1998; Slowikowski & Jarratt, 1997; Lee & Ulgado, 1997; Raajpoot, 2004). Another distinctive yet related problem is the need of utilizing such knowledge into operational tactics. The literature in marketing and business has long been addressed similar findings. For example, living style (Kucukemiroglu, 1999), image pertains to particular countries and products (Pecotich & Rosenthal, 2001), preferred products and quality (Lee & Sirgy, 1999; Balabanis & Diamantopoulos, 2004), preferred pricing and channel (Piron, 2002), ways and procedures of determining satisfaction (O'Cass & Lim, 2002), the extent of service quality (Huddleston et al., 2001), and many others. Strategic actions based on customer knowledge tend to stay fine tune with target customers, from which obtain good level of customer preference and satisfaction (Sheth, Sisodia & Sharma, 2000; Selden & MacMillan, 2006), and consequently contribute to organizational return (Cano et al., 2004; Lenskold, 2004; Kirca et al., 2005; Cross & Dixit, 2005).

Compare to tangible inputs, customer and consumer related elements are mostly intangible, tacit, frequently market-specific. Except codifiable customer information that could be obtained from the market, customer related knowledge is normally generated from purposefully interactions with rivalries and customers and thus highly possible to be unique and inimitable (Barney, 1991; Prahalad & Hamel, 1990). This means customer-based knowledge is extremely valuable input to the firm (Duncan & Moriarty, 1998). Lacking support by long-term customer relationship, venture parties' subjective considerations, such as cooperating intent, task complementarily, or partner characteristics can hardly sufficiently receive and properly transforming it into valuable knowledge (Wulf, Odekerken-Schroder &



Iacobucci, 2001). Joint venturing with customer-oriented partners provides optimal alternative for MNE's entry difficulties.

In the international expansion studies, expanding through strategies of local adaptation or global standardization remains a debate for the former focus on meeting local customers' demand, whereas the latter concern more on the overall levels of cost. So-called 'GLOCAL' took the middle way by simultaneously performing strategically integrate global strategy as well as operationally response to specific local demands. In fact, 'GLOCAL' is more a slogan than a strategy or at least shall be confined in certain product lines since a workable strategy is that driving customers' acceptance or promoting customer's preference. Responding to customer's need remains the core to this strategy. This is particularly true in the ever-growing heterogeneous market segments in today's business environment where more and more cultural factors emerge to shape consumer behavior (Blackwell et al., 2006). Accordingly, aligning partners whose perception toward the venture were on task complementarity or on partner similarity would become challenge to both childrens and parents. Allying partners who effectively bridge the gap of tacit customer-based knowledge could be an optimal alternative for MNE. In sum, taking customer related factors into account of partner selection would be the key to the success of international joint venture (Sheth et al., 2000).

## 2.4. Hypotheses

### 2.4.1. *Customer related factors and IJV performance*

Customer is the primary object of any sets of company activities. Companies obtain satisfactory return and subsequent sustainable competence by satisfying target customers' need from time to time (Levitt, 1960; Porter, 1980). No matter how MNE enter a market, perceived satisfaction of customers in the market will be decisive in surviving the MNE's venture in the market. MNEs enter a market under strategy of global integration are likely to take task as a primary consideration in partner decision in order to achieve parents' goals instead of the one for jointed business. This task-oriented joint venture is in fact the agent of parent firms, thus resources are likely to be directed for the principal's benefit. Taking task factors as single criterion for potential partner assessment will have few attraction to customers. In the other hand, determining a partner simply centered on such partner's trustability and capability but not on its capabilities of satisfying expected customers will have no influence on customers' preference.

No matter what factors were applied to determine a partner, any cross-border joint venture needs to involve its target customers as major consideration for survival. This means customers will be eventually included in the new venture business. Taking customer related factors well in advance in the partner seeking stage may not only guarantee a market-oriented subsidiary but also a highly motivated team (Kirca et al., 2005). Team that collectively market-oriented will be more prone to customer demands, of which in turn attract preference and loyalty. This research thus proposes a positive correlation between customer-related factors and IJV performance.

H<sub>1</sub>: As the task related factors and partner related factors remain the partner selection criteria, using customer related factors in selecting venture partner positively affects the performance of international joint venture.

### **2.4.2. Customer related factors and market orientation**

Starting from resources available, firms' market development options may vary from totally non-market oriented to fully market-oriented (Day & Nedungadi, 1994). The literature suggests that market-oriented strategy that simultaneously caring competition and customers is superior to other approaches in terms of both customer-based and cost-based performances. Task related factors in the past studies implicitly require the partner to jointly accomplishing the parent's corporate goals. Parent firms' mission acts as the primary criteria in guiding partner seeking. As to, the literature alternatively prescribes the partner related factors as trustable and strategically 'fit' to corporate mission (Lasserre, 1984; Harrigan, 1988; Geringer, 1991; Barclay & Smith, 1997). Both of task and partner related factors underlying partner selection inevitably ignore the importance of customer factors, and thus the formed venture is unlikely to be market oriented but competition oriented or self-centered (Day & Nedungadi, 1994).

Complementary resources are unlimited, ranging from financial and production factors to market and channel factors (Geringer, 1991; Hitt et al., 2000; 2004; Gale & Luo, 2004). Taken 'foreignness' as the major shortage of MNE in a host market, most valuable resource it needs is that tacit information centered around target customers. Substantial distance from host market cultures prevent MNE from factually apprehending those behaviors that embedded in culture-specific contexts (McKercher, 2003). Obtaining such customer-based knowledge is unlikely to accomplish as those production factors, heterogeneous knowledge at this kind need long-term customer service experience (Eisenhardt & Martin, 2000; Wulf et al., 2001) or in this case allying with customer-oriented partners.

We may conclude at this point that adding customer related factors into partner decision beyond conventional PRF and TRF will have positive effects on venture's market-oriented potentials for the organization's resources could be integrated as a whole in response to customers' requirement as well as rivalries' actions. (Lorange & Roos, 1990). This research therefore hypothesizes the relationship between customer related factors and market orientation as follow.

H<sub>2</sub>: As the task related factors and partner related factors remain the partner selection criteria of cross-border venture, selecting joint venture partner with customer related factors positively affect the extent of company's market orientation.

### **2.4.3. Market orientation and *ijv* performance**

Market orientation at organizational level has been proved positively affect organizational performance, profit, revenue, and market share (Cano et al., 2004; Kirca et al., 2005). Market-oriented organizations receive superior image on customer perceived quality and satisfaction (Saxe & Weitz, 1982). In the other hand, market orientation also internally benefit the organization by increasing organizational commitment, employee's morality, job satisfaction, reducing role conflict (Siguaw, Brown & Widing, 1994; Kirca, Jayachandran & Bearden, 2005), of which in turn further facilitate a favorable loop of service profit chain (Lovelock, 2003). Evidences could be found across various industries and contexts. For example, in hospital business (Wrenn, 1997), hotel (Sargeant & Mohamad, 1999), educational services (Qureshi, 1993), and manufacturing (Kohli et al., 1993) are some of notable studies. In terms of other contextual factors, studies have addressed the scale of firms (Pelham, 1997), contexts of varied stages of value chain (Siguaw, Simpson & Baker, 1998), and further

validated in cross-country study (Ward, Girardi & Lewandowska, 2006). All of these among others provide evidences for a positive linkage between firm's market orientation and performances. Moreover, evidence on the positive impacts of market orientation on employee's customer orientation attitude and behavior (Kirca et al., 2005) will further reaffirm the customer's favorable perception (Siguaw, et al, 1998).

There are debates regarding the linkage between market orientation and organizational performances, some criticize its' strength of the linkage and some conclude a negative or not significant relationship (Agarwal, Erramilli & Dev, 2003; Au & Tse, 1995; Bhuian, 1997; Sandvik & Sandvik, 2003). Yet these inconsistent conclusions are found special not general cases (See detail in Nakata & Sivakumar, 2001). Like other companies that formed under foreign direct investment or wholly owned, companies by cross-border collaboration are the same in terms of striving for customer acceptance. This research thus hypothesizes the higher the market orientation of an international joint venture business will positively result in a better performance.

H<sub>3</sub>: Performance of an international joint venture in host market positively correlates with the extent of market orientation of this venture business.

### 3. METHODS

#### 3.1. Measurement

Likert scale is used to measure the respondents' perception toward each inquiry by providing '1' as not important, and '5' as very important.

**Task related factors.** *Task related factors*, as defined by Geringer (1991), are those technical or resource factors that are expected to be required for the accomplishment of particular task. Geringer (1991) interviewed corporate managers with a list of critical success factors that summarized from studies of Steiner (1968), Tomlinson (1970), Stopford & Wells (1972), Renforth (1974), Tomlinson & Thompson (1977), Beamish (1984), and conclude a fifteen items list named as task related factors. Studies conducted by Khan & Suh (2005) and Wang & Kess (2006) in the context of China provide that scale developed by Geringer (1991) is cross-culturally generalizable. Taiwan and China share same or similar culture heritage, thus apply this scale in the context of same Chinese community would be appropriate. This research deleted three items after the pilot test. Nine item were kept for use after exploratory factor analysis and expert validation with  $\alpha = 0.9429$ .

**Partner related factors.** Evidence shows that IJV performance directly links with partner related factor (Robson, 2002). Unfortunately, *partner related factors* were not like task factor that was well defined in Geringer (1991). From the transactional cost perspective, any partner that assumes lower uncertainty and costs would be an ideal partner (Beamish & Banks, 1987; Geringer & Hebert, 1989; Gulati & Singh, 1998; Madhok & Tallman, 1998). Local partner in host country could also be viewed as agent to the firm, thus criteria of determining a qualified agent, such as level of opportunism or trustable (Hoffmann & Schlosser, 2001) from this candidate's records are good indications for IJV partner. In order to create value that could

not achieve by traditional transactions, factors related to potential partner may include operational efficiency and effectiveness, free of opportunism, trustable, and optimally is strategically fit or are resource complementary (Harrigan, 1988; Kanter, 1994; Littler & Leverick, 1995; Barclay & Smith, 1997; Douma, Bilderbeek, Idenburg & Looise, 2000; Insch & Steensma, 2006). Six items retained for the partner related factors with  $\alpha = 0.9145$ .

***Customer related factors.*** This factor group refers to customer's and competitor's factors that directly affect customers purchasing behavior in individual stage. Market knowledge composes market-based resources and marketing support resource (Hooley, Greenley, Cadogan & Fahy, 2005), also termed as market-based asset (MBA), of which directly result in firm's profitability (Srivastava, Shervani & Fahey, 1998). Customer related factors in this research include all that knowledge acquiring, interpreting, and integrating associated with customers and competitors. As a market-driven organization, firms shall be capable of market sensing, customer linking, channel bonding, and technology monitoring (Day, 1994). Channel bonding is task related, and customer bonding is customer related, whereas the rest are closely associated with competitors. This research summarized literature and use a five item scale to capture the construct of customer related factor with  $\alpha = 0.8773$ . These are capabilities of acquiring customer knowledge toward product and services, acquiring competitors' information, and a structural information system that could be used to receive, analyze, and distribute customer-related information.

***Market orientation.*** Although customer capital is the most important component of a firm's resource (Petrash, 1996), knowledge on rivalries is also critical for their actions may impose dual impacts on both restricting the firm's production outcomes and altering customer's behavior (Porter, 1980; Hunt & Morgan, 1995; Blackwell et al., 2006). All market orientation related scales substantially include both customer and competitor, i.e. MARKOR (Kohli et al., 1993), MKTOR (Narver & Slater, 1990), and the one proposed by Deshpande, Farley & Webster (1993). Deshpande and colleagues modify MARKOR and MKTOR as a simplified version but involve all major considerations in the original scales. As industrial experts also suggest, this research adopts DFW as measurement for market orientation. Alpha for market orientation is satisfactory at 0.8414.

***Joint venture performance.*** Objectively or subjectively measures company performance make not much difference for these are closely associated. Studies on market orientation tend to measure the performance by customer loyalty, customer satisfaction, innovation, and product quality (Kirca et al., 2005). Customer satisfaction fosters customer's trust and commitment, of which in turn create a reliable long-term relationship and subsequently revenue growth (Morgan & Hunt, 1994). Customer loyalty increase repetitive purchasing, reduce complain, lower operating and service costs, and accordingly enrich organizational performance (Szymanski & Henard, 2001). Other elements in this construct include customer rating that trying to capture customer's current image on the firm's product and service. This is expected to have positive relationship with market orientation (Day & Nedungadi, 1994). Relative cost and relative profit are another two inquiries to examine the outcomes of the firm's commitment to the customers. Relative profit is presented in reverse form that will

need inverse coding later. Share of the market is used to identify the status of competition in the market. This construct has seven items with,  $\alpha = 0.9293$ .

**Validity.** Content validity is confirmed by two actions. Items of the questionnaire are all drawn from literature is the first to assure a content validity. This research has also invited several international business as well as marketing scholars to review the draft, and then consult with industrial experts for the appropriateness of each question. The questionnaire has three language editions, Chinese, English, and Japanese. All three editions have been edited through back-translation procedures (Kerlinger & Lee, 2000). Construct validities, convergent and discriminant, are confirmed by examining the  $p$  value of pair correlations, in which correlations and  $p$  values of related items in the same construct are high and significant and those for different constructs are low or not significant.

**Common method variance.** To avoid common method variance (CMV) that is highly possible causing bias in research outcomes with incorrect correlation between independent and dependent variables. This research invited CEO or high rank executive to answer the first part of questionnaire, the independent variables. Functional managers, as assigned or further invited by the CEO, answer the second part of questions, dependent and control variables. Since respondents to the questionnaire are different and answer in different places, data collected could be highly reliable that no CMV bias will appear.

### 3.2. Samples

Unit of analysis for this research is the joint venture company that established in Taiwan. Companies including both manufacturing and service sectors that at least 15% foreign capital and no single party owned 75% shares of equity. Samples are purposefully taken from several business groups. The first group is the companies in the synergy production system (*Keiretsu*), of which represents typical supply chain in Taiwan. Companies in the export processing zone are included in the second group of companies for these firms were expected to aim rather on foreign than local markets. Members of trading association in different regions are the third group, for these companies involved certain levels of import or export business. Traditional manufacturers across major industrial parks and service and retailing giants are the fourth and fifth groups.

## 4. RESULTS AND ANALYSES

This research dispatched 500 questionnaires, and 353 are completed and collected. 32 questionnaires were ignored due to absence of information regarding dependent variable or other important parts. The overall response rate is high as 64.2%.

## 4.1. Sample Description

### 4.1.1. Descriptive statistics

Data are first analyzed to obtain global features of the data. As shown in table 1, firms in the data are mostly established more than two years (80%), Japan and USA (include Canada) are two major home country of foreign investor, 80% of respondents perceived similar or few if any cultural distance between partners, service and retailing industries are the major contributors of data, who served varied customers.

**Table 1. Descriptive statistics**

History	N	%	Accu. %
< 1 year	56	17.45	18.69
2-3 years	86	26.79	45.48
4-5 years	115	35.83	80.06
> 5 years	64	19.94	100
<b>Region</b>			
Japan	130	40.5	40.5
N. America	95	29.6	70.09
W. Europe	47	14.64	84.74
Others	49	15.26	100
<b>Cultural Distance</b>			
Similar	132	41.12	41.12
Some	144	44.86	85.98
Large	45	14.02	100
<b>Industry</b>			
Service	153	47.66	47.66
Retailing	73	22.74	70.4
Manufacturing	88	27.41	97.82
Trading	7	2.18	100
<b>Customers</b>			
Industrial	65	20.25	20.25
Reseller	91	28.35	48.6
Consumer	119	37.07	85.67
Varied	46	14.33	100

### 4.1.2. Cross-tabulation

**Parent country and markets.** Major responding firms, 44.24% of sample, report local market as primary customer segment. As shown in table 2, Japanese firms that next to the others have organized joint-venture here purposefully for Taiwan customers. However, there is no significant difference among the foreign parents on the preference of local or export markets,  $\chi^2 = 10.811$ ,  $p = 0.094 > 0.05$ .

**Parent country and partner selection factors.** As indicated in table 2, Chi-square test provides  $\chi^2$  values for CRF, TRF, and PRF are 15.893, 8.665, 19.123 respectively, whereas PRF is not significant. This means the nationality has no difference in using PRF as favorable

selection criteria, yet there are some differences among nationalities in using CRF and TRF as a guide for a potential partner. Examine a little detail, Japanese parents emphasize more on CRF as the first and PRF the second. On the contrary, European parents highlight the TRF as primary searching criterion, whereas American firms pay equal attention to these three factors. It is interesting to note that most studies since Geringer (1991)'s were conducted in the Europe or near East with a conclusion of favoring TRF as the primary partner consideration factor. European firms in this study are different from other two groups of nationality in favoring particular selection factors.

**Industry and local / export markets.** Chi-square test indicates, as shown in table 2,  $\chi^2=30.509$ ,  $p<0.05$ , means market preference varies from one industry to another. Service and trading industries are the notable groups of favoring local market, and the manufacturing group exports more than domestic markets.

**Industry and partner selection factors.** As suggested by the chi-square test, industry significantly places different weights on individual selection factors. As shown in table 2,  $\chi^2$  are 16.998, 29.246, and 60.306 for TRF, PRF, and CRF respectively. Service and retailing industries are the two mostly notable groups that emphasized on CRF and the next on PRF. Locating in the lowest cell of each factor, the manufacturing group seems not placing particular favor to any specific factor.

## 4.2. Partner Selection Factors and IJV Performance

The literature tends to hypothesize partner selection factors with the level of the subsidiary's performance. In the marketing literature, as suggested by Day & Wensley (1988) and Day & Nedungadi (1994), performance could be categorized as customer-based performance (CUP) and competitor/cost-based performance (COP) to reflect fully the outcomes of company's effort in attracting customers as well as in competing with rivalries. Moreover, scholars generally agreed that COP and CUP should be consolidated as a single index in order to reflect the reality of corporate performance (Narver & Slater, 1990; Kohli et al., 1993; Day & Nedungadi, 1994). This study concerns on the overall performance (OP).

### *Customer-based performance*

The model features the regression of TRF and PRF on CUP, as shown in table 3, indicates a low level of explanation for customer-based performance with  $R^2=0.015$ , of which reveals PRF and TRF are not sufficient in explain the variance of the firm's performance in attracting customers. By adding CRF into the model, variance explained up to an acceptable level at 0.293, in which CRF represents the major source of impacts (0.463), much higher than PRF and TRF. This reveals the importance of customer related factors as a role in better generating customer satisfaction and customer loyalty.

**Table 2. Cross-tabulation of nationality and industry**

Region		1	2	3	4	Industry		1	2	3	4
Local	n	64	37	15	26	Local	n	74	38	30	
	M %	45.07	26.06	10.56	18.31		M %	52.11	26.76	21.13	
	R %	49.23	38.95	31.91	53.06		I %	48.37	52.05	34.09	
Export	n	36	33	17	18	Export	n	46	12	39	7
	M %	34.62	31.73	16.35	17.31		M %	44.23	11.54	37.5	6.73
	R %	27.69	34.74	36.17	36.73		I %	30.07	16.44	44.32	100
	n	11.21	10.28	5.3	5.61	Both	n	33	23	19	
Both	M %	30	25	15	5		M %	44	30.67	25.33	
	R %	40	33.33	20	6.67		I %	21.57	31.51	21.59	
$x^2=10.811, p=0.094$						$x^2=30.509, p=0.001$					
TRF / Region		1	2	3	4	TRF/ Industry		1	2	3	4
High	n	33	20	16	4	High	n	46	16	10	1
	TRF %	25.38	21.05	34.04	8.16		TRF %	63.01	21.92	13.7	1.37
Middle	n	60	47	24	35	Middle	n	75	38	47	6
	TRF %	46.15	49.47	51.06	71.43		TRF %	45.18	22.89	28.31	3.61
Low	n	37	28	7	10	Low	n	32	19	31	
	TRF %	28.46	29.47	14.89	20.41		TRF %	39.02	23.17	37.8	
$x^2=15.893, p=0.0015$						$x^2=16.998, p=0.009$					



**Table 2 (Continued)**

PRF /Region	1	2	3	4	PRF/ Industry	1	2	3	4	PRF /Region	1
High	n	35	14	12	11	High	n	46	17	High	n
	TRF %	26.92	14.74	25.53	22.45		PRF %	63.89	23.61		TRF %
Middle	n	69	60	25	22	Middle	n	78	43	Middle	n
	TRF %	53.08	63.16	53.19	44.9		PRF %	44.32	24.43	29.55	1.7
Low	n	26	21	10	16	Low	n	29	13	31	
	TRF %	20	22.11	21.28	32.65		PRF %	39.73	17.81	42.47	
$\chi^2=8.665, p=0.193$						$\chi^2=29.246, p=0.001$					
CRF/ Region		1	2	3	4	CRF/ Industry		1	2	3	4
High	n	53	24	13	16	High	n	63	27	10	6
	TRF %	40.77	25.26	27.66	32.65		CRF %	59.43	25.47	9.43	5.66
Middle	n	60	41	23	15	Middle	n	70	34	34	1
	TRF %	46.15	43.16	48.94	30.61		CRF %	50.36	24.46	24.46	0.72
Low	n	17	30	11	18	Low	n	20	12	44	
	TRF %	13.08	31.58	23.4	36.73		CRF %	26.32	15.79	57.89	
$\chi^2=19.123, p=0.004$						$\chi^2=60.306, p=0.001$					
Region: 1, Japan; 2, USA & Canada; 3, West Europe, 4, Others						Industry: 1, Services; 2. Retailing; 3. Manufacturing, 4. Trading					

N= 321

**Table 3. Partner selection factors and performances**

Models	CUP		COP		OP	
	1	2	3	4	5	6
Constant	3.311*	2.217*	0.350*	0.383*	1.830*	1.300*
TRF	0.068	-0.075	0.243*	0.248*	0.156*	0.087
PRF	0.065	0.063	0.644*	0.644*	0.354*	0.353*
CRF		0.463*		-0.014		0.225*
<i>R</i>	0.121	0.541	0.797	0.797	0.645	0.716
<i>R</i> <sup>2</sup>	0.015	0.293	0.635	0.644	0.416	0.513
<i>Adj. R</i> <sup>2</sup>	0.008	0.286	0.632	0.631	0.412	0.508
<i>F</i>	2.353	43.72	276.015	183.577	113.107	111.35

CUP, customer-based performance; COP, competition-based performance; OP, Overall performance; TRF, Task related factors; PRF, Partner related factors; CRF, Customer related factors.

### ***Competition-based performance***

Alternative set of performance international joint venture concerned is the competition-based performance, of which was most often used to assess the business success, particularly in those strategically important markets. More gain from such performance means successfully surpasses rivalries' in the certain campaign. Model 4 in table 3 indicates that PRF and TRF explained 63.4% of COP variance. This means TRF and PRF could be used together in successful predicting a firm's COP. Adding CRF as the third predictors in the model, variance to be explained is somehow strengthened as  $R^2 = 0.644$ . PRF is the major predictors in both models with high coefficient relation (0.644), and CRF in the model has a negative impact on COP. This explicitly indicates that selecting potential partner base on PRF would be effective and efficient as long as the subsidiary is designed solely for competition-based performance. Negative impacts of CRF on COP may implicitly advise us that incline too much on customers' demand may jeopardize COP.

### ***Overall performance***

The literature generally advocates to simultaneously aware both CUP and COP for short and long term returns (Narver & Slater, 1990; Day & Wensley, 1988; Kohli & Jaworski, 1990). PRF and TRF, as shown in table 3, together explain 41.6% of variance of OP. PRF is again the major predictors (0.354) of overall performance. In the last model, this research adds CRF with PRF and TRF in predicting OP. Although variance explained is lower than that in model 4, this seems to be a satisfactory model for OP as the dependent variable is closer to the reality, and  $R^2 = 0.513$  is sufficient in most management studies. In sum, PRF remains the major predictors in the last model, CRF as the second, and TRF as the least and could be replaced by CRF. Figure 2 shows how the model changes with adding CRF.

## **4.3. Market Orientation**

Two sets of relationship are interesting to determine with market orientation. One is how partner selection factors affect the level of a firm's market orientation, and in the other hand,

how such market orientation is in turn affecting overall performance. In the first set of relationship determination, model that involve TRF and PRF as the predictor shows a respective power of 0.052 (n. s.) and 0.295 with  $R^2=0.224$ . PRF is better a performance predictor in model 1. Adding CRF as another predictor,  $R^2$  of the model up to 0.459, where CRF appears as the best predictor, followed by PRF. This means adding CRF in partner selection, firms will be more likely to be market oriented, from which support  $H_2$ .

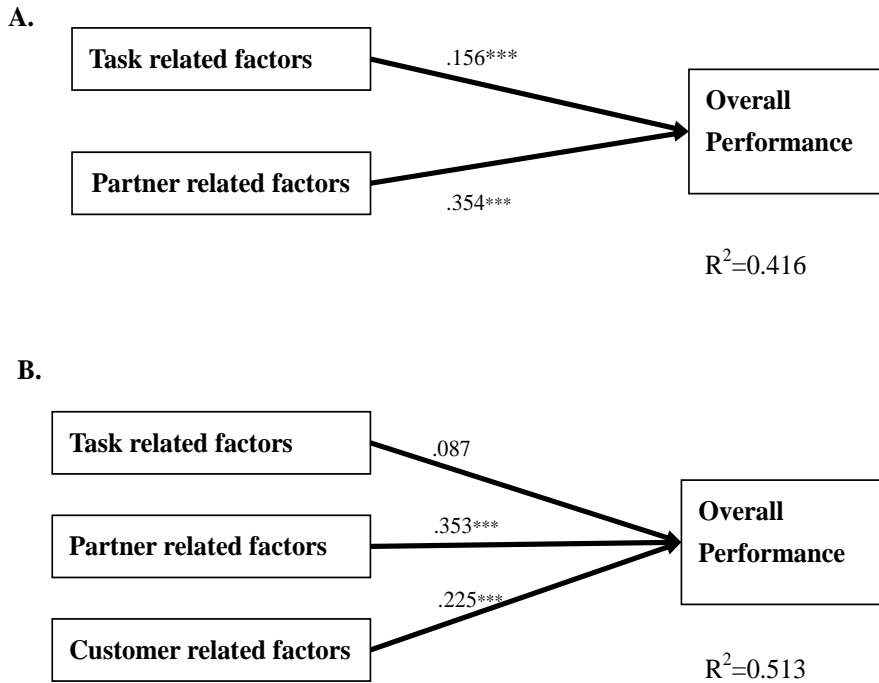


Figure 2. Partner selection factors and overall performance of IJV

**Table 4. Partner selection factors, market orientation, and performance**

D. V.	Market orientation (MO)		O. P.
Models	1	2	3
Constant	2.534*	1.432*	1.311*
TRF	0.052	0.015	
PRF	0.295*	0.249*	
CRF		0.381*	
M. O.			0.673*
<i>R</i>	0.474	0.677	0.667
$R^2$	0.224	0.459	0.445
<i>Adj. R<sup>2</sup></i>	0.208	0.441	0.440
<i>F</i>	13.606	26.293	76.301

\*  $p < 0.05$

### ***Market orientation and overall venture performance***

Previous studies generally advocate that market orientation directly link with firm's performances in many different terms (Kirca et al., 2005). This research analyzes the relationship of these two constructs and receive similar results. Shown as in the right column of table 4,  $R^2=0.445$ , the effect of market orientation on overall performance is high as 0.673. Market orientation is a powerful predictor of overall performance.

## **5. CONCLUSIONS**

### **5.1. Conclusions**

Main purpose of this research is to explore and confirm the existence and importance of the customer-related factors in selecting an ideal international joint venture partner. The study confirms the importance of CRF by linking this construct with IJV performance.

This research first identifies that adding CRF into partner selection has substantially improved the variance explained of overall performance of an IJV (Pan, 2004a; Levitt, 1960; 1983; Lenskold, 2004), of which support Hypothesis 1. This research has also confirmed the IJV with higher level of market orientation earned better customer-based performance as well as overall performance (Klein & Dave, 1997).

Factors of partner selection significantly affect IJV's marketing strategies (Geringer, 1990; Arino & Abramov, 1997; Al-Khalifa & Peterson, 1998). Seeking partners under task-related factors in mind, firms incline to have a lower level of market orientation, whereas firms that seek partners under customer-related appear to have a higher level of market orientation. Noteworthy is the additive of CRF into original PRF and TRF has substantial and positive effects on IJV's market orientation, and eventually helpful to the overall performance of a joint-ventured business (Day & Nedungadi, 1994; Ricci, 2003). Hypothesis 2 is duly supported.

Market-oriented operation that simultaneously appreciates information on both customers and competitors directly result in firm's performance (Kohli & Jaworski, 1990; Deshpande et al., 1993; Diamantopoulos & Hart, 1993; Day & Nedungadi, 1994; Au & Tse, 1995; Agarwal et al., 2003; Cano et al., 2004). Consistent to previous studies, the model in this research that linking market orientation and customer-based performance has the best level of variance explained, followed by the model that predicting overall performance. This provides evidence regarding the predicting value of marketing orientation, and support the hypothesis 3. Adding the construct of customer-related factors into the model not only strengthen the level of explanation power on IJV performance but also affect the predicting ability of the task-related factor. This is Noteworthy is these two constructs has very low collinearity.

### **5.2. Implications**

#### ***5.2.1. Theoretical implications***

Extending studies of partner selection for international joint venture (Tomlinson, 1971; Geringer, 1991; Arino & Abramov, 1997; Glaister & Buckley, 1997; Al-Khalifa & Peterson,

1998; Tatoglu, 2000), this research further addresses the importance of customer related factors beyond traditional PRF and TRF. Taking customer capital of knowledge-based view, this research proves the importance of customer related factors as critical partner criteria (Stewart, 1998; Petrash, 1996; Edvinsson & Malone, 1997; Reid et al, 2001) other than PRF and TRF. This has some important academic implications.

Knowledge on customers' purchasing behavior is important and integral part of resources that firm required to establish a competitive advantage. Although the knowledge-based view has explicitly identified the customer capital as one of the major knowledge resources, it limits its consequences by confining such capital within customer value perception (Petrash, 1996, p.366). Possible reasons that past studies ignoring the customer-related factors may stem from scholars were inclined to view this issue from the perspective of strategic marketing rather than from consumer behavior. Recently, academicians urge to learn from customers, to explore more into customers' mind (Garcia-Murillo & Annabi, 2002; Tiwana, 2002). Evidence provided in this research indicates that factors affecting purchasing behavior in each stage, from external environment factors to consumer internal factors, shall be included in the firm's customer information systems. Availability of such an information system is an integral part of customer-related factors for the decisions of IJV partner.

Regression analysis shows that task related factors has limited predicting ability on IJV's competitor-based performance, and not on customer-based performance. This reveals that task factors alone without help of market orientation may be not sufficient in explaining IJV performance. Customer related factor is important in predicting customer-based performance as well as overall performance, but not competitor-based performance. Compare to CRF and TRF, PRF that composed by partner's trustability, ability, and owning strategic fitted resources is a conventional yet powerful predictor for every kind of performance. Research finding has reconfirmed the capability of resource-based view in explaining the partner selection process (Lasserre, 1984; Beamish, 1987; Harrigan, 1988; Kanter, 1994; Brouthers et al., 1995; Dacin et al., 1997; Douma et al., 2000).

### ***5.2.2. Managerial implications***

MNE's attempt in geographical spanning, with the help of venture partner, shall replace TRF with CRF or to the minimum add PRF as part of primary seeking and assessing criteria (Diamantopoulos & Hart, 1993; Rose & Shoham, 2002; Ellis, 2006). In the past two decades, a plethora of Taiwanese firms sought overseas development in a wide variety of markets. However, many of them with task-related factors in mind in recruiting partners for the venture had experienced failures. Alternatively, those collaborated with partners who are pro-customers had secured an abundant growth and competitive advantage. For example, Tingyi (Master Kang instant noodle), I-Land Foods (Want Want snacks) and China Motor Corporation (CMC vehicles) are those cases that expanding with the help of market-oriented partners.

Local firms that seeking foreign investments shall also focus their attractions on those customer capital, market information systems, as well as customer knowledge databanks that not accessible in the open market. In doing so, firms will be easier to attract and locate market-oriented prospective as marketing strategies, and consequently gain a favorable customer acceptance and a better venture performance (Day & Nedungadi, 1994; Littler & Leverick, 1995; Hofstede, Steenkamp & Wedel, 1999; Kaynak & Kara, 2002). The most notable success example of market-oriented cooperation is the joint venture between

Carrefour (France) and President Enterprise (Taiwan), of which obtains a great success in competing with other joint-ventured hypermarkets. In the other hand, Taiwan automakers could be a good lesson for not seeking partners based on customer-related factors. In the early 1960s, plenty of Taiwan automakers sought to attract foreign joint ventures based on assembly skills, assembly plant location, and market potential (not customer knowledge). Half century after that time, automobile industry in Taiwan had hardly been regarded as an independent or competitive industry.

Market orientation, as a strategic approach, starts at learning from customers (Mascarenhas et al., 2004), exploring comprehensively what determines a customer purchasing decision. Firms shall move from product-centric to be customer-centric (Selden & MacMillan, 2006) and behave as a customer-centric organization. Customer-centric organizations view customers as business partners (Slater & Narver, 1994a; Ricci, 2003), and thus more incline to commit themselves to understand customers, from which accumulate customer capital and upgrade current techniques in exploiting such knowledge. As numerous empirical studies confirmed, these customers return good level of preference and loyalty to the companies as partners for their needs (Kirca et al., 2005; Gosselin & Bauwen, 2006).

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*Chapter 9*

## **INFLUENCE OF INDUSTRIAL STRUCTURE ON MANAGERIAL KNOWLEDGE: A NEW VISION OF PORTER'S FIVE FORCES SCHEME**

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### **ABSTRACT**

The aim of this article is to show that, although criticized from new managerial perspectives, Porter and Industrial Organization schemes continue to be essential to the understanding of enterprise competitiveness, in the era of knowledge, and could be connected to the knowledge-based-view. In this vein, our study analyzes Porter and Industrial Organization, and the Resource-Based and Knowledge-Based perspectives to show the importance of these schemes.

In addition, by means of a Delphi study using international experts, and a sample of 189 hospitality firms, our study tries to show and analyze whether, how and why managers have different knowledge of quality of perception of the different environmental competitive forces identified by Porter in the post-Internet context.

Following the application of structural equations models, the managers analyzed in our study hold different quality of perceptions of the various forces. This demonstrates the importance the structural environment has in conforming managerial knowledge or perception, one of the most important resources highlighted in new Resource-Based, and Knowledge Management literature.

### **INTRODUCTION**

In spite of the enormous proliferation of competing schemes in the business strategy literature, two fundamental paradigms have emerged as the most influential in the last two

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decades. First, Competitive Positioning, as proposed by Michael Porter (1980) from the Harvard Business School in the 1980s, and, second, the Resources and Capabilities-Based view of the firm that evolved during the 1990s (Penrose, 1959; Wernerfeld, 1984; Prahalad and Gary Hamel, 1990; Barney, 1991; Petteraff, 1993). The purpose of this article is to show that, although criticized from the Resource-Based view, Porter and Industrial Organization (IO) schemes continue to be essential models in the era of knowledge.

We attempt to demonstrate that the five forces determined by Porter notably affect one of the most important resources identified by the Resource-Based perspective, that of managerial knowledge, one of the basis of knowledge-based-view. The study sets out to emphasize the importance of IO schemes by analyzing whether managers have different knowledge on or perceptions of the various environmental competitive forces, using the scheme established by Porter (2001) about how the Internet influences the industry structure. We consider this situation to be important because it could imply the validation of Porter's five forces model from a new and theoretically contrary approach, the Resource-Based perspective. In addition it would imply that the quality of the diverse sources of information in the enterprise on the various forces are also different, playing these forces a crucial role to explain managerial bias, or the fact that managerial biases or capabilities influence the correct perception of the different structural forces.

## THEORETICAL PERSPECTIVE

In classic Industrial Organization it has been traditionally assumed that firm managers are incapable of influencing both industrial conditions and company performance, due to restrictions imposed from industrial forces (Bain, 1956; Mason, 1939). This deterministic vision is also followed by those Organization Theory researchers who emphasize the role of the environment, perspectives such as Population Ecology, Institutional Theory, or Contingency Theory: Are managers free to act, or are their actions determined by external constrictions such as technology, competition or the government? (Beech, 2000) Einstein pointed out that the world we have created produces problems that we cannot resolve by far at the same level as they have been produced (Chandon and Nadler, 2000:127). According to this premise, the fields of organizational literature that focus on the environment posit strategy formation as a reactive process whereby the business organization forfeits individual initiative to the external environment (Wyer et al., 2000).<sup>1</sup>

Nevertheless, while also recognizing the influence of environment, the determinist vision was widely modified in the 80's years with the development of Strategic Management, particularly following the analyses developed by Porter (1980; 1985; 1990; 1991), which

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<sup>1</sup> For instance, Population Ecology suggests that managerial action is largely ineffective in overcoming natural selection processes and inertia inside the organization (Hannan and Freeman, 1977) due to excessive environmental complexity and turbulence, which act as a hurdle to the understanding of and rapid adaptation to this environment. Other argumentations such as those deriving from Institutional Theory emphasize the importance of the institutional environment and the concomitant rules in conditioning the survival of the enterprise. Additionally, the Contingence perspective argues that growing environmental turbulence obliges enterprises to develop more sophisticated systems in order to control the growing unpredictability, complexity and novelty of modern changes. While the growing dynamism, size and complexity of the environment also increase uncertainty (Hitt, 2000:7), we must finally add that in this situation, managers do not have enough time to respond to competitive threats and to be able to implement changes (Longenecker and Fink, 2001).

focuses on firm rather than industry performance. In general, strategy literature suggests that successful organizations are able to obtain co-alignment with their external environment (Phillips, 2000). It must not be forgotten however, that the basic premise behind most of the economic theories, such as the Positioning School, led by Michael Porter, is that the industrial structure plays an important role in the determination of the competitive strategies potentially available to the organization in the market (Kumar and Subramanian, 1997). According to Porter (1980:23) the structure of an industrial sector has a strong influence in determining the competitive game rules and also the strategic possibilities potentially available to the enterprise.<sup>2</sup> Even so, and although IO emphasizes the power of environmental factors in dictating a firm's strategic behavior, Porter (1991) views the market environment as partly exogenous and partly subject to influences by company action.<sup>3</sup> After this, the competitive strategic choice, and hence the performance of an enterprise, depends on the degree of attractiveness of the industry and the position obtained vis-à-vis competitors.

One of the main aims for each and every enterprise is to achieve a sustainable competitive advantage (Mathews, 2000:114). For the Positioning school, "the essence of formulating competitive strategy is relating a company to its environment" (Porter, 1980, p.3).<sup>4</sup> The industry structure strongly dictates the conditions and competitive rules for the company and also the potential strategies available to the company, so executive managers are in fact analysts who study large amounts of data in order to recommend generic strategies (Mintzberg *et al.*, 1998:84). Porter offered insights into how firms can obtain competitive advantage through positioning in the context of industry structure and pursuing strategies appropriate to that structure. In order to analyze and understand both the current industry structure and the future attractiveness of a business area, and as basis to identify the key strategic issues confronting organizations within the industry, Porter (1980) devised a model by which managers could assess the profit potential for a given industry by analyzing the "five competitive forces". From all the perspectives, Michael Porter's Competitive Forces Model has not only become an important tool for analyzing an organization industry structure in strategic process. Actually, it is by far the most widely used framework for an assessment of the profit potential in industry, and it became the dominant paradigm in the 1980s (Teecce *et al.*, 1997). This model allows a systematic and structured analysis of market structure and competitive situation to be undertaken, examining the key forces that drive overall profitability.

The competitive forces approach, which uses competitive strategy as a broad formula for how a business is going to compete (Porter, 1980: xvi), emphasizes the importance of focusing on the forces that determine an industry's attractiveness, to decide what sort of industry it is, and to find a profitable position in the industry as the means to reach sustained

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<sup>2</sup> Porter's basic idea was to integrate the traditional IO perspective with the strategic management tradition, distilling at the same time several decades of research in industrial organization into a set of prescriptions for managers. The IO perspective views firms as a bundle of strategic activities aiming to adapt to the industry environment by seeking an attractive position in the market arena (Williamson, 1991; McGahan and Porter, 1997; Spanos and Lioukas, 2001). And in this vein Porter (1980) states that the capability of an enterprise to create economic returns depends on its ability to exploit market imperfections.

<sup>3</sup> As Spanos and Lioukas (2001:911-912) point out, Porter's perspective "despite being clearly rooted in the tradition of the Bain-Type IO, constitutes a definite attempt to reinstate the firm as a critical unit of analysis".

<sup>4</sup> This school stresses that the value of the industry's history and the analysis of competitors are the basis for the predetermination of positioning in the business market (Wyer *et al.*, 2000).

competitive advantage.<sup>5</sup> The Five Forces Model is rooted in industrial economics, but embodies the notion that competition is much broader than just rivalry or location, and takes into account product features, services and processes, supply and demand, complementary products and substitutes, the relationship between volume and cost of production, or market structures such as monopoly, oligopoly or perfect competition. These five forces are: the threats of substitute products, the relative strength of buyers, the bargaining power of suppliers, the threats of potential entrant competitors to the industry, and the rivalry among industry incumbents. The stronger these “five competitive forces” are, the less profitable the industry. In order to deal with these forces, or to remain competitive in a particular branch of industry and outperform competitors, Porter stresses the importance of developing a defensible position, choosing from among three potentially successful generic strategies: overall differentiation, cost leadership and focus.<sup>6</sup>

Porter’s vision is also supported by other literature fields and authors such as Fleisher and Bensoussan (2003). For instance, theoretical developments in the New Industrial Economy consider the study of company behavior, and the way in which this behavior affects industry configuration to be essential. The interest in this new development could come from the attempt to modelize the problems derived from “strategic interdependence”, a characteristic element of oligopoly markets, where the firm is conscious that its performance depends not only on its own decision, but also on those of other enterprises. These new developments increasingly highlight the importance of considering variables such as the expectations the enterprise forms of its competitors, the importance of information, and the expectations of the competitive reaction from concurrence (Donsimoni *et al.*, 1984). If we consider again the diverse literature that focuses on environmental determinism, we cannot ignore the excessive environmental complexity and turbulence stressed by Population Ecology (Wyer *et al.*, 2000). However, even for Ecology Theory the organization has a possible choice, albeit accidental; managers must therefore attempt to obtain the maximum advantage from the environment, or create relationships with other organizations in order to reduce the selection pressures of this environment (Hannan and Freeman, 1977:961). Mintzberg *et al.* (1998:290) also state that context has different consequences for some Contingence theorists, depending on the process of strategy elaboration by top managers. As a consequence, the ability of a firm to conform strategy election could mean the difference between survival or “death” (Hartman *et al.*, 1998). On the other hand, from Resources Theory, Daily and Dalton (1994) point out that as much as some top managers’ actions influence the firm’s access to valuable resources and information, environmental dependence will be low.

However, although Porter’s theories dominated the 80’s, they have some limitations in today’s market environment. For instance, certain authors criticize the fact that they do not take into consideration new business models and market dynamics, or the fact that Porter’s list is not all-inclusive. Hence, work by Dill (1958), Ackoff (1970), Aldrich (1979) Gailbraith and Schendel (1983), or Wheelen and Hunger (2000), suggests additional elements for the competitive dimension. Even so, the main critics come from the new developments in the

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<sup>5</sup> According to Porter (1980:xiv), the five forces model offers a “... general framework for analyzing the structure of an industry and its competitors”.

<sup>6</sup> For Porter, strategy is a consistent array or configuration of activities (Porter, 1991:102) aimed at creating a specific form of competitive advantage. To sum up, Porter and his followers maintained that sustainable competitive advantage could only accrue to firms that position themselves in the marketplace through dedicated cost leadership, differentiation or a focused combination of the two (Lee and Mukker, 1999:584)

field of strategic management, which in the 90s, underwent a major shift in the focus on the sources of sustainable competitive advantage: from industry to firm specific effects (Spanos and Lioukas, 2001). These authors criticize the generalized framework considered by IO because it does not consider in depth the enterprise as an individual agent, or how company strategy can contribute to the maintenance of a differing profitability among organizations located in the same business.<sup>7</sup> In order to avoid these problems, new theoretical developments have come out of the literature, such as the Strategic Theory Based on Competences (Hamel and Prahalad, 1989, 1994a,b; Hamel and Heene, 1994) and particularly the Resources and Capabilities Theory, that focus on the distinctive competences and the resource and capability assets within the enterprise, as determinant key success factors.<sup>8</sup> These theories represent a fundamental advance in the literature, by going deeply into certain core capabilities of the enterprise. However, and as Schoemaker (1997:61) points out, a strategic view must also consider future scenarios, the industrial competitive structure, and the distinctive capabilities of the industry. As De Vasconcellos and Hambrik (1989) state, the identification of core capabilities must take place in the context of the key industrial factors, and therefore the focus on company internal analysis must always take the environment into account.

Despite these criticisms, some authors continue to use Porter's approaches in their works, and others maintain that Porter's approaches and the new perspectives complement each other in explaining a firm's performance (Amit and Schoemaker, 1993; Peteraf, 1993; Collis and Montgomery, 1999, Spanos and Lioukas, 2001). These authors state that "both are important to understanding how organizations achieve sustained competitive advantage" (Coulter 1997:40), and they are complementary, since they emphasize different dimensions of strategy, greatly contributing to the development of a strong business strategy (Hax and Wilde II, 2003).<sup>9</sup> It has, for example, possible complementarities with Resources Theory, as Tallman (1991) points out, or with the Strategic Theory Based on Competences, as Schoemaker (1997) maintains.<sup>10</sup> Moreover, recent thinking in Resource-Based Theory has directly tackled the issue of "Dynamic Capabilities" and strategies towards flexibility and responsiveness to changes in the environment (Teece *et al.*, 1997). As Spanos and Lioukas (2001:911) point out, it has been recently recognized that "Porter's framework and Resource-Based approach constitute the two sides of the same coin".<sup>11</sup> Thus it can be seen that empirical work exists to

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<sup>7</sup> In this way, authors such as Tallman (1991:71) criticize the theoretical focus developed from IO, because of its excessive deterministic conception when considering that only the market positioning in an industry is a significant input on which to base company decisions and thus for its performance.

<sup>8</sup> In this way, whereas Porter views strategy as being primarily industry driven, these new perspectives posit that the essence of strategy is defined mainly by the firm's unique resources and capabilities (Rumelt, 1984).

<sup>9</sup> According to Mintzberg *et al.* (1998:16), "Strategy concerns both organization and environment". As Hanson *et al.* (2002:7) points out, "analyses of its external and internal environments provide a firm with the information required to develop its strategic intent and strategic mission" and in this way "through an effective combination of results gained by using both the IO and the Resource-based model, firms dramatically increase the probability of achieving strategic competitiveness and earning above-average returns" (*ibid.*, 2002:20)

<sup>10</sup> In this way this author emphasizes the essentiality of developing an industrial external analysis, previous to the internal analysis and the in-depth study of "Core Capabilities". Although this author emphasizes the fact that core capacities analysis provides the basis to develop a strategic view for the future, his methodology uses an industrial analysis and strategic segmentation analysis, which help to define the fight field about competitors, barriers and potential profits.

<sup>11</sup> According to these authors (*ibid.*, 912), compatibility between the two models is justified by certain reasons: a) the two perspectives are complementary to explain firms' performance in the sense that by drawing insights from both, one can gain a more balanced view on the resources of competitive advantage; b) both perspectives seek to explain the same phenomenon of interest; c) because the unit of analysis is identical in both cases (*i.e.*, the

support both schemes (Hanson *et al.*, 2002), and hence, there are authors such as Robinson and Mc Dougall (1998), McGahan (1999), or Hanson *et al.* (2002), who continue to support the significance of the impact of industry characteristics on firm performance.

Having examined these complementary aspects, what still seems to be needed is the conceptual and practical integration of Resource-Based analysis with the Five Forces analysis. This research aims to demonstrate that Porter's approach can also be important to comprehend the nature of managers' knowledge, as we consider this knowledge to be influenced by the forces determined by Porter. In the last few years, a new related stream of discussion has emphasized knowledge as a main strategic asset (Nonaka and Takeuchi, 1995). Kogut and Zander (1996) state that knowledge is the firm's main resource, since it has been redefined as a social community specializing in speed and efficiency in the creation and transfer of knowledge. It is "a source of competitive advantage" (Randeree, 2006:146), or the fundamental basis of competition (Zack, 1999). To most of the schools that focus on the internal firm process, knowledge management attributes, *i.e.* a firm's ability to acquire, learn, accumulate, evaluate, assimilate, integrate, and diffuse, deploy, and exploit knowledge, are critical, because it is itself a skill or competence that may provide strategic advantage (Madhok, 1997; Zack, 1999). This is particularly crucial in the "New Economy" and continuous innovations in information technology, because the substantial change in and the size and complexity of the new landscape produce significant uncertainty (Hitt, 2000:7), and in this situation the maxim "knowledge is power" has a deep-seated relevance (Carroll and Tansey, 2000; Girard, 2006). As Drucker (1993) stresses, in the New Economy, knowledge is not simply just another resource, but the sole essential resource nowadays. On this point, organizations that are most efficient in gathering, processing, and distributing information and then using it to make better business decisions will enjoy a competitive edge in achieving success in their field (Myburgh, 2000).

The Resource-Based approach normally agrees that the strategically most important resource is Knowledge (Hult, 2003:189; Oslerloh and Frey, 2000:539). Prahalad also argues that the knowledge based view is the essence of the Resource-Based perspective (Mintzberg *et al.*, 1998: 216). Meroño-Cerdan *et al.* (2007:60) stated that "the knowledge-based view... states that the sources of competitive advantage are not all the firm's internal resources, but just the intangible knowledge-related assets of the organisation and its capability to integrate knowledge. According to Van Aken and Weggeman (2000:140), modern competition is essentially based on knowledge, because firms seek to learn and develop capabilities more quickly than their competitors.

However, knowledge is not found in the firm as an artificial organism, but rather lies in the members of the enterprise, "new knowledge always begins with an individual" (Nonaka, 1998, cited by Girard, 2006:26). In this vein, Hamel and Prahalad stated that managers have the "key role of identifying, developing and managing" capabilities (Nonaka and Takeuchi, 1995:48-49).<sup>12</sup> As Mezas and Starbuck (2007:7) point out, "many practices in organization rely on managers' perceptions", and managers' perceptions form the bases for firms' actions and strategies. Managerial knowledge or managerial perception, "include everything that goes

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firm); and d) because both perspectives acknowledge the importance of an attractive strategic position (*i.e.*, competitive advantage) viewed as an outcome of firm strategy activities.

<sup>12</sup> Moreover, according to Hamel and Prahalad (1993), the construction and fit of the strategic assets is essential, and the manager must know how to combine and transform the different resources in the way that they multiply the value of each one at the same time as they equilibrate their resources.

into managers' understanding of their work situation" (Mezias and Starbuck 2003:4). The managerial knowledge or perception of the key aspects of the enterprise and the environment are crucial because "how individuals in organizations make decisions and the quality of their final choices are largely influenced by their perceptions" (Robbins, 1998:115), and because depending on the nature of the perceptions, decision-makers will react accordingly, and thus, erroneous attributions can lead to actions that fail to correct the problem, (or actions that may even exacerbate the problems) (Zacharakis et al., 1999).

In this way, as long as we can demonstrate that Porter's scheme is important to an understanding of managers' knowledge or perceptions, we will be able to stress the importance of the IO perspective, and thus the revitalization of Porter work, and the connexion between this perspective and the knowledge-based-view. This is the objective of the present study.

## METHODOLOGY

Our study made use of two main data sources. Firstly, we carried out a Delphi study with international experts on tourism to measure their perception of the post-Internet competitive environment (Appendix I). Secondly, we addressed a questionnaire to the CEOs of hospitality enterprises to obtain their perception of the post-Internet competitive environment, in order to compare their individual perceptions with those resulting from the Delphi study, thus enabling the Quality of Managerial Perception to be determined. In short, we used the Porter (2001) scale to obtain the quality of managerial perception, measuring this quality of managerial perception as the difference between the managers' responses and those from the Delphi study.

The scale used highlighted the effect of the new post-Internet environment on the five forces model. We used this scale because it was devised by Porter himself, and because it refers to a difficult and recent object of perception. In addition, we chose to study the hospitality sector for various reasons: the lack of strategic studies in this sector,<sup>13</sup> the importance of the Internet in its development, and the simplicity of collecting data.<sup>14</sup>

### **The "External" Measurement of the Hospitality Structure: The Delphi Study**

Firstly, we carried out a Delphi study in order to determine the "correct" perception of the post-Internet competitive hospitality environment. This "correct" perception was then compared with each manager's individual perception on the same questions, in order to obtain his or her "quality of managerial perception". We consider this to be an appropriate method to

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<sup>13</sup> This study also attempts to respond to the fact that, despite the importance of strategy in the hospitality literature, there is a paucity of empirical investigation of strategy in this sector (Olsen and Roper, 1998).

<sup>14</sup> The rapid development, and intensive and essential use of the Internet in this sector, mainly as a resource to capture new customers, but also for other purposes should be stressed. Almost all hospitality firms have access to and make use of the Internet, and thus, the data gathering process is relatively simple.

analyze this “correct” perception, because of the characteristics of the Delphi method and the repute of the experts that participated in this study.

### ***The Delphi technique***

The Delphi technique is a qualitative method of gathering group information. It can be defined as a structured brainstorming, based on the collection and analysis of expert opinion (Jarich, 1998:6). It takes its name from the mountain where the ancient Greeks met to consult with the oracles. The objective of this method is to forecast the potential opportunities and future trends, taking into account the impossibility of studying the issues in isolation from the economic, social and political context in which they develop (Dalkey *et al.*, 1972).

The method is considered to be especially useful in contexts of imperfect information. It is regarded as one of the most appropriate techniques for the study of the tourism sector, and for the long term predictions in high probability situations of changes of unknown dimension and lack of suitable numerical data (Archer, 1987). For this reason, its importance is crucial in the prediction of changes in the context of the New Economy and the advent of Internet. Its use in tourism can be observed in articles by D’Amore (1977), Kaynak and Macaulay (1984), Green *et al* (1990), or more recently Lloyd *et al.* (2000) or Miller (2001).

**Table 1. Technical file on the Delphi Method**

Ambit	<i>National and International Experts in Tourism</i>
Date of the empirical work	<i>September 2001 to January 2002</i>
Type of study	<i>DELPHI</i>
Sample size	<i>30 Questionnaires in 1st round 19 Questionnaires in 2nd round</i>

The method comprises various stages. First, experts’ opinions are gathered anonymously through questionnaires. These data are then analyzed, and finally, the experts are provided with a summary of the information, to allow them to modify their opinions. The process is repeated in successive rounds until the answers converge appropriately.

### ***Characteristics of the Delphi Sample and the sampling process***

The Delphi Study was undertaken with Spanish and International experts in the period between September 2001 and January 2002 (see Table 1). The process started with the definition of the problems, the examination of the research objectives, and the preparation of the questionnaire. The experts were then selected and contacted. In the composition of our group of experts, we sought to include university professors specialized in Tourism and Tourism Information Technology, members of public administrations, and professionals from tourism and hospitality enterprises or other organizations.

Every effort was made to personally contact the experts.<sup>15</sup> The importance of personal contact with experts is crucial to providing initial motivation that will then lead to the

<sup>15</sup> Contact with Spanish and International experts was largely made through TURITEC’99 (National Congress on Tourism and Communication and Information Technology), the AECIT conference of 2001 (Spanish Association of Scientific Experts in Tourism). In addition some national conferences such as the ACEDE and AEDEM congresses (main Spanish scientific organizations in management and business administration), and diverse international conferences were also used.

successful development of the process. The objectives of the project were explained, together with our reasons for soliciting their opinions. Finally, the confidentiality of their responses was guaranteed. The process was carried out by e-mail, although experts' motivation was also improved by telephone contact.

Having established the quality of the initial scale used, developed by Porter (2001), the preliminary Delphi process was limited to separating the questionnaire into four hospitality businesses: rural hotels, spa hotels, city hotels and sun and beach hotels. After this initial phase, the questionnaire was sent out to the experts. As this step was intended to collect qualitative opinions, a 7-point Likert scale was used, in ascending order in accordance with the expert's agreement with the specific item.

From the initial questionnaires sent, 30 replies were received, 13 Spanish and 17 international. Once the data had been compiled and analyzed, we returned the results of this round to the experts (we provided them with mainly the median and the Interquartile Range), in order to obtain a new estimation and get closer to the "correct" perception of the post-Internet market structure. Questionnaires were filled in again with some modifications and comments. In this round, a total of 19 questionnaires were received, 8 Spanish and 11 international. Having obtained the acceptable degree of consensus, the analysis was judged to be complete. Precedents with a 3-step Delphi method do exist, which are regarded as being sufficient to obtain a high degree of group consensus (Green *et al.*, 1990, or Miller, 2001). As Green points out, it has been demonstrated that with each extra round, both the number of experts and the degree of consensus obtained decrease. In addition, the final total number of experts is also acceptable, given the quality of their opinions, and the numerous Delphi studies that have used 20 initial experts (Masser and Foley, 1987), or as few as 10 (Dalkey and Helmer, 1963; Dalkey *et al.*, 1972).

Miller (2001) refers to authors such as Taylor or Wheeler to highlight the importance of selection, and the equilibrium of the sample to ensure the goodness of the results. The quality and diversity of the experts that participated in our study should be mentioned; 5 Spanish professors and international experts from Belgium, Cyprus, France, Greece, Malta, Mexico, Peru, Thailand, Taiwan, USA, and UK took part. In addition, the international experts included prestigious academics in tourism and management. The participation of representatives from business associations and the public administration system was also notable, with the involvement of members such as the general director of a national association of tourism enterprises, or members from various national or regional tourism organizations.

## **The Questionnaire to Managers**

The evaluation of managerial perception was based on a questionnaire sent by e-mail to the CEOs of Spanish hospitality enterprises. The following section explains the advantages of this process and the characteristics of our questionnaire.



### ***Self-administered questionnaires sent by e-mail***

This methodology included aspects from self-administered questionnaires via mail and telephone interviews, given that this procedure provided for a more personal contact with the interviewees.

The advantages and disadvantages of self-administered questionnaires are well summarized by Nichols (1990:11); Smith (1995:63), and Descombe (1998:105-107). Advantages include a higher response rate than other methods, relatively economic costs, simple administration, the possibility of collecting data that can be expressed statistically through graphs and tables, the partial anonymity of the method, carried out in order to reduce the personal interaction effect, the wide geographical scope or the control permitted in the distribution of questionnaires. All these advantages can also be observed with the electronic method. However, Internet insecurity negatively affects the response rate. In addition, Internet does not enable us to overcome some of the chief difficulties of the postal method. Among these, it should be pointed out that the pre-codified answers may prevent experts from answering in specific ways; a certain bias may arise in the answers which coincide more with the point of view of the researcher as opposed to that of the expert: experts are free to answer certain questions randomly, or there may be a lack of qualitative depth in the answers. However, as Lyon et al (2000:1058) point out, this method can bring advantages such as the possibility of obtaining uniform interpretations that can allow for comparison, the use of standardized questions or the fact that scales can be developed directly to cover the highlighted construct, promoting the validity of these constructs.

With regard to telephone interviews, Pope (1993) outlines the following advantages: (1) a broad, geographically dispersed sample can easily be obtained; (2) it is easily supervised; (3) the interviewed can clarify certain questions; (4) it is associated with greater speed and low cost. To these advantages might be added the opportunity for interviewers to use their writing abilities through e-mail. In addition, e-mail overcomes the main disadvantages of telephone interviews, such as limited interview time, the lack of expression or the impossibility of showing images, articles etc. to the interviewee during the interview, or tiredness associated with telephone interviews.

It should also be pointed out that we used managerial perception rather than real facts. As Lyon *et al.* (2000:1058-1059) state, the use of managerial perception can lead to problems related to the lack of internal consistence, functional bias, or due to their subjective character. In addition certain interpretation problems arise from the standard codification of the answers. However, according to these authors, managerial perceptions provide the most precise evaluation of the conditions inside the enterprise. In addition, these perceptive measures provide the possibility of having more specificity levels than do other aggregated methods.

### ***Questionnaire characteristics and the sampling process***

In the questionnaire to firms, CEOs were asked about the post-Internet hospitality structure. The same questions put to the experts in the Delphi study were used, to enable responses to be compared and to calculate the quality of perception of each CEO. The 17 questions from Porter's scale were used (2001).

The technical details of this study are shown in Table 2. According to the Spanish Institute of Statistics (INE), 14,881 hotels were registered in Spain in 2001. However there is no data on the number of hospitality firms. Our study was aimed at hospitality firms,

excluding hostels and other residences. In addition, our questionnaires were sent only to firms that provide their e-mail addresses on the main specialized Spanish web pages. Accordingly, the population of our study was approximately 3,500 hospitality firms, which we sub-divided into spa hotels, sun and beach hotels, city hotels and rural hotels. Questionnaires were sent to the CEOs of these enterprises between February and June 2002. The total number of questionnaires collected was 194, although 5 of them were removed because of errors or having been received late. This response rate gave, for a confidence level of 95 %, a sample error of 5.48%. The survey was comprised of closed questions, with multi-item measurement Likert scales of 7 points, comparison with competitors, as in Slater and Olson (2000). In addition, we asked the managers demographic questions about the enterprise and about themselves. The database was created using SPSS.

**Table 2. Technical file on the questionnaire to managers**

Date of the empirical work	<i>September 2001- January 2002</i>
Sample population and scope	<i>Hospitality enterprises from all Spain, with e-mail published on the main Spanish tourism websites, providing an approximate total of 3,500</i>
Sample size	<i>189</i>
Type of interview	<i>Structured questionnaires sent by e-mail</i>
Sample error	<i>± 5.48%</i>
Confidence level	<i>95% for the most unfavorable case (p=q=50%)</i>

## Analytic Tools

This study used the Structural Equations methodology. According to Bollen (1989:1), in the Multiple regression analyses or ANOVA (analysis of the Variance), the regression coefficients or variance error of the estimators derive from the minimization of the sum of the square differences of the observed dependent variance and of this predicted for each case. However, the structural equations methodology differs in that it emphasizes the covariance more than the cases, and, instead of minimizing the functions of the observed and predicted individual values, it minimizes the difference between the sample of covariances and the covariances predicted by the model. The structural equation models comprise the analysis of the covariance structure, the analysis of the latent variable, or the confirmatory factorial analysis (Hair et al., 1998:612). These techniques are distinguished by two main characteristics, the estimation of the multiple and cruised dependence relations, and the capability of representing non-observed concepts, taking into account the measurement error in the estimation process, and also simultaneously estimating all the coefficients and evaluating the fit of the whole model with the general data (Reisinger and Turner, 1999:72; Kristoff-Brown et al., 2002:37-38).

In general these models are “a powerful analytical tool, whose true value lies in using simultaneously observed and latent variables that play different roles within the general analysis” (Luque, 2000:492). In addition, they “constituted one of the most powerful tools for

the study of causal relationships about non-experimental data when these relationships are of a lineal kind” (Batista and Coenders, 2000:12).

To sum up, in order to determine the measurement scale of the quality of managerial perception we used the following steps:

The Delphi study collected expert opinions on the post-Internet hospitality structural environment, using the Porter (2001) scale of measurement. We collected the data from all the experts and calculated the arithmetic mean of their answers. These data are considered to be of good quality as they came from qualified experts and were collected with an appropriate convergence method.

Secondly, from the questionnaire addressed to top hospitality managers, we obtained their individual opinions on the same questions put to the experts in the Delphi method.

Once the whole sample had been obtained, we calculated the square difference between the individual opinion of each top manager for each variable and the mean of each variable obtained in the Delphi study. This difference revealed the “non-quality of perception” of each manager in relation to each variable.

We then proceeded to the configuration of the structural model. In order to validate the scale with our data, we carried out the following tests: 1) a dimensionality analysis using Confirmatory Factorial Analyses and proving the fit of the model; 2) a reliability analysis for the parameters estimated and the latent variables; 3) analysis of validity of the measurement instruments.

According to Bagozzi (1981), when new measures are introduced, the convergent, discriminating and content validity must be corroborated. In order to do this, we used empirical tests to examine the suitability of the scale used, analyzing the dimensionality, reliability and validity of the Porter scale, using confirmatory factor analysis (CFA).

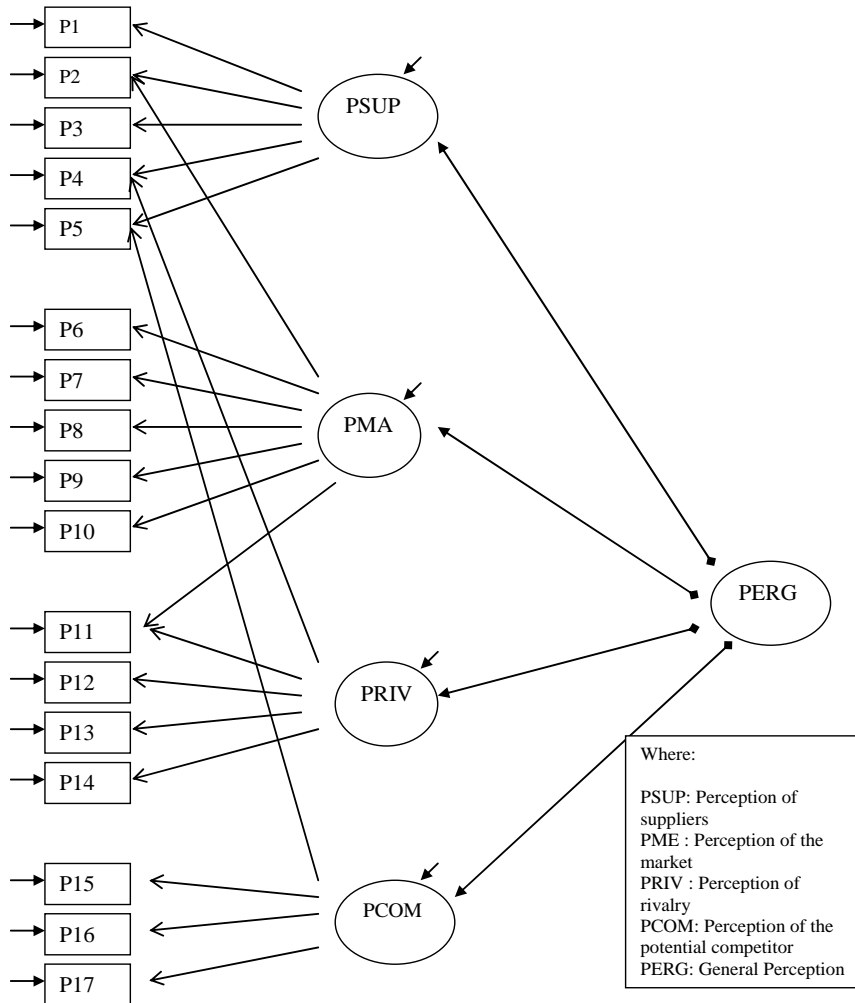
Factorial analyses are usually used to reduce the amount of data to a level that can be easily used (Kinnear and Taylor, 1991). Basically they consist of applying linear combinations of original variables, to represent underlying dimensions or constructs that summarize or justify an original series of variables that must be observed (Hair *et al.*, 1998). Among these analyses we can highlight the EFA, which attempts to observe the more likely possibilities according to the data. The CFA is a more sophisticated tool. It is a multivariate technique that tests the likelihood of a previously formulated relationship or hypothesis. This research uses the CFA technique to measure performance, because it draws statistical inferences leading to a stricter and more objective interpretation of the validity than with the EFA (Gerbing and Anderson, 1988).<sup>16</sup>

The CFA procedure includes the steps of specification, identification, estimation, and evaluation and interpretation. The first step, or specification phase, consists of establishing

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<sup>16</sup> The CFA technique is included in a broad family of structural equation models (Hair *et al.*, 1998: 612). The use of CFA is very suitable for drawing up measurement scales, because it allows us to test the degree of correspondence that exists between the measures and the concepts that they are attempting to measure (Bagozzi and Phillips, 1982: 460). In addition, they allow us to overcome the weakness of the measurements, because they take measurement error into account, simultaneously estimating all the coefficients and evaluating the fit of the model with the data, as in each structural technique (Kristof-Brown *et al.*, 2002: 37-38).

dependence variables among the different variables, in accordance with theory (Bollen, 1989). In our case, as pointed out above, this step follows the Porter (1980) five forces scheme. In the identification phase we have to ensure that the model's parameters can be derived from the variances and covariances between the observed variables, in order to estimate the model. One necessary condition establishes that the number of equations, or elements other than the variances-covariances matrix, must be bigger than the number of parameters to be estimated. This difference is called "degree of freedom". The next step is to estimate the results with the aim of looking for the theoretically inconsistent estimates (Hair *et al.*, 1998:659).



Source: Author's own from Porter (1980) and Porter (2001).

Figure 1. Initial Model to measure managerial perception of the post-Internet competitive environment

This research uses the CFA technique to estimate the parameters with EQS 5.7b. This program uses the Maximum Likelihood method by default, offering consistent estimators for big samples, with continuum variables, and a multi-normal distribution (Bollen, 1989).

However, our research violates the assumption of multivariate normality and it uses a continuous variable when it uses Likert scales. In this situation, some authors such as Satorra and Bentler (1994, 2001) suggest using other methods such as Robust Standard Estimators, implemented in EQS and the statistic that bears their name. We have used this method in our work. Finally, the evaluation of the model attempts to observe how well our data correspond with the proposed model

## RESULTS

### Dimensionality Analysis

For each analysis we have to start from the premise that each scale or structural model is based on a strong theoretical definition that shows the construct or the relationship that we intend to measure. First of all, a dimensionality analysis of each scale must be carried out, to prove the existence of one single concept or underlying characteristic in all the indicators that show one single construct (Anderson and Gerbing, 1988). With this process we attempt to corroborate the existence of the dimensions that configure the proposed model on managerial perception. In order to do this, we used the Confirmatory Factorial Analysis technique, in an attempt to contrast the model shown in Figure 1.

Our model hypothesizes that managerial perception of the structural environment is conceived as a second order factor that comprises four dimensions or factors: The perception of suppliers (PSUP), the perception of the market (PMA) (in which we include both customers and substitute products), the perception of rivalry in the industry (PRIV), and the perception of potential competitors (PCOM).<sup>17</sup> Secondly, the model hypothesizes that each indicator has positive factorial weights in the factors that theoretically it has to measure, and null factorial weights for the other factors. Finally we have to specify the correlation among measurement errors in the scale.

Previous to the estimation of the global factorial model (see Figure 1), the dimensionality of each first order factor corresponding to the individual dimensions must be analyzed. In Table 3 we show the adjustment measures of the models that indicate the individual dimensions. In this step, the initial proposed models are modified according to the reliability of the parameters, the individual weights or the correlation between the measurement errors, obtained after carrying out the Lagrange Test. The initial models for each individual dimension are shown in Appendix I, where an asterisk indicates the indicators eliminated in the initial process.

In Table 3 we show the fit measures in each individual dimension. The observation of all indices shows the closeness of our fit. First of all, every model is supra-identified with more than two degrees of freedom. According to the absolute fit measures (to show the

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<sup>17</sup> Although we would like to have used Porter's original scheme, the fact that we use perceptions and not competitive forces, and the existence of few items to measure the substitutive products, led us to consider a variable that indicates the perception of the market, that connects both dimensions, customers and substitute products. It should be pointed out that we were not able to use the CFA technique for each dimension, because there were insufficient items to confirm each of these dimensions, as we have a saturated model, without sufficient degrees of freedom. In addition, Porter's (1980) schemes indicate that some items can influence some dimensions, so we have included this fact in our model.

correspondence between the matrix estimated by the model and the observation matrix) we can corroborate how highly significant the Satorra-Bentler  $\chi^2$  is, as it is greater than 0.05. In addition, the GFI is greater than 0.9, and the RMSEA lower than 0.08 in almost all cases. As for the incremental fit measures (to compare the proposed model with a null model showing the lack of any association among the model's variables), all of them (AGFI, BBNFI, BBNNFI, RCFI and IFI) are greater than 0.9 in almost all the models, as described by theory. Finally, the NC (that correlates the quality of the model with the number of estimated coefficients needed to obtain these levels of fit) falls within the ideal interval of 1-2 in two models, and always below 5 points in every model. If we look carefully, we can see relative problems in the model PCOM. To avoid these problems we could eliminate certain items or assume some correlation between some measurement errors. However, the inconvenience of these modifications belies their use.<sup>18</sup>

Once the dimensionality for each of the first order factors had been corroborated, we were able to analyze the second order factor model. The adjustment of this analysis also suggests the elimination of some items, which are shown with two asterisks in Appendix I.

Table 4 presents the standard estimators of the main parameters in the final model. Apart from the fit of the model, it can also be observed that, in this model, all the parameters are statistically significant for a level of 95%, and most of the factorial weights are greater than 0.4.

The evaluation of fit of the final model is shown in Table 5.<sup>19</sup> This table shows all the indexes to have the desired values. First of all the model is supra-identified with twenty-six degrees of freedom. If we start with the absolute fit measures, we can observe that the Satorra-Bentler  $\chi^2$  statistic is highly significant. In addition, the GFI is greater than 0.9, and the RMSEA lower than 0.08. According to the incremental fit measures, except the AGFI that has a value of 0.895, all the rest (BBNFI, BBNNFI, RCFI and IFI) are greater than 0.9. Finally, as the NC has a value of 1.1556, it falls within the ideal interval of 1-2 and close to 1.

### **Reliability analysis**

According to Hayes (1992:50), reliability can be defined as the degree in which the measures are free of any bias resulting from causal errors. This reliability ensures that the measurement process gives the same results, independently of the model or of the way in which this model is developed. In short, in contrast to the validity analysis, which refers to the goodness with which one measure defines a concept, reliability is related to the coherence of measure (Hair *et al.*, 1998).

Within the structural equation modeling framework, reliability has to be measured for each indicator and finally for the whole model. Bollen (1989), Sharma (1996) and other authors propose measuring the individual reliability with the square multiple correlation coefficient ( $R^2 > 0.5$ ).

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<sup>18</sup> In this case we cannot eliminate any item, because it would cause a saturated model, with 0 degrees of freedom. It should also be noted that the EQS program suggests a correlation between the measurement errors of items P4 and P5 in model PSUP, correlations that we have implemented to obtain a better fit of the model

<sup>19</sup> After the application of the initial models, and following the previously established criterion, some items were eliminated. In addition, the program shows the existence of correlation between the measure errors of indicators P8 and P12, a correlation that we established to improve the fit.

**Table 3. Fit measures of the individual models on managerial perception.**

Fit Measures	Individual Model			
	PSUP	PMA	PRIV	PCOM
<b>Satorra-Bentler <math>\chi^2</math></b>	4.898	3.501	2.328	5.861
Degrees of Freedom	4	5	2	2
<b>Sig. Level</b>	0.298	0.623	0.312	0.053
GFI	0.987	0.984	0.986	0.976
<b>RMSEA</b>	0.054	0.053	0.101	0.141
<b>AGFI</b>	0.951	0.952	0.929	0.882
<b>BBNFI</b>	0.980	0.965	0.965	0.932
<b>BBNNFI</b>	0.982	0.975	0.929	0.832
RCFI	0.992	1	0.995	0.901
<b>IFI</b>	0.993	0.988	0.977	0.946
NC	1.225	0.700	1.164	2.930

**Table 4. Standard estimators and measurement error of the final model to measure managerial perception.**

Measure	PSUP	PMA	PRIV	PCOM	PERG	Errors
P1	0.780					0.629
P2	0.569					0.728
P3	0.764					0.645
P4	0.402					0.777
P5	0.446					0.742
P7		0.635				0.773
P8		0.725				0.689
P11		0.821				0.571
P2		0.219				0.728
P12			0.684			0.729
P4			0.353			0.777
P15				0.631		0.776
P5				0.368		0.742
PSUP					0.393	0.919
PMA					0.999	0.045
PRIV					0.983	0.185
PCOM					0.885	0.466

**Table 5. Fit indexes of the second order factorial model on managerial perception.**

Identification of the model	Final scale to measure managerial perception
Degrees of freedom	26
<b>Estimation of the model</b>	
<i>Absolute fit measures</i>	
Satorra-Bentler $\chi^2$	30.055
Sig level	0.265
GFI	0.950
<b>RMSEA</b>	0.075
<i>Incremental fit measures</i>	
<b>AGFI</b>	0.895
<b>BBNFI</b>	0.927

<b>BBNNFI</b>	0.931
RCFI	0.984
<b>IFI</b>	0.961
Parsimony fit measures	
NC	1.156
AIC	1.270. (compared with 639.095 from the independent model)

**Table 6. Reliability of the scales used to measure managerial perception**

Model	Construct reliability	Indicators	R2 of indicators
PSUC	0.75	P1	0.597
		P2	0.457
		P3	0.572
		P4	0.313
		P5	0.345
PMA	0.7	P2	0.191
		P7	0.341
		P8	0.527
		P9	0.123
		P11	0.754
PRIV	0.69	P4	0.265
		P11	0.679
		P12	0.397
		P14	0.379
PCOM	0.65	P5	0.209
		P15	0.402
		P16	0.633
		P17	0.288
PERG	0.92	P1	0.609
		P2	0.469
		P3	0.583
		P4	0.396
		P5	0.449
		P7	0.403
		P8	0.526
		P11	0.674
		P12	0.468
		P15	0.398
		PPRO	0.155
		PME	0.998
		PRIV	0.966
		PCOM	0.783

The reliability for the whole model is usually measured with the construct reliability, with appropriate measures greater than 0.7, although this value can be smaller depending on the study (Hair *et al.*, 1998). Table 6 shows the results obtained for the initial models and for the general model. These results show that the observed variables are representatives of the latent construct. Nevertheless the individual reliability is not greater than 0.5<sup>20</sup> for each indicator. We also encountered problems with the construct reliability of PCOM. However the global

<sup>20</sup> However, these items have not been eliminated in order to avoid any affect on the content validity of these dimensions



model shows the existence of high reliability, which validates the goodness of all previous analyses.

### **Validity analysis**

The purpose of validity analysis is to confirm that what we are measuring actually is the construct we are attempting to evaluate. It is usually measured with three kind of validity: content validity, convergence validity and discriminant validity.

Content validity implies that the indicators measure all the aspects making up the concept. The criterion to measure this validity depends on the theoretical literature review and it is highly subjective (Bollen, 1989:185). The theoretical argumentation of our article, the utilization of the Delphi technique, and the use of the measurement scale established by Michael Porter, go some way to corroborating the content validity of our measure.

The convergence validity indicates that the various items used to measure the concept are strongly and positively correlated (Churchill, 1979). This validity can be contrasted with the factorial analysis, and therefore the fit of the models, especially due to the goodness of incremental fit measures such as AGFI or BBNFI, corroborate this validity. Secondly, the magnitude of factorial weights, with values greater or near 0.4 (Hair et al., 1998) also ensures this validity. Finally, we should mention the statistical significance of each weight obtained between the indicator and the latent variable ( $t$  value greater than 1.96 with  $\alpha=0.05$ ), as indicated by Anderson and Gerbing (1982).

Finally, discriminant validity measures the correlation among the outputs obtained with this measure and other related constructs. Certain Structural Equations mechanisms can be used to measure this validity, such as the  $\chi^2$  differences test (Jöreskog, 1971). However, we chose other two frequently used mechanisms. One of these attempts to reveal the standard correlation between the latent variables, since if they are high (more than 0.9, or even 0.8) the latent variables cannot be considered as a different construct. The other mechanism compares the Cronbach's alpha of each scale with the correlation of each scale with the others. As can be observed in Table 7, all the standard correlations between different dimensions are lower than 0.8. In addition, all the Cronbach's alpha are greater than any correlation between each scale and all the others.

**Table 7. Correlation matrix and Cronbach's alpha, to measure the discriminant validity of the managerial perception measurement scale**

	PSUP	PMA	PRIV	PCOM
<b>PSUP</b>	<b>0.7981</b>			
<b>PMA</b>	0.673**	<b>0.6993</b>		
<b>PRIV</b>	0.607**	0.622**	<b>0.7331</b>	
<b>PCOM</b>	0.558**	0.597**	0.584**	<b>0.6993</b>

\*\* The correlation is significant for a level of 0,01 (bilateral).

Cronbach's  $\alpha$  in the main diagonal.

## CONCLUSION

This study has used the Resource-Based and Knowledge Management perspectives to show the importance of Porter and Industrial Organization schemes. We have tried to demonstrate that the five forces determined by Porter notably affect one of the most essential resources identified by the Resource-Based view, managerial knowledge. This point has been demonstrated by showing that managers have different knowledge or quality of perception of the different environmental competitive forces.

Perceptual processes are critical within the framework of the “New Economy”, due to the continuous generation of new scenarios arising from the transformation of economic, technological and organizational environments. This new turbulent environment has brought about situations that cannot be compared with any previous situations. Although huge amounts of information may now be available to managers, time restrictions and uncertainties about how to cope with increasingly complex environments are growing. In this context, knowledge has become the most important resource to firm success, and as such, we need to know how to increase this knowledge if we want to improve the effective firm’s competitive bases.

The differing qualities of perception of the various structural forces is important, firstly because give that these environmental forces are independent dimensions or constructs, that have to be considered as Porter showed, this demonstrates the importance of Porter’s work, and the need to study the competitive environment following precisely the five forces he established.

Secondly, while not ignoring the fundamental importance of the Resources and Capabilities-Based view, our study demonstrates that the industrial structure continues to play a determinant role in the new literature, as it also affects the development of one of the most important of these resources and capabilities: managerial knowledge. This is demonstrated by the confirmation of the existence of differing managerial perceptions of the various structural forces which implies that the quality of the diverse sources of information in the enterprise on the various forces are also different, playing these forces a crucial role to explain managerial bias, or the fact that managerial biases or capabilities influence the correct perception of the different structural forces. Both facts are crucial to the development of the firm, hence, apart from showing that IO and Porter’s five forces model once again demonstrate their fundamental relevance in the explanation of firm performance, our study could open a new area of research in the literature of management by connecting Porter’s work with knowledge-based-view.

However, conclusions drawn from this study must take into account the limitations of our sample and the methodology used. Restrictions might include the fact that qualitative data was used. Nevertheless, according to Lyon *et al.* (2000:1058-1059), managerial perceptions provide the most precise evaluation of conditions inside an enterprise, and we are not aware of any more sophisticated measures to evaluate this perception. In addition, the quality of the experts used in our Delphi study, the characteristics of this method, and the large sample of CEOs that participated in the second questionnaire are guarantees of the quality of the study.

Finally, we consider relevant the need for future research that could enhance our analysis. Further research might use the same perspective with different samples in the tourism sector or in other industries, or could use different methodologies. We also suggest that a more

complete scale of Porter's five forces be used to avoid certain methodological problems. In addition, it would be interesting to discover how important quality of perception is in the explanation of firm performance. This would represent the objective for a new analysis.

## ACKNOWLEDGMENT

Financial support from "Fundació Caixa Castelló-Bancaixa", and "Turismo de España" (from Spanish Economy Ministry), are gratefully acknowledged.

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## APPENDIX I

Indicators used to measure the perception of how the Internet Influences Industry Structure (source, Porter, 2001)

- P1. Procurement using the Internet tends to raise bargaining power over suppliers.
- P2. Procurement using the Internet can give suppliers access to more customers

- 
- P3. The Internet provides a channel for suppliers to reach end users, reducing the leverage of intervening companies.
  - P4. Internet procurement and digital markets tend to give all companies equal access to suppliers, and gravitate procurement to standardized products that reduce differentiation.
  - P5. Internet reduces barriers to entry and the proliferation of competitors downstream shifts power to suppliers.
  - P6. Internet makes the overall industry more efficient, the Internet can expand the size of the market\*.
  - P7. The proliferation of Internet approaches creates new substitution threats.
  - P8. Internet eliminates powerful channels or improves bargaining power over traditional channels.
  - P9. Internet shifts bargaining power to end consumers\*\*.
  - P10. Internet reduces customer switching costs\*.
  - P11. Internet reduces differences among competitors as offers are difficult to keep proprietary.
  - P12. Migrates competition to price.
  - P13. Widens the geographical market, increasing the number of competitors\*.
  - P14. Internet lowers variable cost relative to fixed cost, increasing pressures for price discounting\*\*.
  - P15. Internet reduces barriers to entry such as the need for a sales force, access to channels, and physical assets – anything that Internet technology eliminates or makes easier to do reduces barriers to entry\*\*.
  - P16. Internet applications are difficult to keep proprietary from new entrants.
  - P17. A flood of new entrants has come into many industries\*\*.
- \* indicates the indicators eliminated in the scale to fit initial first order factors. \*\* shows those items eliminated for the adjustment of the second order factor model.





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