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Capacity Utilization, Congestion and Production Performance: An Empirical Examination*

Sui-Hua Yu†
National Chung Cheng University

ABSTRACT: Increases in capital expenditures in various industries have triggered companies to make sustained efforts to manage capacity related costs. More research is being devoted to the allocation of capacity related costs and its role in incremental decision-making. To date, however, such research consists mainly in analyses of the relation between capacity utilization and cost, while the relevant empirical evidence is lacking. This study fills in this lacuna by investigating empirically the impact of capacity utilization on production performance and the moderating impact of manufacturing flexibility and manufacturing variability on the performance effect of capacity utilization. Empirical results based on six-month machine-level data from one semiconductor wafer fabrication company indicate that increased capacity utilization not only leads to longer waiting time and longer manufacturing cycle time but also causes decrease in production quality and thus increase in operating costs, with the implication that maximizing the level of capacity utilization is not necessarily optimal for firms. In addition, the empirical results reveal that performance degradation arising from high capacity utilization is greater in a production environment with higher levels of manufacturing variability. But, firms can reduce the impact of capacity utilization on production performance by improving manufacturing flexibility. This study makes the following contributions to extant research. First, it provides initial empirical evidence for congestion cost with the finding that production performance decreases with increase in capacity utilization. Second, its empirical findings relating manufacturing flexibility and manufacturing variability to performance impact of capacity utilization increase our understanding of the behavior of congestion cost

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† Corresponding author. 168 University Rd., Min-Hsiung, Chia-Yi, Taiwan, ROC. Tel: 886-5-2720411ext34507, Fax: 886-5-2721197, E-mail: actshy@ccu.edu.tw.

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I. INTRODUCTION

In recent years, the issue of allocating and managing capacity related cost has become increasingly important to the practice and management accounting research owing to rapid developments in information technology and improvements in production technology. Conventional management accounting analyses make the assumption that the opportunity cost of capacity is zero. Therefore, in a capacity-constrained environment, maximizing capacity utilization is believed to be the key to achieving cost advantage (Banker et al. 1988; McNair 1996; Cooper and Kaplan 1999). In practice, firms all dedicate themselves to reducing or eliminating unused capacity in order to improve capacity productivity and cost performance (Campbell 2004).

Operations research, however, indicates that the cost of increasing capacity utilization in stochastic and congested production environments is significantly different from the cost considered in traditional management accounting analyses. Specifically, in a stochastic production environment, increasing capacity utilization increases congestion and thus causes increase in waiting time, manufacturing cycle time, inventory carrying costs and operating costs. Besides, increased cycle time and delivery delay might lead as well to lower sales price realizations (Karmarkar et al. 1985; Banker et al. 1988). Putting these factors together, the relevant cost of raising capacity utilization is actually positive, but not zero. Ignoring these costs, therefore, might lead to sub-optimal management decisions.

Congestion is widely studied in operations and production management literature, so prior studies tended to focus on strategies to eliminate congestion in the production environments by production scheduling, dispatching and plant layout decisions (for example, Connors et al. 1996; Benjaafar and Gupta 1998; Benjaafar 2002). Few analyzed the cost of congestion. In management accounting, Banker et al. (1988) was the first one to propose the concept of congestion cost. They used mathematical analysis and a single numerical example to prove the existence of congestion cost, indicating that the opportunity cost of capacity is a smooth function but not discontinuous. However, although congestion cost was investigated in several studies, empirical evidence on congestion cost remains scarce.

Balakrishnan and Soderstrom (2000) and Gupta et al. (2003) are two studies providing initial evidence for the existence of congestion cost by examining the impact of capacity utilization on performance and cost. Using data from hospitals and one printing company, they found that increased capacity utilization leads to degradation in performance and increase in operating costs. Besides, Balakrishnan and Soderstrom (2000) found that the adverse impact of capacity utilization on performance is contingent

on the specifics of the process, implying that congestion cost differs in different manufacturing environments. However, they did not go on to investigate which factors drive congestion cost and in which ways congestion cost can be reduced. The understanding of the behavior of congestion cost is constrained. To fill in the gap between the extant researches, this study investigates empirically the following research questions. (1) How does capacity utilization affect production performance? (2) How does manufacturing variability affect the relationship between capacity utilization and production performance? (3) How does manufacturing flexibility affect the relationship between capacity utilization and production performance? The conceptual framework of this study is presented in Figure 1.

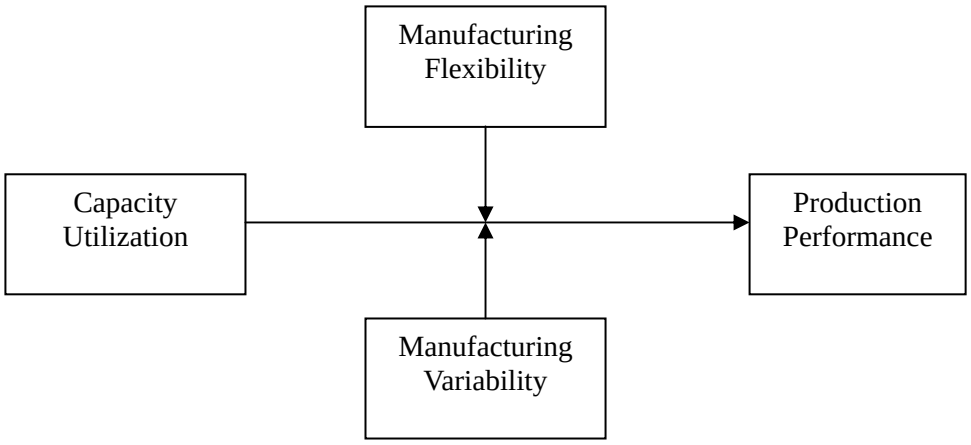

Figure 1: Conceptual Framework

The semiconductor manufacturing industry is technologically complex and capital-intensive. In this industry, equipment depreciation accounts for a large proportion of production cost and manufacturing strategies focus mainly on increasing capacity utilization and minimizing production cost while improving quality and delivery time performance (Uzsoy et al. 1992). However, several problems in this environment make manufacturing management more difficult and challenging. They are complex product flows, random rework, evolving process technologies, diverse equipment characteristics, and frequent machine breakdowns. These factors contribute to a highly stochastic and congested manufacturing environment, which provides an ideal setting for us to investigate the association between capacity utilization, congestion and production performance.

Analyzing six-month machine-level data obtained from one semiconductor manufacturing company, this study finds that increased capacity utilization not only leads to longer waiting time and manufacturing cycle time but also causes decrease in production quality, and thus, increase in operating costs, with the implication that maximizing the level of capacity utilization is not necessarily optimal for firms. Besides, the empirical results also indicate that performance degradation arising from high capacity utilization is greater in a production environment with higher level of

manufacturing variability; but firms can reduce the impact of capacity utilization on production performance by improving manufacturing flexibility. These results indicate that congestion costs increase with increase in manufacturing variability but decrease with increase in manufacturing flexibility.

The reminder of the paper is structured as follows. Literatures on capacity utilization and congestion cost are reviewed in Section II. Research hypotheses are developed in Section III. Research site and its capacity management practices are described in Section IV. In Section V, I discuss the data collection and research methodology. Empirical results are presented in Section VI. Conclusions, limitations and directions for future research are discussed in Section VII.

II. LITERATURE REVIEW

Definition and Measurement of Capacity

Capacity is the maximum workload an operating unit can handle in a production environment (Stevenson 1996) measured either by time or by output quantity. Generally speaking, there are five measurements of capacity: theoretical capacity, practical capacity, normal capacity, budgeted capacity and actual capacity. Theses five measurements differ in the assumption of available capacity. For example, theoretical capacity is the optimal amount of work that a process or plant can complete using a 24-hour, 7-day operation with zero waste. Practical capacity is the level of output generally attained by a process, which adjusts theoretical capacity downward for unavoidable nonproductive time. Actual capacity is the capacity deployed by the company for a production period, which is usually the lowest level of output among the five capacity measurements (McNair and Vangermeersch 1998). Theoretical capacity and practical capacity are the two measurements used most frequently by firms in their capacity cost management systems because the other three measurements embed too much waste in standards to help continuous improvement of capacity productivity (McNair and Vangermeersch 1998).

According to capacity management literature, it is important to analyze capacity deployment for firms while making capacity improvement decisions. Capacity deployment can be classified into three categories: productive capacity, nonproductive capacity and idle capacity. Productive capacity is capacity that provides value to the customer and results in the production of good products or services. Idle capacity is capacity currently not in use, either planned or unplanned. It may exist for management policy, marketing, contractual or legal reasons. Nonproductive capacity is capacity neither in productive state nor in idle state. It is usually an undesirable use of capacity, such as setups, unplanned maintenance, making scrap or performing rework and thus offers an opportunity for improvement. To improve capacity productivity, firms generally target idle capacity and nonproductive capacity for elimination or reduction (Klammer 1996). Understanding the sources of idle capacity and nonproductive capacity is helpful to create more productive capacity and to increase productivity further.

Congestion and Capacity Utilization Related Studies

Operations research shows that the arrival of production lots into each workstation is a stochastic process. As utilization approaches capacity limit, congestion increases and

generally causes performance degradation. Congestion, therefore, is studied widely in production management literature but the focus is mainly on strategies for eliminating or reducing congestion through management policies to achieve performance objective. For example, Connors et al. (1996) developed an open queuing network model for performance analysis of semiconductor manufacturing facilities and analyzed how to attain planned cycle times in a congested production environment. Benjaafar and Gupta (1998) investigated how to reduce manufacturing cycle time and inventory levels using flexible manufacturing strategies in a capacity-constrained environment. Benjaafar (2002) presented a model that captures the relationship between facility layout, congestion and two performance measurements, then uses this model to analyze how plant layouts help reduce manufacturing lead times and minimize work-in-process inventories. Benjaafar et al. (2004) developed a model to analyze whether product variety causes congestion and leads further to increases in inventory carrying costs.

In management accounting literature, most studies focus on examining analytically the allocation of capacity related costs and its role in incremental decision-makings (for example, Hansen and Magee 1993; Balakrishnan and Sivaramakrishnan 1996; Banker et al. 2002), but few investigated the cost of congestion empirically. Banker et al. (1988) was the first one to propose the concept of congestion cost. Using a queuing model and one numerical example, they showed that operating costs increase with increase in capacity utilization. Based on findings from Banker et al. (1988), Balakrishnan and Soderstrom (2000) and Gupta et al. (2003) provide initial empirical evidence on congestion cost. Using data from 225,473 maternity admissions at 30 hospitals in the state of Washington, Balakrishnan and Soderstrom (2000) test whether the rate of Caesarian section increases on congested days and find that congestion leads to increased Caesarian section rate only for “at risk” patients, indicating that cost of congestion is contingent on the specifics of the process. Gupta et al. (2003) collect data from one printing company in Taiwan and examine empirically the impact of capacity utilization on operating performance, revenues, costs and profitability. Their empirical results indicate that increased capacity utilization not only results in decline in production efficiency and increase in product cost but also leads to lower profit.

Although these studies show the cost of congestion, we lack understanding of the drivers of congestion cost. In fact, several operations studies reveal that congestion costs differ in different processes and environments. For example, Benjaafar and Gupta (1998) indicated that the impact of capacity utilization on cycle time is larger in manufacturing environments with a greater level of manufacturing variability. Benjaafar (1994) and Benjaafar (2002) showed that firms can reduce the adverse impact of congestion on cycle time and work-in-process inventory level by improving manufacturing flexibility and adopting plant specific layout designs, respectively. To fill in the gap between current researches and increase our understanding of the behavior of congestion cost, this study not only examines empirically the adverse impact of capacity utilization on production performance but also investigates how manufacturing variability and manufacturing flexibility affect performance impacts of capacity utilization.

III. HYPOTHESES DEVELOPMENT

The theory of constraints proposed by Goldratt and Cox (1986) holds that bottleneck

resource is the only constraining factor in a production environment. To achieve the maximum throughput, bottleneck resource must be fully utilized and never be out of service because of breakdowns or lack of work. Conventional management accounting analyses also suggest that maximizing capacity utilization is the best way to minimize production cost. However, in accordance with queuing theory, maximizing capacity utilization increases congestion in the system and thus leads to increased inventory level, longer manufacturing cycle time and higher operating cots. Firms, therefore, should not only consider reduction of capacity cost but should evaluate the increase in operating costs when determining the optimal capacity utilization (Karmarker et al. 1985; Bitran and Tirupati 1989; Bitran and Morabito 1999).

From the queuing theory perspective, in a stochastic production environment, an increase in capacity utilization increases overall congestion in the production environment, thus resulting not only in queuing delays for the new product but also in increased delays for all existing products, the so-called “spillover effects”. In other words, when a facility runs close to capacity, the incremental cost of an additional order is not only its direct cost, but also the cost of externalities it imposes on other products (Balakrishnan and Soderstrom 2000). Banker et al. (1988) also indicate that costs of producing one additional lot include not only the cost of capacity consumed in the production process but also additional cost arising from increased manufacturing cycle time and queuing delay, such as higher inventory carrying cost, lower sales prices realization, cost of expediting and cost of rework.

In addition, Balakrishnan and Soderstrom (2000) documented that congestion leads to increased Caesarian section rate and thus increased operating cost based on data from 225, 473 maternity admissions at 30 hospitals in Washington state. Analytical models in operations research show consistently that congestion increases and system performance degenerates when a production system is close to its capacity constraint (Hopp and Spearman 2001). Queuing model results also show that both average waiting time per production lot and manufacturing cycle time of all products in the system increase as capacity utilization increases (Fry and Blackstone 1988; Buss et al. 1994; Bitran and Tirupati 1989). Schaffer (1981) suggests that only 5% of manufacturing lead time is value-added in a stochastic production environment because much time is wasted on waiting due to increased capacity utilization and congestion. Using data from one printing company in Taiwan, Gupta, Randall and Wu (2003) also find that capacity utilization has an adverse impact on production efficiency, quality and costs. Those discussions lead to the following hypothesis.

Hypothesis 1: Production performance decreases with the increase in capacity utilization.

As to the impact of manufacturing variability on performance impacts of increased capacity utilization, several analytical studies provide some insights. For example, Banker et al. (1988) find that the impact of capacity utilization on manufacturing cycle time is larger in a manufacturing environment with a greater level of manufacturing variability. Miller (1987) also finds that job-shop plants generally keep lower capacity utilization to buffer against higher manufacturing variability. Specifically, the level of

manufacturing variability is greater in job-shop plants, and thus the cost of congestion is larger in this production environment. To reduce operating cost and improve performance, firms usually preserve more idle capacity to deal with the manufacturing variability.

Manufacturing variability is believed to be the primary driver of nonproductive capacity. It generally comes from customer demands, supplier deliveries and production flow (Klammer 1996；Hopp and Spearman 2001). These variations mainly result from short-term scheduling decisions and the randomness in many processes. Specifically, customer variability usually arises from the uncertainties in the ordering process. The sources of customer variability include business cycles, seasonal cycles, rush orders and erratic order flows, etc. Internal variability comes from a variety of sources. The most common source is the variations in processing time and setup time. But, machine setups, unplanned maintenance, breakdowns, scrap, rework, power failure and lot sizing all contribute to increased variability in production flow, as well. Whatever the source of variability is, reducing variability is considered one of principal ways to improve operating performance on the assumption that capacity utilization remains unchanged (Banker et al. 1988; Hopp and Spearman 2001).

Using an analytical model, Benjaafar (2002) shows that operating performance is driven by system congestion, which is a function of system variability. That is, manufacturing variability in the system increases system congestion and enlarges the queuing delay. Graves and Tomlin (2003) indicate that manufacturing variability not only increases congestions at workstations but also results in floating bottlenecks, which increase scheduling complexity and manufacturing lead times. Additionally, using data from a large financial services provider, Campbell (2004) indicated that the uncertainty in timing and processing of customer service requests leads to congestions and performance degradation. Firms therefore must invest in more excess capacity to buffer against greater uncertainty while maintaining service quality. In other words, a greater level of manufacturing variability or uncertainty increases the adverse impact of capacity utilization on production performance. Hence, I formulate the second hypothesis as follows.

Hypothesis 2: The greater the manufacturing variability is, the higher the impact of capacity utilization on production performance is.

Manufacturing flexibility is another important factor moderating the relation between capacity utilization and production performance (Benjaafar 1995). Manufacturing flexibility is the ability to absorb environmental uncertainties and respond effectively to changing circumstances (Gerwin 1987; Upton 1994). It provides a firm with the capability to deal with shifts in market requirements and helps to relieve problems caused by uncertainty and dynamic environments (Boyer and Leong 1996). Therefore, firms with greater manufacturing flexibility are more able to handle uncertainties and unplanned changes arising from internal or external environments. Specifically, manufacturing flexibility enables a firm to respond to changes in customer demands more quickly, produce a variety of products more effectively and deal with breakdowns or material defects that occur in the production process more efficiently (Gerwin 1993; Upton 1995)。

Benjaafar (1994) investigated analytically the relationship between manufacturing flexibility and performance of manufacturing systems and found that performance measurements, such as part flow time and level of work-in-process inventory, are a strictly decreasing function of flexibility with fixed capacity utilization. That is, when flexibility is introduced into a system, a great improvement in performance is achieved. Furthermore, the higher the capacity utilization is, the greater the impact of manufacturing flexibility on performance improvement is. Using a mathematical model, Benjaafar (1995, 1996) analyzed the impact of machine flexibility and routing flexibility on manufacturing performance. He found that an increase in manufacturing flexibility leads to a 50% reduction of manufacturing cycle time when capacity utilization is 90% but the extent of performance improvement gradually decreases with the increase in manufacturing flexibility. Besides, he also found that the impact of manufacturing flexibility on performance is greater in a highly utilized production environment. In other words, introducing manufacturing flexibility can dramatically improve performance when capacity utilization is high. Based on findings from Benjaafar (1996), increasing one unit level of manufacturing flexibility can reduce 4.5 units of manufacturing cycle time when capacity utilization is 90% but the reduction in manufacturing cycle time shrinks to less than one unit when capacity utilization is 60%. Furthermore, Benjaafar (1995, 1996) found that performance variability is a strictly decreasing function of flexibility. That is, increasing flexibility decreases the variability in manufacturing cycle time. Benjaafar and Gupta (1998) analyzed the benefits of flexibility by comparing system performance in flexible manufacturing systems and dedicated manufacturing systems. They suggested that the adverse impact of capacity utilization is smaller in flexible manufacturing systems but larger in dedicated ones. Combining these results, manufacturing flexibility is expected to reduce the adverse impact of capacity utilization on performance. Therefore, the following hypothesis is proposed.

Hypothesis 3: The greater the level of manufacturing flexibility is, the less the impact of capacity utilization on production performance is.

IV. RESEARCH SITE

The research site is a semiconductor wafer fabrication company dedicated to IC foundry services. The semiconductor manufacturing industry is highly capital-intensive. Specifically, building one typical eight-inch foundry plant requires capital investment of over forty billion NT dollars while building one twelve-inch foundry plant requires over one hundred billion NT dollars. Besides, capital investment increases dramatically with developments in manufacturing processes. Therefore, effectively utilizing capacity is the key to achieving cost advantage in this industry.

Furthermore, the wafer fabrication industry is the most competitive industry in the world. Firms in this industry face higher operating risk than companies in other industries because the manufacturing process is highly complex and a large equipment investment is required (Wen et al. 2001; Carayannis and Alexander 2004). Therefore, to maintain competitive advantage in such a risky and competitive environment, the company under research needs not only to increase machine utilization and throughput rate continuously,

but also to shorten manufacturing cycle time and respond quickly to the volatility in customer demands.

To manage capacity effectively, the research site uses the Overall Equipment Effectiveness system (OEE hereinafter), which is used widely in the semiconductor industry (Van Zant 2000). Under this system, capacity is measured in total time available. That is, 24 hours per day, 7 days per week, 365 days per year. In addition, one OEE metric is computed. OEE actually is a multiplication of three efficiency measurements: availability efficiency, performance efficiency and quality efficiency (Murphy et al. 1996). These three measurements enable efficiency losses to be identified. These include: breakdowns, setups, reduced speed, minor stoppages, defects (or rework) and yield loss (Nakajima 1988). Since these efficiency losses are the drivers of nonproductive capacity utilization, firms can improve capacity productivity by continuously eliminating these losses.

Semiconductor manufacturing is not only an extreme capacity-constrained manufacturing environment but also one of the most variable process and product manufacturing environments in the world (Uzsoy et al. 1992; Konopka 1996). Specifically, it has the following characteristics (Thompson 1995). The manufacture of a product generally requires hundreds of process steps, and a single machine group may be utilized more than once as successive circuit layers are added. Besides, each product has its own process route. The process routings of different products differ in the types of machines visited, the sequence of machines visited, and in the process times spent on the machines (Jeng et al. 1998). During the manufacturing process, a lot usually re-enters the same process area several times, but it does not necessarily go through the same sequence of steps or visit the same set of machines, the so-called “reentrant flow”. Therefore, production planning and scheduling is quite challenging in this environment. In addition, one wafer fab usually has a variety of different machine types, which further increases the complexity of operations. Other characteristics, such as frequent equipment alignment and calibration, hot lot, rework and scrap additionally contribute to the variability in the semiconductor manufacturing environment. Congestion, therefore, is quite pervasive in the wafer fab.

Especially in boom periods[1], the impact of congestion on time and delivery performance is even more significant. Because product life cycle is short in the semiconductor industry, time-to-market is an important value driver. Manufacture cycle time and delivery performance, therefore, are major determinants of customer value. Increased cycle time can lead to delivery delays and decline in customer satisfaction, thus causing lower sales price realizations. Besides, the carrying costs of inventories increase along with the increase in manufacturing cycle time. Therefore, the research site is dedicated to improving delivery and time performance while maintaining high capacity utilization. Specifically, engineers deal with congestion that occurs at the research site and improve cycle time through efficient scheduling, dispatching, plant layout and

[1] According to 2003 IEK-ITIS plan made by the Industrial Technology Research Institute, capacity utilization in the wafer fabrication industry declined to 40% in the third quarter of year 2001 but has been going up ever since. By the second quarter in year 2002, capacity utilization reached 80%. Because the research period of this study spans the first two quarters in year 2002, a boom period, congestion was quite pervasive at the research site, and operations management was emphasized at that time.

increased manufacturing flexibility.

One of mechanisms used to increase manufacturing flexibility is to bundle machines that are able to perform the same operations as one group. In this way, one production lot can be assigned to several process machines in each step, so several alternate routes are available to continue producing a given set of lots in case of breakdowns; this is called "routing flexibility". Alternative routing capability also allows for efficient scheduling and helps overcome such production interruptions as machine breakdowns, rush orders and rework. Workload across machines is then balanced and nonproductive uses of capacity, such as idling and minor stoppage can thus be reduced. Cycle time is thereby improved (Sethi and Sethi 1990)。

V. RESEARCH METHODOLOGY

Sample Selection and Data Collection

I conduct this study using data from one dedicated wafer fabrication company. The company is one of the largest semiconductor manufacturing companies in Taiwan, with approximately a 35,000 wafer capacity per fab. During the period of this study, monthly data were obtained for a period of up to six months (beginning from January 2002) for machines located in one eight-inch wafer fab. Periodic visits were made to the research company to collect data and meet with senior managers, plant managers and engineers. Data for this research were collected from multiple sources, including company internal documents, archival records and interviews.

Because this study is intended to examine the association between capacity utilization, congestion and production performance, a congested operating environment is required. The author first reviewed the field data and then spoke with the plant manger and engineers to determine the period of study[2], which spanned from January to June 2002. To ensure that the empirical results are driven by specific machine types, various machine types are included in this study. The machines selected are believed to be representative of a typical machine mix in the research company. Besides, machines with zero manufacturing variability and zero capacity utilization are deleted from the sample.

Variable Measurement

Dependent Variables

Waiting Time (*WAIT*). This variable is computed as average waiting time before the start of operation for production lots performed by each machine.

Manufacturing Cycle Time (*CYCLE*). This variable is computed as average manufacturing cycle time from start to completion of the operation for production lots performed in each machine.

Production Quality (*YIELD*). This variable is computed as one minus the percentage

[2] According to operations research, congestion is more likely to appear in an operating environment with higher capacity utilization. Field data show that average capacity utilization of the research site is 92.37% in the first six months of year 2002 and 65.9% in the latter six months of year 2002. From interviews with engineers, I also find that congestion existing in the wafer fab during January 2002 to June 2002. Therefore, the first six months of year 2002 are chosen as the research period.

of wafers scrapped in each machine.

Independent Variables

Capacity Utilization (*UTIL*). Capacity utilization can be measured in percentage of actual output or in the percentage of time a constrained resource is used. This study uses time-based measurement. Specifically, capacity utilization is measured as the percentage of time of a machine spent in productive and nonproductive uses. Capacity usage is tracked on a monthly basis. Productive use is the actual running time of a machine and does not include time when the machine is idle, breaking-down or getting setups for production lots. Nonproductive use is the time a machine spends in waiting, breakdown, repair and maintenance, getting setups and performing tool tests.

Manufacturing Variability (*VAR*). The most prevalent sources of variability in manufacturing environments include natural variability, random outages, setups, operator availability and recycling. The impact of these factors can be divided into two variability measurements: process time variability and arrival time variability (Hopp and Spearman 2001). Based on operations research, a reasonable relative measurement of the variability of a random variable is the standard deviation divided by the mean, which is called the coefficient of variation. Therefore, I use the process time coefficient of variation and arrival time coefficient of variation to measure manufacturing variability. Specifically, the process time coefficient of variation is computed as the standard deviation in lot-level process time divided by mean process time, and the arrival time coefficient of variation is computed as the standard deviation in lot-level inter-arrival time divided by mean inter-arrival time.

Manufacturing Flexibility (*FLEX*). According to production management literature, the manufacturing system of the semiconductor manufacturing plant is characterized by greater level of routing flexibility (Jeng et al. 1998). Therefore, one routing flexibility measurement is designed to investigate the impact of manufacturing flexibility on performance of capacity utilization. Routing flexibility is the capability of the system to use alternate processing centers to continue producing a given set of parts in spite of machine breakdowns (Sethi and Sethi 1990; Chen et al. 1992; Chandra and Tombak 1992). In this study, the number of alternate machines per processing operation is used to define routing flexibility.

Control Variables

Production Volume (*LOTS*). The number of production lots processed by each machine is used to capture the impact of production volume.

Product Mix Complexity. Considering the characteristics of a semiconductor manufacturing environment, I design three measurements to control the impact of product mix complexity on production performance: the number of process technologies performed, the percentage of RD lots processed, and the percentage of hot lots processed in each machine. RD lots refer to lots processed for experimental and test purposes, not for production. Hot lots refer to lots processed in first priority orders to meet special customer demands.

Empirical Models

$$CYCLE_t = \alpha + \beta 1 LOTS_t + \beta 2 TECH_t + \beta 3 HOT_t + \beta 4\ RD_t + \beta 5 UTIL_t + \beta 6 UTIL_t * FLEX_t + \beta 7 UTIL_t * VAR_t + \beta 8 UTIL_t * ARR_t + \beta 9 CYCLE_{t-1} + \varepsilon \quad (M1)$$

$LOTS_t$ = the number of production lots processed in each machine in period t;
$TECH_t$ = the number of process technologies performed in each machine in period t;
HOT_t = the percentage of hot lots processed in each machine in period t;
RD_t = the percentage of RD lots processed in each machine in period t;
$UTIL_t$ = the percentage of time of a machine spent in productive and nonproductive uses in period t;
$FLEX_t$ = the number of alternate machines per processing operation in each machine group in period t;
VAR_t = process time coefficient of variation for each machine in period t;
ARR_t = arrival time coefficient of variation for each machine in period t;
$CYCLE_t$ = average manufacturing cycle time from start to completion of operation by each machine in period t;
$CYCLE_{t-1}$ = average manufacturing cycle time from start to completion of operation by each machine in period t-1.

$$WAIT_t = \alpha + \beta 1 LOTS_t + \beta 2 TECH_t + \beta 3 HOT_t + \beta 4\ RD_t + \beta 5 UTIL_t + \beta 6 UTIL_t * FLEX_t + \beta 7 UTIL_t * VAR_t + \beta 8 UTIL_t * ARR_t + \beta 9 WAIT_{t-1} + \varepsilon \quad (M2)$$

Where,
$WAIT_t$ = average waiting time before the start of operation of each machine in period t;
$WAIT_{t-1}$ = average waiting time before the start of operation of each machine in period t-1.

$$YIELDt = \alpha + \beta 1 LOTS_t + \beta 2 TECH_t + \beta 3 HOT_t + \beta 4\ RD_t + \beta 5 UTIL_t + \beta 6 UTIL_t * FLEX_t + \beta 7 UTIL_t * VAR_t + \beta 8 UTIL_t * ARR_t + \beta 9 YIELD_{t-1} + \varepsilon \quad (M3)$$

Where,
$YIELD_t$ = one minus the percentage of wafers scrapped in each machine in period t;
$YIELD_{t-1}$ = one minus the percentage of wafers scrapped in each machine in period t-1.

Data Analysis Method

To test the first hypothesis, I design three empirical models, models M1, M2 and M3, and test whether the coefficient on capacity utilization is significantly different from zero. Production volume and product mix complexity that might impact production performance are all included in the models. One-period lag waiting time, manufacture

cycle time and production quality are also included in model M1, M2 and M3, respectively, to correct for the one-order serial correlation problem. The same models are used to test the second and the third hypothesis, as well. By investigating the regression coefficients on three interaction items, I analyze the moderating effects of manufacturing flexibility and manufacturing variability on performance impacts of capacity utilization.

To enhance the robustness of the empirical results, I use both linear regression models and duration models. First, OLS is used to estimate model M1 to M3 and the linear relation between capacity utilization and production performance is tested. Then, I use the duration model to test the performance impact of capacity utilization. The analysis procedure is as follows. First, an accelerated failure time model is built based on Cox (1972). Then, four probability distributions are assumed to test if cumulative inertia exists. They are exponential, Weibull, lognormal and generalized gamma distribution. Finally, Maximum Likelihood Method is used to estimate the models. By examining the coefficients on capacity utilization and three interaction items, I test if capacity utilization affects manufacturing cycle time and analyze if performance impact of capacity utilization is moderated by manufacturing flexibility and manufacturing variability.

VI. EMPIRICAL RESULTS

Descriptive Statistics

Table 1 provides descriptive statistics for capacity utilization, manufacturing flexibility, manufacturing variability and three performance measurements. On average, capacity utilization is 83.75 %, less than 100%. This indicates that idle capacity remains, even though the machines at the research site are highly utilized. Capacity usages are further analyzed. Percentage of time spent in nonproductive uses is 14.71%, indicating that about one seventh of capacity is wasted in machine breakdowns, getting setups, performing repair and maintenance and processing scrapped wafers. Percentage of idle capacity is 16.25%, indicating that about one sixth of capacity is idled because of lower customer demand. In addition, I also find that average production yield is 99.9%, showing that the production quality in the research site is extremely high. As for time performance, it takes about 112 minutes to process one production lot with each machine, and average waiting time reaches 72 minutes.

On the other hand, 1,028 production lots were processed in the research site each month during the research period. As for product mix complexity, I find that the average number of process technologies is 11, the average percentage of RD lots is 24.09 % and the average percentage of hot lots is 2.3%, indicating that product mix complexity is high at the research site and needs to be controlled while testing the performance impact of capacity utilization. Besides, product mix complexity not only arises from the variety of process technologies, but from product innovation and variation in lead times. Furthermore, I also find that one routing flexibility measurement and two manufacturing variability measurements are all larger than zero, showing that there is manufacturing flexibility and variability at the research site.

Table 1: Descriptive Statistics

Variables	N	Mean	Std. Err	Min	Max
Productive capacity utilization	2539	69.334	18.966	0	100
Non-productive capacity utilization	2539	14.712	12.798	0	92
Waiting time	2539	72.035	136.779	0.010	3042.36
Manufacturing cycle time	2539	111.964	148.812	4	3090.77
Production quality	2539	0.999	0.002	0.920	1
Number of lots processed	1935	1027.880	960.184	9	6850
Number of process technologies	1935	11.413	7.108	1	62
Percentage of RD lots processed	2539	0.241	0.177	0	1
Percentage of hot lots processed	2539	0.023	0.021	0.001	0.285
Total capacity utilization	1892	83.751	16.131	4	100
Manufacturing flexibility	2539	9.717	7.057	1	29
Process time variability	2539	1.291	2.517	0.030	34.650
Arrival time variability	2517	0.443	0.310	0.059	3.357

The analysis of correlation among variables is presented in Table 2. Pearson correlation coefficients are listed in the upper triangle and Spearman correlation coefficients are listed in the lower triangle. From Table 2, I find that capacity utilization is negatively correlated with production quality and positively correlated with manufacturing cycle time and waiting time. These results suggest that increased capacity utilization is associated with declines in production performance, which is consistent with the prediction. Besides, the correlation between independent variables is mostly lower than 0.7, which indicates there is no multicollinearity problem.

Impact of Capacity Utilization on Production Performance (H1)

This study analyzes the impact of capacity utilization on production performance by investigating how production quality, manufacturing cycle time and waiting time change with the increase in capacity utilization. Both linear regression models and duration models are estimated. The empirical results are presented in Table 3, Table 4 and Table 5.

The first hypothesis predicts that increased capacity utilization leads to declines in quality and time performance. From Table 3, each model is statistically significant at the one percent level and displays moderate to high explanatory power. In model M1, the coefficient of capacity utilization is significantly positive (coefficient = 0.9308, t-value = 5.45), indicating that, on average, it takes much longer time to process a production lot as capacity utilization increases. In model M2, I obtain similar findings. The coefficient of capacity utilization is significantly positive (coefficient = 1.0229, t-value = 6.19), as well, indicating that waiting time increases with the increase in capacity utilization.

Table 2: Correlation Matrix

variables	Productive capacity utilization	Nonproductive capacity utilization	Waiting time	Manufacturing cycle time	Production quality	Number of lots processed	Number of process technologies	Percentage of RD lots processed	Percentage of hot lots processed	Total capacity utilization	Process time variability	Arrival variability	Manufacturing flexibility
Productive capacity utilization		-0.5411**	0.1424**	0.1242**	0.0846**	0.3881**	0.3232**	-0.2586**	-0.0649**	0.7432**	-0.1185**	-0.2660**	0.1854**
Nonproductive capacity utilization	-0.5183**		-0.0123	-0.0242	0.0023	-0.2740**	-0.2759**	0.2157**	-0.0453*	0.1546**	0.1235**	0.0895**	-0.1515**
Waiting time	0.2959**	0.0435*		0.8080**	-0.0798**	-0.1426**	0.00068	0.1372**	-0.1864**	0.4251**	-0.3601**	0.0267	-0.3089**
Manufacturing cycle time	0.1224**	0.1027**	0.9781**		-0.0323	-0.2405**	-0.0657**	0.0905**	-0.0986**	0.1436**	0.1716**	0.1976**	-0.1766**
Production quality	-0.0781**	0.0160	0.0070	0.0437*		0.0353	0.0523*	-0.2104**	-0.2342**	0.1141**	-0.0696**	-0.0526**	0.0929**
Number of lots processed	0.5469**	-0.3162**	0.0455*	-0.3666**	-0.2763**		0.5947**	-0.1822**	-0.0581*	0.2373**	-0.0222	-0.1376**	-0.0452*
Number of process technologies	0.4259**	-0.3571**	0.1586**	-0.1195**	-0.1786**	0.6178**		0.0671**	-0.1360**	0.1597**	0.0481*	-0.0600**	-0.1080**
Percentage of RD lots processed	-0.2379**	0.2388**	0.1101**	0.0896**	-0.1162**	-0.2145**	-0.0555*		-0.1227**	-0.1300**	0.1015**	-0.0252	-0.1043**
Number of hot lots processed	-0.0401*	-0.0491*	-0.1551**	-0.0968**	-0.0989**	-0.0190	-0.1021**	-0.2905**		-0.1155**	0.0078	-0.0051	-0.0023
Total capacity utilization	0.7328**	0.0476*	0.1743**	0.2040**	-0.1068**	0.4915**	0.3293**	-0.1111**	-0.1102**		-0.2502**	-0.3183**	0.0917**
Process time variability	-0.4081**	0.3266**	0.2082**	-0.3116**	-0.0169	-0.0818**	-0.1315**	0.0989**	0.0702**	-0.0447+		0.0128	-0.1058**
Arrival time variability	-0.3896**	0.2245**	0.1658**	0.1918**	0.1273**	-0.4839**	-0.1949**	0.0076	-0.0344+	-0.2386**	0.0938**		-0.1589**
Manufacturing flexibility	0.1908**	-0.1414**	0.1774**	-0.2691**	0.1447**	0.0291	-0.0416+	-0.1188**	0.0154	0.0650**	0.0259	-0.1930**	

a.Pearson coefficient in the upper triangle; Spearman coefficient in the lower triangle.
b.+, *, ** = statistically significant at the 10%, 5%, 1% levels (two-tailed test), respectively.
c.All correlations are based on pooled data and should be interpreted with caution.

Table 3: Impact of Capacity Utilization on Manufacturing Cycle Time and Waiting Time: Linear Regression Models (t-statistics in parentheses)

Independent Variables	Expected Sign	Manufacturing Cycle Time	Waiting Time
Intercept	?	-34.39941*	-59.27620**
		(-2.30)	(-4.10)
$TECH_t$	+	0.56476	0.57765
		(1.36)	(1.44)
HOT_t	+	-185.39776+	-294.76394**
		(-1.87)	(-3.05)
RD_t	+	8.83857	23.39393+
		(0.62)	(1.70)
$LOTS_t$	-	-0.01803**	-0.01317**
		(-5.84)	(-4.49)
$UTIL_t$	+	0.93077**	1.02287**
		(5.45)	(6.19)
$UTIL_t$*$FLEX_t$	-	-0.01427**	-0.01520**
		(-3.64)	(-4.02)
$UTIL_t$*VAR_t	+	0.05343**	0.05644**
		(4.52)	(4.96)
$UTIL_t$*ARR_t	+	0.55407**	0.56623**
		(6.51)	(6.91)
$CYCLE_{t-1}$	+	0.58128**	--
		(33.40)	
$WAIT_{t-1}$	+	--	0.52138**
			(28.96)
N		1186	1186
Adj R2		0.6150	0.5568
F-statistics		211.30	166.41
(p-value)		(0.0001)	(0.0001)
Durbin-Watson D		1.747	1.653

Note: +, *, ** = statistically significant at the 10%, 5%, 1% levels (two-tailed test), respectively.

From Table 4, we see the results that generalized gamma distribution has the highest log likelihood value and exponential distribution has the lowest log likelihood value, showing that generalized gamma distribution has the highest fitness and exponential distribution has the lowest. Besides, the coefficient on capacity utilization is significantly positive across the four models, indicating that a greater level of capacity utilization leads to longer manufacturing cycle time. Put together, those results support the first hypothesis.

Table 4: Impact of Capacity Utilization on Manufacturing Cycle Time: Duration Models (χ 2-statistics in parentheses)

Independent Variables	Expected Sign	Exponential	Weibull	Lognormal	Generalized Gamma
Intercept	?	3.0906**	3.4828**	2.8294**	3.1976**
		(248.20)	(1975.30)	(940.57)	(1418.94)
$TECH_t$	+	-0.0013	-0.0017	0.0015	-0.0019
		(0.06)	(0.72)	(0.33)	(0.84)
HOT_t	+	0.6799	1.0474+	-0.6624	0.7945
		(0.29)	(3.54)	(1.16)	(2.39)
RDt	+	-0.0237	0.0555	-0.1326	0.0521
		(0.02)	(0.56)	(2.29)	(0.51)
$LOTS_t$	-	-0.0001**	-0.0000*	-0.0002**	-0.0001**
		(9.93)	(6.38)	(157.35)	(29.39)
$UTIL_t$	+	0.0095**	0.0021*	0.0169**	0.0072**
		(16.49)	(4.72)	(255.61)	(40.11)
$UTIL_t*FLEX_t$	-	-0.0001	-0.0000	-0.0002**	-0.0000*
		(1.66)	(0.32)	(42.72)	(4.81)
$UTIL_t*VAR_t$	+	0.0007**	0.0015**	0.0003**	0.0009**
		(22.77)	(433.19)	(19.14)	(106.94)
$UTIL_t*ARR_t$	+	0.0005	0.0007	0.0017**	0.0005
		(0.21)	(2.66)	(11.07)	(1.43)
$CYCLE_{t-1}$	+	0.0052**	0.0061**	0.0032**	0.0055**
		(272.36)	(1759.62)	(881.39)	(1281.49)
Scale parameter		1.0000	0.3659	0.4899	0.3932
Shape parameter		1.0000	1.0000	0.0000	0.5717
Log likelihood value		-1289.0388	-657.0557	-837.9552	-640.9388
N		1188	1188	1188	1188

Note: +, *, ** = statistically significant at the 10%, 5%, 1% levels (two-tailed test), respectively.

The results on the impact of capacity utilization are presented in Table 5. Each model is statistically significant at one percent level and displays moderate explanatory power. From estimation results for model M3, I find that the coefficient for the capacity utilization variable is significantly positive (coefficient = 0.00001643, t-value = 3.04), indicating that production quality increases with increase in capacity utilization. The result is contrary to the prediction of H1. After interviews and discussions with engineers, I find that the operators accumulate experience through repetitive operations and thus reduce the chance of scrapping wafers as capacity utilization increases. However, based on operations research, the probability of incurring operation errors will finally increase and production quality will finally decline as capacity utilization approaches 100%. To test whether congestion leads to lower production quality, one additional congestion variable (CONGES) is included in model M3. Empirical results are presented in Table 5, as well.

Table 5: Impact of Capacity Utilization on Production Quality (t-statistics in parentheses)

Independent Variables	Expected Sign	Original (No congestion variable)	90% Congestion level	95% Congestion level	98% Congestion level
Intercept	?	1.01370**	1.02179**	1.02623**	1.02230**
		(34.46)	(34.72)	(34.84)	(34.76)
$TECH_t$	-	0.00001270	0.00001735	0.00001522	0.00001152
		(0.95)	(1.30)	(1.14)	(0.87)
HOT_t	-	-0.03459**	-0.03424**	-0.03609**	-0.03558**
		(-10.14)	(-10.07)	(-10.57)	(-10.44)
RD_t	-	-0.00330**	-0.00338**	-0.00343**	-0.00332**
		(-7.12)	(-7.31)	(-7.42)	(-7.20)
$LOTS_t$	+	-1.47981	-1.0968	-7.11743	-5.0051
		(-1.53)	(-1.13)	(-0.72)	(-0.50)
$CONGES_t$	-	--	-0.00067347**	-0.00076036**	-0.00081821**
			(-3.08)	(-3.71)	(-3.32)
$UTIL_t$	-	0.00001643**	0.00003121**	0.00002743**	0.00002204**
		(3.04)	(4.33)	(4.47)	(3.90)
$UTIL_t*FLEX_t$	+	1.757038	1.810383	1.737041	1.882232
		(1.42)	(1.47)	(1.41)	(1.53)
$UTIL_t*VAR_t$	-	-9.31493	-1.0558	-1.66878	-1.71202
		(-0.25)	(-0.28)	(-0.44)	(-0.45)
$UTIL_t*ARR_t$	-	-0.00000219	-0.00000177	-0.00000194	-0.00000233
		(-0.81)	(-0.66)	(-0.72)	(-0.87)
$YIELD_{t-1}$	+	-0.01414	-0.02325	-0.02742	-0.02416
		(-0.48)	(-0.79)	(-0.93)	(-0.82)
N		1186	1186	1186	1186
Adj R2		0.1438	0.1500	0.1530	0.1510
F-statistics		23.12	21.90	22.41	22.08
(p-value)		(0.0001)	(0.0001)	(0.0001)	(0.0001)
Durbin-Watson D		2.079	2.087	2.078	2.080

Note: +, *, ** = statistically significant at the 10%, 5%, 1% levels (two-tailed test), respectively.

To design the congestion variable, I first review the field data and find that machines with utilization equal to or higher than 95% account for 20% of the whole sample. So, I label the machines with capacity utilization lower than 95% as “non-congested” and those with 95% or higher capacity utilization as “congested”. Then, I design the congestion variable as a dummy. For non-congested machines, the congestion variable is zero. As for congested machines, the congestion variable is one. Finally, I include the congestion variable in the model M3 and re-estimate the model. From Table 5, the model with congestion variable displays a higher explanatory power. In addition, the coefficient of congestion is significantly negative (coefficient = -0.00076036, t-value = -3.71), indicating that congestion has a negative impact on production quality, which is consistent with the prediction of H1. To examine whether the results are driven by the definition of the congestion variable, I further use 90% and 98% as cutoff points to define “congestion” respectively and estimate the model again. Empirical results are all shown in Table 5. From Table 5, we find that the coefficient of congestion is consistently negative across models with different definitions of congestion, indicting that a greater

level of capacity utilization does lead to lower production quality. The first hypothesis is supported.

Impact of Manufacturing Variability and Manufacturing Flexibility on Performance Effects of Capacity Utilization (H2, H3)

From Table 3, I find that the coefficient of interaction between capacity utilization and process time variability is significantly positive (coefficient = 0.05343，t-value = 4.52) and the coefficient of the interaction between capacity utilization and arrival time variability is significantly positive, as well (coefficient = 0.55407，t-value = 6.51), in model M1, indicating that the impact of capacity utilization on manufacturing time increases with the increase in manufacturing variability. In addition, in model M2, I also find that the coefficient of the interaction between capacity utilization and process time variability is significantly positive (coefficient = 0.05644，t-value = 4.96) and the coefficient of the interaction between capacity utilization and arrival time variability is significantly positive, as well (coefficient = 0.56623，t-value = 6.91), indicating that increased capacity utilization leads to a greater increase in waiting time as manufacturing variability is larger. Considering the nonlinear relation between capacity utilization and production performance, I estimate the duration models and provide additional empirical evidence on the moderating effect of manufacturing variability in Table 4. From Table 4, we also find a significantly positive coefficient of the interaction between capacity utilization and manufacturing variability. These results consistently corroborate the predictions of the second hypothesis. As for the analysis of production quality, the results are shown in Table 5. From Table 5, I find that the interactions between capacity utilization and two manufacturing variability measurements both are negative (coefficient = -9.31493, -0.00000219 respectively) but do not reach a statistically significant level, indicating that manufacturing variability does not significantly affect the relation between capacity utilization and production quality.

The results for the impact of manufacturing flexibility are also shown in Table 3, Table 4 and Table 5. From Table 3, I find that the coefficient of the interaction between capacity utilization and manufacturing flexibility is significantly negative (coefficient = -0.01427，t-value = -3.64) in model M1, implying that the impact of capacity utilization on manufacturing cycle time decreases with the increase in manufacturing flexibility. That is, manufacturing flexibility helps to mitigate adverse impact of capacity utilization on production performance. Model M2 yields similar findings. The coefficient of the interaction between capacity utilization and manufacturing flexibility is significantly negative (coefficient = -0.01520，t-value = -4.02), indicating that the greater the level of manufacturing is, the smaller the impact of capacity utilization on waiting time is. Further analysis of moderating effect of manufacturing flexibility is presented in Table 4. The results show that the coefficient of the interaction between capacity utilization and manufacturing flexibility is consistently negative across models with four different probability distribution assumptions. For the two models with higher fitness in particular, the coefficient is significantly negative, showing that manufacturing flexibility reduces the adverse impact of capacity utilization on time performance. The results support the third hypothesis. As for model M3, the interaction between capacity utilization and

manufacturing flexibility is positive (coefficient = 1.757038, t-value = 1.42), supporting the prediction of H3. But, for the coefficient which is not statistically significant, the moderating effect of manufacturing flexibility on the relation between capacity utilization and production quality is not empirically validated.

VII. CONCLUSIONS AND DISCUSSIONS

This study examines the impact of capacity utilization on waiting time, manufacturing cycle time and production quality and further investigates whether manufacturing flexibility and manufacturing variability affect the performance impact of capacity utilization in the context of semiconductor manufacturing. Empirical results indicate that increased capacity utilization not only leads to longer waiting time and longer manufacturing cycle time but also causes decreases in production quality, thus increasing operating costs, with the implication that maximizing the level of capacity utilization is not necessarily optimal for firms. Besides, empirical results also indicate that performance degradation arising from high capacity utilization is greater in a production environment with higher level of manufacturing variability. Still, firms can reduce the impact of capacity utilization on production performance by improving manufacturing flexibility.

This analysis makes the following contributions to extant research. First, this study provides empirical evidence on congestion cost, indicating that production performance decreases with increase in capacity utilization in semiconductor manufacturing. Second, as far as I know, this study is the first one to analyze empirically the drivers of congestion cost. The empirical findings relating manufacturing flexibility and manufacturing variability to performance impact of capacity utilization contribute to our understanding of the behavior of congestion cost. Specifically, manufacturing variability increases the extent of performance degradation arising from increased capacity utilization, thus increasing the cost of congestion. As for manufacturing flexibility, it is beneficial for firms to reduce the adverse impact of capacity utilization on performance, thus reducing the cost of congestion. Finally, previous studies often ignored the impact of manufacturing variability and flexibility while analyzing capacity-related costs. This study finds that opportunity cost of capacity production might be under- or over-estimated without considering these two factors, causing capacity utilization decisions to be made sub-optimally.

Empirical analyses of this study also have a number of implications for management, as well. First, I find that manufacturing cycle time of each production lot with each machine increases by about one minute as capacity utilization increases by 1 %. On average, producing one production lot requires three hundred production steps. Manufacturing cycle time of one production lot will thus increase about five hours if the capacity utilization increases 1 %. Furthermore, congestion of front-end machines will result in increasing variability of back-end machines and thus increase the complexity of scheduling and cause an even greater production delay. These results suggest that managing capacity effectively is the key to achieving superior delivery performance in the semiconductor-manufacturing environment. Besides, they shed light on the importance of understanding congestion cost for capacity planning, scheduling and order acceptance decisions.

Specifically, as to production planning decisions, this study finds that increased capacity utilization leads to congestion, thus causing decrease in production performance, with the implication that maximizing the level of capacity utilization is not necessarily optimal for firms and keeping excess capacity might rather be helpful to reduce costs. For production scheduling decisions, this study finds that a greater level of capacity utilization usually results in the degradation of delivery and time performance. These results suggest that firms would better operate at a level of capacity utilization below 100 %, maintain buffer capacity and manage schedules to smooth utilization across machines. For order acceptance decisions, this study suggests that costs of decreased quality and time performance resulting from accepting additional orders or rush orders must be considered while determining optimal product mix.

In addition, this study finds that capacity utilization has a greater impact on production performance at workstations with a higher level of manufacturing variability. These results suggest that firms can either keep greater capacity slack and higher work-in-process level to buffer against manufacturing variability or reduce the level of manufacturing variability, if they would like to improve performance in a capacity-constrained environment. Finally, the empirical results indicate that manufacturing flexibility is helpful in solving congestion problems and improving time and quality performance. Therefore, firms can achieve high capacity utilization and production performance level simultaneously through increasing their manufacturing flexibility.

Limitations

This study has several limitations. Since the data are collected from a single company, the results of the empirical analysis are driven by the specific economics of the research site; thus, the generalizability of the findings is inevitably constrained. However, the research site is representative of other companies in the semiconductor manufacturing industry and congestion cost is present anytime a firm makes capacity-related decisions. Hence, I believe that several aspects of this study's findings are germane to other companies and other industrial settings. Besides, Itter and Larcker (2001) indicate that field studies can provide a deeper analysis of management practice and contribute to theory development despite that they often have low external validities. Another limitation pertains to data availability. Since data linking the responsible scheduling and maintenance engineers to each machine is not available, I cannot investigate the impact of preventive and maintenance policies and scheduling performance on capacity utilization. Since performance in preventive and maintenance policy and scheduling policy are not systematically correlated with capacity utilization, the robustness of the empirical results is not affected. But, readers still need to exercise caution in generalizing the results of this study.

Future Studies

Future studies can test if the impact of capacity utilization on production performance is driven by other factors, such as organizational characteristics. Besides, this study focuses on the costs of congestion. Operations research indicates that higher capacity utilization can also increase revenues through processing more customer orders.

Future researches are needed to investigate the impact of capacity utilization on revenue, production cost and operating cost, thus to offer insight for determining the optimal level capacity utilization in the face of conflicting cost and revenue implications.

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產能利用率、擁擠與生產績效：實證研究

尤隨樺
國立中正大學會計與資訊科技學系

摘要：由於資訊科技的發展與生產技術的改進，許多產業的資本密集度持續上升，因此產能成本的分攤及其有效管理成為許多廠商關注的焦點，也是近年來管理會計文獻討論的重要議題。關於擁擠現象，在作業與生產管理文獻，一直是重要的研究議題，也是營運管理的重要考量，但既存研究對於擁擠現象的討論主要集中在如何透過生產排程、廠房配置或派工決策等消除生產過程中的擁擠(例如：Connors et al. 1996；Benjaafar and Gupta 1998；Benjaafar 2002)，極少分析擁擠現象的攸關成本。至於管理會計文獻，最早是由 Banker et al. (1988)透過數學模式證明擁擠成本的存在，並提出：產能利用率與成本之間的關係應係呈現一平滑的曲線，但迄今實證研究仍然極為有限，僅有 Balakrishnan and Soderstrom (2000)及 Gupta et al. (2003)分別以醫院及印刷廠為研究對象探討之。

另一方面，儘管 Balakrishnan and Soderstrom (2000)及 Gupta et al. (2003)的實證結果指出高產能利用率與生產績效的下降有關，證明即使在產能供給大於產品需求的情況下，提高產能利用仍會存在機會成本，彌補了產能相關研究的不足，但 Balakrishnan and Soderstrom (2000)也發現：高產能利用率對績效的負向影響會因為環境特性的不同而改變，顯示環境特性可能為擁擠成本的動因，但究竟有哪些因素會影響擁擠成本？如何影響？又廠商是否可能透過管理政策的實施達到同時維持高產能利用率與高績效水準的目標？則仍有待進一步的研究分析之。因此，有鑑於擁擠成本之實證證據的缺乏，以及了解前述問題有助於釐清擁擠成本之習性，裨益產能相關決策的擬定，本研究乃延伸既存文獻，實證探討以下問題：(1) 產能利用率如何影響生產績效？(2)製造變異性如何影響產能利用率與生產績效之間的關係？(3)製造彈性如何影響產能利用率與生產績效之間的關係？

關於產能利用率與生產績效之間的關係，依據 Goldratt and Cox (1986)所提出的限制理論，瓶頸資源是生產環境中唯一的限制因素，因此，要增加產出應能極大化瓶頸資源的利用率。依據傳統管理會計的觀點，也認為在生產環境中，當產能被使用的比例愈高，單位成本愈低，然而，以等候理論為

基礎，則有學者提出：極大化瓶頸資源會導致擁擠現象，造成存貨水準的增加及時間績效的惡化，進而導致營運成本的提高，因此，最佳產能利用率的決定應取決於產能成本與相關營運成本之間的取捨(Karmarker et al. 1985; Bitran and Tirupati 1989; Bitran and Morabito 1999)。

具體而言，依據作業研究，在一隨機性的製造環境中，當產能利用率較高時，會增加整個工廠的擁擠程度，不只造成新產品等候的延遲，也會造成既有產品等候的延遲，此即所謂的外溢效果(spillover effect)，因此，當廠房的運作接近產能限制時，增加一項訂單的額外成本不只是該張訂單的直接成本，還包括強加於其他產品上的外部性(Balakrishnan and Soderstrom 2000)，例如：較高的在製品存貨持有成本、較長的前置時間導致較低的銷售價格，以及由於交期預測的不精確所產生的急件成本等。因此，吾人可預期：

假說一：假設其它條件不變，生產績效會隨著產能利用率的增加而降低。

至於環境特性對產能利用率與生產績效間之關係的影響，採用分析性模式，Benjaafar (2002)指出：當製造環境中的變異性愈高時，愈容易發生擁擠的現象，繼而造成等候時間的延長。Graves and Tomlin (2003)則發現：來自於製造環境的變異性不僅會增加個別工作站發生瓶頸的機率，也會形成生產流程中瓶頸飄移的現象，造成浮動瓶頸(floating bottlenecks)，因而增加生產排程的複雜性與生產週期時間的延長。另一方面，以金融服務業為例，Campbell (2004)發現：當廠商在顧客服務的處理與時點上面臨愈高的不確定性，愈容易發生擁擠現象與生產績效的降低，因此，為維持相同的服務品質，廠商需要保留較高的超額產能(excess capacity)，亦即將產能利用率控制在較低的水準，換言之，當製造環境的不確定性或變異性愈高時，產能利用率對生產績效的影響愈大。因此，吾人可推論假說二如下：

假說二: 假設其他條件不變，當製造變異性愈高，產能利用率對生產績效的影響愈大。

此外，作業研究指出：製造彈性也是影響產能利用率與生產績效間之關係的重要因素(Benjaafar 1995)，所謂製造彈性，係指製造系統吸收環境不確定性的能力，也是一種因應改變的能力(Gerwin 1987; Upton 1994)，根據Benjaafar (1994)對製造彈性、產能利用率與績效間之關係的分析，他發現當產能利用率水準固定不變時，製造彈性愈高的工作站其等候時間愈短、生產週期時間變異性愈低，亦即，製造彈性可減低產能利用率對製造績效的負面影響，甚且當產能利用率愈高時，製造彈性造成之績效改進幅度愈大。Benjaafar (1995, 1996)採用數學模型分析路徑彈性與機器彈性對製造績效的影響，則發現：當產能利用率達90%時，增加一單位的彈性可使生產週期

時間減少 50%，Benjaafar and Gupta (1998)也發現：比較彈性製造系統與不具彈性的製造彈性，在前者的環境下，產能利用率對製造績效(生產週期時間)的影響較小，而在後者的環境，產能利用率對生產週期時間的影響較大。是故，可預期：

假說三：假設其它條件不變，當製造彈性愈高，產能利用率對生產績效之影響愈小。

在研究對象的選擇上，本研究以資本密集度最高且製造環境具有高度不確定性的產業--半導體產業為例，由於該產業設備投資高，折舊年數短，平均而言，固定成本佔生產成本的六成以上，因此，比其他產業維持較高的產能利用率，加以技術複雜度高、生產流程長、當機發生頻繁且不易事前預測，具有較高的製造變異性，故而擁擠是半導體製造環境中普遍存在的現象，這些特性有助於吾人探討產能利用率、擁擠現象與生產績效之間的關係。在資料分析方法方面，為增加實證結果的可靠性，本研究同時採用多種方法。具體而言，本研究除了先採用 OLS 檢測產能利用率與生產績效間之線性關係外，在時間模型的部份，並額外採用存活期間模型(duration model)分析產能利用率與生產績效間之非線性關係。

採用來自一家半導體製造商六個月的機台別資料，本研究發現：當產能利用率愈高時，不僅個別生產批量之等候時間與生產週期時間會因此而延長，高產能利用率也會導致生產品質的下降，繼而造成營運成本的提高。另一方面，當製造環境的變異性愈大時，因高產能利用率所導致之績效下降的幅度愈大，擁擠成本愈高；至於製造彈性，則可調節產能利用率對生產績效的負面影響，減少因高產能利用率所帶來之等候時間及生產週期時間的延長，有助於擁擠成本的降低。

在研究方面，本研究對既存文獻提供額外的洞察，具有以下幾項貢獻：首先，本研究以半導體產業為例，驗證擁擠成本的存在，提供了額外的實證證據。其次，目前尚未有研究實證探討擁擠成本的影響因素，本研究則彌補此一研究的不足，指出：當製造環境的變異性愈大時，因高產能利用率所導致之績效下降的幅度愈大，擁擠成本愈高；至於製造彈性，則可調節產能利用率對生產績效的負面影響，有助於擁擠成本的降低，可據以解釋不同產業環境下產能利用率的差異；最後，本研究發現製造彈性與製造變異性對產能利用率與生產績效間之關係具有調節效果，顯示：倘若忽略該些因素，可能造成次佳的產能利用率決策。

在實務方面，本研究對產能規劃、生產排程與訂單接受等管理決策的擬定提供了重要的洞察。具體而言，在產能規劃決策方面，本研究發現極大化

產能利用率不一定為最佳，維持部份閒置產能可能反而有助於成本的降低；在生產排程決策方面，本研究則建議廠商在安排生產排程時宜盡量使各機台之產能利用率維持在低於 100%的水準，保留部分的緩衝產能(buffer capacity)，或者使各機台的負荷量維持平均；在訂單接受決策方面，本研究之結果顯示廠商應考量額外生產一項產品或接受緊急訂單對其他正常批量之時間與品質績效的影響，據以決定最適的產品組合。其次，本研究也發現：在一產能受限(capacity-constrained)的環境下，若欲維持特定的績效水準，廠商應減少製造環境中的變異性，或者藉由維持較高的產能寬裕(capacity slack)、較高的存貨水準或允許較長的製造前置時間以因應製造變異性的影響；最後，本研究發現倘若廠商想要同時維持高利用率與生產績效，可考慮由製造彈性的提升著手。

儘管本研究對既存文獻與管理實務提供了前述的貢獻，但仍存在以下限制：首先，本研究僅以一家個案公司為研究對象，研究結果的一般性可能因此受到限制；其次，廠商的維修政策與生產排程之良窳也是影響產能利用率的重要因素，但基於資料限制，本研究無法檢視此類管理政策對產能利用率之影響，儘管維修政策與生產排程決策並未與產品組合複雜性之衡量呈系統性相關，不至於影響本研究之實證結果，但對本研究之研究結果作一般化推論時仍應注意此點限制。

關鍵詞：產能利用率、製造變異性、製造彈性、生產績效、半導體產業

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Components of the Valuation Allowance of Deferred Tax Assets under Taiwan's New Income Tax Accounting*

Song-Horng Lin
National Cheng Kung University
TsingZai C. Wu
National Cheng Kung University

ABSTRACT: This paper employs the Tobit regression model to examine the determinants of the valuation allowance of deferred tax asset (*DTA* hereafter) for verifying the existence of positive and negative evidence under paragraph 17 of Taiwan's SFAS No. 22, *Accounting for Income Tax*, for firms listed in the Taiwan Stock Exchange. Our empirical results indicate that the future reversals of existing taxable temporary differences, the three-year average return of earnings before interest on total assets, the tax planning, the DTA derived from Other Post-Employment Benefits (OPEB) temporary difference, and the DTA derived from other original temporary differences are negatively correlated with the relative amount of the reported valuation allowance of DTA. That is, the more positive evidences of these five determinants have, the lower valuation allowance of DTA will be. However, the three-year cumulative losses, the negative cash flows, or operating income, or net income in three successive years, and the net operating loss carryforwards are positively related to the relative amount of the reported valuation allowance of DTA. Namely, the more negative evidence these three determinants have, the higher valuation allowance of DTA will be. These research findings imply that the amounts of DTA valuation allowances reported by Taiwan's listed firms generally conform to the requirements of Taiwan's SFAS No.22. The standards-setting goals of Income tax accounting are accomplished in Taiwan.

Keywords: Valuation Allowance of Deferred Tax Asset, Tax Planning Strategies, More Likely Than Not, Accounting Standards Setting

Data Availability: Data used in this study are from public sources.

* We appreciate comments of two anonymous reviewers and participants of 2004 annual meeting of the Taiwan Accounting Association. All remaining errors are our solely responsibilities.

I. INTRODUCTION

Since the purposes of accounting standards and tax laws are not the same, their measurements and recognition timing for income may differ. Such discrepancies lead to the differences between financial income and tax income. Income tax accounting standards require such differences in income should be allocated among related periods (so-called interperiod tax allocation) by deferred tax assets (*DTA* hereafter) and deferred tax liability (*DTL* hereafter). These treatments result in complexity of income tax accounts. In the U. S., the accounting standards for income taxes were revised from APB Opinion No. 11 to SFAS No. 96 and finally to SFAS No. 109. The treatment for deferred income taxes was also changed from the "income-statement method" to the "balance-sheet method", which relaxes the recognition of the DTA. Taiwan has not had a comprehensive and consistent treatment for the accounting for income taxes until the promulgation of Taiwan's SFAS No. 22, *Accounting for Income Taxes*, in 1994 and its revision because of the implementation of the integrated taxes system in Taiwan in 1999.

The most significant change in Taiwan's SFAS No. 22, and also U.S. FASB SFAS No. 109, is to relax the recognition criteria for DTA and allow more items to be included in DTA. However, management must establish a valuation allowance account if it is more likely than not that all or some portion of the DTA will not be realized[1]. Such treatment makes the estimation of DTA's economic benefits more reasonable. The accounting for contingencies (SFAS No. 5) required that a contingent loss should be recorded in financial statement if it is probable to occur and the amount can be reasonably estimated, a contingent gain, however, is only disclosed in the notes to financial statement. Thus, when the recognition criteria of DTA were relaxed by the new income tax accounting, its realizability must be evaluated. Since the evaluation of DTA is subject to manager's judgment, management may have various incentives for earnings management through exploiting their discretion on the amount of valuation allowance of DTA (Miller and Skinner, 1998；Visvanathan, 1998；Bauman and Bauman, 2000；Lu, 2000；Bauman et al., 2001；Eighme, 2001；Burgstahler, Elliott and Hanlon, 2002；Kumar and Visvanathan, 2003；Schrand and Wong, 2003；Frank and Rego, 2003；Phillips, Pincus, Rego, and Wan, 2003). In this study, we collect positive and negative evidence from the standards-setting perspective and the accounting-choice perspective to investigate the components and managerial implications of valuation allowance of DTA for listed firms in Taiwan.

Two earliest studies exploring the determinants of valuation allowance of DTA are works of Behn et al. (1998) and Miller and Skinners (1998). Based on the rules of FASB SFAS No. 109, Behn et al. (1998) set up ten proxies of positive and negative evidence to verify whether management determining the realizability of DTA follows the guidelines of income tax accounting standards in the U. S. Their research findings suggest that management indeed considers all available positive and negative evidences in

[1] The new accounting standard for income taxes requires that, in addition to future deductible temporary differences, expected future taxable income that can offset operating losses or investment tax credit in later years may be recognized as DTA. Nevertheless, when management of an enterprise evaluates the likelihood of realizing DTA, he/she should set up a valuation allowance account to reduce the book value of the DTA if any negative evidence shows that it is "more likely than not" that DTA can not be realized.

determining the amount of valuation allowance of DTA. Miller and Skinner (1998) examined the components of valuation allowance of DTA based on the sources of taxable income. Their empirical results indicated that the reported amount of valuation allowance of DTA for the U. S. firms depends on the likelihood of realizing DTA in the future. Three factors affecting the amount of such valuation allowance are: (1) managers' expectations about the amount of future taxable income, (2) the relative amounts of DTA and DTL, (3) the realizability of tax benefits of loss carryforwards and investment tax credits.

Unlike studies of Behn et al. (1998) and Miller & Skinner (1998), we follow the economic variables suggested by Bauman (1997) to explore the determinants of the valuation allowance of DTA for listed firms in Taiwan. Due to differences[2] in economic development, industry structure, and income tax laws between Taiwan and U.S., management's discretion on components of valuation allowance of DTA might be different too. Studies of Wu & Lin (2003), Zhang (2001), Chen (1998) and Miller & Skinner (1998) evidence that management indeed follow income tax laws and financial accounting standards when determining the amount of valuation allowance of DTA. However, they do not further analyze related positive and negative evidence in determining DTA.

This study explores the determinants of valuation allowance of DTA from the standards-setting and accounting-choice perspectives. We choose our determining variables based on (1) positive and negative factors affecting the amount of valuation allowance of DTA; (2) factors evaluating future taxable income; (3) the evaluating criterion of "more likely than not" that DTA would be realized; (4) probable future events; and (5) tax-planning strategies, respectively. We also examine the impacts of unit change of these variables on the amount of valuation allowance of DTA (i.e. the *marginal effects* of these variables) to understand structural relations among determinants of valuation allowance of DTA. Prior empirical literature has not yet studied the marginal effects for valuation allowance of DTA. Our research findings may provide empirical evidence on the marginal effects. This is the primary contribution of our paper.

We collect data for firms listed in the Taiwan Stock Exchange for the time period of 1995-2002. Sample firms are across nineteen industries and totaled 1,831 firm-year observations. Empirical results of this study show that the future reversals of existing taxable temporary difference, the average return of earnings before tax and interest on total assets for three years, the tax planning strategies, the DTA derived from the temporary difference from Other Post-Employment Benefits (OPEB hereafter), and the DTA derived from other original temporary differences are negatively correlated with the relative amount of the recorded valuation allowance of DTA. However, the cumulative loss in recent three years, the negative cash flows (operating income or net income) in

[2] Taiwan's accounting standard for income taxes (SFAS No. 22) requires that (1) the additional 10% tax levied on un-distributed corporate earnings, the imputation tax credits and the tax credit rates on the balance sheet date must be disclosed in the notes to the financial statements; (2) after the implementation of integrated taxes system in 1998, investment revenues in equity method become "permanent differences" since corporate shareholders' dividends need not to be taxed; (3) after the implementation of integrated taxes system, firms giving up the tax benefit of deferring taxation on dividends will not occur again because investment revenues are not taxable under the new tax system; (4) loss carryback is not allowed in Taiwan's Income Tax Law. These requirements are different from those in the U. S. FASB SFAS No. 109.

past three successive years, and the net operating loss carryforwards are positively related to the relative amount of the recorded valuation allowance of DTA. Such research findings confirm that when Taiwan's managers evaluate the likelihood of realization of DTA, they do check any negative evidence that shows it is "more likely than not" that DTA can not be realized. And if it is so, they will set up a valuation allowance account to reduce the book value of the DTA.

The remaining sections are arranged as follows: Section II reviews related literature on the evaluation, discretion and determinants of valuation allowance of DTA. Section III explains our hypotheses and research models. Section IV illustrates our research design. Section V demonstrates the results of hypotheses testing and analyses. Our conclusions and recommendations are presented in Section VI.

II. LITERATURE REVIEW

Evaluation and Discretion of DTA Valuation Allowance

Since the current income-tax accounting standard relaxes the recognition of DTA and allows more items to be included in DTA, management shall establish a valuation allowance account to fairly measure the DTA. When management exercises its judgment in recognizing DTA, DTL and valuation allowance of DTA, they may use the valuation allowance of DTA as a vehicle for earnings management. Existing studies are inconsistent[3] in conclusions about managers' discretion on valuation allowance of DTA and earnings management. Whether such conflicting results are due to differences in determinants of valuation allowance of DTA in respective studies is worth studying. We explore the components of valuation allowance of DTA in the standards setting perspective and the accounting choice perspective as follows. (SFAS No. 109, 1992；Behn et al., 1998；Xu, 1993；Taiwan's SFAS No. 22, 1994、1999；Chen, 1998；Zhang, 2001；Cheng, 2002)

The Standards Setting Perspective

Taiwan's SFAS No. 22, *Accounting for Corporate Income Taxes*, requires that the DTA account is composed of future deductible temporary differences, loss carryforwards and investment tax credits, which are expected to be realized in the future. As management of an enterprise determines the amount of valuation allowance of DTA, he/she should evaluate the likelihood of realizing DTA based on obtainable evidence. If

[3] Numerous studies on earnings management of valuation allowance of DTA had been conducted in the past. Studies of taking valuation allowance level as a dependent variable include Miller and Skinner (1998), Bauman (1997), Bauman and Bauman (2000), Chen (1998), Zhang (2001), and Wu and Lin (2003). Studies of taking valuation allowance change as a dependent variable have Visvanathan (1998), Lu (2000), Bauman et al. (2001), Eighme (2001), Schrand and Wong (2003), Kumar and Visvanathan (2003), and Frank and Rego (2003). However, study of taking change ratio of valuation allowance as a dependent variable only has Burgstahler et al. (2002). From the perspectives of empirical results and testing efficiency, the studies of taking the change or change ratio for valuation allowance as a dependent variable has more significant result than that for valuation allowance level.

both positive and any negative evidence showing that it is ”more likely than not” that some portion or all of DTA cannot be realized, management must set up a valuation allowance account as a contra account to reduce the book value of DTA. Any adjustment to the valuation allowance of DTA will become part of income tax expenses (on an after-tax basis) under the caption of income from continuing operations, and thus affects reported net income on a dollar-for-dollar basis. Taiwan’s *Law of Income Taxes* (Article 39) requires that the tax benefit of net operating loss carryforwards will not be realized unless a firm has future taxable income to be deducted. The Statute for Upgrading Industries also requires that the investment tax credit is a tax benefit given to a firm for its investment in research and development, human resource training, equity investment, purchasing new equipments or technologies, etc. If evidence shows that it is “more likely than not” that some portion of loss carryforwards and investment tax credits cannot be realized at the end of the fifth year, a valuation allowance of DTA should be set up.

The Accounting Choice Perspective

Both Taiwan’s SFAS No. 22 and U.S. SFAS No. 109 propose many basic requirements for valuation allowance of DTA. These requirements include: (1) positive and negative evidence; (2) evaluation of future taxable income; (3) the “more likely than not” criterion; (4) considerations on future events; (5) execution of tax-planning strategies. Their basic concepts are explained respectively as follows.

Positive and Negative Evidence

An enterprise shall consider all available positive and negative evidence to determine whether, based on the weight of that evidence, a valuation allowance is needed. In judging the relative impact of positive and negative evidence, management shall evaluate the reliability of the evidence. A valuation allowance of DTA account shall be set up unless there exist sufficient and adequate positive evidence for not doing so. Examples of positive evidence, which reduces the need for the valuation allowance of DTA, include: (1) existing contracts or firm sales backlogs that will produce more than enough taxable income to realize the DTA according to current sales prices and cost structures; (2) an excess of appreciated value over the tax basis of the entity’s net assets in an amount sufficient to realize the DTA; (3) a strong earning history exclusive of a loss (for example, an unusual, infrequent, or extraordinary item) that can be demonstrated to be an aberration rather than a continuing condition. Examples of negative evidence, which suggests establishing or increasing the valuation allowance of DTA include: (1) cumulative losses in recent years; (2) a history of unused operating loss or tax credit carryforwards expired; (3) losses expected in early future years; (4) unsettled events that would adversely affect future operating and profit levels on a continuing basis in future years; (5) carryforward, investment tax credit periods that are short enough to limit the realization of tax benefits. Due to differences in economic development, managers in different countries may have different subjective judgment on the relative impacts of positive and negative evidence on the realization of DTA in exploiting their discretion on the amount of valuation allowance.

Evaluation of Future Taxable Income

The realization of DTA depends on the existence of taxable income in future periods

either in which deductible temporary differences are reversed, or before losses carryforwards or investment tax credits expire. According to the Taiwan's SFAS No.22, there are three possible future taxable income sources that can be used to realize DTA: (1) future normal taxable income exclusive of temporary differences reversals and loss carryforwards; (2) future reversals of existing taxable temporary differences; (3) future taxable income from tax planning. Both (1) and (3) involve manager's subjective judgment, but (2) is more objective and can be verified.

Of the above sources of future taxable income, if one or more income sources are enough to infer that a valuation allowance of DTA account need not to be set up, then other income sources are no longer considered. However, the determination of the amount of valuation allowance of DTA need consider all possible taxable income sources. Due to the lack of loss carrybacks clause in Taiwan's *Law of Income Taxes*, management of an enterprise need not consider the corporate earnings before the year net operating loss occurs in evaluating the realizability of DTA. Nevertheless, managers have much subjective judgment in evaluating future taxable income, which, in return, will makes managers have much discretion on the amount of valuation allowance of DTA.

The "More Likely Than Not" Criterion

Managers usually involve subjective judgment when applying the "more likely than not" criterion. If managers want to recognize the potential future tax savings, they must evaluate enterprise's future substantial profitability subjectively. In other words, managers should apply some subjective discretion in order to recognize DTA (Xu, 1993). According to U. S. SFAS No. 5, *Accounting for Contingencies*, a contingent loss shall not be reported in financial statements unless it is "probable" to occur and the loss amount can be reasonably estimated. In practice, the "probable" criterion refers to 80% to 90% probability of occurrence. However, the U. S. SFAS No. 109 uses the "more likely than not" criterion to account for the realization of deferred taxes assets and defines it as more than 50% occurrence. The major reason is that "probable" is too extreme to accept, and "possible" (i.e. refers to 20% to 80% probability of occurrence) is too vague to clearly understood. As irrealizability of DTA increases from 50% toward 100%, the amount for contra account of DTA should also be increased. But, whether the amount of this contra account should be *proportionally* increased, the answer is not clear in both Taiwan's SFAS No. 22 and U.S. SFAS No. 109.

The above "more likely than not" criterion provides the determination of 50% irrealizability of DTA a gray area. This criterion is not sufficient to guide management of an enterprise in determining the valuation allowance of DTA. Management must evaluate all available positive and negative evidence to determine the realizability of DTA. Accordingly, the application of "more likely than not" criterion indeed includes much subjectivity and judgment. Taiwan's SFAS No. 22 required that management of an enterprise should establish a valuation allowance account for DTA to reduce its book value if any available evidence indicates it is more likely than not that all or some portion of the DTA will not be realized.

Considerations on Future Events

The amounts of DTA or DTL shall be computed in the enacted tax rate applicable to the last-dollar taxable income (i.e. *marginal tax rate*) for existing temporary differences,

which are expected to be reversed and settled in future periods. If new tax rates for future years are not yet enacted into law, the current rates may be used. When changes in the tax laws or rates are enacted[4], their effects on the existing deferred income tax accounts shall be recomputed at the end of the current year. The net effect is reported as an adjustment to income tax expense (or benefits) in the period of the change.

After the recognition of valuation allowance of DTA, if the realizability of DTA in later periods is affected by environmental changes, management shall recompute the amount of valuation allowance of DTA. Any adjustments shall be recognized as part of income tax expenses (or benefits) under the caption of income from continuing operations. However, Taiwan's SFAS No. 22 further requires the valuation allowance account and DTA should be eliminated simultaneously if available evidence shows that DTA indeed cannot be realized.

If an enterprise's tax status changes from nontaxable to taxable, the DTA or DTL shall be recognized on the date of status change. Similarly, if an enterprise's tax status changes from taxable to nontaxable, the DTA or DTL shall be eliminated on the date of status change. The effect of recognizing or eliminating the DTA or DTL shall become part of income tax expenses (or benefits) under the caption of income from continuing operations.

From the above requirements on DTA, DTL and allowance, one can realize that their recognitions are influenced by many future events yet to be determined. These future events may include changes in tax laws (or tax rates), changes in the future environment, changes in tax status, and changes in the amount of valuation allowance of DTA resulting from the positive/negative evidence. Since these future events are usually uncertain, management has much discretion on the determination of valuation allowance of DTA.

Execution of Tax Planning Strategies

To avoid tax benefits of loss carryforwards and ITC being expired, management of an enterprise may take tax planning for the purpose of fully realizing DTA. Such actions, referred as *tax-planning strategies*, must be prudent and feasible. Both Taiwan's SFAS No. 22 and U. S. SFAS No. 109 (paragraph 246) require that the allowable tax-planning strategies for the income tax accounting must comply with the following three conditions: (1) they will lead to the realization of DTA (include realizing and recognizing taxable income in advance, changing accounting method used in the tax return, selecting the inception date of tax deferring periods, and giving up the tax benefit of deferring taxation etc.); (2) they must conform to the "conservatism" and "feasibility" requirements; (3) they would not be taken under normal situation and are taken only when avoiding the expiration of tax benefits of operating losses and tax credit carryforwards are warranted.

Sometimes implementing tax-planning strategies may result in significant expenses or losses and thus reduce the net benefit of tax planning. If adopting tax planning makes DTA realization less than possible expenses or losses, such tax-planning strategies cannot

[4] After the implementation of integrated tax system in Taiwan in 1998, Taiwan's accounting standards for income tax (SFAS No. 22, paragraph 26) are revised and required that if the investment revenue of equity method was recognized in past years, its temporary difference should be recomputed. Empirical results show that Formosa Plastics Corporation's after-tax net income increased $3.1 billion, while its DTL decreased in 1997.

be referred as “prudent and feasible”. An enterprise shall consider tax-planning strategies in determining the amount of valuation allowance required. Any significant expense or loss from implementing such tax planning shall be included in the valuation allowance of DTA.

From above explanations to DTA and its allowance, one can realize that management of an enterprise has much judgment in evaluating the likelihood of realization of DTA. However, such discretion will be of much benefit to management for adjusting the reported income. It also provides flexibility for manager to forecast future events and execute tax-planning strategies.

Determinants of DTA Valuation Allowance

For the standards-setting perspective, Taiwan’s SFAS No. 22 and the U.S. FASB SFAS No. 109 require that when evaluating the likelihood of realization of DTA, management of an enterprise shall set up a valuation allowance account to reduce the book value of the DTA if any negative evidence shows that it is “more likely than not” that deferred tax assets cannot be realized. According to this regulation, Heiman-Hoffman and Patton (1994) adopted an experimental investigation method[5] to examine the evaluation of auditors in DTA for the U. S. firms. They found that the amount of DTA in impairment approach is higher than that in affirmative approach, suggesting that auditors’ value-judgment is influenced by mental condition of anchoring and adjustment. Such results are consistent with SFAS No. 109 requiring management must consider all available positive/negative evidence to determine probability of occurrence in future taxable income sources in determining whether a valuation allowance account is needed.

Bauman (1997) explores the determinants for recognizing the valuation allowance of DTA from economic consideration and accounting choice perspectives. With regard to economic variables, he finds that firm size and tax-planning strategies exhibit significantly negative associations with the valuation allowance, while poor operating performance has a positive association with the valuation allowance. However, the debt level variable is found having significant relation with valuation allowance, which is an additional determinant outside SFAS No. 109. Such findings suggest that managers will attempt to exercise opportunistic accounting choice when determining the amount of valuation allowance of DTA (Holthausen, 1990). Based on requirements of SFAS No. 109, Behn et al. (1998) examines the determinants of the deferred tax allowance account by weighing all available positive and negative evidence to evaluate future taxable income. Their empirical results show that taxable income in prior years, future reversals of temporary differences, the origin of the temporary differences, the OPEB temporary difference, the potential for future income, tax-planning strategies, and firm’s current financial positions are factors strongly associated with the relative amount of the

[5] Impairment approach sets the initial value as a certain amount and adjusts negatively when a negative evidence appears. On the other hand, affirmative approach sets initial value as zero and adjusts positively as a positive evidence appears. Prior psychological and accounting studies indicate that while individuals exercise impairment or affirmative approach to make value-judgment, the amount of value-judgment in impairment approach is larger than that in affirmative approach. The possible reason is that value-judgment may be influenced by mental condition of “anchoring” and “adjustment” (Kahneman and Tversky, 1973；Joyce and Biddle, 1981).

valuation allowance of DTA. Miller and Skinner (1998) explore the components of valuation allowance of DTA based on related regulations of U. S. income tax laws and income tax accounting standards. Their empirical results indicate that the amount of valuation allowance of DTA depends on its likelihood of realizing DTA in the future. Three factors affecting the amount of such valuation allowance are: (1) management's expectation about the amount of future taxable income, (2) the relative amounts of DTA and DTL, and (3) the realizability of tax benefits of loss carryforwards and investment tax credits.

Current studies in Taiwan concerning the valuation allowance of DTA are empirical in nature. Chen (1998) examines the valuation of deferred taxes and find that the valuation allowance of DTA is highly related to future taxable income, debt ratio, and materiality level of DTA. However, her model cannot satisfactorily explain the cross sectional variance of the valuation allowance. Zhang (2001) examines the earnings management problem of DTA valuation and investigates whether management follow the guidance of Taiwan's SFAS No. 22 in determining the amount of valuation allowance of DTA. He finds no significant relation between earnings management and valuation allowance of DTA. Nevertheless, his variables are highly associated with the level of valuation allowance of DTA, implying that management would consider a firm's current financial position when they determine the level of valuation allowance of DTA. The study of Wu and Lin (2003) show that the more the net DTA a firm has, the higher the valuation allowance of DTA will be; the higher the expected future taxable income is, the lower the valuation allowance of DTA will be; and the more the loss carryforwards are, the higher the valuation allowance of DTA will be. Among them, the loss carryforwards variable is the most powerful determinant for valuation allowance of DTA. Many firms prefer to use loss carryforwards to set up the valuation allowance of DTA. These results are consistent with the conclusions of Miller and Skinner (1998).

III. HYPOTHESES

Taiwan's SFAS No. 22 (paragraph 15) requires that the realization of DTA depends on the existence of appropriate taxable income in periods that deductible temporary differences reverse, or before tax losses or tax credits expire. There are three possible taxable income sources that can realize DTA: (1) irreversible existing taxable temporary differences (i.e. future taxable income exclusive of reversing temporary differences and carryforwards); (2) future reversals of existing taxable temporary differences; and (3) future taxable income from tax-planning strategies. Items (1) and (2) are the most important sources of taxable income since item (3) is limited in scope[6]. When management of an enterprise evaluates the necessity of setting up a valuation allowance of DTA based on all available evidences (positive and negative), he/she must judge the possible influences and reliability of these evidences. A valuation allowance of DTA

[6] The tax-planning strategies refer to plans aiming at fully using tax benefits of loss carryforwards and ITC within the time limit. The strategy should conform to the "conservatism" and the "feasibility" requirements. Any significant expense or loss from such tax planning shall be included in the valuation allowance of DTA. Taiwan's *Law of Income Taxes* (Article 39) requires that "A corporation with sound accounting system and "blue" tax returns may deduct losses in the prior five years from current years' taxable income for the purpose of figuring current income taxes payable."

account shall be set up unless there exists sufficient and adequate evidence for not doing so. Based on our literature review, we select thirteen proxies (nine positive evidences and four negative evidences) affecting the valuation allowance of DTA and set up the following hypotheses.

The Influence of Positive Evidence on the Evaluation of DTA Valuation Allowance

With respect to the positive evidence, the first variable we choose is the amount of future reversals of existing taxable temporary differences. This variable is considered as a source of future taxable income available to realize DTA. If this amount is high, then a firm will have more taxable amount can be deducted in the future reversal years, which implies that the higher the realizability of DTA is, the lower the valuation allowance of DTA will be. The second variable is the existence of major customers for the past three years. A firm must keep the close sales relationship with its significant customers to support future revenue growth. According to U.S. SFAS No. 30, if ten percent or more of the revenue of an enterprise is derived from the sales to any custom, the fact and the amount of the revenue shall be disclosed. If a firm consistently reports the existence of major customers, then this trend is assumed to be continued and therefore represents the positive evidence that future taxable income will realize a firm's DTA.

The third variable is a firm's future earning growth representing a stable profitability. If a firm's EPS continuously increase, it is positive evidence that a firm will have future taxable income to realize DTA. The fourth variable is the average return of earnings before tax and interest on total assets for three fiscal years. It reflects a strong earnings history that will build up future deductible amount (paragraph 17 of Taiwan's SFAS No. 22). This variable can be used to measure a firm's past financial performance to evaluate the occurrence probability of future taxable income. That is, if a firm had better financial performance in the past, it will have higher probability to create future taxable income for realizing a firm's DTA.

The fifth variable is tax-planning strategies. It is an action that management might not ordinarily take in the normal course of business, but it will be undertaken for realizing a tax benefit of investment tax credits and/or loss carryforwards that would otherwise expire. If the execution of tax-planning strategies is successful, the firm would have higher tax savings and lower effective tax rate. Therefore, the realizability of DTA will be higher, and the valuation allowance of DTA will be lower. The existence of a tax-planning strategy implies that a valuation allowance is not needed for some portion or all of a DTA.

The sixth and seventh variables are DTA derived from the Other Post-Employment Benefits (OPEB) temporary difference and that from other original temporary difference (ORIGIN, referred as DTA less OPEB and loss carryforwards) respectively. We separate DTA from deductible temporary differences into OPEB and ORIGIN. The major reason is their realizability are not the same, and we can identify the impact of such separations on valuation allowance individually. Usually, the longer the period between recognition in financial statement and the deductibility of that amount in future taxable income is, the higher the uncertainty of its ultimate deductibility will be. Loss carryforwards are cerated when the loss of a particular year is taken forward in the future. Since loss carryforwards

are normally created owing to insufficient income, its DTA is less certain in realization than those DTA created by other deductible temporary differences (Read and Bartsch, 1992). Generally speaking, the realizabilities of OPEB and ORIGIN are different[7]. But their realizbilities are higher than that of loss carryforwards. The higher the amount of OPEB and ORIGIN is, the lower the valuation allowance of DTA will be.

The eighth variable is the ratio of equity market value to equity book value. This variable can be used to measure a firm's future profitability. Taiwan's accounting standards for income tax (SFAS No. 22, paragraph 17) provides one example of positive evidence as an excess of the appreciated value over the tax basis of the entity's net assets. In such case, a firm is expected to have future taxable income sufficient to realize the DTA. Thus, we anticipate that the larger the ratio of equity market value to its book value is, the lower the valuation allowance of DTA will be. The ninth variable is a strong earning history exclusive of a loss (for example, an unusual, infrequent, or extraordinary item) that demonstrates loss is an aberration rather than a continuing condition. Such evidence implies that a firm will create taxable income to realize its DTA in the future.

All of the nine variables are positive evidence that a firm will create taxable income in the future. They represent that a firm will create future taxable income to realize its DTA and reduce of valuation allowance of DTA. Therefore, we set up the following hypothesis:

Hypothesis 1: When management evaluates the sources of future taxable income, the stated positive evidence is negatively correlated with the amount of recorded valuation allowance of DTA.

The Influence of Negative Evidence on the Evaluation of DTA Valuation Allowance

With respect to the negative evidence, the first variable is the cumulative losses in recent three years. Such variable is the most used negative evidence, and also represent the most that a firm will not create future taxable income to realize its DTA. Therefore, its valuation allowance of DTA will be increased. The second variable is the negative cash flows (operating income or net income) in three successive years, reflecting that a firm may face the risk of financial crisis. This variable represents that a firm will not create future taxable income to realize its DTA. Therefore, its valuation allowance of DTA will be increased.

The third variable is a firm's material contingency[8], which represents that unsettled contingencies will adversely affect future operating and profit levels on a continuing basis in future years. This variable is also negative evidence that a firm will not have sufficient future taxable income to realize DTA. The fourth variable is loss carryforwards regulated in the Article 39 of Taiwan's *Law of Income Taxes*. Due to its limitation in the applicable

[7] Pension expenses are usually recognized in current year, and will be paid in later periods. Such deferred tax assets attributable to deductible temporary difference have higher uncertainty of realization. However, if deferred tax assets are derived from other original deductible temporary difference rather than OPEB and loss carryforwards, then their uncertainty of realization is lower.

[8] Material contingencies data are unavailable from the data bank of *Taiwan Economic Journal* (TEJ). Such data is hand-collected from the notes to annual financial statements.

scope, the realizability of DTA from loss carryforward is lower than that of DTA from other deductible temporary differences. If tax benefit of loss carryforwards is not used within the five years time limit, then such tax benefit will not be realized. The valuation allowance of DTA will be increased accordingly.

All of the four variables are negative evidence that a firm will not create taxable income in the future. Their valuation allowances of DTA will be increased. Therefore, we set up the following hypothesis：

Hypothesis 2: When management evaluates the sources of future taxable income, the negative evidence is positively correlated with the amount of recorded valuation allowance of DTA.

IV. RESEARCH METHODOLOGY

Sampling Procedures and Data Source

Taiwan's accounting standard for income taxes was promulgated on June 30, 1994 and effective for financial statements issued after December 31, 1995. Therefore, our research period is ranged from 1995 to 2002. We delete firms owned by the government and firms in the banking, insurance, mutual fund, brokerage industries because of their special industrial characteristics and accounting[9]. Moreover, we also eliminate outlier data of 1% in each variable after screening out inappropriate firms by above rules.

Data sources of this study are from: (1) retrievals from the *Taiwan Economic Journal* (*TEJ*) for financial figures and financial ratios; (2) hand-collected based on *SFI on Line of Anyan*'s data bank for valuation allowance of DTA, loss carryforwards, significant customers and contingencies that are disclosed in annual and/or quarterly financial reports. Total firm-year data are 1,398 as shown in Table 1.

Table1: Sample Selection Process and Sample Data Statistics

Total firm-years on valuation allowance of DTA from 1995 to 2002.	3,037
Deduct：	
Firm-years with fiscal year end other than December 31.	(16)
Firms-years without complete data related to deferred income taxes.	(355)
Firms-years without complete disclosure in financial statements.	(458)
Firms-years with missing variables and outlier data.	(377)
Final test sample	1,831

Empirical Models

Based on the previous discussions on our research hypotheses, we employ a Tobit regression model to examine determinants associated with the amount of the valuation allowance of DTA for verifying the positive and negative evidence in paragraph 17 of Taiwan's new accounting for income tax.

[9] Generally speaking, utility enterprises regulated by the government have less earnings management incentives. Firms in the banking have no deferred tax account, and firms in the mutual fund and trust institution have no income tax expense. These firms are deleted from our sample.

$$ALLOW_{it} = \beta_0 + \beta_1 FUTURE_{it} + \beta_2 MAJOR_{it} + \beta_3 GROWTH_{it} + \beta_4 AVEROA_{it} + \beta_5 STRATEGY_{it} + \beta_6 OPEB_{it} + \beta_7 ORIGIN_{it} + \beta_8 MARKET_{it} + \beta_9 ABERR_{it} + \beta_{10} CUMLOSS_{it} + \beta_{11} DISTRESS_{it} + \beta_{12} CONTIN_{it} + \beta_{13} NOLCF_{it} + \nu_{it} \quad (1)$$

In the above regression, the dependent variable is the ratio of valuation allowance of DTA to deferred tax assets. And its independent variables depend on individual positive and negative evidence. Definitions of the dependent variable and independent variables are shown as following.

Dependent variable

$ALLOW_{it}$ = Valuation allowance of DTA / Deferred tax assets. (Note: "Deferred tax assets" here refers to the amount *before* deducting the valuation allowance of DTA. That is, the "gross amount" of deferred tax assets.)

Independent variable

$FUTURE_{it}$ = future reversals of existing taxable temporary difference.
= Deferred tax liability / Deferred tax assets

$MAJOR_{it}$ = the major customers for the past three years, it is a dummy variable which is coded as 1 if a firm reports any significant customers for three consecutive years, and 0 otherwise.

$GROWTH_{it}$ = a firm's future earning growth, it is a dummy variable which is coded as 1 if $\text{EPS}_{it} \geq \text{EPS}_{it-1} \geq \text{EPS}_{it-2}$, and 0 otherwise.

$AVEROA_{it}$ = average return of earnings before tax and interest on total assets for three fiscal years.
$= (\text{ROA}_{it} + \text{ROA}_{it-1} + \text{ROA}_{it-2})/3$, where, $\text{ROA}_{it} = \text{EBIT}_{it}/\text{ASSET}_{it}$, EBIT_{it} is earnings before tax and interest, and ASSET_{it} is total assets.

$STRATEGY_{it}$ = tax-planning strategies. Considering the data availability, we assume the proxy of tax-planning strategies is the effective tax rate (ETR). When pre-tax income is positive, ETR is calculated as income tax expense divided by pre-tax net income. But when pre-tax income is negative and current tax payment is positive (zero), ETR is assigned to one (zero).

$OPEB_{it}$ = DTA derived from the Other Post-Employment Benefits temporary difference / Deferred tax assets.

$ORIGIN_{it}$ = DTA derived from other original temporary difference / Deferred

tax sassets. (Note: "ORIGIN" here also refers as DTA less OPEB and loss carryforwards).

$MARKET_{it}$ = Equity market value / Equity book value, where deferred tax is not included in the book value of equity. It is the proxy for an excess of appreciated value over the tax basis of the entity's net assets.

$ABERR_{it}$ = Interaction which can be measured by $CUMLOSS_{it} * D_{it}$, where, $CUMLOSS_{it}$ is a dummy variable which is coded as 1 if cumulative net income is negative for the three-year period ending with the most recent reporting period, and 0 otherwise. D_{it} is also a dummy variable which is coded as 1 if a net loss incurred in only one of the preceding three years, and 0 otherwise.

All of the nine variables are positive evidence that a firm will create taxable income in the future. Their expected coefficients are negative.

$CUMLOSS_{it}$ = Cumulative losses in recent three years, it is a dummy variable which is coded as 1 if cumulative net income is negative in recent three years, and 0 otherwise.

$DISTRESS_{it}$ = A firm has negative cash flows (operating income or net income) in three successive years, it is a dummy variable which is coded as 1 if a firm has such situation, and 0 otherwise.

$CONTIN_{it}$ = A firm's material contingency, it is a dummy variable which is coded as 1 if a firm has such situation, and 0 otherwise.

$NOLCF_{it}$ = DTA derived from loss carryforwards[10] / Deferred tax assets.

All of the four variables are negative evidence that a firm will not create taxable income in the future. Their expected coefficients are positive.

In determining the factors of valuation allowance of DTA, different firms may have different propensities towards valuation allowance, even though they are not found to have the valuation allowance. Since many firms' valuation allowances of DTA are zeros, we adopt a Tobit model to construct our regression. Equation (1) can be transformed into equation (2). The dependent variable y_i we observe is:

$$\begin{cases} y_i = y_i^* & \text{if } y_i^* > 0 \\ y_i = 0 & \text{if } y_i^* = 0 \end{cases} \qquad (2)$$

Dependent variable y_i is the valuation allowance of DTA recorded in financial

[10] Wu and Lin (2003) indicate that the association between investment tax credits and valuation allowance of DTA is positive but not significant. Such result is not consistent with their hypothesis. The possible reason is that tax incentive effect of investment tax credits was reduced after the integrated taxes system was implemented in Taiwan in 1998. Therefore, when we reexamine the determinants of valuation allowance of DTA, the component for investment tax credits is not included.

statement. y_i^* is a latent variable and represents a firm's exact propensity to the valuation allowance. Assume:

$$y_i^* = \beta' x_i + \varepsilon_i , \qquad \varepsilon_i \sim N(0, \sigma^2), \quad i = 1,2,\ldots, n, \tag{3}$$

Where, i are sample firms; x_i are explanatory variables in equation (1); β' are regression coefficients of explanatory variables; ε_i is an error term. If $y_i^* > 0$, then the observed valuation allowance is $y_i = y_i^*$. If $y_i^* \leq 0$, only $y_i = 0$ is observed, and the exact value of y_i^* is not observed. That is, when $y_i = 0$, the exact value for y_i^* is not observed. It is a latent variable of valuation allowance. For example, even though both firms A and B are observed to have no valuation allowance ($y_A = y_B = 0$), firm A may still have a higher propensity toward valuation allowance ($y_A^* > y_B^*$). Once business conditions are changed, y_A^* may exceed zero at a higher speed than that of y_B^*, so that $y_A > 0$ will be observed while y_B is still equal to zero.

Based on the explanations of the Tobit model, we suggest the following four equations derived from equation (2) and (3) used to examine the economic implications among the variables (Greene, 1995、2000；Lin, 2000；Chen, 2002；Chen et al., 2002).

$$E(y_i / x_i, y_i > 0) = \beta' x_i + \sigma \frac{\phi(z)}{\Phi(z)} , \tag{4}$$

$$\frac{\partial E(y_i | x_i, y_i > 0)}{\partial x_{ij}} = \beta_j \left[1 - z \frac{\phi(z)}{\Phi(z)} - \left(\frac{\phi(z)}{\Phi(z)} \right)^2 \right] , \tag{5}$$

$$E(y_i | x_i) = \beta' x_i \Phi(z) + \sigma \phi(z) , \tag{6}$$

$$\frac{\partial E(y_i | x_i)}{\partial x_{ij}} = \beta_j \Phi(z) , \tag{7}$$

Where, $\phi(z)$ and $\Phi(z)$ are standard normal density function and cumulative standard normal distribution function, respectively; x_{ij} is the value of the j^{th} variable in the i^{th} observation vector (the i^{th} firm)；and $z = \beta' x_i / \sigma$, the standard normal deviation.

Equation (4) only reflects situation where $y_i > 0$. Given $x = x_i$, it is the expected value of valuation allowance for those firms having valuation allowance ($y_i > 0$), while firms without valuation allowance ($y_i = 0$) are excluded. In such data characteristic, the traditional ordinary least squares regression will lead to biased and inconsistent $\hat{\beta}$ (the

estimator of β). This is because the second term ($\sigma \frac{\phi(z)}{\Phi(z)}$) in equation (4) is ignored. Given $x = x_i$, equation (5) represents the marginal effect of a unit increase in the j^{th} variable of x_{ij} vector on the expected value of y_i for those firms having valuation allowance. It only considers firms with $y_i > 0$, and ignores the fact that the change in x_{ij} may cause some firms' propensity for valuation allowance to increase from $y_i^* \leq 0$ to $y_i^* > 0$, i.e., to make a firm without valuation allowance becoming a firm having valuation allowance as situations change.

In addition, equation (6) represents, given $x = x_i$, the overall expected value of valuation allowance not only for the $y_i > 0$ firms, but also for the $y_i = 0$ firms. Equation (7) is the partial derivative function of equation (6). We use equation (7) to examine the effect of a unit increase in the independent variable on the marginal increase in the valuation allowance for both firms already having valuation allowance, and those firms having no valuation allowance but would subsequently having it if situation changes. Therefore, equation (7), instead of equation (5), plays the main role to examine the determinants of valuation allowance in this study since it carries more relevant economic implications. As for the effect of dummy variable on dependent variable, we use equation (8) to compute this marginal effect (Greene, 1995、2000；Lin, 2000):

$$E(y_i | \bar{x}_i, dummy = 1) - E(y_i | \bar{x}_i, dummy = 0) \quad (8)$$

V. ANALYSES OF EMPIRICAL RESULTS

Descriptive Statistics and Correlation Coefficients

Table 2 demonstrates descriptive statistics and *t*-test analysis of independent variables for valuation allowance of DTA. To facilitate examining the effect of relevant variables on valuation allowance, we divide whole sample into two groups according to whether valuation allowance exists. It reveals that future reversals of existing taxable temporary difference (FUTURE) are different between two groups with 10% level of significance. It also indicates that average return of earnings before tax and interest on total assets for three fiscal years (AVEROA), tax-planning strategies (STRATEGY), a strong earning history exclusive of a loss that can be demonstrated to be an aberration rather than a continuing condition (ABERR), cumulative losses in recent three years (CUMLOSS), firm has negative cash flows (operating income or net income) in three successive years (DISTRESS), and net operating loss carryforwards (NOLCF) are different between two groups with 1% level of significance. These results suggest that the determinants of valuation allowance for firms with valuation allowance of DTA are consistent with positive/negative evidence per paragraph 17 of Taiwan's new accounting for income tax (Taiwan's FASB No. 22).

Table 2: Descriptive Statistics and T-test Analysis of Variables in the Determinants of Valuation Allowance

Variablesa	Mean (Std. Dev.) All Firms	Firms With a Valuation Allowance	Firms With No Valuation Allowance	t value	p value
FUTURE	2.15 (42.87)	2.72 (58.50)	1.51 (6.52)	1.867*	0.075*
MAJOR	0.10 (0.30)	0.09 (0.29)	0.11 (0.31)	-1.436	0.151
GROWTH	0.14 (0.34)	0.13 (0.34)	0.14 (0.35)	-0.798	0.425
AVEROA	7.08 (7.60)	4.31 (7.19)	10.22 (6.79)	-18.098***	0.000***
STRATEGY	0.18 (0.31)	0.15 (0.30)	0.22 (0.31)	-4.530***	0.000***
OPEB	-0.037 (4.60)	-0.19 (6.31)	0.14 (0.30)	-1.557	0.120
ORIGIN	0.55 (4.65)	0.58 (6.35)	0.51 (0.71)	0.332	0.740
MARKET	1.52 (2.35)	1.51 (2.46)	1.54 (2.22)	-0.331	0.740
ABERR	1.53 (2.35)	0.10 (0.29)	0.02 (0.15)	6.725***	0.000***
CUMLOSS	0.23 (0.42)	0.38 (0.49)	0.05 (0.22)	19.387***	0.000***
DISTRESS	0.13 (0.33)	0.21 (0.40)	0.04 (0.19)	11.729***	0.000***
CONTIN	0.98 (0.13)	0.98 (0.13)	0.99 (0.12)	-0.759	0.448
NOLCF	0.22 (0.43)	0.33 (0.45)	0.09 (0.36)	12.521***	0.000***
N(Sample Number)	1,831	973	858	—	

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels for the one-tail tests.

[a] ALLOW: valuation allowance of DTA / deferred tax assets；FUTURE is future reversals of existing taxable temporary difference, it is defined deferred tax liability / deferred tax assets；MAJOR is the major customers for the past three years, it is an indicator variable which is coded 1 if a firm reports any significant customers for three consecutive years, and 0 otherwise；GROWTH is a firm's future earning growth, it is an indicator variable which is coded 1 if $EPS_{it} \geq EPS_{it-1} \geq EPS_{it-2}$ and 0 otherwise；AVEROA is average return of earnings before tax and interest on total assets for three fiscal years, it is defined $(ROA_{it} + ROA_{it-1} + ROA_{it-2})/3$, ROA=EBIT/ASSET, EBIT is earnings before tax and interest, and ASSETis total assets；STRATEGY is tax-planning strategies, after considering the dara availability, we assume that the proxy of tax-planning strategies is effevtive tax rate (ETR), when pre-tax net income is positive, ETR will be obtained from income tax expense divided by pre-tax net income, but when current tax payment is positive (zero), ETR is one (zero)；OPEB：DTA derived from the Other Post-Employment Benefits temporary difference / deferred tax assets；ORIGIN：DTA derived from other original temporary difference / deferred tax sassets. (note: "ORIGIN" here also refers to DTA less OPEB and loss carryforwards)；MARKET：equity market value / equity book value, where deferred tax is not included in the book value of equity, it is the proxy for an excess of appreciated asset value over the tax basis of the entity's net assets；ABERR is an interaction which can be measured by CUMLOSS * D, CUMLOSS is a dummy variable which is coded 1 if cumulative net income is negative for the three-year period ending with the most recent reporting period and 0 otherwise, D is also a dummy variable which is coded 1 if a net loss was incurred in only one of the preceding three years and 0 otherwise；CUMLOSS is cumulative losses in recent three years, it is a dummy variable which is coded 1 if cumulative net income is negative in recent three years and 0 otherwise；DISTRESS is a firm has negative cash flows (operating income or net income) in three successive years, it is a dummy variable which is coded 1 if a firm has such situation and 0 otherwise；CONTIN is a firm's material contingency, it is a dummy variable which is coded 1 if a firm has such situation and 0 otherwise；NOLCF：DTA derived from loss carryforwards / deferred tax sassets.

Table 3 illustrates Pearson correlation coefficients for independent variables of valuation allowance of DTA. It reveals that there is a negative correlation coefficient (r=-0.992) between ORIGIN and OPEB. This is because DTA created by deductible temporary differences can be divided into ORIGIN and OPEB. As ORIGIN is high, then OPEB will be low, and vice versa. In addition, empirical results also show that there is a negative correlation coefficient (r=-0.587) between cumulative losses in recent three years (CUMLOSS) and average return of earnings before tax and interest on total assets for three fiscal years (AVEROA). Intuitively, this is because the lower net income a firm has, the smaller the stock price will be; and the higher return of investment a firm has, the higher the stock price will be.

Analyses of Tobit Model and OLS Model

Table 4 illustrates Tobit maximum likelihood estimation regression results for determinants of valuation allowance of DTA. It indicates that all coefficients are consistent with our expectation. The future reversals of existing taxable temporary difference (FUTURE), average return of earnings before tax and interest on total assets for three fiscal years (AVEROA), tax planning strategies (STRATEGY), the DTA derived from Other Post-Employment Benefits temporary difference (OPEB), and the DTA derived from other original temporary difference (ORIGIN) are negatively correlated with the relative amount of the recorded valuation allowance, suggesting that the more these positive evidence a firm has, the lower valuation allowance of DTA will be. Such results imply our H_1 is supported. That is, when management evaluates the sources of future taxable income, the positive evidence is negatively correlated with the relative amount of the recorded valuation allowance of DTA.

For the negative evidence, empirical results also show that cumulative losses in recent three years (CUMLOSS), firm has negative cash flows (operating income or net income) in three successive years (DISTRESS), and net operating loss carryforwards (NOLCF) are positively related to the relative amount of the recorded valuation allowance, suggesting that the more these negative evidence a firm has, the higher valuation allowance of DTA will be. These results imply our H_2 is also supported. That is, when management evaluates the sources of future taxable income, the negative evidence is positively correlated with the relative amount of the recorded valuation allowance of DTA.

Table 3: Correlation Coefficients of Determinants of Valuation Allowance (N=1,831)

Variables[a]	*ALLOW*	*FUTURE*	*MAJOR*	*GROWTH*	*AVEROA*	*STRATEGY*	*OPEB*	*ORIGIN*	*MARKET*	*ABERR*	*CUMLOSS*	*DISTRESS*	*CONTIN*	*NOLCF*
ALLOW	1.000 (0.000)[b]													
FUTURE	0.033 (0.159)	1.000 (0.000)												
MAJOR	-0.008 (0.718)	-0.011 (0.651)	1.000 (0.000)											
GROWTH	-0.006 (0.793)	-0.013 (0.583)	-0.005 (0.825)	1.000 (0.000)										
AVEROA	-0.466 (0.000***)	-0.013 (0.571)	0.011 (0.634)	0.015 (0.508)	1.000 (0.000)									
STRATEGY	-0.149 (0.000***)	-0.009 (0.713)	-0.022 (0.337)	-0.073 (0.002***)	0.043 (0.064*)	1.000 (0.000)								
OPEB	-0.049 (0.035**)	-0.988 (0.000***)	0.009 (0.713)	0.012 (0.612)	0.029 (0.210)	0.012 (0.604)	1.000 (0.000)							
ORIGIN	0.019 (0.415)	0.981 (0.000***)	-0.011 (0.641)	-0.009 (0.709)	0.000 (0.999)	-0.002 (0.928)	-0.992 (0.000***)	1.000 (0.000)						
MARKET	0.006 (0.812)	-0.013 (0.585)	0.002 (0.941)	-0.028 (0.239)	-0.010 (0.661)	-0.014 (0.563)	0.010 (0.677)	-0.008 (0.738)	1.000 (0.000)					
ABERR	0.137 (0.000***)	0.117 (0.000***)	0.013 (0.579)	0.004 (0.870)	-0.209 (0.000***)	-0.011 (0.653)	-0.120 (0.000***)	0.110 (0.000***)	0.052 (0.026**)	1.000 (0.000)				
CUMLOSS	0.461 (0.000***)	0.049 (0.036**)	-0.015 (0.520)	-0.021 (0.360)	-0.587 (0.000***)	-0.073 (0.002***)	-0.062 (0.008***)	0.036 (0.128)	0.043 (0.064*)	0.474 (0.000***)	1.000 (0.000)			
DISTRESS	0.373 (0.000***)	-0.015 (0.519)	0.022 (0.357)	-0.026 (0.258)	-0.408 (0.000***)	-0.099 (0.000***)	0.006 (0.803)	-0.022 (0.354)	0.017 (0.470)	0.032 (0.165)	0.454 (0.000***)	1.000 (0.000)		
CONTIN	0.015 (0.528)	0.006 (0.807)	-0.014 (0.538)	0.014 (0.558)	0.018 (0.000***)	0.007 (0.763)	-0.002 (0.916)	0.004 (0.851)	0.008 (0.735)	-0.138 (0.100*)	-0.023 (0.333)	0.010 (0.664)	1.000 (0.000)	
NOLCF	0.402 (0.000***)	-0.021 (0.367)	-0.009 (0.713)	-0.016 (0.502)	-0.403 (0.000***)	-0.028 (0.237)	0.013 (0.585)	-0.093 (0.000***)	0..008 (0.743)	0.143 (0.000***)	0.405 (0.000***)	0.305 (0.000***)	0.006 (0.793)	1.000 (0.000)

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels for the one-tail tests.

[a] All variables are defined in table 2.

[b] Pearson correlation coefficients are in the column, and P-values are in the parentheses.

Table 4: Analysis of Tobit Model and Ordinary Least Squares (OLS) for the Determinants of Valuation Allowance of DTA

$$ALLOW_{it} = \beta_0 + \beta_1 FUTURE_{it} + \beta_2 MAJOR_{it} + \beta_3 GROWTH_{it} + \beta_4 AVEROA_{it} + \beta_5 STRATEGY_{it} + \beta_6 OPEB_{it} + \beta_7 ORIGIN_{it} + \beta_8 MARKET_{it} + \beta_9 ABERR_{it} + \beta_{10} CUMLOSS_{it} + \beta_{11} DISTRESS_{it} + \beta_{12} CONTIN_{it} + \beta_{13} NOLCF_{it} + \nu_{it} \quad (1)$$

		Tobit(N=1,831)					OLS(N=1,831)		
Variables[a]	predicted sign	coefficient [∂E (y*/x)/∂x]	t value	p value	[∂E (y/x)/∂x]	$\overline{X}$	coefficient	t value	p value
Intercept	+/-	0.163	1.757*	0.079*	—	—	0.230	4.333***	0.000***
FUTURE	-	-0.006	-3.402***	0.001***	-0.006	2.1536	-0.002	-2.310**	0.021**
MAJOR	-	-0.038	-0.987	0.324	-0.035	0.0999	-0.006	-0.287	0.774
GROWTH	-	-0.007	-0.223	0.824	-0.006	0.1365	-0.000	-0.027	0.978
AVEROA	-	-0.019	-9.076***	0.000***	-0.018	7.0791	-0.009	-8.772***	0.000***
STRATEGY	-	-0.179	-4.636***	0.000***	-0.169	0.1818	-0.120	-5.556***	0.000***
OPEB	-	-0.111	-3.567***	0.000***	-0.105	-0.0367	-0.018	-1.112	0.266
ORIGIN	-	-0.046	-1.756*	0.079*	-0.043	0.5503	0.005	0.352	0.725
MARKET	-	-0.003	-0.808	0.419	-0.003	1.5238	-0.001	-0.489	0.625
ABERR	-	-0.046	-0.890	0.373	-0.042	0.0617	-0.061	-1.933*	0.053*
CUMLOSS	+	0.231	5.889***	0.000***	0.213	0.2267	0.169	7.244***	0.000***
DISTRESS	+	0.129	3.343***	0.000***	0.119	0.1262	0.121	5.198***	0.000***
CONTIN	+	0.047	0.528	0.597	0.043	0.9836	0.055	1.082	0.279
NOLCF	+	0.163	4.374***	0.000***	0.154	0.2183	0.160	7.358***	0.000***
Chi-square/F-Statistic			-1141.438					70.806	
Pseudo R^2/Adj-R^2			32.8%					33.2%	

***, **, * indicate significance at the 0.01, 0.05, and 0.10 levels for the one-tail tests.
[a] All variables are defined in table 2.

Moreover, in examining the effect of a unit increase in the positive/negative evidence variable on the expected value of valuation allowance of DTA, β coefficient [∂E (y*/x)/∂x] cannot be used to explain the marginal effect of explanatory variables on dependent variable. We must calculate the [∂E (y/x)/∂x] by β and multiply $\Phi(\beta' x_i / \sigma)$, so that we can justify the marginal effect of a unit increase in the explanatory variables on the expected value of valuation allowance. The sixth column of table 4 shows that when the execution of tax-planning strategies is more successful, the tax benefit derived from deductible temporary difference and loss carryforwards is more easily realized. If effective tax rate is adjusted 1%, the ratio of valuation allowance to DTA will decrease about 16.93%. In addition, if a firm has cumulative losses in recent three years, valuation allowance will increase $21.38 for $100 of DTA; if a firm has negative cash flows (operating income or net income) in three successive years, valuation

allowance will increase $11.93 for $100 of DTA; if a firm has loss caryforwards, valuation allowance will increase $15.47 for $100 of DTA. Finally, to compare with results from Tobit regression, we also demonstrate the OLS regression estimation coefficients in table 4. It reveals that OPEB becomes insignificant and ABERR becomes significant compared with Tobit regression model, which implies that there are potential biases in the OLS regression estimation coefficients.

VI. CONCLUDING REMARKS

In this paper, we provide empirical results supporting the proposition that managers will take into account all available positive and negative evidence when they determine the amount of valuation allowance of DTA. Our empirical results indicate that future reversals of existing taxable temporary difference, average return of earnings before tax and interest on total assets for three fiscal years, tax planning strategies, the DTA derived from Other Post-Employment Benefits (OPEB) temporary difference, and the DTA derived from other original temporary difference are negatively correlated with the relative amount of the recorded valuation allowance. That is, the more positive evidence a firm has, the lower valuation allowance of DTA will be. However, cumulative losses in recent three years, firm has negative cash flows (operating income or net income) in three successive years, and net operating loss carryforwards are positively related to the relative amount of the recorded valuation allowance. Namely, the more negative evidence a firm has, the higher valuation allowance of DTA will be. The above research findings imply that the amount of DTA valuation allowance conforms to the requirements of Taiwan's SFAS No.22 and standards-setting goals seem achieved.

In determining the amount of valuation allowance, we find some valuation allowance is due to managers' subjectivity and judgment, for example, future reversals of existing taxable temporary difference; others are due to overall consideration of tax planning, for example, tax planning strategies, the DTA derived from Other Post-Employment Benefits temporary difference, and net operating loss carryforwards. When the execution of tax-planning strategies is more successful, the tax benefit derived from deductible temporary difference and loss carryforwards will be more easily realized. These results imply that effective execution of tax-planning strategies and managers' discretionary judgment influence the determination of valuation allowance of DTA. And it may refer that management of a firm may have various earnings management incentives to exploit their discretion on the amount of valuation allowance of DTA.

With respect to determining the amount of valuation allowance, some of valuation allowance is from a firm's operating performance, for example average return of earnings before tax and interest on total assets for three fiscal years, cumulative losses in recent three years, and a firm has negative cash flows (operating income or net income) in three successive years. If a firm has cumulative losses in recent three years, negative cash flows (operating income or net income) in three successive years, and net operating loss caryforwards, the valuation allowance will increase $58.78(=21.38+11.93+15.47) for $100 of DTA. These findings imply that DTA of a firm will not be realized eventually if its operating results cannot improve continuously. It indirectly confirms the implementation of paragraph 17 of Taiwan's SFAS No. 22 that management of an enterprise should consider establishing a valuation allowance account for DTA to reduce

its book value if any available evidence indicates it is more likely than not that all or some portion of the DTA will not be realized.

Overall, our empirical results are not the same with those of Behn et al. (1998) and Miller and Skinner (1998). The major reason is that our study further examines all available positive/negative evidence affecting the recognition of valuation allowance and indirectly confirms the existence of positive/negative evidence per paragraph 17 of Taiwan's SFAS No. 22. Such results can provide three implications in the valuation allowance of DTA: (1) management of an enterprise must make necessary judgment per positive/negative evidence in determining the valuation allowance of DTA and make trade-off of relevance and objectivity in related accounting information; (2) auditors can focus on specific factors (e.g., sources of future taxable income, tax-planning strategies) in their auditing and evaluation of areas of evidence in applying Taiwan's SFAS No. 22 guidelines; (3) these empirical conclusions may also highlight specific variables to be used by firms in developing their own approach for estimating the valuation allowance of DTA.

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遞延所得稅資產備抵評價組成因子之研究

林松宏
國立成功大學會計系
吳清在
國立成功大學會計系

摘要：台灣第 22 號會計公報與美國 SFAS No. 109 公報最大之變革便是「放寬」遞延所得稅資產之認列標準，允許較多遞延所得稅資產之入帳，但也對遞延所得稅資產大半無法實現之部分提列備抵評價，使得遞延所得稅資產之經濟效益估計更趨合理。過去傳統會計處理對「或有損失」之認列，基於穩健原則只有在發生可能性極大，金額可合理估計時才入帳，對於「或有利得」會計處理頂多給予揭露表達，因此當遞延所得稅資產認列條件被放寬後，相對也須對其實現可能性加以評估。但由於遞延所得稅資產評價，涉及公司管理當局主觀判斷，管理當局有可能基於不同之盈餘管理動機，利用遞延所得稅資產備抵評價(以後簡稱 DTA 備抵評價)之會計裁量權進行盈餘管理。

目前國外文獻對所得稅會計公報之研究，主要分為四類。第一類為所得稅會計公報實施後對資本市場之股價反應；第二類為遞延所得稅資產備抵評價盈餘管理效果，第三類為遞延所得稅折現評價適切性研究，第四類為遞延所得稅費用之盈餘管理偵測。台灣有關所得稅會計公報之研究，早期傾向會計處理探討、實施狀況報導及會計處理準則適用之說明。至於第 22 號所得稅會計處理準則公報實施後，研究方向則轉為注重遞延所得稅資訊內涵(蘇淑美, 1997)、備抵評價決定因素(陳依依, 1998；吳清在與林松宏, 2003)、備抵評價盈餘管理(張至誼, 2001;吳清在與林松宏, 2003)以及價值攸關性(張仲岳與梁鈺涓, 2001；張慧珊, 2002；吳清在與林松宏, 2003)之分析。

本文針對 DTA 備抵評價組成因子之考量，從「準則制定」及「會計選擇」兩方面，分別就正面與負面證據、評估未來課稅所得、「多半可能」基準評估、多方考量未來事項及執行所得稅規劃策略等五項，選取影響 DTA 備抵評價金額之變數，並分析這些變數單位變動對 DTA 備抵評價金額造成之影響(即邊際影響)，俾瞭解 DTA 備抵評價組成因子之結構關係，並進一步探討其組成因子所具有之管理意涵。目前實證文獻上，尚未有針對 DTA 備抵評價之決定因素探討其邊際影響者，本文研究結果正足以彌補此一研究缺口，此為本文最主要之研究貢獻。

從「準則制定」層面而言，台灣 FAS No. 22 及 SFAS No.109 均規定公

司管理當局在評估遞延所得稅資產實現可能性時，若有任何負面證據顯示遞延所得稅資產將有「超過 50%之機率」無法實現，則宜考慮設立備抵評價科目，將遞延所得稅資產帳面價值降低。Heiman-Hoffman and Patton (1994)依據此一規定採用實驗調查法檢視審計人員對遞延所得稅資產之評價，發現在「負向法」下(先將遞延所得稅資產設定某一金額，然後隨著負面證據之出現向下調降)遞延所得稅資產評價金額較「正向法」下(先將遞延所得稅資產設定為零，然後隨著正面證據之出現向上調升)為大，顯示審計人員之價值判斷普遍受到定錨(anchoring)與調整(adjustment)心理狀態之影響。Bauman (1997)針對「經濟考量」與「會計選擇」探討 DTA 備抵評價之組成因子，發現在經濟考量變數方面，公司規模、租稅規劃策略與備抵評價呈現顯著負向關係，而當期營業績效愈差，備抵評價金額愈大，兩者也有顯著關係。在會計選擇變數方面，發現負債水準是 SFAS No. 109 公報規定以外但會影響備抵評價之重要變數，顯示管理當局在提列備抵評價金額時，會有意圖從事投機性之會計選擇。Behn et al. (1998)也根據 SFAS No. 109 之規定探討 DTA 備抵評價之組成因子，他們從正負面證據評估公司未來課稅所得，實證結果顯示：以前年度之課稅所得、暫時性差異之未來迴轉、暫時性差異之發生、員工退休後給付所產生之暫時性差異、未來所得之潛在可能性、租稅規劃策略及公司目前財務狀況等因素，皆會影響 DTA 備抵評價金額。Miller and Skinner (1998)從會計公報及稅法相關規定探討 DTA 備抵評價之決定因素，發現管理當局在設立 DTA 備抵評價科目時，金額之決定取決於遞延所得稅資產未來實現之可能性，其相關因素有(1)管理當局對未來課稅所得大小之預期，(2)遞延所得稅資產與遞延所得稅負債相對金額之高低，(3)所得稅抵減及虧損扣抵遞轉之租稅利益之實現與否。

目前台灣在 DTA 備抵評價之研究，都是採用實證方式進行。陳依依(1998)探討遞延所得稅資產之評價，發現未來課稅所得之正負面證據、負債比率及重要性影響與備抵評價之提列有高度相關，惟整體模型並無法完全解釋備抵評價科目的橫斷面差異。張至誼 (2001)檢視遞延所得稅資產評價之盈餘管理，並探討管理當局是否會根據所得稅會計公報之考量來決定備抵評價金額，實證結果發現並無證據顯示整體上市公司管理當局有採用 DTA 備抵評價來進行盈餘管理，但 DTA 備抵評價水準與所建立之變數具有高度相關，意味著管理當局在評估備抵評價水準時，有依據公報之規定考量公司目前之財務狀況。吳清在及林松宏(2003)研究發現遞延所得稅資產相對較遞延所得稅負債為多之公司其備抵評價金額會較大，預期未來課稅所得較高之公司其備抵評價金額會較小，而虧損扣抵遞轉較大之公司其備抵評價金額會較大，對備抵評價金額最具解釋力之變數，為公司虧損扣抵遞轉金額之大小，顯示許多公司偏愛選擇虧損扣抵遞轉來設定 DTA 備抵評價金額，這些結果與 Miller

and Skinner (1998)之研究結論一致。

本文依據上述所得稅會計公報及稅法相關規定(Taiwan SFAS No. 22, 1994、1999；FASB SFAS No. 109)，並參考國內外相關文獻(Heiman-Hoffman and Patton, 1994；Bauman , 1997；Behn et al., 1998；Miller and Skinner, 1998；徐景亮, 1993；Taiwan SFAS No. 22, 1994、1999；陳依依, 1998；張至誼, 2001；鄭丁旺, 2002；吳清在及林松宏, 2003)，提出下列二項假說：

假說一：管理當局在判斷未來課稅所得來源時，正面證據與 DTA 備抵評價金額之提列呈負向關係。

假說二：管理當局在判斷未來課稅所得來源時，負面證據與 DTA 備抵評價金額之提列呈正向關係。

由於我國所得稅會計公報於 1994 年 6 月 30 日公布，對 1995 年以後之財務報表才開始生效。為配合財務報告之規定，本文取樣自 1995～2002 年在台灣證券交易所上市之年度資料，並將公用事業、金融業、保險業、共同基金及信託機構等因產業特性及會計處理與其他產業明顯不同之公司排除，同時我們也將各變數中前後 1%之樣本資料刪除，以控制極端值。所選取之研究樣本橫跨 19 種產業，共得出公司年(firm-year)資料計 1,831 筆。

本文依據研究假設之推論，針對台灣所得稅會計公報所規定之正負面證據，建立 DTA 備抵評價決定因子之多變量迴歸模式如下：

$$ALLOW_{it} = \beta_0 + \beta_1 FUTURE_{it} + \beta_2 MAJOR_{it} + \beta_3 GROWTH_{it} + \beta_4 AVEROA_{it}$$

$$+ \beta_5 STRATEGY_{it} + \beta_6 OPEB_{it} + \beta_7 ORIGIN_{it} + \beta_8 MARKET_{it}$$

$$+ \beta_9 ABERR_{it} + \beta_{10} CUMLOSS_{it} + \beta_{11} DISTRESS_{it} + \beta_{12} CONTIN_{it}$$

$$+ \beta_{13} NOLCF_{it} + \nu_{it}$$

式中應變數定義如下：

$ALLOW_{it}$ ＝DTA 備抵評價，以當年年底備抵評價金額除以當年年底遞延所得稅資產。

式中自變數定義如下：

$FUTURE_{it}$ ＝現存應課稅暫時性差異未來迴轉金額，以當年遞延所得稅負債除以當年遞延所得稅資產總額($DTL_{it}/GDTA_{it}$)表示。

$MAJOR_{it}$ ＝連續三年之重要客戶，為一虛擬變數，若公司報表附註中連續三年都揭露某重要客戶資訊，則取值為 1，否則為 0。

$GROWTH_{it}$ ＝未來盈餘成長趨勢，為一虛擬變數，若公司 $EPS_{it} \geq EPS_{it-1} \geq EPS_{it-2}$，則取值為 1，否則為 0。

$AVEROA_{it}$ ＝三年來平均稅前息前資產報酬率，以 $(ROA_{it}+ROA_{it-1}+ROA_{it-2})/3$ 表示，$ROA_{it}=EBIT_{it}/ASSET_{it}$，其中 $EBIT_{it}$ 為稅前息前淨利，$ASSET_{it}$ 為期末總資產。

$STRATEGY_{it}$ ＝所得稅規劃策略，以有效稅率作為代理變數，本文考慮資料取得可行性，當公司稅前淨利為正時，有效稅率以所得稅費用除以稅前淨利； 當稅前淨利為負，且當期支付稅額為正(零)時，有效稅率為一(零)。

$OPEB_{it}$ ＝員工退休後給付(負債)所產生之遞延所得稅資產，以遞延所得稅資產總額加以平減。

$ORIGIN_{it}$ ＝原始發生之遞延所得稅資產，係以全部遞延所得稅資產減去營業損失抵減後之遞延所得稅資產，再減除 $OPEB_{it}$ 後之餘額，再以遞延所得稅資產平減。

$MARKET_{it}$ ＝權益市值對權益帳面值(不包括遞延所得稅)之比率，以其作為淨資產評估價值超過課稅基礎之代理變數。

$ABERR_{it}$ ＝過去三年內只有一年發生損失，顯示過去三年內獲利能力轉強，虧損只是偶然情況，以 $CUMLOSS_{it}*D_{it}$ 表示，$CUMLOSS_{it}$ 為虛擬變數，若公司三年來之淨利相加為累積虧損，取值為 1，否則為 0；D_{it} 亦為虛擬變數，若公司三年來只有一年發生虧損，取值為 1，否則為 0。

以上九個變數為公司可能產生預期未來課稅所得之正面証據，預期係數為負。

$CUMLOSS_{it}$ ＝近三年來之累積虧損，為一虛擬變數，若公司三年來之淨利相加為累積虧損，取值為 1，否則為 0。

$DISTRESS_{it}$ ＝過去三年營業現金流量、營業淨利及淨利三者中，有其中之

一連續為負，為一虛擬變數，代表公司有財務危機風險，若公司果真有上述現象發生，取值為 1，否則為 0。

$CONTIN_{it}$ ＝公司存有重大或有事項，為一虛擬變數，代表企業經營環境有可能對企業未來經營及獲利產生持續性負面影響。若公司有此種現象發生，取值為 1，否則為 0。

$NOLCF_{it}$ ＝營業損失抵減所產生之遞延所得稅資產，淨營業虧損須於未來年度有課稅所得可遞轉扣除才能實現所得稅利益(所 39)，以遞延所得稅資產總額加以平減。

以上四個變數為公司不可能產生未來課稅所得之負面証據，預期係數為正。

實證結果發現，現存應課稅暫時性差異未來迴轉金額、三年來平均稅前息前資產報酬率、所得稅規劃策略、員工退休後給付之遞延所得稅資產、原始發生之遞延所得稅資產等五個變數其正面證據愈多，公司管理當局所需提列之備抵評價金額愈少，愈可免提備抵評價金額。然而，三年來之累積虧損、過去三年營業現金流量或營業淨利或淨利三者中，有其中之一連續為負，及營業損失抵減所產生之遞延所得稅資產等三個變數，其負面證據愈多，管理當局所需提列之備抵評價金額也愈多，愈須提列備抵評價金額。另外，在邊際影響實證方面也發現，公司管理當局若避免虧損扣抵與所得稅抵減逾期未用之策略愈成功，公司從可抵減暫時性差異或虧損扣抵所獲得之所得稅利益愈容易實現，有效稅率每修正 1%，備抵評價佔遞延所得稅資產之比例可降低約 16.93%。公司若近三年來之損益累積為虧損，則每一百元之遞延所得稅資產中，備抵評價會增加 21.38 元；公司若過去三年營業現金流量、營業淨利及淨利三者中，有其中之一連續為負，則每一百元之遞延所得稅資產中，備抵評價會增加 11.93 元；公司若有營業損失抵減發生，每一百元中約有 15.47 元無法實現必須提列 DTA 備抵評價金額。這些結果證實台灣上市公司所列報之遞延所得稅資產備抵評價之金額，大都能符合財務會計準則公報第 22 號第 17 段之規定，達成準則制定之目的。

整體而言，上述實証結果與 Behn et al. (1998)及 Miller and Skinner (1998)兩篇文章之研究結論有所差異，主要原因是本文深入剖析所有可能影響備抵評價提列之正負面證據之相關變數，間接證實台灣所得稅會計公報第 17 段所規定提列備抵評價時所應考慮之正負面因素之存在。此項結果對未來實證研究具有三種意涵：(1)管理當局在決定備抵評價金額時，對正面及負面證據須作必要判斷，俾利會計資訊在攸關性及客觀性間作明確取捨；(2)本文可提供審計人員依據所得稅會計公報規定，針對特定因素(如未來課稅所得來

源、所得稅租稅規劃等)證據予以必要評估及查核；(3)實證結論有助於管理當局發展一套屬於企業本身用以估計 DTA 備抵評價金額之方法。

本文後續研究可考慮下列方向，首先是 DTA 備抵評價之盈餘管理效果，國外許多實證研究已證得所得稅會計公報規定之 DTA 備抵評價會計裁量權，其盈餘管理思潮已從傳統代理理論與準則制定層面，轉為資本市場與管理動機層面，此種轉變主要是因為實證處理係採同質性樣本(金融業)或具盈餘管理動機樣本。因此，以隨機樣本重新檢測 DTA 備抵評價盈餘管理效果是否仍然存在，可釐清管理當局在「資本市場動機」、「契約動機」及「管制動機」所具有管理意涵。其次，過去文獻研究也指出 DTA 備抵評價之變動揭露，除可傳遞公司 DTA 金額、實現可能性及其未來課稅所得性質與金額等資訊給投資人(Kuma and Visvanathan, 2003)，以反應所產生之資訊效果與資訊特質外，DTA 備抵評價變動揭露亦可用來評估並預測公司未來獲利能力，使公司未來營業績效反應在當期股價上，具有股價資訊性。針對 DTA 備抵評價所具有之兩種相對性效果進行研究，可進一步瞭解 DTA 備抵評價變動對公司股價與未來營業績效之影響，使市場投資人與管理當局能有效釐清其真正之會計意涵。

關鍵字：遞延所得稅資產備抵評價、所得稅規劃策略、多半可能、準則制定

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Determinants and Market Reaction of Assets Impairment in Taiwan*

Wan-Ting Hsieh
Kun Shan University of Technology
TsingZai C. Wu†
National Cheng Kung University

ABSTRACT: On July 1, 2004, Taiwan's Financial Accounting Standards Committee of the Accounting Research and Development Foundation issued SFAS No. 35, *Accounting for the Impairment of Assets*. This accounting standard came effective in the financial year ending after December 31, 2005, with early application encouraged. Taiwan's SFAS No. 35 provides for accounting for assets impairment conservatively by recognizing impairment loss to reflect the market value of long-lived assets but not the unrealized gains of assets. SFAS No. 35 will affect accounting earnings, carrying amounts of long-lived assets, and, supposedly, the stock prices for listed firms in Taiwan. This paper examines determinants of assets impairment and its market reaction. First, we examine the determinants of early adoption of Taiwan's SFAS No. 35 for firms listed in the *Taiwan Stock Exchange* and the *GreTai Securities Market*. We investigate the motivation of adoption of assets impairment accounting in reporting purposes and operational purposes per literature. Our empirical results show that determinants for early adopters of Taiwan's SFAS No. 35 are the taking a "big bath" purpose (the reporting motivation) and factors reflecting the accrual-based and cashflow-based recoverability of long-lived assets, such as changes in sales and changes in operational cash flows (operational motivations). Secondly, we examine factors affecting the "amounts" of assets impairment in both reporting and operational perspectives. Our empirical results show the following: (1) For early adopters, the amounts of assets impairments are associated with only reporting motivations (the taking a big-bath purpose, the income smoothing purpose, and the changes in top management). (2) For non-early adopters, the amounts of assets impairment are associated with, not only the reporting perspective (the income smoothing purpose, the changes in top management), but also the firms' operational perspective (such as stock returns and sales

* We appreciate comments from two anonymous reviewers and participants of 2005 TAA annual meeting. Any remaining errors are our sole responsibilities.
† tsingzai@mail.ncku.edu.tw.

growth). When analyzing the "amounts" of assets impairment losses for five different types of assets (long-term investments, fixed assets, identifiable intangible assets, goodwill, and other assets), we find that impairment loss for goodwill is less likely to be associated with reporting motivation, probably because restoration of previously recognized impairment loss for goodwill is prohibited under SAFS No. 35. Finally, we examine market reactions to announcements of assets impairment in Taiwan. Our empirical tests of the shareholder wealth effects of impairment announcements reveal that, (1) the stock market reacts significantly and negatively to fourth-quarter impairment losses, but not to fourth-quarter unexpected earnings for early adopters of Taiwan's SFAS No. 35; and (2) the stock market does not react significantly to first-quarter impairment losses, but does react thusly to first-quarter unexpected earnings for all listed firms. The latter is consistent with Francis *et al.* (1996). In addition to Francis's explanations, we further interpret this result in terms of the same reporting dates for annual report and first-quarter report in Taiwan. Unlike the U.S. Securities Exchange Commission, which requires public firms to submit their 10-K on May 31 and their first-quarter 10-Q on April 15, Taiwan's Securities and Future Bureau (SFB) requires that annual report and first-quarter report be submitted on the same day (April 30) by public firms in Taiwan. Simultaneous announcements of annual report and first-quarter report may further explain our empirical results: the unexpected fourth-quarter earnings reflected in the previous year's annual report has no the information content at the end of the first quarter since information may have already been reflected in the beginning of the year. However, as expected, unexpected first-quarter earnings do have information content when they are announced. For assets impairment, on the contrary, investors react to the CPA-audited impairment losses in the annual report while no statistical evidence shows that investors react to CPA-reviewed first-quarter impairment losses.

Keywords: Assets Impairment, Taiwan's SFAS No. 35, Determinants, Market Reaction

I. INTRODUCTION

In the history of Taiwan's Statements of Financial Accounting Standards (hereinafter *SFAS*), no standard like Taiwan's SFAS No. 35 (2004), *Accounting for the Impairment of Assets*, caused such strong concern in the market and financial press, except SFAS No.18, *Accounting for Pension*. As early as December 1995, the U.S. Financial Accounting Standards Board (hereinafter *FASB*) issued the U.S. SFAS 121, *Accounting for the Impairment of Long-Lived Assets and for Long-Lived Assets to be Disposed of*. This statement requires that, if an asset is impaired on the financial report date, an enterprise must recognize the impairment loss in order to avoid overstating the value of the asset. In addition to recording historical costs when acquisition and periodically depreciating or amortizing the original costs, long-lived assets are required to be carried at the lower of their carrying values or recoverable values. In January of 2001,

the International Accounting Standards Board (hereinafter IASB) also released International Accounting Statement No. 36, *Impairment of Assets*, for the accounting of impairment losses of long-lived assets. In addition, the U. S. FASB released U. S. SFAS 142, *Goodwill and Other Intangible Assets*, to regulate the accounting of goodwill and other intangible assets when acquired and after acquisitions, including their impairments, in July 2001.

For a long time, Taiwan's Generally Accepted Accounting Principles required the recording of long-lived assets by their historical costs less accumulated depreciations (or amortizations). However, when increases in the consumer price index accumulate to 25% compared to the recorded costs, long-lived assets can be recognized by the current value to reflect assets appreciation. Nevertheless, before SFAS No. 35, Taiwan's accounting standards for long-lived assets had never considered assets impairment. Long-lived assets could only be written-up, but never written-down, causing an imbalance phenomenon in the accounting records for long-lived assets. This limited accounting for long-lived assets seriously reduced the relevance of the financial reports. And, the carrying amounts of long-lived assets could not fully reflect value changes caused by progress in technology and effect of the business cycle. This accounting treatment had long been criticized by accounting and finance circles in Taiwan. In order to match the International Accounting Standards and to improve the transparency of financial statements, Taiwan's Financial Accounting Standards Committee of the Accounting Research and Development Foundation of the Republic of China issued SFAS No. 35 *Accounting for the Impairment of Assets* on July 1, 2004. This new accounting standard was effective for financial statements ending on and after December 31, 2005, with early adoption encouraged. Taiwan's SFAS No. 35 is based on the International Accounting Standard No. 36 and partly refers to related U. S. accounting standards, especially U.S. SFAF No. 121 and SFAS No. 142. The new accounting requires that an enterprise conduct an "impairment test" for the values of long-lived assets (including long-term equity investments, fixed assets, recognizable intangible assets, goodwill, and other assets) on the balance sheet date. If the carrying amount of a long-lived asset is higher than its "recoverable amount", then an impairment loss must be recognized on the income statement instantly. Later on, if there were any indications that previously recognized impairment losses did not exist, the restoration of that loss would be permitted on that balance sheet date. (However, restoration of previously recognized impairment losses for goodwill is prohibited under Taiwan's SFAS No. 35 because subsequent increases in the recoverable amounts of goodwill may be partly from goodwill generated internally in the enterprise, instead of the disappearance of the cause of asset impairments that existed previously. In accounting theory, a firm should not record internally generated goodwill. Therefore, the restoration of impairment loss for goodwill is not allowed.) Through recognition and restoration of impairment loss for ling-lived assets, Taiwan's SFAS No. 35 *conservatively* reflects the value of long-lived assets since assets appreciation is not discussed in Taiwan's SFAS No. 35.

On August 26, 2004, Wistron,[1] a member of the Taiwan's Acer group, announced in a press conference that she would recognize an impairment loss of NT$5.5 billion for her

[1] Economic Daily, Commercial Times, DigiTimes, August 27, 2004.

long-term investment in Aopen accounted by the equity method, and an impairment loss of NT$10.51 by revaluating the long-lived assets in Wistron Philippines (equivalently NT$1.88 impairment losses per share in total) in her 2004 semiannual report, according to the spirit of SFAS No. 35. Wistron's annual earnings forecast thus decreased from a profit of NT$8.5 billion to a loss of NT$8 billion. (Equivalently, her EPS would be reduced from NT$1.89 to -NT$1.05). This information caused panic in the market, and Wistron's stock price slumped by 13% within two days. In the beginning of 2005, Taiwan's Yageo officially declared she would adopt SFAS No. 35 early in her 2004 annual report in a press conference on February 23, 2005. Yageo "cleared the deck" by recognizing impairment losses of NT$120 billion (equivalent to NT$5.23) for long-lived assets under SFAS No. 35 at the end of fourth quarter in 2004. Most impairment losses were from goodwill revaluation. These impairment losses corroded half of Yageo's contributed capital and made Yageo's EPS drop from NT$0.23 to -NT$5[2]. On the next day, Yageo's stock price fell dramatically. Subsequently, Taiwan's Chinalife announced the early adoption of SFAS No. 35 in the fourth quarter of 2004 on March 28, 2005. Chinalife claimed she would recognize an impairment loss of NT$37.93 billion (NT$4.78 per share) from her long-term investments. The Chinalife's annual profit was turned to a loss. (Equivalently, her EPS was dropped from NT$0.66 to -NT$4.12). This news resulted in Chinalife's stock price slump and lock to be traded due to a decrease in price by more than 7% on the next day. This event negatively affected all stock prices of listed financial institutions in Taiwan, and selling pressure on the stock market was intense on that day. The Taiwan Stock Exchange Index declined 87 points to 5961 points on March 29, 2005. On March 2005, the average U. S. Dow Jones stock index was up. The downward adjustment in Taiwan Stock Exchange Index around the end of March 2005 seemed to be reflecting the negative impact of SFAS No. 35.

From the beginning of 2005 on, Taiwan's stock market was under the haze of SFAS No. 35. The "January effect" of Taiwan's stock market didn't show up in 2005. Worrying that implementing SFAS No. 35 would reduce firms' net worth and negatively impact stock price, many firms explicitly hoped Taiwan government would rescind this accounting standard. Such a hope was not realized, however. On April 1, 2005, Taiwan's Executive Yuan claimed that SFAS No. 35 (effective January 1, 2005) and the new *Statute of Labor Pension* (effective July 1, 2005) were the two most influential regulations affecting Taiwan's economic performance in 2005. And, she directed the Ministries of Finance and Economic affairs to take special notice and respond prudently[3]. On April 4, 2005, Taiwan's Premier held a Yuan meeting with his cabinet members to discuss Taiwan firms' complaints about SFAS No. 35 in regard to its negative impact on firms' earnings and stock price. The meeting concluded that although SFAS No. 35 might negatively affect stock market in the short term, its positive effect would show up in the long term. The reform of financial regulations in Taiwan could not halt. Since SFAS No. 35 came effective in January 2005, its impact on 2004 annual report (to be disclosed on April 30, 2005) would not be substantial. Ten days later, the Financial Supervisory Commission of Executive Yuan (thereafter *FSC*) made a special report to the Finance Committee of the

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2 *Economic* Daily, February 23, 2005; *Wealth Magazine*, Vol. 278, May 2005.

3 News Report Center of the Chinese Television System, April, 1, 2005, 12:46 p. m..

Legislative Yuan on the "stock market reaction to the new SFAS No. 35" on April 13, 2005. The FSC argued that the overall effects of SFAS No. 35 were not substantial. However, some legislators did not agree. It was estimated that government-owned firms, such as Taiwan Sugar Co., Chinese Petroleum Co., Taiwan Power Co., etc., would recognize approximately NT$500 billion in assets impairment in total, which would greatly affect earnings return to the National Treasury. All non-operational funds under respective ministries, such as the Water Resource Fund, etc., would also recognize about NT$300 billion assets impairment. Furthermore, allowing firms themselves to determine the adoption timing and the assets being revaluated by appraisers, SFAS No. 35 left a lot of loopholes for insider trading[4]. Facing tremendous opposition from industrial and commercial circles, the Business Services of the Ministry of Economic Affairs finally passed a resolution on April 23, 2005 allowing firms with contributed capital under NT 30 million a 2-year grace period to delay applying SFAS No. 35 until the end of 2007.

Undoubtedly, the accounting treatment of assets impairment under SFAS No. 35 will affect a firm's net worth and its current earnings. However, estimating the amount of impairment loss will become a challenge to the credibility of a firm's management and financial statements. SFAS No. 35 defines the impairment loss of an asset as the difference between its carrying amount and the recoverable value if the former is larger than the latter. The recoverable value of an asset is its "value in use" or its "net fair value", whichever is larger where the "value in use" of an asset is determined by discounting future cash flows from the asset. Therefore, management has to estimate a discount rate and forecast future cash flows from a long-lived asset in order to determine the "value in use". In addition, the fair value of an asset depends on the liquidity of that asset. If fair market value is unavailable, estimating the fair value of a long-lived asset shall be subject to the judgment of managers or appraisers. Hence, determining the impairment loss of an asset under SFAS No. 35 cannot escape the manager's discretion.

Taiwan's SFAS No. 35 was issued on July 1, 2004 and came effective for financial statements ending on and after December 31, 2005, with early adoption encouraged. Thereafter, firms in Taiwan could voluntarily adopt the new SFAS No. 35 early in the third quarter or the fourth quarter of 2004, or face mandatory adoption of this standard in the first quarter of 2005. Managers have full discretion on the adoption time of SFAS No. 35. Our first research issue in this study is to investigate the determinants of early adoption of SFAS No. 35 for listed firms in Taiwan. Previous studies on the adoption timing of U. S. SFAS No. 121 revealed that the determinants can be classified into two categories: management's "reporting motivations" and a firm's "operational factors". Management's reporting motivations reflect several scenarios. If a firm has unexpectedly high earnings performance, its management has incentive to recognize a large amount of impairment loss to smooth out earnings (the "income-smoothing" purpose); if a firm has unexpectedly poor earnings performance, management has incentive to clear the dirty deck of impaired assets to improve investors' perceptions of the future financial performance of the firm (so-called "taking a big bath" purpose); when a firm changes its management, new managers may exercise greater scrutiny over existing assets and want to clean up assets impairments. Furthermore, some firms may determine the timing of

[4] *Economic Daily*, April 14, 2005.

adopting SFAS No. 35 due to their respective "operational factors".

In judging the impairment of long-lived assets, SFAS No. 35 unequivocally requires management to examine external and internal information (such as technology, market, economic and legal environment or the market of the assets) to see whether significant adverse changes affecting the fair value of long-lived assets occur. Therefore, based on management's "reporting motivation" and a firm's "operational factors", managers may exploit the discretion allowed under SFAS No. 35 in determining the amount of impairment losses for long-lived assets. Our second research issue is to explore the determinants of the size of assets impairment.

Finally, we examine market reactions to the announcement of assets impairment losses. Previous studies suggest that impairment announcements may have any of three different information contents: The first one is that impairment information reflects a decrease in economic values of company assets. Under this viewpoint, a negative market reaction to this impairment announcement is expected. The second one is that impairment information is a signal of changes in strategy to improve future performance. A positive market reaction to this impairment announcement is expected. The third one is that impairment information may reflect a firm's willingness and ability to manage earnings opportunistically. It is not clear whether investors react positively or negatively to this information.

This study investigates determinants of the timing and the amount of assets impairment decisions for listed firms in Taiwan. We also examine market reaction to impairment announcements. Our paper is organized as follows: Section two summarizes prior studies on assets impairment. Section three describes our hypotheses and research design. Section four presents sample selection, descriptive statistics and empirical results. Section five includes sensitivity tests. Section six presents our conclusions and suggestions.

II. LITERATURE REVIEW

Before the U.S. SFAS No. 121 was issued in December 1995, there was no mandatory accounting requirement for firms to reduce the carrying value of a long-lived asset that had become impaired. During this period of time, the only related FASB standard was the SFAS No. 5, *Accounting for Contingencies* (1975), which provided some general guidelines by requiring firms to recognize impairment loss only if an asset might be impaired and the amount of loss could be reasonably estimated. However, the discretionary flexibility of SFAS No.5 resulted in various accounting treatments and reportings of assets impairments. Before the issuance of SFAS No. 121, the U.S. GAAP, in fact, allowed managers a lot of discretion in deciding when to recognize a writedown and how much to write down the assets. And consequently, assets impairment decisions became a matter of managers' discretion.

Most studies done in the U.S. on assets writedowns under SFAS No. 5 were information-content research. However, the empirical results were inconsistent as to whether assets writedowns constituted good or bad news. Some studies argued that firms' recognizing assets impairment was good news, since it conveyed a signal of possible improvement in future performances. For example, Strong and Meyer (1987) examined the effect of announcements of asset writedowns under SFAS No. 5 on security returns.

They found negative average CARs around the impairment announcements date. However, the negative returns were reversed in sixty days after the impairment announcement date. Therefore, they endorsed the argument that recognizing assets impairment conveyed signals of improving future performance. Rees, the Gill and Gore (1996) held the same position. Examining the relationship between assets writedowns under SFAS No. 5 and abnormal accruals, Rees et al. found that firms recognized significantly more negative abnormal accruals in the years of assets writedowns, and these accruals were not reversed in subsequent years. They argued that the writedowns and concurrent discretionary accruals were appropriate responses of managers to a changing economic environment, rather than managers' opportunistic earnings management. Managers could use their discretion to signal value-relevance information to investors so that assets writedowns helped in valuing a firm.

However, some argued that recognizing assets impairment reflected real damage to the firm's earning power. Elliott and Shaw (1988) found that U.S. firms usually recognized assets writedowns under SFAS No. 5 in audited annual reports, instead of in interim reports. They showed that assets writedowns would cause long-term decreases in stock returns. Their empirical results did not support the argument that recognizing assets impairment conveyed a signal of improving future performance. Francis, Hanna, and Vincent (1996) obtained similar results. Studying firms' characteristics for assets writedowns decisions and market reaction to writedowns under SFAS No. 5, Francis et al. discovered that assets writedowns were positively related to changes in CEOs. They also found negative market reaction to assets writedown announcements. Bartov, Lindah, and Ricks (1998) found significantly negative stock returns in years after a firm recognized assets writedowns under SFAS No. 5. They argued that the market might not fully understand the economic consequences of assets impairment.

Nevertheless, some studies documented no significant market reaction to assets writedown under SFAS No. 5. Zucca and Campbell (1992) argued that recognizing assets impairment was, for a firm, managing earnings (e.g., taking "big baths" or smoothing income). They found no significant market reaction to assets writedown announcements under SFAS No. 5, since investors could see through manipulations. Hogan and Jeter (1998) also found no significant relationship between CAR and assets writedowns under SFAS No. 5. They argued that asset writedowns might reflect changes in CEOs, rather than substantial impairments in long-lived assets.

With respect to motivations to write down long-lived assets, Strong and Meyer (1987), Elliott and Shaw (1988), Zucca and Campbell (1992), Francis et al. (1996), Rees et al.(1996), Hogan and Jeter (1998) all found that firms' writedown decisions were generally associated with managers reporting motivations. Examining the motivation of revaluating long-lived assets for 72 Australian firms during the years 1981 through 1990, Easton, Eddy and Harris (1993) interviewed CFOs of these sample firms and found that assets revaluation showed very weak association with stock performance. Revaluation of long-lived assets was not done in a timely manner. Further, Easton and Eddey (1997) extended the Easton et al. (1993) study by including a recent period (1990~1993) when Australian firms most likely suffered assets impairment. Barth and Clinch (1998) also extended the Easton et al. (1993) study to examine the explanatory power of assets revaluations regarding stock price and two-years-ahead earnings forecasts. Both studies

concluded that assets revaluation for a firm generally was not done in a timely manner in general. Using U.S. data, Heflin and Warfield (1997) obtained similar results. They documented that American firms delayed recognizing assets writedowns for three years on average. They indicated managers recognizing assets writedowns aimed at managing earnings, instead of recording the real assets impairment. Managers tended to recognize assets writedowns in the years when earnings were really poor to "clear the deck" or in the years when earnings were extremely good to smooth reported earnings. Deng and Lev (1998) also documented that, after recognizing assets impairment, a firm's returns on assets and returns on equity tend to increase in the next year.

After U.S. SFAS No. 121 was issued in December 1995, few studies examined the impact of SFAS No. 121. Comprix (2000) documented that firms recognizing assets impairment under SFAS No.121 would make the book values of their long-lived assets closer to market values. Also, investors would value a firm lower if it recognized assets impairment. In addition, the records of earnings performance and the history of assets impairment could influence investors' valuation of the firm. Riedl (2004) found the assets writedowns were highly related with economic factors before SFAS No.121. However, after SFAS No. 121, firms recognizing assets impairment aimed at taking a "big bath" to manage earnings, reflecting managers' opportunistic reporting behavior rather than providing private information to reduce information asymmetry. Consequently, Riedl argued that the quality of financial reporting after SFAS No.121 decreased.

In Taiwan, there was no accounting standard for assets impairment before Taiwan's SFAS No. 35 was issued in 2004, nor was there any academic study relating to assets writedowns under Taiwan's SFAS No. 9, *Accounting for Contingencies and Subsequent Events* (1986), to the best of our knowledge. Due to expected severe impacts of Taiwan's SFAS No. 35 on financial statements and stock prices, we investigate the determinants of the timing and amount of assets impairment for listed firms in Taiwan. In addition, we examine market reaction to impairments announcements in Taiwan in this study.

III. HYPOTHESES DEVELOPMENT

We first investigate the determinants of adoption timing of SFAS No. 35 for listed firms in Taiwan. Taiwan's SFAS No. 35 was promulgated on July 1, 2004 and was effective on January 1, 2005. However, early adoption was allowed. Therefore, managers could use reporting flexibility in determining whether to adopt SFAS No. 35 on time in the first quarter of 2005 or earlier in 1994. The adoption time of SFAS No. 35 is at the managers' discretion.

Zucca and Campbell (1992) argued that recognizing assets writedowns under SFAS No. 5 was one of the means of earnings management. Some managers managed earnings for taking "big baths," others for income smoothing. Riedl (2004) also found that, after SFAS No.121 was issued, the main motivation for recognizing assets impairment losses was for taking "big baths" for improving the future profitability of the firm. Francis et al. (1996) documented that in the years of changing CEOs, recognizing assets writedowns was very common. This implies the new CEO intends to clean up losses that occurred in the tenures of preceding CEOs to make a fresh start. This is literature evidence that recognizing assets impairment losses is associated with managers' reporting motivation.

Furthermore, SFAS No. 35 requires that, if there is any indication that an asset may be impaired, managers should estimate the recoverable amount of impaired long-lived assets in order to make sure the long-lived assets are impaired. Such "indications" include simultaneously internal and external information. Therefore, firms adopting SFAS No. 35 early are driven, not only by managers' reporting motivation, but also by the firms' operational factors. Thus, our first hypothesis is proposed as follows：

Hypothesis 1: The adoption timing of SFAS No. 35 is associated with both management's "reporting motivations" and a firm's "operation factors."

The proxies and predicated signs of "reporting motivations" and "operational factors" are described in the next section.

Secondly, we explore the amount of assets impairment for listed firms in Taiwan. Although Taiwan's SFAS No. 35 provides some guidance on the evaluation, measurement, recognition of impairment loss, this statement could not totally eliminate management's discretion on the timing and amount of assets impairment. In addition, before assets impairment loss is determined, management is required by SFAS No. 35 to consider not only firm's internal information, but also external information outside the firm, such as significant unfavorable current and future changes in industry technology, market, economic, legal environments, and the market to which the asset belongs. Therefore, the amount of assets impairment may be affected by both management's "reporting motivations" and a firm's "operational factors." Accordingly, our second hypothesis is proposed as follows:

Hypothesis 2: The amount of assets impairment decision is associated with management's "reporting motivations" and a firm's "operational factors."

The proxies and expected signs of "reporting motivations" and "operational factors" are also described in the next section.

Finally, we examine the information content of assets impairment for Taiwan's listed firms. Francis et al. (1996) indicated that announcement of assets writedowns might be interpreted by investors in three different ways. First, it might signal a real decrease in the economic value of assets so that negative market reaction to the impairment announcement would occur. Second, it might signal changes in management strategy and improvement in future profitability so that positive market reaction to the impairment announcement would happen. Third, it might signal management's manipulation of earnings so that market would not react to the assets impairment announcement. Previous studies of market reaction to assets impairment were inconsistent. Strong & Meyers (1987), Rees et al. (1996) found significantly positive market reaction to the assets writedowns announcements. On the contrary, Elliot and Shaw (1988), Francis et al. (1996) documented significantly negative market reaction to the assets writedowns. Nevertheless, Zucca and Campbell (1992), Hogan and Jeter (1998) found insignificant market reaction to assets writedowns.

Most stock transactions in Taiwan's stock market are made by individual investors.

Individual investors accounted for 77.57%[5] of total trading volume in the Taiwan Stock Exchange in 2004. Institutional investors that have ability to hire accounting and finance professionals to examine financial statements only accounted for 22.43% of total trading volume. Therefore, we do not expect that the current Taiwan stock market as a whole could fully understand financial reports. As indicated in Section I, Taiwan's stock market reactions to early adopters of SFAS No. 35 were extremely negative, causing serious concerns from Taiwan's Executive Yuan, Legislative Yuan, Financial Supervisory Commission and the financial press. Therefore, we expect that investors will react negatively to the assets impairment information for firms early adopting SFAS No. 35 and recognize assets impairment loss in 2004 annual reports (which are audited by external auditors). However, since assets impairment involves management judgment and estimation, unaudited quarterly financial statements receive less credibility. Accordingly, the negative market reaction to the assets impairment loss in the unaudited 2005 first-quarter financial report would be reduced. Thus, our third hypothesis is proposed as follows:

Hypothesis 3: Taiwan's stock market would negatively respond to assets impairment losses disclosed in the 2004 annual report (which was audited by external auditors), and in the first quarter of 2005 (which was not audited by external auditors) to a lesser extent.

IV. RESEARCH DESIGN

Determinants of the Timing and Amount of Assets Impairment Decision

Taiwan's SFAS No. 35 was issued on July 1, 2004, and effective for financial statements ending on and after December 31, 2005, with early adoption allowed. That is, managers could early adopt SFAS No. 35 in the second, third, or fourth quarter of 2004, or adopt it in the first quarter of 2005. Elliott and Shaw (1988) found that U.S. firms usually recognized assets impairment losses in the audited annual report. We also find that Taiwan's listed firms chose early adoption of SFAS No. 35 in the 2004 annual report (fourth quarter), rather than in the second or third quarter of 2004.

We investigate first the determinants of adoption timing of SFAS No. 35. Our experiment group consists of early adopters of SFAS No. 35 in the 2004 annual report for listed firms in Taiwan; the control group consists of firms matching our experiment group in terms of market value (size), industry, and recognizing impairment loss in the first quarter of 2005. Secondly, we explore the determinants of amount of assets impairment losses. Our experiment group thus consists of firms recognizing assets impairment losses in 2004 annual report or in the first quarter of 2005, while the control group consists of firms matching our experiment group in terms of market value (size), industry, and not recognizing impairment loss in the same periods. Finally, we examine information content of assets impairment for listed firms in Taiwan. The sample consists of listed

[5] "Statistics of Investors Structure in terms of Trading Volume on TSEC Market," by Securities and Futures Bureau, Financial supervisory Commission, Executive Yuan, 2005. (http://www.sfb.gov.tw/statistics/point/9507/t16.xls)

firms in Taiwan with assets impairment disclosure.

We define assets impairment loss as the difference between the carrying amount of long-lived assets and its economic value (recoverable amount), including decrease in investment income resulting from impairment loss on long-term equity investments by the equity method. Impairment losses for five types of long-lived assets (that is, long-term equity investment, fixed assets, goodwill, identifiable intangible assets and other assets) are available from footnote of each firm's financial statements.

Logistics regression is employed to examine the adoption timing of SFAS No. 35 for listed firms in Taiwan in Hypothesis 1. We estimate a logistics regression as follows:

$$ADOPT_i = \alpha_0 + \alpha_1 BATH_i + \alpha_2 SMOOTH_i + \alpha_3 \Delta MGT_i + \alpha_4 FIN_i + \alpha_5 \Delta INDROA_i + \alpha_6 ELEC_i + \alpha_7 RET_i + \alpha_8 \Delta SALE_i + \alpha_9 \Delta OCF_i + \alpha_{10} MTB_i + \varepsilon_i \quad (1)$$

where,

$ADOPT_i$: indicator variable, which equals 1 if firm *i* recognizes impairment loss in 2004 annual report, and 0 otherwise.

Hypothesis 2 explores the determinants of the amount of assets impairment. If a firm does not recognize assets impairment loss, the value of dependent variable (amount of impairment) is zero. Once assets impairment loss is recognized, the dependent variable will be a ratio scale. The dependent variable, therefore, is a truncated datum. Thus, we employ a tobit regression to explore the amount of assets impairment (Hypothesis 2). We estimate a tobit regression as follows:

$$WOTA_{it} = \alpha_0 + \alpha_1 BATH_{it} + \alpha_2 SMOOTH_{it} + \alpha_3 \Delta MGT_{it} + \alpha_4 FIN_{it} + \alpha_5 \Delta INDROA_{it} + \alpha_6 ELEC_{it} + \alpha_7 RET_{it} + \alpha_8 \Delta SALE_{it} + \alpha_9 \Delta OCF_{it} + \alpha_{10} MTB_{it} + \varepsilon_{it} \quad (2)$$

where,

$WOTA_{it}$: firm *i*'s impairment loss[6] at quarter *t*, divided by firm *i*'s total assets

[6] The assets impairment losses under SFAS No. 35 may not be deductible from undistributed earnings that are subject to 10% surtax. The Tax Agency of the Ministry of Finance, R.O.C. announced that:

"SFAS No.35 Accounting for the impairment of assets requires that long-lived assets, such as fixed assets, identifiable intangible assets, goodwill, and long-term equity investment by equity method, should valuated in the lesser of carrying value and its recoverable amount. The difference between the recoverable amount and carrying value shall be recognized as impairment loss. If such impairment loss (except for goodwill) does not exist or is reduced in subsequent period, the firm should restore previously recognized impairment loss as income in that period."According to Article 66-9 of the income tax law, the 10% surtax on undistributed earnings is based on taxable income. In calculating the undistributed earnings, gain or loss derived from the time difference between financial accounting and tax regulation would not be deductible or addable. Hence, unrealized impairment loss or restoring previously recognized impairment loss under SFAS No.35 belongs to the timing differences between financial accounting and tax regulation. Accordingly, impairment loss and its restored amount would not be a deduction or an addition in calculating the 10% surtax of undistributed earnings. Impairment loss under SFAS No.35

at the end of quarter *t-1*.

$BATH_{it}$: proxy for taking big baths. If ΔE_{it}[7] < median of the "unexpected negative earnings"[8], then $BATH_{it} = \Delta E_{it}$; otherwise, $BATH_{it} = 0$.[9]

$SMOOTH_{it}$: proxy for income-smoothing. If ΔE_{it} > median of the "unexpected negative earnings"[10], then $SMOOTH_{it} = \Delta E_{it}$; otherwise, $SMOOTH_{it} = 0$.[11]

ΔMGT_{it} : indicator variable, which equals 1 if firm *i* changes its top management (defined as CEO, chairman of the board or CFO) from year *t-1* to *t*; and 0 otherwise.

FIN_{it} : extent of demand for capitals = (total amounts of firm *i*'s issuance of equity capital and corporate bonds in quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*.)

$\Delta INDROA_{it}$: growth rate of return on assets for the industry = (the median of growth rate of return on assets from quarter *t-1* to *t* in firm *i*'s industry).

$ELEC_{it}$: indicator variable, which equals 1 if firm *i* belongs to electronics industry at the end of quarter *t*; and 0 otherwise.

RET_{it} : firm *i*'s quarterly stock returns = (fim *i*'s stock returns from quarter *t-1* to *t*).

$\Delta SALE_{it}$: firm *i*'s growth in quarterly sales = (firm *i*'s sales in quarter *t* − firm *i*'s sales in quarter *t-1*) / firm *i*'s total assets at the end of quarter *t-1*.

ΔOCF_{it} : firm *i*'s growth in cash flows from operations = (firm *i*'s cash flows from operations in quarter *t* − firm *i*'s cash flows from operations in quarter *t-1*) / firm *i*'s total assets at the end of quarter *t-1*.

MTB_{it} : indicator variable, which equals 1 if firm *i*'s market-to-book ratios is below 1 at the end of quarter *t*; and 0 otherwise.

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belongs to unrealized loss. Tax regulation allows firms to recognize losses in assets only when assets are damaged, discarded, disposed of, or disinvestment or liquidation of investee companies." (Taxation Agency, 2005/2/25) Apparently, firms recognizing assets impairment loss under SFAS No. 35 in Taiwan cannot save taxes. Therefore, we do not consider the tax effect of impairment loss in this paper.

7 Unexpected earnings (ΔE_{it}) = (firm *i*'s pre-impairment earnings in quarter *t* − firm *i*'s earnings in quarter *t-4*) / firm *i*'s total assets at the end of quarter *t-1*.

8 Unexpected negative earnings is defined as unexpected earnings being less than zero. We then rank all unexpected negative earnings for all firms in the same period and find its median.

9 As suggested by Reidl (2004).

10 Unexpected positive earnings is defined as unexpected earnings being more than zero. We then rank all unexpected positive earnings for all firms in the same period and find its median.

11 As suggested by Reidl (2004).

Reporting motivations

Management has considerable discretion on the timing of adopting SFAS No. 35 and on the amount of assets impairment. Zucca and Campbell (1992) indicated that if managers' objective in recognizing assets impairment is to manipulate earnings, they might take either the "income-smoothing" tactic or the "taking-big-baths" tactic. Murthy (1985), Antle & Smith (1986), Lambert et al. (1987) argued that management's incentive plans generally tie in with reported income. Managers have motivations to maximize their bonuses through manipulating accounting earnings. Income smoothing literature argues that if management incentive plans are based on the income-smoothing purpose, managers will do so for their personal interest. Thus, management will selectively recognize assets impairment losses in periods with high earnings to attain the goal of income smoothing. Taking big baths literature argues that when earnings are abnormally low, management has incentive to "clear the deck" by recognizing assets impairment losses to signal that "the worst period has already passed and the future will be bright."

Following Riedl (2004), we use independent variables BATH and SMOOTH to represent the taking-big-baths tactic and the income-smoothing tactic, respectively. BATH is defined as the unexpected negative earnings if they are lower than the median for all firms in the same quarter, and zero otherwise. It represents that the firm has unexpected poor earnings performance. On the contrary, SMOOTH is defined as the unexpected positive earnings if it is higher than the median for all firms in the same quarter, and zero otherwise. It represents that the firm has unexpected good earnings performance. When management employs the taking- big-baths tactic to manipulate earnings, it will adopt SFAS No. 35 in the period of exceptionally poor earnings to "clear the deck." We expect a negative relation between BATH and early adoption of SFAS No. 35 or the amount of impairment losses. On the other hand, if management uses the income-smoothing tactic to manipulate earnings, it will adopt SFAS No. 35 in the period of exceptionally good earnings performance to recognize a large amount of impairment losses. We expect a positive relation between SMOOTH and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

Other reporting motivations include change in top management. New management has incentive to "clear the deck" by recognizing assets impairment losses to improve its future financial performance. Following Francis *et al.* (1996), ΔMGT is defined as changes in CEO, chairman of the board, or CFO. We expect a positive relation between ΔMGT and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

When a firm needs long-term capital, it may issue capital stock or corporate bond. However, the ability to raise capital and the cost of the new capital depend on a firm's reported earnings. In order to raise additional capital at lower cost, management would be reluctant to recognize assets impairment losses. We use FIN (the amount of seasonal equity and debt issuances deflated by total assets) to capture the need for long-term capital. We expect a negative relation between FIN and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

Operational factors

SFAS No. 35 requires that, when there are indications that an asset may be impaired on the financial reporting date, management should estimate the recoverable amount of the impaired long-lived assets to make sure the long-lived assets are impaired and to adjust the value of assets according to current position. Such "indications" include internal information and external information. Examples of internal information for assets impairment are: evidence of physical damage or obsolescence of an asset, or significant adverse changes in the scope or in the manner in which an asset is used or is expected to be used have occurred or will take place in the near future. Examples of external information for assets impairment are: the decline of an asset's market value during the period being significantly larger than the expected decline as a result of the passage of time or normal use; or significant adverse changes in industrial technology, market, economy, legal environment, or in the market to which the asset belongs having occurred during the period or will take place in the near future. Since an assets impairment decision could be driven by industry condition, a firm's operational condition and assets usage condition, we further consider the operational factors in order to capture the cross-sectional variation of impairment losses.

Assets impairment may be related with changes in industrial technology and business environment. Firms in a declining industry are more likely to recognize larger amounts of impairment losses; and firms in a growing industry are less likely to have assets impairment. Therefore, the industry performance can influence the timing of adopting SFAS No. 35 and the amount of assets impairment losses. We use the change in industry return on assets (Δ INDROA) to capture the industry effect on the timing and amount of assets impairment decisions, and we predict a negative association between them, as suggested in Riedl (2004). In addition, due to the fact that the electronics industry has a higher reinvestment ratio and shorter life cycle, firms in this industry are more likely to recognize assets impairment losses. We expect a positive relationship between the electronics industry indicator (ELEC) and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

Furthermore, assets impairment losses may be affected by a firm's past operational and assets-usage conditions. Francis et al. (1996) suggested that the worse a firm's past stock price performance has been, the more likely management will clear the deck of impaired assets. Since a firm's stock price reflects investors' expectation on the firm's future performance, we employ stock returns before assets impairment (RET) to capture investors' expectation on the firm's future performance, and expect a negative relationship between RET and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

Poor usage and idle capacity of an asset will reduce its value. Riedl (2004) argued that recognizing assets impairment losses implies lowering the recovery of specific assets. He used sales growth (ΔSALE) to capture assets recovery in an accrual basis and used operational cashflows growth (ΔOCF) to capture assets recovery in cash basis. We expect a negative relationship between Δ SALE (or Δ OCF) and the amount of assets impairment losses. However, when determining the adoption timing of SFAS No. 35, management will consider whether a firm can bear the impact of recognizing impairment losses. A firm will early adopt SFAS No. 35 only when its sales growth and operational cashflows

growth are high enough. Accordingly, we expect a positive association between Δ SALE (or Δ OCF) and the early adoption of SFAS No. 35.

In addition, SFAS No. 35 states that, when the carrying amount of an asset is larger than its market value, it is an indication that an asset may be impaired. Therefore, if a firm's market-to-book ratio (MTB) is below 1, then the firm's assets may be impaired. We expect a negative relationship between MTB and the early adoption of SFAS No. 35 or the amount of assets impairment losses.

The Relationship between Assets Impairment Losses and Stock Returns

This paper also examines market reaction to assets impairment losses in event study. As described earlier, assets impairment losses may have negative, positive, or no market reactions, which are interpreted as decrease in economic value of assets, providing a signal of improving future profitability, or opportunistic earnings management, respectively. We retrieve the earnings announcement dates in *Taiwan Economic Journal* (*TEJ*) databank for the firms that disclosed assets impairment losses in their interim and annual financial statements from the second quarter of 2004 to the first quarter of 2005. We use the event-study module in *TEJ* to calculate firm *i*'s market-adjusted returns accumulated from day -2 to +1 as dependent variable. The estimation period is from day -302 to -3 relative to the announcement date (day 0). Since assets impairment information is disclosed in interim or annual reports, market will react to the assets impairment losses and unexpected earnings simultaneously. Therefore, we include unexpected earnings (UE) as independent variable in our testing mode (3) to control the effect of earnings announcement. In addition, firm size (SIZE) is also included for controlling the size effect:

$$CAR_i(-2,1) = \beta_0 + \beta_1 WOTA_i + \beta_2 UE_i + \beta_3 SIZE_i + \varepsilon_i \quad (3)$$

where,

CAR_i(-2,1) : firm *i*'s market-adjusted return accumulated from day -2 to +1 relative to the announcement date (day 0).

Independent variables are:

$WOTA_i$: firm *i*'s assets impairment losses at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*.

UE_i : (firm *i*'s pre-impairment earnings at quarter *t* − firm *i*'s earnings at quarter *t-4*) / firm *i*'s earnings at quarter *t-4*.

$SIZE_i$: Natural logarithm of firm *i*'s total assets at the end of quarter *t-1*.

In addition, footnote information in financial statements segregate impairment losses from five different types of assets (i.e., long-term equity investment, fixed assets, goodwill, identifiable intangible assets and other assets). Aggregating impairment losses from five types of assets into a single item may lose some information. Thus, following the suggestion in Francis et al. (1996), we also include impairment losses from five

different types of assets, respectively, in our testing model (4) to investigate possible different market reactions for each type of asset.

$$CAR_i(-2,1) = \gamma_0 + \gamma_1 EQUTA_i + \gamma_2 FATA_i + \gamma_3 GWTA_i + \gamma_4 IATA_i + \gamma_5 OATA_i + \gamma_6 UE_i + \gamma_7 SIZE_i + \varepsilon_i \quad (4)$$

where,

CAR_i(-2,1) : firm *i*'s market-adjusted return accumulated from day -2 to +1 relative to the announcement date (day 0).

$EQUTA_i$: firm *i*'s impairment loss for long-term equity investment at quarter *t* (decrease in investment income resulting from impairment loss on long-term equity investments in equity method), divided by firm *i*'s total assets at the end of quarter *t-1*.

$FATA_i$: firm *i*'s impairment loss for fixed assets at quarter t, divided by firm i's total assets at the end of quarter *t-1*.

$GWTA_i$: firm *i*'s impairment loss for goodwill at quarter t, divided by firm i's total assets at the end of quarter *t-1*.

$IATA_i$: firm *i*'s impairment loss for identifiable intangible assets (except for goodwill) at quarter *t*, divided by firm i's total assets at the end of quarter *t-1*.

$OATA_i$: firm *i*'s impairment loss for other assets at quarter *t*, divided by firm i's total assets at the end of quarter *t-1*.

UE_i : firm *i*'s change in pre-impairment earnings from quarter *t-4* to *t*, divided by firm *i*'s earnings at quarter *t-4*.

$SIZE_i$: Natural logarithm of firm *i*'s total assets at the end of quarter *t-1*.

IV. EMPIRICAL RESULTS

Sample Selection and Data Sources

On July 1, 2004, the Financial Accounting Standards Committee of the Accounting Research and Development Foundation of the Republic of China issued SFAS No. 35, *Accounting for the Impairment of Assets*. This accounting standard came effective for financial statements ending on and after December 31, 2005, with early adoption permitted. Therefore, Taiwan's listed firms are required to adopt SFAS No. 35 in the first quarter of 2005. First of all, we examine the determinants of adoption timing of SFAS No. 35 and the amount of assets impairment losses, respectively, for listed firms in Taiwan.

Panel A of Table 1 illustrates our sample selection process. From the updated quarterly financial data of listed firms in the *TEJ* Finance database (May 2005), we find 341 listed firms in Taiwan recognizing assets impairment losses in their 2004 annual reports or in the first quarter of 2005. However, the *TEJ* database doesn't include firms

that made long-term equity investments accounted by the equity method and reduce their investment income due to assets impairment losses recognized by investee companies. We believe that such long-term equity investor companies should be included in our sample since these investor companies have significant influence on major decisions of investee companies, such as the adoption timing of SFAS No. 35 and the amount of assets impairment losses recognized. After checking data disclosed on the Taiwan's Market Observation Post System, we include additional 36 firms with long-term equity investment having the stated nature in our sample.

However, we exclude 3 firms (Walsin Lihwa, Zinwell and Universal Technology) that have assets impairment losses in both 2004 annual report and the 2005 first quarterly report. In addition, 10 firms in the banking industry are also excluded because the accounting of this regulated industry is substantially different from accounting for firms in other industries. Our final sample firms with asset impairment losses consists of 364 listed companies, including 105 firms recognizing assets impairment losses in their 2004 annual reports (the "early adopters" of SFAS No. 35) and 259 firms recognizing impairment loss in the first quarter of 2005 (the "non-early adopters").

In testing Hypothesis 1 (Investigating the determinants of the adoption timing of SFAS No. 35), the experiment group is those 105 firms recognizing assets impairment losses in their 2004 annual reports, and the matched control sample consists 105 firms that adopted SFAS No. 35 in the first quarter of 2005 in the same industry and of similar market value (size). In total, we have 210 observations for testing the Hypothesis 1. However, when testing Hypothesis 2 (Exploring the determinants of the amount of assets impairment losses), the experiment group is those 364 firms recognizing assets impairment losses in either their 2004 annual reports or 2005 first-quarter reports, and the matched control sample consists another 364 firms that did not recognize assets impairment losses in the same period, in the same industry and of similar market value (size). The final sample size for Hypothesis 2 is 728 firms.

In order to further analyze the determinants of the amount of assets impairment losses for each of the five types of long-lived assets (i. e., long-term equity investment, fixed assets, goodwill, identifiable intangible assets and other assets), we collect respective impairment data from footnotes of 2004 annual reports and 2005 first-quarter reports in the financial report database of the Market Observation Post System. The event dates of assets impairment losses disclosure and earnings announcement are retrieved from financial announcement dates in the financial market events data of the *TEJ* Firm Database.

Panel A of Table 1 illustrates the industry distribution of firms with assets impairments. We find sample firms are concentrated in the electronics industry (49.73% = 181/364), which is consistent with our hypothesis proposing that SFAS No. 35 will have more effect on the electronics industry. In addition, the proportion of firms with assets impairments in the Taiwan Stock Exchange (= 20.45% = 245/1198) is close to that in the GreTai Securities Exchange (OTC) (19.50% = 119/610).

Table 1: The Sample Selection and Industries Compositions

Panel A：Sample Selection Process

Firms with impairments in the first six months of 2005 in *TEJ* database	341
add: Firms reducing their investment income resulting from impairment loss on long-term equity investments accounted for in the equity method	36
less: Firms with impairment disclosures in both their 2004 annual reports and 2005 first-quarter reports	(3)*
Firms in the Banking industry	(10)
Final sample: Firms with assets impairments	364
Early adopters (impairments disclosed in the 2004 annual reports)	105**
Non-early adopters (impairments disclosed in the 2005 first-quarter reports)	259
Matched sample: Firms without assets impairments (for Hypothesis 2)	364

* Three firms (Walsin Lihwa, Zinwell and Universal Technology) disclosed assets impairment losses in both their 2004 annual reports and 2005 first-quarter reports, as shown in the TEJ Database.

** The control group for Hypothesis 1 consists of firms that adopted SFAS No. 35 in the first quarter of 2005.

Panel B：Sample Compositions by Industries, Exchanges, and Timing of Adopting SFAS No. 35

			Exchange		Adopting SFAS No. 35	
Industries	Number	Percentage	TSE-Listed firms(n=1198)	OTC-Listed firms(n=610)	Early Adopters	Non-Early Adopters
Cement	7	1.92%	7	0	1	6
Foods	12	3.30%	11	1	3	9
Plastics	9	2.47%	8	1	0	9
Textiles	30	8.24%	25	5	9	21
Machinery	11	3.02%	8	3	2	9
Wire & Cable	10	2.75%	10	0	3	7
Chemicals	15	4.12%	8	7	2	13
Glass	4	1.10%	4	0	3	1
Paper & Pulp	3	0.82%	3	0	0	3
Steel & Iron	14	3.85%	12	2	8	6
Rubber	2	0.55%	2	0	0	2
Automobiles	1	0.28%	1	0	0	1
Electronics	181	49.73%	99	82	53	128
Construction	27	7.42%	19	8	8	19
Transportation	4	1.10%	3	1	2	2
Tourism	2	0.55%	1	1	0	2
Wholesale	8	2.20%	6	2	5	3
others	24	6.59%	18	6	6	18
TOTAL	364	100.00%	245	119	105	259

Descriptive Statistics of the Sample

Table 2 provides descriptive statistics for firms with assets impairment disclosures. In panel A of Table 2, we show the extent of impairment losses for early adopters and non-early adopters of SFAS No. 35. Among 364 sample firms, 105 (28.85%) are early adopters and 259 (71.15%) are non-early adopters. The mean of impairment losses per share (0.7427) and the mean of assets-deflated impairment loss (0.0318) for early adopters are significant higher than that of non-early adopters (0.3536 and 0.0168 respectively). It seems that an early adopter has incentives to "clean the deck" through recognizing a large amount of impairment losses.

Types of long-lived assets subject to revaluation under SFAS No. 35 include long-term equity investments accounted for by the equity method, fixed assets, goodwill, identifiable intangible assets, and other assets. Panel B of Table 2 shows descriptive statistics of these five types of impairment losses. The total percentage of firms recognizing these five types of impairment losses is over 100% (=541/364), which implies some firms recognize more than two types of impairment losses. Furthermore, we also find the rankings in percentage and extent of the types of impairment losses are the same. The top three types of assets suffering impairment losses are: fixed assets (31.61%), long-term investments (27.17%) and other assets (26.43%). In addition, the impairment losses per share and assets-deflated impairment losses for these three assets are also substantially higher than other types of long-lived assets, such as goodwill and identifiable intangible assets.

Table 3 shows the relationship between the timing of adopting SFAS No. 35 and earnings performance. For 105 early adopters, 65 (61.9%) have pre-impairment net losses and 40 (38.1%) have pre-impairment net income. For 259 non-early adopters, on the contrary, 121 (46.7%) have pre-impairment net losses and 138 (53.3%) have pre-impairment net income. The χ^2 value of the contingency table is 6.8957 ($p < 0.01$) and categorical φ coefficient is 0.1376. These statistics show that a firm's earnings performance significantly affects its adoption time of SFAS No. 35. Firms with poor earnings performance would take "big baths" by recognizing impairment losses in hope that their future earnings will improve. Therefore, their managers early adopt SFAS No. 35 in 2004 annual report to clean up assets impairment losses.

Panel A of Table 4 presents descriptive statistics for sample firms with and without assets impairment losses, respectively. Univariate analyses show that, irrespective of other factors, firms with assets impairment losses have significantly higher ΔMGT but significantly lower BATH and MTB. It seems that management's reporting motivations (changes in top management, taking big baths) and a firm's operational factor (the market-to-book ratio) are significantly different between impairment observations and non-impairment observations.

Table 2: Descriptive Statistics for Sample Firms with Impairment Disclosure

Panel A：The Frequency and Amounts of Impairment Losses

Adoption of			Impairment loss per share[1]				Deflated impairment loss[2]			
SFAS No. 35	Number	Percentage	Max.	Min.	Mean	Median	Max.	Min.	Mean	Median
Early adopters	105 [3]	28.85%	7.9868	0.0197	0.7427	0.4087	0.3120	0.0008	0.0318	0.0167
Non-early adopters	259 [4]	71.15%	4.0574	0.0000	0.3536	0.1521	0.1944	0.0000	0.0168	0.0065
Total	364	100.00%								

Panel B: The Frequency and Amounts of Different Types of Impairment Losses

Types of	Early adopters		Non-early adopters		Total		Impairment loss per share[1]				Deflated impairment loss[2]			
Impairment loss	n	%	n	%	n	%	Max.	Min.	Mean	Median	Max.	Min.	Mean	Median
Long-term investment	44	41.90%	103	39.77%	147	27.17%	6.0800	0.0000	0.1225	0.0000	0.2121	0.0000	0.0049	0.0000
Fixed assets	55	52.38%	116	44.79%	171	31.61%	4.0574	0.0000	0.1840	0.0000	0.1944	0.0000	0.0086	0.0000
Goodwill	14	13.33%	21	8.11%	35	6.47%	2.1748	0.0000	0.0286	0.0000	0.0849	0.0000	0.0014	0.0000
Identifiable intangible assets	13	12.38%	32	12.36%	45	8.32%	2.1129	0.0000	0.0287	0.0000	0.0998	0.0000	0.0014	0.0000
Other assets	43	40.95%	100	38.61%	143	26.43%	3.4240	0.0000	0.1019	0.0000	0.2957	0.0000	0.0048	0.0000
	169 [3]		372 [4]		541									

[1] Impairment losses per share = impairment losses / outstanding shares
[2] Deflated impairment losses = impairment losses / total assets at the beginning of the quarter
[3] Early adopters consist of 105 firms. Because some firms recognize multiple types of impairment losses, the total observations for early adopters are 169.
[4] Non-early adopters consist of 259 firms. Because some firms recognize multiple types of impairment losses, total observations for non-early adopters are 372.
[5] Majority of firms recognize only some types of impairment losses. Therefore, the minima and medians of impairment loss per share and assets-deflated impairment losses are 0's.

Table 3: Contingency Table for Timing of Adopting SFAS No. 35 and Earnings

Adoption Timing of SFAS No. 35	Pre-impairment Net Loss	Pre-impairment Net Income	Total
Early adopters	65 (61.9%)	40 (38.1%)	105 (100%)
Non-early adopters	121 (46.7%)	138 (53.3%)	259 (100%)
Total	186	178	364

[1] Pre-impairment net loss and pre-impairment net income refer to pretax net income and net loss before assets impairment losses.

Table 4: Sample Statistics and Variable Definitions

Panel A：Summary Statistics for Whole Sample (n = 728)

	Impairment observations (n = 364)		Non-impairment observations (n = 364)		Test statistics	
Variable	Mean	Median	Mean	Median	*t*-value	*Z*-value
Reporting Motivations:						
BATH	-0.0103	0.0000	-0.0061	0.0000	1.87*	1.69*
SMOOTH	0.0165	0.0000	0.0128	0.0000	1.04	0.21
Δ MGT	0.3542	0.0000	0.1853	0.0000	5.24***	4.88***
FIN	0.0026	0.0000	0.0028	0.0000	-0.11	0.59
Operational Factors:						
Δ INDROA	-0.0062	-0.0078	-0.0061	-0.0078	-0.37	-0.32
ELEC	0.5000	1.0000	0.5000	1.0000	0.00	0.00
RET	-0.0212	-0.0475	-0.0012	-0.0114	-1.32	-1.60
Δ SALE	-0.0166	-0.0112	-0.0178	-0.0125	0.18	0.00
Δ OCF	-0.0019	-0.0040	-0.0080	-0.0088	1.00	1.22
MTB	1.0951	0.9009	1.2886	1.0912	-3.44***	-3.70***

Panel B：Summary Statistics of Impairment Observations (n=364)

	Early-adopters (n = 105)		Non-early adopters (n = 209)		Test statistics	
Variable	Mean	Median	Mean	Median	*t*- value	*Z*-value
Reporting Motivations:						
BATH	-0.0283	0.0000	-0.0031	0.0000	-4.54***	7.08***
SMOOTH	0.0034	0.0000	0.0209	0.0000	4.01***	-3.99***
Δ MGT	0.3552	0.0000	0.3551	0.0000	0.24	0.24
FIN	0.0057	0.0000	0.0014	0.0000	1.26	0.15
Operational Factors:						
Δ INDROA	-0.0061	-0.0105	-0.0062	-0.0078	0.18	-3.47***
ELEC	0.5048	1.0000	0.4942	0.0000	0.26	0.26
RET	-0.0058	-0.0065	-0.0322	-0.0583	1.24	1.64
Δ SALE	0.0157	-0.0014	-0.0288	-0.0144	4.00***	4.68***
Δ OCF	0.0279	0.0079	-0.0141	-0.0107	4.09***	4.64***
MTB	1.0922	0.8667	1.0972	0.9325	-0.06	-0.76

*, **, and *** indicate statistical significance levels of 10%, 5% and 1%, respectively.

Variable definitions:

$BATH_{it}$: the proxy for taking big baths = (ΔE_{it} < median of the "unexpected negative earnings", then $BATH_{it} = \Delta E_{it}$; otherwise, $BATH_{it}$ = 0.) $SMOOTH_{it}$: the proxy for income-smoothing = (ΔE_{it} > median of the "unexpected negative earnings", then $SMOOTH_{it} = \Delta E_{it}$; otherwise, $SMOOTH_{it}$ = 0.) ΔMGT_{it} : equals 1 if firm *i* changes its top management (defined as CEO, chairman of the board or CFO) from year *t-1* to *t*; and 0 otherwise. FIN_{it} : total amounts of firm *i*'s issuance of equity capital and corporate bonds in quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $\Delta INDROA_{it}$: the median of growth rate of return on assets from quarter *t-1* to *t* in firm *i*'s industry. $ELEC_{it}$: equal 1 if firm *i* at quarter *t* belongs to the electronics industry, and 0 otherwise. RET_{it} : firm *i*'s quarterly stock returns from quarter *t-1* to *t*. $\Delta SALE_{it}$: firm *i*'s change in sales from quarter *t-1* to *t*, divided by total assets of firm i at quarter *t*. ΔOCF_{it} : firm *i*'s change in cash flows from operations from quarter *t-1* to *t*, divided by total assets of firm *i* at quarter *t*. MTB_{it} : equal 1 if firm *i*'s market-to-book ratios at quarter *t* is below 1, and 0 otherwise.

Panel B of Table 4 partitions the impairment observations into early-adopters and non-early adopters. Univariate analyses show that, irrespective of other factors, early-adopters of SFAS No. 35 have significantly lower reporting motivations in BATH and SMOOTH. They also have significantly higher operational factors in ΔSALE, ΔOCF, and significantly lower operational factor in ΔINDROA. Overall, the majority of management's reporting motivations and a firm's operational factors are significantly different between early-adopters and non-early adopters. Since univariate analyses of Table 4 do not consider the effects of other independent variables, we further employ the multivariate analyses in the following section.

Table 5: Logistics Regression: The Timing of Adopting SFAS No. 35 (n=210)

$$ADOPT_i = \alpha_0 + \alpha_1 BATH_i + \alpha_2 SMOOTH_i + \alpha_3 \Delta MTG_i + \alpha_4 FIN_i + \alpha_5 \Delta INDROA_i + \alpha_6 ELLC_i + \alpha_7 RET_i + \alpha_8 \Delta SALE_i + \alpha_9 \Delta OCF_i + \alpha_{10} MTB_i + \varepsilon_i \quad (1)$$

Variable	Predicted Sign	Coefficients (χ^2 value in parentheses)
Intercept		0.2630 (0.32)
Reporting Motivations:		
BATH	−	-41.6901 (16.37) ***
SMOOTH	+	-10.7116 (1.48)
Δ MGT	+	0.2134 (0.37)
FIN	−	6.5466 (1.17)
Operational Factors:		
Δ INDROA	−	-1.4359 (0.01)
ELEC	+	-0.2897 (0.44)
RET	−	1.0880 (1.55)
Δ SALE	+	13.2301 (15.48) ***
Δ OCF	+	11.6091 (12.60) ***
MTB	−	-0.3651 (1.68)
Likelihood ratio		83.1915 ***
Concordant		85.5%

a.*, **, and *** indicate statistical significance levels of 10%, 5% and 1%, respectively.

b.Variables definitions:
$ADOPT_i$: equals 1 if firm *i* recognizes impairment losses in 2004 annual report, and 0 otherwise. $BATH_i$: the proxy for taking big baths = (ΔE_i < median of the "unexpected negative earnings", then $BATH_i = \Delta E_i$; otherwise, $BATH_i$ = 0.) $SMOOTH_i$: the proxy for income-smoothing = (ΔE_i > median of the "unexpected negative earnings", then $SMOOTH_i = \Delta E_i$; otherwise, $SMOOTH_i$ = 0.) ΔMGT_i : equals 1 if firm *i* changes its top management (defined as CEO, chairman of the board or CFO) from year *t-1* to *t*; and 0 otherwise. FIN_i : total amounts of firm *i*'s issuance of equity capital and corporate bonds in quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $\Delta INDROA_i$: the median of growth rate of return on assets from quarter *t-1* to *t* in firm *i*'s industry. $ELEC_i$: equal 1 if firm *i* at quarter *t* belongs to the electronics industry, and 0 otherwise. RET_i : firm *i*'s quarterly stock returns from quarter *t-1* to *t*. $\Delta SALE_i$: firm *i*'s change in sales from quarter *t-1* to *t*, divided by total assets of firm i at quarter *t*. ΔOCF_i : firm *i*'s change in cash flows from operations from quarter *t-1* to *t*, divided by total assets of firm *i* at quarter *t*. MTB_i : equal to 1 if firm *i*'s market-to-book ratio at quarter *t* is below 1, and 0 otherwise.

Multivariate Analysis: Hypothesis One

Table 5 presents the results of logistics regression for exploring the determinants of the timing of adopting SFAS No. 35 for listed firms in Taiwan (Hypothesis 1). The experiment group consists of firms that early adopted SFAS No. 35 in their 2004 annual report (n = 105), and the matched control group consists of firms that adopted SFAS No. 35 in the first quarter of 2005 (n = 105). The concordant of the logistics regression is 85.5%.

We find that, among the reporting motivations, only taking big baths (BATH) (estimated coefficient = -41.61901, $p < 0.01$) is significantly negative, as predicted. Income smoothing (SMOOTH) and other reporting motivations are insignificant. These results reflect that firms which experienced poor earnings performance are apt to early adopt SFAS No. 35. Remarkably, among operational factors, only Sales Growth (ΔSALE) (estimated coefficient = 13.2301, $p < 0.01$) and cash flow growth (ΔOCF) (estimated coefficient = 11.6091, $p < 0.01$) are significantly positive, as predicted. These results show that when determining the timing of adopting SFAS No. 35, management will consider whether a firm can endure the impact of impairment losses. Only if sales growth and operational cashflows growth are high enough will a firm early adopt SFAS No. 35.

Multivariate Analyses: Hypothesis Two

Table 6 presents the results of tobit regressions in examining the determinants for amounts of assets impairment losses for early adopters of SFAS No. 35 (Hypothesis 2). The experiment group consists of 105 firms that early adopted SFAS No. 35 in their 2004 annual report. The matched control group consists of 105 firms without impairment losses in their 2004 annual report, which are matched with our experimental sample firms in terms of market value (size) and industry. The explanatory power of tobit regression is 17.42%. We find the amounts of assets impairment losses for early adopters are only significantly related with management's reporting motivations, such as taking big baths (BATH) (estimated coefficient = -0.1724), income smoothing (SMOOTH) (estimated coefficient = 0.4836) and changes in top management (ΔMGT) (estimated coefficient =0.0219), as predicted. Firms would early adopt SFAS No. 35 to recognize large impairment losses in the period of unexpectedly poor earnings performance to improve future earnings performance or to have the restoration flexibility of impairment losses in the future period (BATH). Firms also may recognize impairment losses in the period of unexpectedly good earnings performance to smooth income (SMOOTH). In addition, new managers would early adopt SFAS No. 35 to recognize a large impairment loss to increase firms' earnings performance in the future period (ΔMGT). Our results are consistent with Zucca and Campbell (1992) who documented that managers recognizing impairment losses aim at taking big baths or smoothing income.

However, firms' operational factors do not affect the amount of assets impairment decision for early adopters in Taiwan. The results in Table 6 indicate managers of early adopters have significant reporting motivations, but insignificant operational factors, for the amount of assets impairment decision. Managers have incentives to "clear the deck" of impaired assets and signal "the worst period has already passed and future performance can be improved." Managers also have incentive to smooth earnings in order to increase their bonuses for the next year. However, the amount of assets impairment decision for

earlier adopters is not significantly associated with firms' operational factors, industrial technology, changes in environment, firms' past operational condition or assets usage conditions.

To examine the above results in depth, we also run separate tobit regressions in Table 6 for each of the five asset types (i.e., long-term equity investment, fixed assets, goodwill, identifiable intangible assets and idle assets) for early adopters. Our empirical results show that the amounts of assets impairment decision for early adopters are driven primarily by management's reporting motivations, especially when top management is changed (Δ MGT). However, firms' operational factors do not play significant roles in the amount of impairment decisions for respective assets types. The explanatory power of regression for long-term equity investment model (20.40%) is the highest one among five assets, and that of goodwill model (4.01%) is the lowest one. In addition, impairment losses from long-term equity and fixed assets for early adopters of SFAS No. 35 are driven primarily by taking big baths (BATH) negatively and changes in top management (Δ MGT) positively. However, impairment losses from idle assets for early adopters are driven primarily by smoothing income (SMOOTH) positively and changes in top management (Δ MGT) positively. Nevertheless, early adopters recognizing impairment losses from goodwill and intangible assets are only driven by changes in top management (Δ MGT) positively, but unaffected by other proxies for management's reporting motivations (estimated coefficients of BATH and SMOOTH are insignificant). Hence, managers of early adopters would not manage earnings through impairment losses from goodwill or identifiable intangible assets. However, managers have motivations to "clear the deck" of impaired fixed assets and impaired long-term investment for improving future earnings. In addition, managers may recognize impairment losses for idle assets in order to smooth earnings and increase their bonuses in the following year.

Table 7 presents the results of tobit regressions in examining the determinants of the amount of assets impairment decision for non-early adopters (Hypothesis 2). The experiment group consists of 259 non-early adopters of SFAS No. 35 in the first quarter of 2005. And, the matched control sample consists of 259 firms without impairment losses in the first quarter of 2005, which are matched with our firms in the experiment group in terms of market value (size) and industry. The explanatory power of tobit regression is 11.04%. Different from early adopters of SFAS No. 35, non-early adopters consider both reporting motivations and operational factors in determining the amounts of assets impairment.

Among reporting motivations for non-early adopters, the income-smoothing proxy (coefficient of SMOOTH = 0.0296) and the top management changes (coefficient of Δ MGT = 0.0075) are significant and consistent with our prediction. The taking big baths variable (BATH) is no longer significant as with early adopters. We infer that firms with unexpectedly poor earnings performance would have adopted SFAS No. 35 early in the fourth quarter of 2004 (evidenced in Table 5). Among operational factors for non-early adopters, stock return performance RET is significant and consistent with prediction, which implies the worse a firm's past stock price performance has been, the more likely its management will recognize the assets impairment losses. However, the sales growth variable, Δ SALE, is significant and contrary to our prediction. Firms with higher sales

growth may face more technological innovations and, therefore, may need to recognize more assets impairments.

Table 6: Tobit Regressions: Determinants for the Amounts of Assets impairment Losses for Early Adopters (n=210)

$$WOTA_{it} = \alpha_0 + \alpha_1 BATH_{it} + \alpha_2 SMOOTH_{it} + \alpha_3 \Delta MGT_{it} + \alpha_4 FIN_{it} + \alpha_5 \Delta INDROA_{it} + \alpha_6 ELEC_{it} + \alpha_7 RET_{it} + \alpha_8 \Delta SALE_{it} + \alpha_9 \Delta OCF_{it} + \alpha_{10} MTB_{it} + \varepsilon_{it} \quad (2)$$

Variable	Predicted Sign	Generic Tobit Regression	Separate Tobit regressions: Long-term investment	Fixed assets	Goodwill	Intangible assets	Idle assets
Intercept		0.0003	-0.0007	0.0034	0.0004	-0.0003	-0.0026
		(0.04)	(-0.23)	(1.93)*	(0.16)	(-0.16)	(-0.66)
Reporting Motivations:							
BATH	—	-0.1724	-0.1376	-0.0410	0.0089	0.0092	-0.0118
		(-3.30)***	(-5.76)***	(-2.77)***	(0.40)	(0.66)	(-0.35)
SMOOTH	+	0.4836	0.0483	-0.0330	-0.0035	0.0356	0.4361
		(2.58)***	(0.56)	(-0.62)	(-0.04)	(0.71)	(3.60)***
Δ MGT	+	0.0219	0.0045	0.0040	0.0040	0.0031	0.0063
		(4.35)***	(1.95)*	(2.80)***	(1.87)*	(2.31)**	(1.94)*
FIN	—	-0.0171	-0.0082	-0.0017	0.0055	-0.0010	-0.0117
		(-0.27)	(-0.17)	(-0.10)	(0.21)	(-0.06)	(-0.29)
Operational Factors:							
ΔINDROA	—	-0.0666	0.3915	-0.0021	0.0571	0.0931	-0.6063
		(-0.12)	(1.57)	(-0.01)	(0.25)	(0.64)	(-1.72)*
ELEC	+	0.0007	0.0017	-0.0014	0.0035	0.0026	-0.0058
		(0.11)	(0.56)	(-0.71)	(1.26)	(1.47)	(-1.34)
RET	—	0.0015	-0.0075	0.0015	-0.0042	0.0011	0.0107
		(0.13)	(-1.36)	(0.44)	(-0.84)	(0.34)	(1.38)
Δ SALE	—	-0.0317	0.0017	0.0037	-0.0057	-0.0001	-0.0312
		(-1.04)	(0.12)	(0.43)	(-0.45)	(-0.02)	(-1.59)
Δ OCF	—	0.0075	-0.0102	-0.0005	-0.0110	0.0044	0.0249
		(0.26)	(-0.79)	(-0.06)	(-0.93)	(0.57)	(1.36)
MTB	—	0.0019	0.0011	-0.0011	0.0002	-0.0002	0.0021
		(0.50)	(0.58)	(-1.06)	(0.10)	(-0.23)	(0.86)
Adj. R^2		17.42%	20.40%	9.71%	4.01%	4.59%	12.53%

a.*, **, and *** indicate statistical significance levels of 10%, 5% and 1%, respectively.
b.*t*-value in parentheses
c.Variable definitions:
$WOTA_{it}$: firm *i*'s pre-impairment loss at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $BATH_{it}$: the proxy for taking big baths = (ΔE_{it} < median of the "unexpected negative earnings", then $BATH_{it} = \Delta E_{it}$; otherwise, $BATH_{it}$ = 0.) $SMOOTH_{it}$: the proxy for income-smoothing = (ΔE_{it} > median of the "unexpected negative earnings", then $SMOOTH_{it} = \Delta E_{it}$; otherwise, $SMOOTH_{it} = 0$.) ΔMGT_{it} : equals 1 if firm *i* changes its top management (defined as CEO, chairman of the board or CFO) from year *t-1* to *t*; and 0 otherwise. FIN_{it} : total amounts of firm *i*'s issuance of equity capital and corporate bonds in quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $\Delta INDROA_{it}$: the median of growth rate of return on assets from quarter *t-1* to *t* in firm *i*'s industry. $ELEC_{it}$: equals 1 if firm *i* at quarter *t* belongs to the electronics industry, and 0 otherwise. RET_{it} : firm *i*'s quarterly stock returns from quarter *t-1* to *t*. $\Delta SALE_{it}$: firm *i*'s change in sales from quarter *t-1* to *t*, divided by total assets of firm i at quarter *t*. ΔOCF_{it} : firm *i*'s change in cash flows from operations from quarter *t-1* to *t*, divided by total assets of firm *i* at quarter *t*. MTB_{it} : equals 1 if firm *i*'s market-to-book ratio at quarter *t* is below 1, and 0 otherwise.

To investigate in depth for the above conclusions, we also run separate tobit regressions for each of the five assets types (i.e., long-term equity investment, fixed assets, goodwill, identifiable intangible assets and idle assets). From Table 7, we find that the amounts of each type of assets impairments for non-early adopters are driven mainly by the change in top management (Δ MGT). Specifically, the impairment losses of intangible assets and goodwill for non-early adopters are significantly associated with reporting motivations only, such as BATH (coefficient = -0.0209), SMOOTH (coefficient = 0.0041) and Δ MGT (coefficient = 0.0006) for intangible assets and the change in top management Δ MGT (coefficient = 0.0008) for goodwill. However, the impairment losses of long-term equity investment and fixed assets for non-early adopters are significantly driven by both management's reporting motivations (Δ MGT) and firm's operational factors (Δ INDROA, RET, and MTB for long-term equity investment and ELEC, RET and Δ SALE for fixed assets). Notice that other reporting motivations, such as BATH and SMOOTH, are not significantly associated with impairment losses in long-term equity investment and that of fixed assets for non-early adopters. We infer that firms with impairment losses in long-term equity investment and fixed assets may have adopted SFAS No. 35 in 2004 annual reports. (As shown in Table 6 for early adopters, coefficient of BATH = -0.1376 ($p < 0.01$) for long-term equity investment, and coefficient of BATH = -0.0410 ($p < 0.01$) for fixed assets respectively).

As for goodwill, tobit regressions in Table 6 and Table 7 show that impairment loss of goodwill is driven only by the change in top management (Δ MGT) among all management's reporting motivations. This may be because SFAS No. 35 does not allow restoration of recognized impairment losses for goodwill. Therefore, management cannot manipulate earnings through recognizing impairment losses for goodwill. However, firms recognizing impairment losses of other types of assets (i.e., long-term equity investment, fixed assets, identifiable intangible assets and idle assets) would be driven by managements' earnings management incentives (e. g., taking "big baths" and "income-smoothing").

Multivariate Analysis: Hypothesis Three

We employ OLS multiple regressions to examine market reaction to the disclosure of assets impairment losses (Hypothesis 3) as shown in Table 8. Firms included in our sample are 105 early adopters of SFAS No. 35 (adopted in 2004 fourth quarter) and 259 non-early adopters (adopted in 2005 first quarter) with assets impairment losses. We exclude 49 firms due to lack of stock return data in the TEJ databank (10 for early adopters, and 39 for non-early adopters) and 14 outliers (9 for early adopters and 5 for non-early adopters). Thus, the final sample for market reaction analysis consists of 86 early adopters and 215 non-early adopters of SFAS No. 35. In total, 301 observations are used in our market analyses.

Table 7 Tobit Regressions: Determinants for the Amounts of Assets impairment Losses for Non-early Adopters (n = 518)

$$WOTA_{it} = \alpha_0 + \alpha_1 BATH_{it} + \alpha_2 SMOOTH_{it} + \alpha_3 \Delta MGT_{it} + \alpha_4 FIN_{it} + \alpha_5 \Delta INDROA_{it} + \alpha_6 ELEC_{it} + \alpha_7 RET_{it} + \alpha_8 \Delta SALE_{it} + \alpha_9 \Delta OCF_{it} + \alpha_{10} MTB_{it} + \varepsilon_{it} \quad (2)$$

Variable	Predicted Sign	Generic Tobit Regression	Separate Tobit regressions				
			Long-term investment	Fixed assets	Goodwill	Intangible assets	Idle assets
Intercept		0.0044	0.0007	0.0018	0.0005	-0.0004	0.0015
		(2.01)**	(0.88)	(0.98)	(1.06)	(-1.33)	(2.27)**
***Reporting Motivations*:**							
BATH	−	-0.0329	-0.0134	-0.0128	0.0054	-0.0209	0.0088
		(-0.64)	(-0.74)	(-0.30)	(0.47)	(-2.99)***	(0.46)
SMOOTH	+	0.0296	-0.0062	0.0224	0.0041	0.0041	0.0051
		(1.71)*	(-1.02)	(1.60)	(1.04)	(1.78)*	(0.81)
Δ MGT	+	0.0075	0.0018	0.0036	0.0008	0.0006	0.0007
		(4.74)***	(3.17)***	(2.77)***	(2.29)**	(2.99)***	(1.20)
FIN	−	0.0011	-0.0052	0.0152	-0.0018	-0.0022	-0.0051
		(0.02)	(-0.29)	(0.37)	(-0.15)	(-0.31)	(-0.27)
***Operational Factors*:**							
ΔINDROA	−	-0.1133	-0.2014	0.2328	-0.0731	-0.0377	-0.0341
		(-0.44)	(-2.21)**	(1.10)	(-1.24)	(-1.07)	(-0.35)
ELEC	+	0.0027	-0.0008	0.0045	-0.0002	0.0002	-0.0010
		(1.42)	(-1.23)	(2.91)***	(-0.46)	(0.69)	(-1.40)
RET	−	-0.0188	-0.0015	-0.0151	0.0001	-0.0006	-0.0017
		(-4.18)***	(-0.94)	(-4.11)***	(0.13)	(-1.06)	(-1.02)
Δ SALE	−	0.0196	-0.0009	0.0239	-0.0032	0.0018	-0.0019
		(1.85)*	(-0.25)	(2.76)***	(-1.33)	(1.28)	(-0.49)
Δ OCF	−	0.0167	0.0048	0.0143	0.0014	-0.0013	-0.0026
		(1.48)	(1.41)	(1.45)	(0.63)	(-0.97)	(-0.72)
MTB	−	-0.0015	-0.0007	-0.0002	-0.0003	0.0008	-0.0004
		(-1.42)	(-1.92)*	(-0.18)	(-1.20)	(0.58)	(-1.11)
Adj. R^2		11.04%	5.19%	8.09%	2.48%	4.70%	2.26%

a.*, **, and *** indicate statistical significance levels of 10%, 5% and 1%, respectively.
b.*t*-value in parentheses
c.Variable definitions:

$WOTA_{it}$: firm *i*'s pre-impairment losses at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1* $BATH_{it}$: the proxy for taking big baths = (ΔE_{it} < median of the "unexpected negative earnings", then $BATH_{it} = \Delta E_{it}$; otherwise, $BATH_{it}$ = 0.) $SMOOTH_{it}$: the proxy for income-smoothing = (ΔE_{it} > median of the "unexpected negative earnings", then $SMOOTH_{it} = \Delta E_{it}$; otherwise, $SMOOTH_{it} = 0$.) ΔMGT_{it} : equals 1 if firm *i* changes its top management (defined as CEO, chairman of the board or CFO) from year *t-1* to *t*; and 0 otherwise. FIN_{it} : total amounts of firm *i*'s issuance of equity capital and corporate bonds in quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $\Delta INDROA_{it}$: the median of growth rate of return on assets from quarter *t-1* to *t* in firm *i*'s industry. $ELEC_{it}$: equals 1 if firm *i* at quarter *t* belongs to the electronics industry, and 0 otherwise. RET_{it} : firm *i*'s quarterly stock returns from quarter *t-1* to *t*. $\Delta SALE_{it}$: firm *i*'s change in sales from quarter *t-1* to *t*, divided by total assets of firm i at quarter *t*. ΔOCF_{it} : firm *i*'s change in cash flows from operations from quarter *t-1* to *t*, divided by total assets of firm *i* at quarter *t*. MTB_{it} : equals 1 if firm *i*'s market-to-book ratio at quarter *t* is below 1, and 0 otherwise.

Panel A of Table 8 presents our empirical results for security price reaction to the impairment disclosure, earnings announcement and firm size. From Panel A of Table 8, we find a significantly negative security price reaction to the impairment losses per share (coefficient of WOTA is -10.5864, $p < 0.05$) for early-adopters of SFAS No. 35 in 2004 annual reports. This is consistent with the first half of our Hypothesis 3, which proposes that security price reactions to the amount of impairment losses in *audited* annual report would be significantly negative. This result indicates investors deem that economic values of the assets are substantially impaired as reported in annual reports.

Note that the fourth-quarter unexpected earnings (UE) are not significantly correlated with CAR for early adopters of SFAS No. 35. Nevertheless, these results are consistent with Francis et al. (1996: 131-132). Francis et al. argue that this phenomenon may due to (1) the proxy for unexpected quarter earnings is based on a seasonal random walk and pre-impairment EPS and thus contain some measurement errors that analysts' forecasts may account for; (2) the disclosure date of impairment losses is on the same day as annual report. Since annual report contains earnings and much other information, the noise of earnings information in annual reports is much louder than that in quarterly reports. Therefore, the association between unexpected earnings in annual reports and security price is reduced. In addition, unlike the U.S. SEC requiring registrants disclose annual report on May 31 and the first quarterly report on April 15, the disclosure dates of annual report and that of the first quarter report are on the same day of April 30 for public firms in Taiwan. The simultaneous disclosure date of annual report and the first-quarter report may cause our empirical results, which reflect earnings information in annual report, to have no information content, whereas earnings information in the first quarter has.

For non-early adopters of SFAS No. 35, there is no significantly negative security price reaction to the impairment losses per share WOTA (coefficient = -10.7803). This result is consistent with the second half of our Hypothesis 3, which proposes that security price reactions to the assets impairment losses in the *unaudited* first-quarter report would not be significantly negative due to the creditability of the impairment losses. Investors may deem the amount of assets impairment in the *unaudited* quarterly reports as management's opportunistic earnings manipulation since the amount of assets impairment decision involves much management reporting discretion. On the other hand, security price reaction is significantly positive to unexpected earnings in the first quarter of 2005 (coefficient of UE is 0.0817, $p < 0.05$). This result reflects that the first-quarter earnings disclosure contains less noise than that in annual report. Simultaneous disclosure of annual report and the first-quarter report makes earnings in the annual report have no information content but that in the first-quarter has.

In addition, impairment losses from different types of assets may have different market reaction. Panel B of Table 8 shows the empirical results of market reaction to impairment losses from five long-lived assets in model (4). We find that security price reacts significantly negative only to impairment losses from idle assets (coefficient of OATA = -26.6596, $p < 0.05$) and long-term equity investment (coefficient of EQUTA = -10.2576, $p < 0.05$). On the contrary, we observe no significant reaction to impairment losses of goodwill, identifiable intangible assets, and fixed assets.

Table 8: Market Reaction to the Amount of Impairment announcement

Panel A：Market Reaction to the disclosure of Assets Impairment losses in Total (n = 301)

$$CAR_i(-2,1) = \beta_0 + \beta_1 WOTA_i + \beta_2 UE_i + \beta_3 SIZE_i + \varepsilon_i \quad (3)$$

Variable	Predicted Sign	All samples (Sample =301)	Early adopters (sample=86)	Non-early adopters (sample =215)
Intercept		-7.2149	-6.8217	-6.8848
		(-3.05) ***	(-1.84) *	(-2.25) **
WOTA	—	-9.9432	-10.5864	-10.7803
		(-2.23) **	(-2.32) **	(-1.28)
UE	+	-0.0012	-0.0078	0.0817
		(-0.11)	(-0.75)	(2.27) **
SIZE	+	0.2986	0.2853	0.2841
		(2.84) ***	(1.75) *	(2.09) **
Adj. R^2		3.55%	5.93%	5.28%

Panel B：Market Reaction to the disclosure of Impairment losses for five asset types (n = 301)

$$CAR_i(-2,1) = \gamma_0 + \gamma_1 EQUTA_i + \gamma_2 FATA_i + \gamma_3 GWTA_i + \gamma_4 IATA_i + \gamma_5 OATA_i + \gamma_6 UE_i + \gamma_7 SIZE_i + \varepsilon_i \quad (4)$$

Variable	Predicted sign	Full samples (n =301)	Early adopters (n =86)	Non-early adopters (n =215)
Intercept		-6.66346	-5.1731	-7.0172
		(-3.15) ***	(-1.36)	(-2.25) **
EQUTA	—	-10.2576	-9.2822	-6.0832
		(-2.04)**	(-1.82) *	(-0.35)
FATA	—	-2.8708	4.8708	-5.2256
		(-0.39)	(0.29)	(-0.51)
GWTA	—	0.1975	1.7695	-21.9091
		(0.02)	(0.17)	(-0.65)
IATA	—	-14.3533	-11.2141	-4.5087
		(-0.80)	(-0.60)	(-0.15)
OATA	—	-26.6596	-51.9083	-24.9455
		(-2.43) **	(-3.59) ***	(-1.02)
UE	+	-0.0064	-0.0059	0.0821
		(-0.80)	(-0.55)	(2.24) **
SIZE	+	0.2619	0.2175	0.2905
		(2.80) ***	(1.32)	(2.10) **
Adj. R^2		4.14%	13.50%	3.55%

a.*, **, and *** indicate statistical significance levels of 10%, 5% and 1%, respectively. b.*t*-value in parentheses

c.Variables definitions:

CAR_i(-2,1): firm *i*'s market-adjusted abnormal return accumulated from day -2 to +1 relative to the disclosure date. $WOTA_i$: firm *i*'s pre-impairment loss at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. UE_i : firm *i*'s change in pre-impairment earnings from quarter *t-4* to *t*, divided by firm *i*'s pre-impairment earnings at quarter *t-4*. $SIZE_i$: natural logarithm of firm *i*'s total assets at the end of quarter *t-1*. $EQUTA_i$: firm *i*'s pre-impairment loss for long-term equity investment at quarter *t* (decrease in investment income resulting from impairment losses on long-term equity investments accounted in the equity method), divided by firm *i*'s total assets at the end of quarter *t-1*. $FATA_i$: firm *i*'s pre-impairment loss for fixed assets at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*. $GWTA_i$: firm *i*'s pre-impairment loss for goodwill at quarter t, divided by firm *i*'s total assets at the end of quarter *t-1*. $IATA_i$: firm *i*'s pre-impairment loss for identifiable intangible assets (exclude goodwill) at quarter *t* , divided by firm *i*'s total assets at the end of quarter *t-1*. $OATA_i$: firm *i*'s pre-impairment loss for idle assets at quarter *t*, divided by firm *i*'s total assets at the end of quarter *t-1*.

Impairment loss in fixed assets is the largest one among five types of assets (Table 2). Why doesn't the market react to this impairment information when disclosed? Is it possible that market reacted when the SFAS No. 35 was issued? Our additional analyses (table not shown) indicate market did react to the impairment loss from fixed assets (coefficient of FATA = -10.7444, p = 0.06) around the SFAS No. 35 issue date of July 1, 2004. This result may explain why stock does not react to impairment loss of fixed assets when it is disclosed later.

The significantly negative stock price reaction to impairment losses is driven mainly by early adopters recognizing impairment losses from idle assets (OATA, coefficient = -51.9083, $p < 0.01$) and long-term equity investment (EQUTA, coefficient = -9.2822, $p < 0.10$) in *audited* annual report, as shown in Table 8. Investors may believe impairment losses from idle assets in audited annual report are more reliable and that it reflects substantial impairment in idle assets. The impairment loss from long-term equity investment comes from the decrease in investment income resulting from impairment loss on long-term equity investments accounted for by the equity method. Since this amount is hard to predict, more negative market reaction is expected when a firm discloses the impairment loss from long-term equity investment. Probably due to high discretion on impairment losses in the *unaudited* first-quarter report of 2005, non-early adopters recognizing impairment losses from long-lived assets provoke insignificant market reaction.

V. SENSITIVITY ANALYSES

In this section, we further conduct sensitivity analyses to examine the validity of above empirical results：(1) Employing different definition of "taking big bath" to validate the BATH variable in Tables 5-7; (2) Employing different definition of change in top management to validate the ΔMGT variable in Tables 5-7; (3) Using 105 early adopters of SFAS No. 35 only without matching group to run multiple regression in examining the determinants of assets impairment losses in Table 6; (4) Using 259 non-early adopters of SFAS No. 52 only without matching group to run multiple regression in examining the determinants of assets impairment losses in Table 7; (5) Using different windows for CAR in examining the market reaction to the disclosure of impairment losses in Table 8; (6) Including industry dummies in examining the market reaction to the disclosure of impairment losses in Table 8; (7) Deflating independent variables of Table 8 by stock price at the beginning of the quarter; (8) Employing annual data, instead of quarterly data, to investigate the determinants of early adoption of SFAS No. 35 decision.

Validating the "Taking-Big-Bath" Variable

We further employ the definition of taking-big-bath variable suggested by Francis et al. (1996) to validate our original BATH variable. The new BATH = unexpected earnings if unexpected earnings is less than zero, and new BATH = 0 otherwise, where unexpected earnings = (pre-impairment quarterly earnings in quarter *t* – quarterly earnings in quarter *t-1*) / Total assets in quarter *t-1*]. Empirical results under this new definition of BATH show the followings: the coefficient of new BATH is -64.5809 ($p < 0.01$) with classification concordant of 88.6% in Table 5; the coefficient of new BATH is -0.1885 (p

< 0.01) with explanatory power of 17.67% in Table 6; and the coefficient of new BATH is -0.0999 (p = 0.13) with explanatory power of 11.75% in Table 7. Under the definition of new BATH, the predicted signs, significances and estimated coefficients of independent variables are similar to those in Table 5-7. The validity of original BATH variable is evidenced by this sensitivity analysis.

Validating the "Change-in-Top-Management" Variable

We further employ the definition of Change-in-top-management variable suggested by Riedl (2004) to validate our original ΔMGT variable. The new ΔMGT refers only to change in CEO. Empirical results under this new definition of ΔMGT show the following: coefficient of ΔMGT is -0.3282 (p = 0.85) with classification concordant of 85.4% in Table 5; coefficient of ΔMGT is 0.0242 (p < 0.01) with explanatory power of 14.49% in Table 6; and coefficient of ΔMGT is 0.0074 (p < 0.01) with explanatory power of is 9.519% in Table 7. Under the new definition of change in top management, the predicted signs, significances and estimated coefficients of independent variables are similar to those in Table 5-7. The validity of original ΔMGT is evidenced by this sensitivity analysis.

Using Only Early Adopters of ASFAS No. 35 as Sample in Table 6 to Examine the Determinants of Assets Impairment Losses

We further use early adopters only without matching group in running multiple regressions in Table 6 to examine the determinants of assets impairment losses. Empirical results show the following: the explanatory power of the new multiple regressions is 11.29%. Only management's reporting motivations are associated with impairment losses for early adopters, whereas operational factors are not. The coefficient of BATH = -0.1664 (p < 0.01); the coefficient of SMOOTH = 1.2492 (p < 0.01) and coefficient of ΔMGT = 0.0173 (p = 0.05), which are consistent with our prediction. Using only early adopters as sample, the predicted signs, significances and estimated coefficients of variables are similar to those in Table 6. The validity of results in Table 6 is evidenced by a different sample in regression.

Using Only Non-Early Adopters of SFAS No. 35 as Sample in Table 7 to Examine the Determinants of Assets Impairment Losses

We further use only non-early adopters without matching group in running multiple regression in Table 7 to examine the determinants of assets impairment losses. Empirical results show the following: the explanatory power of the new multiple regressions is 9.26%. Both management's reporting motivations, such as SMOOTH (coefficient = 0.0476, p = 0.08) and ΔMGT (coefficient = 0.0043, p = 0.09), and operational factors, such as RET (coefficient = -0.0317, p < 0.01) and ΔSALE (estimated coefficient = 0.0339, p = 0.08) are associated with impairment losses for non-early adopters of SFAS No. 35. These results are similar to those in Table 7. The validity of results in Table 7 is evidenced by a different sample in regression.

Examining Market Reaction to the Disclosure of Impairment Losses Using

Different Accumulation Windows of CAR

In addition to the accumulation window of [-2, 1] for CAR around the event date of impairment disclosure, we also accumulated CAR for windows of [-3, 1] and [-1, 1] in examining market reaction to the disclosure of impairment losses. Empirical results show the explanatory power of regression (3) for CAR [-3, 1] as dependent variable is 4.51%, with estimated coefficient of WOTA= -10.1471 ($p = 0.03$); the explanatory power for CAR [-1, 1] is 3.10%, with estimated coefficient of WOTA= -5.2336 ($p = 0.07$). The predicted signs, significances and estimated coefficients of independent variables are similar to those in Table 8 under different accumulation windows for CAR.

Including Industry Dummies to Control the Possible Effect of Industry in Table 8.

In order to control the possible effect of industry on our results in Table 8, we include 17 industry dummies in regression (3). (Since there are 18 industries in our 301 sample firms, N-1=17 dummy variables were constructed to avoid the multi-collinearity problem.) Our empirical results show that foods, plastics, construction, and tourism industries have significantly higher market reaction to the disclosure of impairment losses than that of electronic industry. (The coefficient of Foods Industry indicator is 2.2482 ($p < 0.01$), the coefficient of Plastics Industry indicator is 1.4593 ($p = 0.06$), the coefficient of Construction Industry indicator is 0.8931 ($p = 0.08$) and the estimated coefficient of Tourism Industry indicator is 4.1418 ($p < 0.01$).) However, the market reaction of automobiles industry (coefficient = -3.8765, $p = 0.10$) is lower than that of electronics industry. All other industries have indifferent market reaction to the disclosure of impairment losses with electronics industry ($p > 0.10$). Furthermore, signs and significances for other independent variables, such as WOTA (coefficient is -11.2125, $p = 0.01$), SIZE (coefficient is 0.2630, $p = 0.02$), and UE (coefficient is -0.0019, $p = 0.86$), are similar to those in Table 8. Including industry dummies does not change our conclusions from Table 8.

Deflating Independent Variables by the Stock Price at the Beginning of the Quarter in Table 8.

In examining market reaction to the disclosure of impairment losses, we deflate independent variables in regression (3) by stock price at the beginning of the quarter, instead of total assets in Table 8, and rerun the regressions. Our empirical results show that the coefficient of WOTA is -12.1277 ($p < 0.01$), the coefficient of SIZE is 0.2685 ($p < 0.01$), and the coefficient of UE is -0.7405 ($p = 0.22$). The validity of the conclusion of original Table 8 is evidenced by using a different deflator for independent variables.

Using Annual Data, Instead of Quarterly Data, to Examine the Determinants of Early Adoption of SFAS No. 35.

In addition to quarterly data, we further use annual data to run a logistic regression in Table 5 to examine the determinants of early adoption of SFAS No. 35 for listed firms in Taiwan. Empirical results show that the coefficient of BATH is -7.5888 ($p = 0.05$), coefficient of MTB is -0.7924 ($p = 0.02$), and other variables are insignificant. The results using annual data are similar to those presented in Table 5 in quarterly data in terms of predicted signs, significances and coefficients.

VI. CONCLUSIONS AND SUGGESTIONS

This paper explores first the determinants of the adoption timing of SFAS No. 35 for listed firms in Taiwan. Our empirical results show that firms that early adopt SFAS No. 35 are significantly associated with management's reporting motivations (such as taking "big baths"), as well as operational factors (such as recovery abilities of long-lived assets under accrual basis (△SALE) and under cash basis (△OCF)).

Second, we investigate the determinants of impairment losses decisions for listed firms in Taiwan. We document that: (1) For early adopters, the impairment losses decision is only associated with management's reporting motivations (such as "taking big baths", "income-smoothing" and "changes in top management"). (2) For non-early adopters, the impairment losses decision is not only associated with management's reporting purposes (such as "income-smoothing", "changes in top management"), but also the firm's operational factors (such as RET, ΔSALE). Furthermore, we analyze the impairment losses decision for five types of assets (such as long-term equity investments, fixed assets, identifiable intangible assets, goodwill, and idle assets). We find that management's reporting motivations (such as "taking big baths" and "income smoothing") would affect the amount of impairment losses for all types of long-lived assets except for good will. The determination of impairment loss for goodwill is less likely driven by management's reporting motivations since restoration of previously recognized impairment loss of goodwill is not allowed under SFAS No. 35, managers would not use impairment loss of goodwill to manage earnings.

Finally, we examine market reaction to the disclosure of impairment losses. Our empirical results show that: (1) the stock market reacted negatively to the impairment losses disclosure in the 2004 *audited* annual report for early adopters, but not for the fourth quarter unexpected earnings, consistent with Francis *et al.* (1996); and (2) the stock market did not react significantly to the impairment losses disclosure in the *unaudited* 2005 first-quarter report, but did react positively to the 2005 first-quarter unexpected earnings. Further analyzing the impairment losses of the five types of long-lived assets, we find investors responded negatively only to impairment losses of long-term equity investments and that of idle assets. Impairment losses of other types of assets had no significant market reaction.

Our study has following limitations: First, a firm's operational factors that we consider in this paper are limited to external information. Internal information, such as actual use condition of long-lived assets, is not included since these data are unavailable. Secondly, the determinants of impairment losses decisions will be driven by the economic environment in the long run. A firm may recognize a large amount of impairment losses in the period of economic boom. Since our sample firms are limited to those that adopted SFAS No. 35 in the fourth quarter of 2004 and the first quarter of 2005, our time periods are too short to include the effect of changing economic environment.

Since SFAS No. 35 allows restoration of previously recognized impairment losses, future studies can explore whether management has used restoration of previously recognized impairment losses to substitute or combine discretionary accruals to manage earnings after SFAS No. 35 was issued. In addition, we only examine the short-term market reaction to the disclosure of impairment losses. Future studies may examine the

long-term market reaction to the recognized impairment losses.

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認列資產減損時點與金額之決定因素及其市場反應

謝宛庭
崑山科技大學會計系
吳清在
國立成功大學會計系

摘要：長久以來，台灣之一般公認會計準則對企業之固定資產係以歷史成本減除累計折舊入帳，在消費者物價指數累積上升達 25%時固定資產得以「資產重估」方式來反應資產之增值，但在 35 號公報發佈前，台灣企業對資產之會計處理，從未考慮資產可能發生之價值減損，導致財務報表「只能上調不能下調」之不對稱情況，嚴重扭曲財務報表之真實性，無法充分反應技術進步、景氣循環等造成資產價值之快速變化。此種無法充分反映長期資產價值之會計處理方式，久為會計界所詬病。為與國際會計準則接軌並提高財務報表之資訊透明度，中華民國會計研究發展基金會財務會計準則委員會乃參考國際會計準則第 36 號公報及美國會計準則第 121 號公報與第 142 號公報，於 2004 年 7 月發布財務會計準則第 35 號公報《資產減損之會計處理準則》，對會計年度開始日在 2005 年 1 月 1 日 (含) 以後之財務報表適用之，但得提前適用。

本文首先探討台灣上市櫃公司選擇適用 35 號公報之「時點」之決定因素，根據文獻研究歸納為「報導動機」與「營運因素」兩大領域。實證結果發現：台灣上市櫃公司是否提前採用 35 號公報主要是受到公司管理當局「一次清洗」 (take a big bath) 之「報導動機」，以及長期資產回收性 (應計基礎下及現金基礎下) 等「營運因素」之影響。

基於「報導動機」與「營運因素」，本文進一步探討台灣上市櫃公司認列資產減損「金額」之決定因素，實證結果發現： (一) 提前適用 35 號公報之公司，其所認列資產減損之金額大小僅受到公司管理當局之報導動機 (洗大澡、盈餘平穩化、公司高階管理當局異動) 所影響； (二) 準時適用 35 號公報之公司，其所認列資產減損之金額大小除受公司管理當局之報導動機 (盈餘平穩化、公司高階管理當局異動) 所影響外，亦受到企業營運因素 (報酬衡量指標、銷貨成長性) 之影響，對準時適用 35 號公報之公司而言，其所

認列資產減損之金額大小不受屬報導動機之洗大澡動機之影響。另外，本文亦探討不同類型之資產減損金額之決定因素，研究發現公司管理當局之盈餘管理行為 (洗大澡及盈餘平穩化) 會影響到公司認列商譽以外之其他類型資產 (長期投資、固定資產、無形資產及閒置資產) 減損之金額，但公司認列商譽減損損失並未受到公司管理當局盈餘管理之行為所影響，本文推論可能係因 35 號公報規定已認列之商譽減損損失不能迴轉，故公司管理當局不會透過認列商譽減損損失來進行盈餘管理。

最後，本文探討公司宣告認列資產減損之股票市場反應，實證結果發現 (一) 於 2004 年第四季年報 (經會計師簽證) 中提前適用 35 號公報之公司宣告認列之資產減損時，資產減損金額有顯著之負面之市場反應，然而，於 2005 年第一季季報 (未經會計師簽證) 準時適用 35 號公報之公司宣告認列之資產減損時，資產減損金額卻無統計顯著之負面之市場反應； (二) 與年報同時發佈之第四季不計資產減損之異常盈餘無顯著之市場反應 (此與 Francis *et al.* 1996 之實證結果一致) ；但第一季不計入資產減損之異常盈餘則有顯著之市場反應。關於此點，本研究除 Francis *et al.* 之解釋外，並增加台灣情況之解釋，亦即台灣年報申報日與第一季季報申報日期相同所致。美國證管會規定美國公開發行公司年報與季報申報日期不同 (年報須於 3 月 31 日前，第一季季報須於 4 月 15 日前申報) ，而台灣證期局規定台灣公開發行公司之去年年報與今年第一季季報皆須同時於今年 4 月 30 日申報，因此，在 4 月底年報所揭露去年第四季盈餘資訊市場已經知曉，本年第一季未預期盈餘才真正有資訊內涵，實證結果反映此項事實。

關鍵字：資產減損、台灣財務會計準則第 35 號公報、決定因素、市場反應

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The Effect of Dismissal Threat on Auditor Independence*

Wen-Ching Chang
National Changhua University of Education
Ling-Tai Lynette Chou
National Chengchi University
Hsiou-wei William Lin
National Taiwan University

ABSTRACT: This study investigates whether the dismissal threat posed by the client jeopardizes auditor independence, where auditor independence is surrogated by the auditor's propensity to issue a going concern opinion on a financially distressed client. We use an auditor switch model to predict the unobserved switches clients would have made had they received an opposite audit opinion, and then measure the unobserved switch probability as a proxy for the dismissal threat. This study identifies two types of strategic response that may result from dismissal threats. One type is the client's coercing the auditor to issue a clean instead of a going-concern opinion. The other type of dismissal threat is that posed by clients who request a shared opinion (involving other auditors) in lieu of a going concern opinion. We argue that whether auditors surrender their independence to these two dismissal threats depends heavily on the professional responsibility and potential future failure costs. The results show that the probability of a financially distressed company's receiving a going concern opinion increases with the likelihood of dismissal to coerce clean opinions. However, the probability of a financially distressed company's receiving a going concern opinion decreases with the likelihood of dismissal to coerce shared opinions. The difference between these two inappropriate audit opinions lies mainly in perceived disutility. Hence, market-based incentives, such as loss of reputation and litigation costs, including the perceived probability of being sued, are essential to preserve auditor independence.

Keywords: Dismissal threat, Auditor switch, Audit opinion, Auditor independence

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I. INTRODUCTION

This paper examines empirically whether threats to dismiss the incumbent auditor decrease the likelihood of a financially distressed company's receiving a going concern opinion. Unfavorable auditor reports have the potential to create adverse consequences, such as suppressing stock prices and making it difficult to raise capital; therefore, management may pressure auditors against issuing unfavorable audit opinions. While independent auditing is essential to efficient capital markets, auditors bear great pressure from the business operations of audit firms under the condition of increasing audit market competition. Therefore, the investing public, financial statement users, and regulators will all be concerned as to whether auditors are susceptible to dismissal threats and sometimes sacrifice their independence to issue favorable audit opinions.

This paper identifies a going-concern opinion as an unfavorable opinion and classifies favorable audit opinions into standard unqualified and unqualified with modified wording (involving other auditors). The going-concern opinion decision is one of the most difficult and ambiguous audit tasks auditors face (Carcello and Neal 2000). Auditor independence is especially important where the difficulty and ambiguity in audit opinion decisions render an auditor vulnerable to management pressure. With respect to the unqualified with modified wording (also called a shared opinion), the auditing standards give auditors the discretion to decide whether to assume responsibility for the work of other auditors. The decision to assume or not to assume responsibility has significant legal as well as professional consequences. In a report with references, the principal auditor does not intend to assume any legal responsibility for the work of the other auditors (SAS 64 AU 543). The question whether principal auditors compromise their independence because of different professional responsibilities involved warrants further study.

Heavy investments in foreign countries and recognizing fictitious overseas revenues, coupled with shared auditor opinions, characterize current scandals in Taiwan, such as Procomp, Infodisc, etc.[1] In 2004, Procomp was sued to remedy injured investors for an amount over NT$ 5 billion, approximately US$ 150 million, because of fraudulent financial statements. Besides lawsuits, the Financial Supervisory Commission took disciplinary action against the auditors of Procomp by enforcing a 2-year suspension of practice according to the Taiwan Securities and Exchange Law. This was partly based on the charge against auditors of Procomp of not having collected sufficient and competent audit evidence on reported investment income from fully owned subsidiaries (Taiwan Commercial Times 2004.7.16).

A massive financial scandal involving Italy's largest food company, Parmalat, has underscored the fact that corporate fraud is a common issue. In December 2003, it was discovered that Parmalat had been using more than EU$ 10 billion of nonexisting assets

[1] Since some of Taiwan's listed companies inflate their income from overseas long-term investments, Taiwan Stock Exchange (TSE) and Gretai Securities Market (GSM) have begun to require the principal auditor to issue a clean opinion to an IPO client, even with the presence of other auditors. If the principal auditor issues a shared opinion, TSE and GSM will reject the application to go listed (Taiwan Economic Daily News 2003.2.17).

to offset more than a decade's worth of liabilities through a network of offshore and foreign finance companies. Deloitte & Touche replaced Parmalat's auditor Grant Thornton in 1999 because of a provision in Italian law, which mandates change of audit firms every nine years. However, Parmalat continued to retain Grant Thornton as its auditor for its Cayman Islands subsidiary, Bonlat, which was not subject to Italian law and was allegedly where the missing assets were located. Although Deloitte & Touche was the first to scrutinize the nonexistent accounts, it gave a shared opinion to Parmalat.[2]

This study examines two types of undue favorableness in audit opinions that may result from dismissal threats. Specifically, management may threaten to dismiss the incumbent auditor and coerce him or her to issue (1) a clean instead of a going-concern opinion, or (2) a shared in lieu of a going-concern opinion. We test for dismissal threats by predicting the unobserved switches management would have made had they received opposite audit opinions. Can management successfully engage in dismissal threats? The effectiveness of the management's dismissal threat, nevertheless, depends on the auditor's trade-offs between the benefits of retaining clients and the costs of sacrificing independence. We do not test if auditors surrender their independence to different types of dismissal threats imposed by *different* clients. In contrast, we test the effects of different types of dismissal threats imposed by the *same* client. Therefore, the benefits of retaining the client are the same for both types of dismissal threat. The difference between these two dismissal threats lies in the cost of sacrificing independence: one is full responsibility; the other is divided.

Shared opinions, which imply responsibility divided among auditors, pose another question for auditors to ward off legal liability in law. Bonner et al. (1998) provide evidence that the judges' and juries' reasoning process concerning auditors' responsibility for detecting fraud might not be the same as the auditors own considerations. They find that auditors are more likely to be sued when the financial statement frauds are of a common variety or when the frauds arise from fictitious transactions. Their analysis rules out various accounting and auditing explanations for the results. Namely, given that litigations occur, auditors may still become defendants in lawsuits no matter what opinions they issue. Even so, from fear of legal liability, they may issue modified audit reports. Carcello and Palmrose (1994) find that, while modifying a client's audit report may not be sufficient to protect auditors from the legal liability, such disclosures reduce the likelihood of litigation. Hence, though shared opinions might not entirely dismiss the principal auditor's responsibility for other auditors' work in the event of a lawsuit or SEC action; they are likely to affect auditors' behavior based on the perception created by auditing standards.

Our results reveal that the probability of issuing a going-concern opinion increases in spite of the client's dismissal threat to coerce clean opinions. In contrast, the auditor reduces his or her propensity to issue a going-concern opinion when the client threatens to dismiss the auditor for issuing a going concern opinion in lieu of a shared opinion. Overall, these findings suggest that whether or not auditors surrender their independence to dismissal threats is closely related to the divisibility of professional responsibility.

In the literature concerning the association between auditor switch and audit opinion,

[2] See O'Rourke (2004) for more details regarding Parmalat.

two lines of inquiry are closely related to the present study. One is the analytical research on the effect of dismissal threat on audit opinion, such as Magee and Tseng (1990), Dye (1991), and Teoh (1992). The other is the empirical research on the effect of auditor switches on audit opinion, such as Krishnan (1994) and Krishnan et al. (1996). The results of the analytical research show that there is a positive relation between dismissal threat and clean opinion, though this remains unsupported by the empirical research. Krishnan et al. (1996) find that clients with high switch probabilities are less likely to receive clean opinions, suggesting that the audit opinion is not affected by a switch threat. However, "dismissal threat" and "switch probability" are different concepts. Prior researchers ignored the possibility that companies receiving clean opinions would have made auditor switches more often had they not received clean opinions. Hence, dismissal threat is a concept of conditional probability, different from the pure switch probability. It is too early to conclude that dismissal threat is futile because of the measurement error resulting from using switch probability as a proxy variable of dismissal threat. The methodology of this study improves on existing research by considering the switch that clients would have made had they received an opposite audit opinion.

The next section reviews the related literature and develops hypotheses. Section 3 describes the methodology employed to test the dismissal threat argument, while section 4 explains how the data were collected and variables measured. Section 5 presents empirical results and the final section concludes the study.

II. DISMISSAL THREATS AND AUDITOR'S GOING-CONCERN OPINION

Unfavorable audit opinions adversely affect clients. For example, prior research associates modified audit opinions with stock price declines (Jones 1996; Chow and Rice 1982; Firth 1978), lower earnings response coefficients (Choi and Jeter 1992), having applications of security offerings returned, and difficulty in raising debt capital (Firth 1980). By switching auditors, Teoh (1992) identifies two ways management might avoid unfavorable audit opinions. First, management can threaten the incumbent auditor to switch to a new auditor. The fear of losing the client can compromise the incumbent's independence. Second, management may switch if it believes a new auditor is more likely than the incumbent to give a clean opinion. Lennox (2000) calls the first method, the switch threat argument; the second, the opinion-shopping argument, which is previously examined by Lennox (2000). This paper focuses on the switch threat argument.[3]

Dismissal Threats to Coerce Clean Opinions Rather Than Going-Concern Opinions

Previous research has identified two economic incentives facing auditors when evaluating the reporting alternatives concerning a company's ability to continue as a going-concern. First, the cost incurred by auditors in issuing a going-concern opinion is

[3] Magee and Tseng (1990) show that the following condition is one of the necessary conditions for a reduction in auditor independence: the client must benefit from the preferred reporting strategy even after an auditor switch. Lennox (2000) finds companies do successfully engage in opinion shopping and therefore Lennox's result may be used as our maintained hypothesis.

the possibility of losing the client and related future quasi-rents. Second, the cost incurred by auditors in issuing a clean opinion is the potential costs of litigation and reputation loss. Several papers have analyzed the economic trade-offs facing the auditor that arise in the going-concern decision, using different proxies. Krishnan and Krishnan (1996) indicate that auditor litigation risk and the relative importance of the client in the auditor's portfolio are factors in the audit opinion decision. Geiger and Raghunandan (2002) argue that not signaling significant concerns regarding the client's ability to continue as a going concern, prior to the filing of bankruptcy, is likely to be construed as an audit failure by those outside the accounting profession. In this situation, auditors may suffer litigation costs as the target of injured investors claiming losses; therefore, the disutility of issuing an inappropriate opinion would be great. Magee and Tseng (1990) show that no compromise of independence will occur when the auditor regards expected disutility as extremely large. Reynolds and Francis (2001) conclude that reputation protection and litigation avoidance are sufficient to override the possible impairment of objectivity resulting from economic dependence. DeFond et al. (2002) conclude that market-based incentives, such as loss of reputation and litigation costs, predominate over the expected benefits from compromising auditor independence. All of these studies focus on the audit opinion trade off between a going-concern opinion and a clean opinion. Accordingly, we develop hypothesis 1 as follows.

H1: The probability of financially distressed companies' receiving going-concern opinions increases with the likelihood of dismissal to coerce clean opinions.

Dismissal Threats to Coerce Shared Opinions Rather Than Going-Concern Opinions

As for circumstances under which clients accept shared opinions but do not accept going-concern opinions, the incentive to compromise independence might be stronger because auditors do not have to bear full responsibility when they fail to qualify a going-concern assumption. In other words, ceteris paribus, the lower the expected disutility of issuing an inappropriate opinion is, the more likely that the auditor surrenders to the dismissal threat. Specifically, in the consideration of the costs of sacrificing independence, principal auditors might think they have referred to other auditors in the audit report and therefore divided responsibility for the audit work. The principal and other auditor are responsible for their own report and work respectively in the event of a lawsuit or SEC action. Furthermore, principal auditors may believe they have completed their audit work with due care and their results will not be perceived as an audit failure, even if clients subsequently experience financial distress that relate to audit work covered by other auditors. Thus, it is perceived that the negligence of other auditors causes less harm to the principal auditor's reputation. In sum, the principal auditor has less expected disutility for issuing a shared opinion than for issuing a clean opinion for clients who deserve a going-concern opinion. Hence, principal auditors are more likely to compromise their independence and to issue shared opinions instead of going-concern opinions to their clients. Hypothesis 2 is developed as follows.

H2: The probability of financially distressed companies' receiving going-concern opinions decreases with the likelihood of dismissal to coerce shared opinions.

III. METHODOLOGY FOR DISMISSAL THREAT ARGUMENT

In the present investigation, we have adapted the analogy of Lennox's (2000) opinion-shopping variable to our dismissal threats variable. In the scenario of a dismissal threat imposed by the client, auditors are more likely to be dismissed if they are inclined to issue an unfavorable audit opinion. On the contrary, auditors are not dismissed if they promise their client to issue a favorable opinion. Hence, the difference in auditor switching probability had the auditor issued opposite opinions can be used to as a proxy variable for dismissal threats and expressed in notation as follows:

$$[\,pr(S=1|Q=1)-pr(S=1|Q=0)]>0,$$

where *pr* is the probability, *Q*=1 (0) stands for the unfavorable (favorable) opinion, and *S*=1 means auditor switch, 0 otherwise.

To estimate the dismissal threat variable, we construct an auditor switch model.

$$S^{*}_{t+1}=\theta X+\theta_1 OA_t+\theta_2 GC_t+u \qquad (1)$$

$$S_{t+1}=1 \quad if\ S^{*}_{t+1}>0,$$

$$S_{t+1}=0 \quad if\ S^{*}_{t+1}\le 0$$

where the error term, *u* is assumed to be normally distributed with mean zero and variance σ_u^2. *S** stands for the latent variable of propensity to switch auditors. *X* controls for other determinants of auditor switch. Two dummy variables (i.e. *OA* and *GC*) are used to capture the audit opinion effect. *OA*=1 (*GC*=1) means a shared (going-concern) opinion, 0 otherwise.

The clean opinion is reflected by both OA and GC coded as 0. Hence, auditors are dismissed in period t+1 with probability *pr* ($S_{t+1}|$ *X*, OA_t=0 and GC_t=0) if they issue a clean opinion in period t. As to the switching probability conditional on a going-concern opinion, we define *pr* ($S_{t+1}|$ *X*, GC_t=1) to accommodate multiple qualifications, which occur frequently in audit practice. From the probability *pr* ($S_{t+1}|$ *X*, GC_t=1), we can represent both single (i.e. *OA*=0, *GC*=1) and multiple qualification (i.e. *OA*=1, *GC*=1) situations. Therefore, when the client prefers a clean to a going-concern opinion, the dismissal threat ($THREAT^{GC\_Clean}$) can be defined as

$$[\,pr(S_{t+1}|X,GC_t=1)-pr(S_{t+1}|X,OA_t=0,GC_t=0)].$$

In situations where a client coerces a shared instead of a going-concern opinion, the dismissal threat ($THREAT^{GC\_OA}$) may be defined as

$$[\,pr(S_{t+1}|X,OA_t=1,GC_t=1)-pr(S_{t+1}|X,OA_t=1,GC_t=0)].$$

This means that, in the multiple qualifications circumstance, the shared opinion has been agreed upon by the client and the auditor, while the going-concern modification opens the door to argument between the client and the auditor.

Both $THREAT^{GC\_Clean}$ and $THREAT^{GC\_OA}$ are estimated by Equation (1) and included in the three-level ordered logistic auditor report model as follows:

$$QUAL^{*} = \gamma Y + \gamma_1 THREAT^{GC\_Clean} + \gamma_2 THREAT^{GC\_OA} + \nu \quad (2)$$

$$QUAL = 2 \;\; if \;\; QUAL^{*} > \mu_1,$$

$$QUAL = 1 \;\; if \;\; QUAL^{*} \le \mu_1,$$

$$QUAL = 0 \;\; if \;\; QUAL^{*} \le 0,$$

where the error term, v is assumed to be normally distributed with mean zero and variance σ_v^2 and $E(u, v)=0$. The latent variable ($QUAL^*$) in Equation (2) represents the auditor's judgment of the client's financial condition. The remaining explanatory variables (Y) control for other determinants of audit opinions. The auditor applies threshold values, μ_1, in determining the modified audit opinion. The auditor's choice of opinions are clean ($QUAL$=0), shared ($QUAL$=1), and going concern ($QUAL$=2) when $QUAL^*$ falls in the ranges of (< 0), (0, μ_1) and (>μ_1), respectively.

The variable $THREAT^{GC\_Clea}$ is used to test H1; accordingly, we expect the coefficient on $THREAT^{GC\_Clean}$ is positive (γ_1>0). As for H2, we predict the coefficient on $THREAT^{GC\_OA}$ is negative (γ_2>0).

IV. THE SAMPLE AND VARIABLE MEASUREMENT

Sample and Data

Data

We apply this test to listed companies in Taiwan and establish the research period from 1999-2001. Since some variable measurements employ data from year t-2 to t+2, our data collection period covers 1997-2003. All the variables used to construct our empirical analysis are retrieved from the Taiwan Economic Journal (TEJ) database.

Sample Selection

Our sample is composed of publicly traded corporations listed on TSE and GSM, excluding financial institutions. To avoid the same company being classified into both switch and non-switch samples, companies in the non-switch sample are required to have kept (i.e., not switched) auditors for at least 3 consecutive years, the exact duration of the research period. In addition, we exclude insolvent companies that are judicially declared a special arrangement by TSE, since an auditor's reporting discretion declines when a company has filed for bankruptcy (Carcello and Neal 2000). Furthermore, we do not include litigation qualifications because liability for lawsuits is not recorded in the financial statements (Krishnan and Krishnan 1996). Following this procedure, our sample is reduced to 1,926 companies-year combinations.

Auditors do not generally issue going-concern opinions for non-stressed companies that suddenly fail (McKeown et al. 1991). Therefore, from the preliminary sample we determine those companies that were potentially financially distressed. As in prior research, we define a company as stressed if it exhibits at least one of the following financial stress signals: (1) negative working capital in year t, (2) a bottom line loss in any of the 3 years prior to year t, and (3) negative operating cash flows in the consecutive 3 years prior to year t. After deleting non-stressed companies, we also exclude companies with insufficient data for estimating Equation (1). Therefore, our final sample for Model

(1) includes 791 companies-years. Owing to adding the lag variable of audit opinion in Equation (2), the final sample for Equation (2) is further reduced to 607 companies-years. Table 1 presents the details of our sample selection procedure.

Table 1: Sample Selection Criteria

Sample selection for Equation (1)	
Initial sample: industrial firms for 1999-2001	2,147
Less: Companies not retaining auditors at least 3 years in the non-switch sample	(145)
Insolvent	(67)
Litigation qualification	(9)
Preliminary sample	1,926
Less: Non-stressed firms	(1,062)
Insufficient data for Equation (1)	(73)
Final sample for Equation (1)	791
Breaking down as:	
Non-switcher[a]	760
Switcher[b]	31
Sample selection for Equation (2)	
Original sample from Equation (1)	791
Less: Insufficient data for Equation (2)	(184)
Final sample for Equation (2)	607
Breaking down as:	
Clean opinions	344
Shared opinions	239
Going concern opinions	24

[a] Companies in the non-switch sample are required to have kept auditors for at least 3 consecutive years (financial institutions and service companies excluded).

[b] Companies in the switch sample are required to dismiss their auditors in year t+1 (financial institutions and service companies excluded).

Variable Measurement

Auditor Switch (S)

A dummy switch (*S*) has been set to one if a company changes its auditor in the year following the issuance of the opinion, zero otherwise. By comparing both the audit firm and the individual auditors in the current year with that in the following year, we identify the auditor switch.[4] Therefore, any one of following conditions shall not be coded as a switch: (1) same audit firm but different individual auditors, (2) audit firm merges, (3) same individual auditors who have joined a new audit firm, and (4) audit firm name changes.

[4] The switching status of each company is verified by examining other sources such as the website information on Market Observation Post System in Taiwan.

Auditor Report (QUAL, OA, GC)

The auditor report (*QUAL*) is the dependent variable in Equation (2). *QUAL* is coded as zero for clean opinions, one for shared opinions, and two for going-concern opinions.[5],[6] Multiple qualifications arising in conjunction with the going-concern opinion are included in the going-concern opinions category. Two opinion dummies (i.e. *OA* and *GC*) are designated as independent variables in Equation (1) due to the three-level *QUAL*. *OA*, shared opinion, is 1 when *QUAL*=1, zero otherwise. *GC*, a going-concern opinion, is 1 when *QUAL*=2, zero otherwise.

Control Variables (X) Included in the Auditor Switch Model

In addition to auditor reports of interest, we control for the effects of other factors likely to affect a client's decision to dismiss its auditor: (1) changes in client characteristics, (2) characteristics of the incumbent auditor, (3) financial distress, and (4) miscellaneous, which are designated as year dummies (*YEAR*j).

(1) Client Changes

We expect a positive relation between auditor switch and each of the following variables that reflect changing auditee characteristics. Johnson and Lys (1990) argue that audit firms achieve competitive advantages through specialization, and that clients purchase audit services from the least cost supplier. Client-auditor realignments thus represent efficient responses to changes in client operations and activities over time. Following the model used by Johnson and Lys, four variables are used as proxies for expansion, profitability, financing and audit risk: changes in asset growth (|*GROWCH*|), changes in cash flow (|*CFOCH*|), changes in financing (|*FINCH*|), and changes in times-interest-earned (|*TIECH*|), respectively. |*GROWCH*| is constructed by the absolute value of the difference obtained from subtracting the pre-switch two-year average assets growth rate from the post-switch average growth rate. The absolute value is used since the primary focus is on whether the client changes its auditor, not the direction of auditor changes. Similarly, the variable, |*CFOCH*|, is the absolute value of change in two-year average operating cash flows (deflated by total assets) before and after an auditor switch. |*FINCH*| is measured by the absolute difference of two-year mean proceeds from external financing before and after the switch, where external financing is measured by the proceeds from newly-issued equity and debt (public or private), divided by total assets. We construct |*TIECH*| from the absolute difference between the two year mean times-interests-earned (*TIE*) before and after the switch. *TIE* is defined as earnings before interests and taxes divided by interest expenditure. We winsorize both the upper and lower 5% of *TIE* because *TIE* is inflated by minor interest expenditures.

A change in top management is often associated with a change in auditors.[7] A new

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[5] In prior auditor report research, an audit opinion was classified as 'modified' for material uncertainties and going-concern problems depending on the severity of qualifications. In Taiwan, as most material uncertainties involve litigation, which cannot be predicted by financial variables, we eliminate the litigation category as has been done by prior research (e.g. Krishnan and Krishnan 1996).

[6] In line with previous research (e.g., Krishnan 1994; Jeter and Shaw 1995), consistency exceptions for voluntary and mandatory accounting changes are one cause for a modified auditor report, but they are included in the clean opinion category because the auditor has little discretion in such matters.

[7] See Chow and Rice (1982), Williams (1988), and Carcello and Neal (2003).

manager may change auditors in order to obtain a fresh perspective on the company's financial results, or because he or she had positive experience with another audit firm (Carcello and Neal 2003). In Taiwan, both the chairman of the board and the chief executive officer (CEO) are charged with the execution of the company's decisions. Therefore, we set dummy variable *MGTCH* to 1 if both chairman and CEO changed in the year the auditor was dismissed or in the previous year and 0 otherwise.

(2) Incumbent Auditor Characteristics

Following Krishnan et al. (1996), we use *IMS* and *BIG5* to represent auditor-related factors and predict a negative relation between these auditor-related factors and auditor switch. The auditor's industry market share (*IMS*) is measured as the percentage of the log of total assets that the auditor audits for all companies in the client's industry[8]. The auditor's industry market share can reflect audit expertise and can also proxy for reputation effect. The greater the auditor's market-share in the client's industry, the less likely the client is to dismiss its auditor (Krishnan et al. 1996). Previous studies have used the Big 5 auditing firms to proxy for both auditor quality and reputation effects. A client is less likely to switch from a Big 5 (Krishnan et al. 1996). Therefore, variable *BIG5* takes the value of one for the member firms of Big 5 in Taiwan, zero otherwise.

(3) Financial Distress

Previous studies (e.g., Schwartz and Menon 1985; Krishnan and Stephens 1995) have suggested that financially distressed companies may be more likely than healthy companies to change auditors. The motivation for such a change could be a need for different services, an inability to pay audit fees or disagreements with the incumbent auditor over accounting policies or disclosures. We use a 2-year consecutive net loss (*LOSS2*) to represent financial distress and predict a positive sign for this variable.

Control Variables (Y) Included in the Auditor Report Model

Besides the threat variables of interest, the choice of independent variables in the auditor report model is classified into four categories: (1) contrary factors, (2) mitigating factors, (3) auditor characteristics (quality and tenure), and (4) miscellaneous.

(1) Contrary factors

Prior studies have found that the greater the client's financial distress, the greater the probability of receiving modified auditor reports (Carcello and Neal 2000; Geiger and Raghunandan 2002). We use dummy variable *DISTRESS* to identify whether the entity has declared insolvency in the subsequent year.[9] We expect a positive relationship between *DISTRESS* and the receipt of a going concern opinion.

Mutchler et al. (1997) find that debt covenant violations are positively associated with the probability of receiving a going-concern opinion. We include leverage variable *LEV* to capture proximity to covenant violations because firms close to violation are

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[8] Each company's industry comes from TEJ's classification of companies into industries, which is based on the TSE version SIC and adjusted by primary products.

[9] Dopuch et al. (1987) consider whether a loss was reported (*LOSS*) in measuring a client's financial health. In contrast, we use *LOSS* as one of several financial stress signals mentioned earlier in section 4.1.2. To avoid multicollinearity, we use the *DISTRESS* variable, which reflects the ex post event of being classified as insolvent, as a proxy for the auditor's ex ante perception that the client's financial condition is deteriorating. The variable's validity depends on whether one can reasonably assume that the auditor is aware of the client's financial condition at the time of issuing the report.

likely to have high leverage (Beneish and Press 1993), and predict a positive sign. *LEV* is measured by total liabilities over total assets at the end of the year.

Following Dopuch et al. (1987), we also include the ratio of receivables and inventories to assets (*RIA*) to capture high-risk accounts, which call for greater caution and exercise of independent auditor judgment. *RIA* is expected to have a positive association with a going concern opinion.

(2) Mitigating factors

We include several factors that are likely to mitigate the probability of receiving a going concern opinion and expect the sign on the coefficients for each mitigating factor to be negative. Client size is generally positively associated with its financial health, which in turn decreases with the likelihood of its receiving qualified opinion (Dopuch et al. 1987; Francis and Krishnan 1999). Furthermore, large companies have more negotiating power in the event of financial difficulties and hence are more likely to avoid bankruptcy (Reynolds and Francis 2001, DeFond et al. 2002). Client size (*SIZE*) is measured as a log of total assets.

Two other mitigating factors in our model include *FASTSALE* and *FFINANCE* because SAS No.59 specifies managerial actions that mitigate the effect of contrary factors, including plans to sell assets, issue new financing or refinance existing debt, and increase ownership equity. Using methodology similar to that of Reynolds and Francis (2001), we examine the subsequent fiscal year financial statements to identify sales of assets or the issuance of new debt or equity. *FASTSALE* is the sum of the proceeds from selling investment and fixed asset in year t+1, scaled by total assets in year t. *FFINANCE* is measured by the issuance of new debt or equity (public or private) in year t+1, divided by total assets in year t.

(3) Auditor characteristics

We include an industry specialist dummy variable (*SPEC*) to control for the impact auditor quality could have on the exercise of independent judgment. High-quality auditors have a greater investment in technology to detect errors and irregularities and are therefore more likely to issue a qualified opinion (Krishnan and Krishnan 1996; Craswell et al. 2002). We expect the sign on the coefficient for *SPEC* to be positive. According to Craswell et al. (1995), we identify the industry specialist if the auditor's market share is greater than 20% in the client's industry with at least 30 companies.[10]

We measure auditor tenure (*TENURE*) as the number of consecutive years that the client has retained the auditor.[11] The longer the auditor tenure, the more complacent the auditor becomes and the less independent the auditor's judgment is (Jeter and Shaw 1995; Geiger and Raghunandan 2002; Craswell et al. 2002). It is also the case, however, that over the years an auditor develops in-depth knowledge of the client's business, which is crucial in performing an effective audit, and thus is more likely to be vigilant in exercising independent auditor judgment (Geiger and Raghunandan 2002; Craswell et al. 2002). Therefore, the sign on the coefficient for *TENURE* could be either positive or

[10] Craswell et al. (1995) used the thresholds of 10% and 20%, respectively, to identify an industry specialist. We chose 20% because both mean and median of *IMS* are greater than 10% (see Table 2).

[11] We truncate auditor tenure at 12 years because of data limitation. Moreover, truncation can reduce the effect of extreme values for clients that have retained their auditors for many years (Carcello and Neal 2003).

negative.

(4) Miscellaneous

The remaining control variables are prior year audit opinion (*PRIOROP*), time listed (*AGE*), and indicator variables for year j (*YEAR*j). *PRIOROP* captures the effect of persistence in audit reporting and is expected to have a positive sign. *AGE* controls firm maturity and is measured as log of the number of years the company has been publicly traded. Finally, *YEAR*j control for any year-specific effects. As with Francis and Krishnan (1999), no directional signs are predicted for *AGE* and *YEAR*j.

V. RESULTS

The Empirical Results for the Auditor Switch Model

Descriptive Statistics

Table 2 presents descriptive statistics on the full sample, switch subsample, and non-switch subsample for the variables used in our auditor switch model (i.e. Equation (1)).[12] The mean and median values of |*GROWCH*| in the full sample are 0.168 and 0.104, respectively, indicating the asymmetry of the sample distribution given the absolute value function used in the calculation of this variable. With respect to the differences tests between switch and non-switch samples, clients are more likely to switch auditors when clients have larger changes in profitability (|*CFOCH*|), have incidence of changes in top management (*MGTCH*), and incur financial distress (*LOSS2*). There was no significant relation between auditor dismissals and change in external financing (|*FINCH*|), auditor industry-market share (*IMS*), and Big 5 (*BIG5*). As for |*TIECH*|, the t-test for the difference in mean values was statistically significant; however, this was not the case for the Wilcoxon rank sum test, suggesting the possibility of extreme values. Additional analyses are presented in section 5.3 that control for the effect of outliers.

As for audit opinions, *OA* accounts for 37.0% of the full sample. In z tests for differences in means for *OA* between switch and non-switch samples, the results show that there is no support for *OA* increasing the propensity of clients to switch auditors. *GC* accounts for only 3.8% of the full sample, suggesting uncommon audit opinions. There are marginally statistically significant differences in *GC* between companies that switch auditors and the comparison group, a result that is consistent with auditors losing clients if they issue unfavorable audit opinions.

[12] The median analysis for dummy variables is not tabulated but is available upon request.

Table 2: Descriptive Statistics for the Variables in Auditor Switch Model

	Full Sample N=791		Non-switcher N=760		Switcher N=30		Test for difference	
	Mean (Median)	Std. Dev.	Mean (Median)	Std. Dev.	Mean (Median)	Std. Dev.	t Value (Z Value)	Pr> |t| (Pr> |Z|)
|*GROWCH*|	0.168	21.471	0.162	18.608	0.298	56.543	1.330	0.192
	(0.104)		(0.104)		(0.139)		(1.685)	(0.092 *)
|*CFOCH*|	0.062	0.078	0.060	0.072	0.115	0.171	1.760	0.088 *
	(0.041)		(0.041)		(0.062)		(1.664)	(0.096 *)
|*FINCH*|	0.051	0.080	0.051	0.079	0.055	0.103	0.180	0.855
	(0.020)		(0.020)		(0.018)		(-0.317)	(0.751)
|*TIECH*|	35.374	119.623	36.406	121.760	10.082	32.430	-3.600	0.001 ***
	(3.645)		(3.698)		(2.505)		(-1.139)	(0.255)
MGTCH	0.076	0.265	0.067	0.250	0.290	0.461	4.597	<.000 ***
IMS	0.162	0.081	0.163	0.081	0.141	0.081	-1.470	0.143
	(0.162)		(0.167)		(0.128)		(-1.515)	(0.130)
BIG5	0.779	0.415	0.780	0.414	0.742	0.445	-0.500	0.615
LOSS2	0.277	0.448	0.264	0.441	0.581	0.502	3.853	0.000 ***
OA	0.370	0.483	0.366	0.482	0.484	0.508	1.330	0.183
GC	0.038	0.191	0.036	0.185	0.097	0.301	1.748	0.081 *

*, **, and *** indicate significance at p < 0.10, 0.05, and 0.01, respectively.
N stands for number of observation.
Tests for differences in the means between non-switcher and switcher are based on t-statistics (z-statistics) for continuous (dummy) variables. Nonparametric tests for differences in location are based on the Wilcoxon rank sum test.
Year t+1is the year of auditor switch.

|*GROWCH*|= absolute difference between two-year average asset growth before and after switch
|*CFOCH*|= absolute difference between two-year average cash flows before and after switch
|*FINCH*|= absolute difference between two-year average financing proceeds before and after switch
|*TIECH*|= absolute difference between two-year average times-interests-earned before and after switch
MGTCH= 1 if both chairman and CEO changed in the year of auditor switch or in the previous year, 0 otherwise.
IMS= incumbent auditor's market share within the client's industry
BIG5= 1 if member firms of BIG 5in Taiwan, zero otherwise.
LOSS2= 1 if consecutive 2 years bottom line loss, zero otherwise.
OA= 1 if shared opinion, zero otherwise.
GC= 1 if going-concern opinions, zero otherwise.

Logit Analysis

Table 3 reports the results from a binary logit analysis of the auditor switch model used to estimate the dismissal threat variables. The overall model is highly significant ($p < 0.000$), and pseudo-R^2 is 17.5 percent.[13] Hosmer and Lemeshow's (1989) test of goodness-of-fit cannot reject the null hypothesis of a well-fitted model (p-value= 0.453).[14]

[13] The explanatory power of Johnson and Lys (1990) and Carcello and Neal (2003) models are 20.1% (p.293) and 11% (p.109), respectively. Our model's explanatory power is comparable with prior studies.

[14] In order to diagnose the problem of multicollinearity, the auditor switch model was also estimated using OLS regression to derive variance inflation factors (VIF). All VIF are less than 1.70, indicating that multicollinearity is not a problem in the model estimation.

Table 3: Results for Logistic Regression of Auditor Switch on Auditor Reports

$$S^*_{t+1} = \theta X + \theta_1 OA_t + \theta_2 GC_t + u \qquad (1)$$

$$S_{t+1} = 1 \quad if\ S^*_{t+1} > 0\ ,$$

$$S_{t+1} = 0 \quad if\ S^*_{t+1} \le 0$$

	Predicted Relation	Estimated Coefficients	χ^2	Pr> χ^2
Intercept		-4.190	41.118	<.000***
Clients Changes				
|*GROWCH*|	+	0.017	3.328	0.068*
|*CFOCH*|	+	1.531	0.644	0.422
|*FINCH*|	+	-0.384	0.030	0.862
|*TIECH*|	+	-0.005	0.585	0.444
MGTCH	+	1.232	6.517	0.011**
Auditor characteristics				
IMS	−	-3.656	1.164	0.281
BIG5	−	0.316	0.265	0.607
Financial Distress: *LOSS2*	+	1.414	11.233	0.001***
Year Dummies: *YEARj*	?	included		
Auditor Rport				
OA	+	0.654	2.529	0.112
GC	+	0.467	0.391	0.532
LR statistic			39.894	<.000***
Hosmer and Lemeshow's (1989) test of goodness-of-fit			7.808	0.453
Pseudo R^2		17.5%		

*, **, and *** indicate significance at p < 10%, 5%, and 1%, respectively.
Year t+1is the year of auditor switch.
Number of observations: 791.

|*GROWCH*| = absolute difference between two-year average asset growth before and after switch
|*CFOCH*| = absolute difference between two-year average cash flows before and after switch
|*FINCH*| = absolute difference between two-year average financing proceeds before and after switch
|*TIECH*| = absolute difference between two-year average times-interests-earned before and after switch
MGTCH = 1 if both chairman and CEO changed in the year of auditor switch or in the previous year, 0 otherwise.
IMS = incumbent auditor's market share within the client's industry
BIG5 = 1 if member firms of BIG 5in Taiwan, zero otherwise.
LOSS2 = 1 if consecutive 2 years bottom line loss, zero otherwise.
OA = 1 if shared opinion, zero otherwise.
GC = 1 if going-concern opinions, zero otherwise.
YEARj = year dummies, j=0,1. For example, YEAR1=1 if sample year=2001, 0 otherwise.

Among the control variables, |*GROWCH*|, *MGTCH*, and *LOSS2* have significant coefficients in the expected direction. Namely, companies are more likely to switch auditors when they have greater changes in firm growth, have incidence of changes in top management, or incur financial distress.

With respect to the audit opinion variables, we find that both *OA* and *GC* have positive signs, as expected, but are insignificant. Possibly, as DeAngelo (1982) notes, qualification avoidance is not an important motivation to change auditors. On the other hand, it is also likely that the threat of a switch is followed by the issuance of a clean opinion, whereupon the client decides not to switch, causing no statistically significant relationship to exist between switching and modified auditor reports. The latter explanation is highly related to our hypotheses. Hypothesis testing allows us to analyze empirically which explanation is the most plausible.

The Empirical Results of the Auditor Report Model

Descriptive Statistics

Table 4 reports descriptive statistics on the full sample, clean opinion subsample, and modified audit opinion (hereafter, *MAO*) subsample for the variables used in our auditor report model (i.e. Equation (2)). As for control variables in Equation (2), the *MAO* subsample is significantly different than the clean opinion subsample in the following dimensions: they are more likely to have incidence of subsequent insolvency (*DISTRESS*), have a higher leverage (*LEV*), are larger in size (*SIZE*), have longer auditor tenure (*TENURE*), are more likely to have received a prior year *MAO*, and have listed for a longer time (*AGE*).

With respect to the experiment variables, the mean value of $THREAT^{GC\_Clean}$ in the full sample is 0.029, indicating that the dismissal probability conditional on a going concern opinion is 2.9% higher than the probability conditional on a clean opinion.[15] The test statistics for $THREAT^{GC\_Clean}$ show there are significant differences in dismissal threats between those receiving clean and modified opinions. Companies with modified opinions pose a higher dismissal threat than do those with clean opinions, suggesting that clients do not appear to succeed on $THREAT^{GC\_Clean}$.

[15] The t-statistics for this mean value is 20.92 with p value < 0.0001; while the p value from the Wilcoxon test is also <0.0001 (untabulated).

Table 4: Descriptive Statistics for the Variables in Auditor Report Model

	Full Sample N=607		QUAL =0 N=344		QUAL =1,2 N=239+24		Test for difference	
	Mean (Median)	Std. Dev.	Mean (Median)	Std. Dev.	Mean (Median)	Std. Dev.	t Value (Z Value)	Pr> |t| (Pr> |Z|)
DISTRESS	0.127	0.333	0.102	0.303	0.160	0.367	2.124	0.034 **
LEV	0.479	0.176	0.455	0.170	0.510	0.179	3.840	0.000 ***
	(0.483)		(0.462)		(0.505)		(3.500)	(0.001 ***)
RIV	0.268	0.200	0.274	0.194	0.260	0.207	-0.850	0.397
	(0.212)		(0.224)		(0.193)		(-1.717)	(0.086 *)
SIZE	15.424	1.191	15.237	1.185	15.668	1.155	4.490	<.000 ***
	(15.346)		(15.094)		(15.593)		(5.200)	(<.000 ***)
FASTSALE	0.018	0.039	0.017	0.045	0.019	0.031	0.460	0.643
	(0.005)		(0.004)		(0.007)		(2.168)	(0.030 **)
FFINANCE	0.066	0.118	0.074	0.134	0.056	0.091	-1.980	0.048 **
	(0.026)		(0.027)		(0.025)		(-0.736)	(0.462)
SPEC	0.224	0.417	0.233	0.423	0.213	0.410	-0.574	0.566
TENURE	7.591	3.124	7.343	3.071	7.916	3.167	2.250	0.025 **
	(9)		(8)		(10)		(2.471)	(0.014 **)
PRIOROP	0.356	0.519	0.076	0.265	0.722	0.541	15.542	<.000 ***
AGE	1.579	1.194	1.362	1.199	1.862	1.127	5.230	<.000 ***
	(1.641)		(1.362)		(2.041)		(5.932)	(<.000 ***)
$THREAT^{GC\_Clean}$	0.029	0.035	0.015	0.016	0.048	0.043	11.980	<.000 ***
	(0.020)		(0.009)		(0.031)		(14.740)	(<.000 ***)
$THREAT^{GC\_OA}$	0.027	0.022	0.025	0.022	0.028	0.023	1.670	0.096 *
	(0.017)		(0.016)		(0.018)		(1.984)	(0.047 **)

*, **, and *** indicate significance at p <10%, 5%, and 1%, respectively.

Tests for differences in the means between *QUAL*=0 and *QUAL*>0 are based on t-statistics (z-statistics) for continuous (dummy) variables. Nonparametric tests for differences in location are based on the Wilcoxon rank sum test.

N stands for number of observations. Where N= # + #, # before (after) "+" represent the sample size of *QUAL*=1(2)

QUAL=	0 if a clean opinion, 1 if a shared opinion, 2 if a going concern opinion.
DISTRESS =	1 if clients are insolvent in the subsequent year, 0 otherwise.
LEV=	total liability over total asset at the end of period
RIA=	ratio of receivables and inventories to assets
SIZE=	client size, measured by the log value of total assets.
FASTSALE=	future asset sale, measured by the proceeds from asset sales, deflated by total assets.
FFINANCE=	future finance, measured by the issuance of new debt or equity, deflated by total assets.
SPEC=	1 if auditor is an industry specialist, 0 otherwise.
TENURE=	auditor tenure
PRIOROP=	audit opinion in the prior year.
AGE=	log of the number of years listed
$THREAT^{GC\_Clean}$=	dismissal threats when clients prefer clean opinions to going-concern opinions
$THREAT^{GC\_OA}$=	dismissal threats when clients prefer shared opinions to going-concern opinions

In order to further explore the two *THREAT* variables, we present the descriptive statistics from various sample partitions. Chung and Kallapur (2003) argue that P_{fire}, the probability of a firm's firing its auditor for reporting the breach, is higher for clients with

stronger incentives to manage earnings, or those with weaker corporate governance structures. In addition, P_{fire} could be lower if the client depends on the auditor for expertise. We use leverage (*LEV*) and changes in asset growth (|*GROWCH*|) to control for client incentives to manage earnings. The strength of corporate governance is proxied by whether the chairman and CEO positions are separate (*CEOCHAIR*), and whether the client has 5% blockholders (*BLOCK*). Auditor expertise is proxied by whether he or she is an industry specialist (*SPEC*). For each continuous variable, we divide the sample into two groups by the median of the variable concerned. For indicator variables, such as *CEOCHAIR*, we divide the sample into two groups. Table 5 presents descriptive statistics on the two *THREAT* variables for various sample partitions.

Table 5: Descriptive Statistics for *THREAT* Variables for Sample Partitions

Panel A: $THREAT^{GC\_Clean}$

Partition	Small group			Large group			Test for Difference			
Variables	N	Mean	Median	N	Mean	Median	t Value	Pr> |t|	Z Value	Pr> |Z|
Proxies for Client Incentives										
LEV	303	2.46%	1.44%	304	3.44%	2.47%	-3.52	0.00***	-5.34	<.00***
|*GROWCH*|	303	2.82%	1.99%	304	3.07%	2.14%	-0.90	0.37	-3.03	0.00***
Proxies for Corporate Governance										
CEOCHAIR	438	2.90%	1.85%	169	3.06%	2.19%	-0.54	0.59	-1.07	0.28
BLOCK	455	3.11%	2.24%	118	2.50%	1.47%	1.73	0.08*	2.83	0.00***
Proxies for Client Dependence on Auditor										
SPEC	471	3.11%	2.16%	136	2.39%	1.70%	2.56	0.01***	2.77	0.01***

Panel B: $THREAT^{GC\_OA}$

Partition	Small group			Large group			Test for Difference			
Variables	N	Mean	Median	N	Mean	Median	t Value	Pr> |t|	Z Value	Pr> |Z|
Proxies for Client Incentives										
LEV	303	2.21%	1.48%	304	3.13%	1.89%	-5.21	<.00***	-5.74	<.00***
|*GROWCH*|	303	2.43%	1.43%	304	2.91%	1.81%	-2.70	0.01***	-4.93	<.00***
Proxies for Corporate Governance										
CEOCHAIR	438	2.66%	1.67%	169	2.71%	1.79%	-0.26	0.79	-0.69	0.49
BLOCK	455	2.77%	1.75%	118	2.40%	1.59%	1.59	0.11	1.82	0.07*
Proxies for Client Dependence on Auditor										
SPEC	471	2.76%	1.73%	136	2.35%	1.47%	2.07	0.04**	2.47	0.01***

*, **, and *** indicate significance at $p < 0.10$, 0.05, and 0.01, respectively.
N stands for number of observations.
Tests for differences in the means between small and large group are based on t-statistics (z-statistics) for continuous (dummy) variables. Nonparametric tests for differences in location are based on the Wilcoxon rank sum test.
Small group means continuous (dummy) partition variables is below median (equal to zero). On the contrary, large group means continuous (dummy) partition variables is above median (equal to 1).

$THREAT^{GC\_Clean}$= dismissal threats when clients prefer clean opinions to going-concern opinions
$THREAT^{GC\_OA}$= dismissal threats when clients prefer shared opinions to going-concern opinions
SIZE= client size, measured by the log value of total assets.
LEV= total liability over total asset at the end of period
|*GROWCH*|= changes in asset growth
CEOCHAIR= 1 if CEO is also the chairman of the board, 0 otherwise.
BLOCK= 1 if client has 5% block-holders, 0 otherwise.
SPEC= 1 if auditor is an industry specialist, 0 otherwise.
TENURE= auditor tenure

As expected, the difference in means between the two groups is statistically significant in sample partition by measures of incentive to manage earnings and client dependence on auditor. For corporate governance factors, the medians of $THREAT^{GC\_Clean}$ and $THREAT^{GC\_OA}$ for firms with 5% blockholders appear to be significantly greater than for firms without 5% blockholders. As for *CEOCHAIR*, we have the expected sign, but not significant. Overall, our *THREAT* variables are greater in subsamples of clients that have higher incentives to manage earnings, weaker corporate governance structures, and are less dependent on auditors, consistent with Chung and Kallapur's (2003) argument.

Logit analysis for auditor reporting

Table 6 reports the results for ordered logit analysis of the auditor switch model. The overall model is significant (LR statistics have p-value less than 0.000). Pseudo R^2 is 60.1%.[16] The highly significant positive coefficient on $THREAT^{GC\_Clean}$ is as predicted in H1. For the sample of potentially distressed companies, the auditor is more likely to issue a going-concern opinion to a client who threatens to dismiss in order to get a clean opinion, after controlling for contrary factors, mitigating factors, auditor characteristics and miscellaneous. The result is consistent with the argument that the expected disutility of issuing an inappropriate opinion is sufficiently large to protect auditor independence.

The coefficient for $THREAT^{GC\_OA}$ in Equation (2) is negative and significant ($p<0.000$), lending a support to H2. In situations with shared legal and professional responsibility and thus lower auditors' expected disutility of sacrificing independence, auditors may easily surrender to dismissal threats and lower the propensity of issuing a going-concern opinion.

In sum, the tests of H1 and H2 indicate that responsibility divisibility is the key factor when an auditor decides whether or not to surrender professional independence to dismissal threats. When the auditor has to assume full responsibility for a wrongly issued clean opinion, he or she is more likely to issue a going-concern opinion to a potentially distressed client. On the contrary, when the auditor can divide the professional responsibility with other auditors, he or she is less likely to issue a going-concern opinion to a potentially distressed client.

[16] We also estimate the equation (2) using OLS regression to derive VIF to assess potential collinearity. None of the VIFs are greater than 3.14, indicating that multicollinearity is not a concern in the auditor report model estimation.

Table 6: Results for Ordered Logistic Regression of Auditor Report on Dismissal Threats

$$QUAL^{*} = \gamma Y + \gamma_1 THREAT^{GC\_Clean} + \gamma_2 THREAT^{GC\_OA} + \nu \quad (2)$$

$$QUAL = 2 \;\; if \;\; QUAL^{*} > \mu_1,$$

$$QUAL = 1 \;\; if \;\; QUAL^{*} \le \mu_1,$$

$$QUAL = 0 \;\; if \;\; QUAL^{*} \le 0,$$

	Predicted Relation	Estimated Coefficients	χ^2	Pr> χ^2
Intercept 2		-8.766	27.219	<.000***
Intercept 1		-3.729	5.330	0.021**
Experimental Variables				
THREAT$^{GC\_Clean}$	+	52.807	83.421	<.000***
THREAT$^{GC\_OA}$	−	-69.686	43.615	<.000***
Control Variables (*Y*)				
DISTRESS	+	1.190	10.315	0.001***
LEV	+	1.969	7.066	0.008***
RIA	+	0.850	2.223	0.136
SIZE	−	0.065	0.365	0.546
FASTSALE	−	-1.184	0.121	0.729
FFINANCE	−	-2.386	3.813	0.051*
SPEC	−	0.326	1.630	0.202
TENURE	?	0.060	2.243	0.134
PRIOROP	+	2.412	102.725	<.000***
AGE	?	0.059	0.225	0.635
YEARj	?	included		
LR statistic			400.947	<.000***
Pseudo R^2		60.1%		

*, **, and *** indicate significance at p < 10%, 5%, and 1%, respectively.
Number of observations: 607.

QUAL= 0 if a clean opinion, 1 if a shared opinion, 2 if a going concern opinion.
THREAT$^{GC\_Clean}$= dismissal threats when clients prefer clean opinions to going-concern opinions
THREAT$^{GC\_OA}$= dismissal threats when clients prefer shared opinions to going-concern opinions
DISTRESS= 1 if clients are insolvent in the subsequent year, 0 otherwise.
LEV= total liability over total asset at the end of period
RIA= ratio of receivables and inventories to assets
SIZE= client size, measured by the log value of total assets.
FASTSALE= future asset sale, measured by the proceeds from asset sales, deflated by total assets.
FFINANCE= future finance, measured by the issuance of new debt or equity, deflated by total assets.
SPEC= 1 if auditor is an industry specialist, 0 otherwise.
TENURE= auditor tenure
AGE= log of the number of years listed.
PRIOROP= audit opinion in the prior year.
YEARj= year dummies, j=0,1. For example, YEAR1=1 if sample year=2001, 0 otherwise.

The control variables, *DISTRESS*, *LEV*, *FFINANCE*, and *PRIOROP* have significant coefficients in the expected direction. Companies are more likely to receive a going concern report if they are financially distressed or with debt default. Future issuance of debt or equity reduces the likelihood of receiving a going concern report. Finally, companies are likely to receive a going concern report because of the persistence in audit opinions.

Sensitivity Analysis

Additional analyses are reported in this section to assure that our results are not caused by measurement errors and model misspecification.

Alternative measurement of |TIECH|. As mentioned in Section 5.1.1, earlier descriptive analyses suggest that |*TIECH*| might contain extreme values. In order to avoid outlier effects, we dichotomize this variable and set |*TIECH*| as 1 if |*TIECH*| $\geqq$ median and zero otherwise. When we rerun Equation (1) with the new |*TIECH*|, the coefficient on the new |*TIECH*| variable remains insignificant. Using the new results from Equation (1) to re-estimate both the $THREAT^{GC\_Clean}$ and $THREAT^{GC\_OA}$ in Equation (2), the coefficients on the two *THREAT* variables are still significant in the expected direction. Therefore, we conclude the results in Table 6 are robust with respect to the extreme values of |*TIECH*|.

Adding market variables as control variables. The audit opinion prediction model of Dopuch et al. (1987) includes financial and market variables. Equation (2) does not include market variable due to sample size consideration. Nevertheless, when we add *RET-MRET* (companies return minus market return) and *BETA* to the model, the coefficients for *RET-MRET* and *BETA* are insignificant, and the two *THREAT* variables are significant in expected direction as shown in Table 6.

Adopting the control variables of Bell and Tabor (1991). Bell and Tabor (1991) develop a model to predict modified audit opinion by using financial statement variables. We replace the control variables originating from the Dopuch et al. (1987) model such as *DISTRESS*, *LEV*, *RIA*, and *AGE* with four control variables from Bell and Tabor (1991): rate of change in ROE, rate of change in the ratio of inventory to net sales, rate of change in the ratio of receivables to inventory, and rate of change in the ratio of current assets to current liabilities. When we rerun Equation (2) with new control variables, none of the new control variables are significant, and the results of the hypotheses tests are still significant in the expected direction. Additional analyses from the complete Dopuch et al. (1987) model and the Bell and Tabor (1991) model further assure that our results are not caused by model misspecification.

First-time qualification. We eliminate prior qualifications to capture first-time qualifiers and rerun the ordered logistic regression of auditor report. As predicted, there exist significant associations between the two *THREAT* variables and propensity to qualify.

VI. CONCLUSION

The Public Oversight Board's Panel on Audit Effectiveness (POB 2000, 109) notes that independence is fundamental to the reliability of auditor's report. This study investigates whether dismissal threats imposed by clients jeopardize auditor independence

and result in auditors' decreased propensity to issue going-concern opinions to financially distressed clients. We identify two types of dismissal threats imposed by the same client. One is the client threatens to dismiss the incumbent auditor unless the auditor issues a clean opinion in place of a going-concern opinion. The other is the client steps down from a clean opinion to a shared opinion but still rejects a going-concern opinion. These two types of dismissal threats come from the same client and therefore offer the same benefits to the auditor if he or she chooses to please the client. However, the two types of corresponding misconduct have different cost impacts on the auditor if he or she chooses to please the client. Possibly due to professional responsibility divisibility, the auditor has less expected cost for issuing a shared opinion than for issuing a clean opinion when he or she fails to qualify the going-concern assumption. Therefore, we expect that these two dismissal threats have different impacts on the auditor's reporting behavior.

Our result shows that the probability of a stressed client receiving a going-concern opinion increases when the client prefers a clean opinion. On the other hand, the result shows that the auditor decreases the propensity of issuing a going-concern opinion when he or she faces a client who is willing to receive a shared opinion. Overall, the results suggest that auditors are susceptible to dismissal threats if they have lower expected costs of issuing an inappropriate audit opinion. Since this study focuses on the effect of dismissal threats on auditor independence without formally discussing the strategic interaction between the auditor and his/ her client, future researches could extend our study by examining the strategic interaction between the auditor and management.

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更換威脅對會計師獨立性之影響

張文瀞
國立彰化師範大學會計學系
周玲臺
國立政治大學會計學系
林修葳
國立台灣大學國際企業學系

摘要：鑒於不利的審計意見會對公司產生一些負面後果(如股價下跌和不易募集資金等)，管理當局便萌生對會計師施加壓力之誘因。Carcello and Neal (2000)認為撤換會計師是公司對會計師施加壓力之方法之一，因此，本文目的在探討更換威脅對會計師獨立性之影響，亦即，當受查客戶不願收到不利的審計意見而以撤換會計師為由脅迫現任簽證會計師時，受查客戶是否可成功地取得較有利的審計意見。

本文共探討二種審計意見類型的更換威脅，分別為客戶(1)不願意收到「繼續經營疑慮」審計意見而威脅會計師出具無保留意見，以及(2)不願意收到「繼續經營疑慮」而威脅會計師出具「提及其他會計師」之審計意見。受查客戶施加的更換威脅是否能成功，取決要素在於會計師留任客戶的經濟利益是否大於犧牲獨立性的成本(Teoh 1992；Krishnan et al. 1996；DeFond et al. 2002)。由於本文並非探討不同客戶對會計師施加不同的更換威脅，而係探討同一客戶對會計師施加二種更換威脅，因此會計師面對二種更換威脅，留任客戶的經濟利益皆相同，不同的是會計師所認知的犧牲獨立性的成本。

在第一種更換威脅的情境下，會計師於受查客戶破產前未能揭露有關繼續經營疑慮問題，反而出具無保留意見，往往會被媒體和社會大眾等審計專業以外的人士認定為審計失敗(Geiger and Raghunandan 2002)，此時會計師成眾矢之的，易成為遭受損失的投資人求償索賠的對象。此外，會計師考量到在無保留意見的情境下，需由自己對投資大眾負完全法律責任，無法分攤予他人。所以，在應揭露繼續經營疑慮問題卻出具無保留意見的情況下，會計師的反效用期望值甚大。將審計意見區分成「繼續經營疑慮」與「無保留」二級，Reynolds and Francis (2001)之實證結果發現客戶規模與繼續經營疑慮審計意見成正相關，因而結論指出會計師聲譽保護效果大於對客戶之經濟依賴性效果。改以非審計公費衡量對客戶之經濟依賴性，DeFond et al.

(2002)並未發現非審計公費與繼續經營疑慮審計意見具顯著負向關聯性，因而結論指出市場基礎誘因(主要為聲譽損失與訴訟成本)是維護會計師獨立性之基石。據此，本文發展假說一如下：

假說一：當更換威脅係來自客戶偏好無保留意見而不願查核報告被附加繼續經營疑慮之保留事項時，會計師出具不利審計意見的機率較高。

相對地，在第二種更換威脅之情境下，針對客戶可以接受「提及其他會計師」卻無法接受「繼續經營疑慮」之審計意見情況，主查會計師考量到倘若客戶的繼續經營問題係隱藏在轉投資收益上，而轉投資收益屬其他會計師的查核範圍，自己已經在查核報告上揭示共享責任，因而與其他會計師各自按自己查核的範圍負法律責任，毋須承擔其他會計師的法律責任。再者，主查會計師可能認為自己已在所屬查核範圍內善盡審計責任，即使日後客戶爆發財務困難，可諉過於其他會計師，較不會因其他會計師的審計過失而被認知為自己的審計失敗，因此主觀認為對聲譽的斲傷不大。所以，相較於前述第一種更換威脅，會計師所認知的反效用期望值變小，較易屈從客戶施加的更換威脅，損害超然獨立性。[17]據此，發展假說二如下：

假說二：當更換威脅係來自客戶偏好提及其他會計師之意見而不願查核報告被附加繼續經營疑慮之保留事項時，主查會計師出具不利審計意見的機率較低。

本研究對「更換威脅」之衡量方法，乃是自 Lennox (2000)的審計意見購買行為類推(analogize)而來。延伸 Lennox (2000)的論點至更換威脅情境：若出具不利審計意見將遭撤換，因此「更換威脅」變數為不利審計意見下被受查客戶撤換的機率，與有利審計意見下被撤換的機率二者之差異，以符號表之如下：

$$[pr(S=1|Q=1,X)-pr(S=1|Q=0,X)]>0$$

其中 *pr* 為機率，*S*=1 (0)代表更換(不更換)會計師，*Q*=1 為不利審計意見，*X* 為影響更換會計師之公司特性。

欲估計更換威脅變數，必須先建構會計師更換模型。茲將模型列示如下：

[17] 在法理上，「提及其他會計師」之審計意見是否可構成會計師免責之要件，由於並未有相關案例，本文無法論斷，且此已超出本文研究範圍。然而，Carcello and Palmrose (1994)發現修正式審計意見雖無法完全保護會計師免除法律責任，但卻可減低會計師被告的機率，此之證據正與本文主張「提及其他會計師」審計意見會影響會計師對犧牲獨立性成本之認知不謀而合。

$$S^*_{t+1} = \theta X + \theta_1 OA_t + \theta_2 GC_t + u \qquad (1)$$
$$S_{t+1} = 1 \quad if\ S^*_{t+1} > 0,$$
$$S_{t+1} = 0 \quad if\ S^*_{t+1} \le 0$$

其中S^*代表更換會計師之傾向，*OA*=1 代表提及其他會計師意見，*GC*=1 代表繼續經營疑慮意見，t+1 為更換會計師年度。

根據式(1)，即可估計「繼續經營疑慮」到「無保留」意見之更換威脅變數($THREAT^{GC\_Clean}$)：$[pr(\hat{S}_{t+1}|X, GC_t = 1) - pr(\hat{S}_{t+1}|X, OA_t = 0, GC_t = 0)]$，以及「繼續經營疑慮」到「提及其他會計師」之更換威脅變數($THREAT^{GC\_OA}$)：$[pr(\hat{S}_{t+1}|X, OA_t = 1, GC_t = 1) - pr(\hat{S}_{t+1}|X, OA_t = 1, GC_t = 0)]$。更換威脅與審計意見關聯性的實證模式則如式(2)所示：

$$QUAL^*_t = \gamma Y + \gamma_1 THREAT^{GC\_Clean}{}_t + \gamma_2 THREAT^{GC\_OA}{}_t + \nu \qquad (2)$$
$$QUAL_t = 2 \quad if\ QUAL^*_t > \mu_1,$$
$$QUAL_t = 1 \quad if\ 0 < QUAL^*_t \le \mu_1,$$
$$QUAL_t = 0 \quad if\ QUAL^*_t \le 0$$

其中 $QUAL^*$為會計師出具審計意見之傾向，μ_1為會計師出具「繼續經營疑慮」審計意見之重大性門檻，。

根據假說 1，會計師堅守超然獨立性，預期$\gamma_1 > 0$，代表受查客戶從事「由繼續經營疑慮改為無保留意見之更換威脅」行為失敗。相對地，根據假說 2，會計師降低超然獨立性，預期$\gamma_2 < 0$，代表受查客戶成功地從事「由繼續經營疑慮改為提及其他會計師意見之更換威脅」行為。

本文係以 1999-2001 年一般產業上市櫃公司為研究對象，基於會計師並不會對非財務困難公司但卻突然宣告倒閉者簽發繼續經營疑慮之審計意見(McKeown et al. 1991)，因此參照前人研究，乃將樣本侷陷在潛在財務困難公司。為避免同一樣本公司既被歸類為更換會計師公司，又於後續年度扮演未更換會計師樣本之情況，乃要求未更換會計師樣本需至少連續三年未曾更換會計師。此外，當公司已經申請破產，會計師審計意見決策之裁量權即有所受限(Carcello and Neal 2000)，因此刪掉當年度屬全額交割股者。再者，財務報表變數無法預測有關訴訟的審計保留事項(Krishnan and Krishnan 1996)，乃再刪除。最後則是刪除資料不全的觀察值。經過上述篩選過程，共得 607 公司_年觀察值。

實證結果顯示，當更換威脅係肇因於公司不願收到「繼續經營疑慮」類

型審計意見而希望收到無保留意見時，會計師簽發不利審計意見的機率不僅沒有降低，反而增加，顯示更換威脅失敗。相對地，當更換威脅係肇因於公司不願收到「繼續經營疑慮」類型之審計意見而希望收到「提及其他會計師」時，會計師簽發不利審計意見的機率降低，顯示更換威脅成功。二種不適當審計意見類型的差異在於認知的反效用期望值(如聲譽損失與訴訟成本，含會計師認知其被告之機率)不同，由此可知出具不適當審計意見的反效用期望值是維持會計師獨立性的關鍵要素。

關鍵詞：更換威脅、更換會計師、審計意見、會計師獨立性