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How Much Does Industry Matter in Taiwan?

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ABSTRACT

This study examines the relative importance of year, industry, corporate, business unit, and transient industry effects on Taiwan business unit profitability between the years 1994 and 2000. Consistent with previous studies, our results indicate that in Taiwan business unit effects are considerably more important to profitability than other effects. When compared to the United States, we find that transient industry effects are more important to profitability in Taiwan, inasmuch as Taiwan manufacturing faced changes in its management environment when industrial investment transferred to Mainland China during the 1990s. This transfer resulted in a rapid change in Taiwan's industry structure that affected profitability. Our findings suggest that Taiwanese firms cannot control the structural factors of industry within the rapidly changing management environment. This may indicate that the competitive advantages of the business unit have a relatively larger influence on firm profitability in Taiwan than in the U.S.

JEL Classification: *L10*

Keywords: *Profitability; Industry effects; Corporate effects; Variance components analysis*

I. INTRODUCTION

Thus far, there has been over twenty years of research into the relative importance of industry and corporate effects on firm profitability. Schmalensee's (1985) study was the first published work addressing this issue. Schmalensee used the variance decomposition method to decompose the total variance of business unit profits in the 1975 Federal Trade Commission (FTC) database. He found industry structure to be the most important influence on firm profitability. Subsequent studies by Rumelt (1991), Roquebert et al. (1996), and McGahan and Porter (1997a, 2002) also explored profit variance by decomposing the variance of business-unit profits into components associated with year, industry, corporate, and business-specific effects. Although the databases and statistical techniques used by the aforementioned researchers were not exactly identical, their results appeared to indicate that both industry and business unit effects had a large influence on business unit profitability, and that business effects were more important than industry effects. On the other hand, the influence of the corporate effects on business unit profitability varied subject to the different statistical and sample screening methods adopted.

Prior relevant studies into this top focused on the advanced countries, especially the United States, whereas those empirical studies that incorporated data of developing countries have been scarce.[1] McGahan and Porter (2002: 849) suggested that "the most direct opportunities for further research reside in exploring new data on the accounting profits of firms in other parts of the world apart from the U.S. in order to yield insight on questions about the relationships between the national economic environment and industrial performance." Taiwan is still considered a developing country at present. In recent years, labor-intensive manufacturing such as the textile and plastic products industries continue to be transferred westward to Mainland China in order to reignite and sustain development in stagnant industrial sectors. As these industries mature with gradual decreases in technological advantages and global competitiveness, they are replaced by new high technology industries such as the semi-conductor industries and other such information and electronics industries. This indicates that the management environment of Taiwan's manufacturing has recently experienced significant changes. Based on the figures published by the Directorate-General of Budget, Accounting and Statistics of Executive Yuan, R.O.C., Taiwanese manufacturing as a proportion of the Gross Domestic Product (GDP) declined from approximately 33.3 percent in 1991 to approximately 25.6 percent in 2001.[2] In the rapidly changing industrial environment, Taiwanese firms cannot control the structural factors of industry. Therefore, the competitive advantages of business units may increasingly play a role of vital importance in Taiwanese firm profitability relative to developed countries, such as the United States.

In light of this, we have, similar to previous relevant research, implemented a variance decomposition analysis for business unit accounting profitability in Taiwanese manufacturing. Our study examines the relative importance of year, industry, corporate, and business unit effects on the profitability of Taiwanese firms. Furthermore, we have also investigated how the effects might have different impacts on firm profitability between different national economic environments.

This paper is structured as follows. In the next section, we briefly review the relevant literature and explore differences between previous studies. We then discuss the data, performance measure, and methodology used in this study. This section is followed by the empirical analysis results and the implications of the differences in the results between our study and foreign studies. Finally, we conclude with a discussion of the results and suggestions for further study.

II. STUDIES ON VARIANCE DECOMPOSITION OF BUSINESS UNIT ACCOUNTING PROFITABILITY

Several prior studies have used American databases to deconstruct the variance of profitability since the mid-1980s (Schmalensee, 1985, Rumelt, 1991, Roquebert et al., 1996, McGahan and Porter, 1997a and 2002). Despite the fact that the results generated by using the variance decomposition analysis cannot represent the drivers of business profitability, some of the implications can be indicated by investigating the relative importance of year, industry, corporate, and business unit effects in determining profitability differences between firms. Table 1 provides a summary of the data, empirical techniques, and results of the studies that decomposed the variance of accounting profitability.[3] Schmalensee's (1985) study that used the 1975 FTC line of business data for manufacturing industries and return on assets (ROA) as a performance measure was the pioneering work among these variance decomposition studies. He found that industry effects were very important and accounted for 19.5 percent of the variance in business unit returns. Market share effects accounted for less than one percent of the variance, while corporate effects did not significantly contribute to the variance. He concluded that industry effects were the most important factor in determining profitability.

Subsequently, Rumelt (1991) argued that market share was an imperfect measure of heterogeneity among businesses. He selected four years of FTC data (1974-1977) for reanalysis, and could therefore measure business-unit and year effects. Rumelt's study also included an additional component, transient industry effect, to measure the year-to-year variations in industry-specific effects. Based on the results from the variance components analysis (VCA), Rumelt reported that business unit effects accounted for 46 percent of the variation in business unit profits, which explained the largest portion of the variance of business unit profitability.[4] On the other hand, he found that industry effects accounted for 16 percent of the variance in profits. Stable industry effects accounted for only approximately 8.32 percent of the variance, with 7.84 percent being due to transient industry effects. Although Rumelt's study concluded that business effects were of much greater importance than industry effects, it maintained that industry effects remain important.

Roquebert, et al. (1996) and McGahan and Porter (1997a) used another database, the Compustat Business Segment Report, to decompose the variance of accounting profitability.[5] Roquebert, et al. used the Compustat data for the 7-year period from 1985-1991, while McGahan and Porter used the data for the 14-year period from 1981-1994. They attempted to explore possible reasons for the divergent findings with those of Schmalensee (1995) and Rumelt (1991) and also examine whether or not

Schmalensee's and Rumelt's results were affected by variations in macroeconomic conditions.

Using a variance components analysis similar to Rumelt (1991), Roquebert, et al. (1996) found large business unit effects and significant industry effects, a finding that corresponded with Rumelt's. On the other hand, Roquebert, et al. found significantly large corporate effects, a result different from Schmalensee's and Rumelt's, which indicated insignificant corporate effect.[6] Roquebert et al. believed that the difference in findings may have been due to the difference in the sampling time periods of the research and the difference in the database reporting regarding the level of a corporation's diversification. Roquebert et al. found that the importance of corporate effects declined as the number of business segments per corporation increased.[7]

McGahan and Porter's (1997a) study differed from those of Schmalensee's (1985) and Rumelt's (1991) not only in the data sets used but also in the methodologies employed. McGahan and Porter argued that the industry-year interaction term in Rumelt's (1991) model might have replaced the interactions between the year effects and other types of effects, and accordingly, allowed for the first-order serial correlation on the error term in their model. As can be seen from the results, in the fourth column of Table 1, the application of different analysis models produced an insignificant variation in the results. Although this indicated the primacy of business unit effects, it also showed the significance of industry effects.[8]

McGahan and Porter (1997a) also found nontrivial corporate effects, although their results were much smaller than those of Roquebert et al (1996). Bowman and Helfat (2001) argued that Requebert et al.'s finding of comparatively large corporate effects might be attributed to the exclusion of single-business corporations from their analysis. Because the corporate effects could not be distinguished from the business segment effects for single-business corporations, the corporate effects were constrained to be zero. According to McGahan and Porter (1997a), excluding single-business corporations could have produced larger corporate effects; however, the estimates of both industry and corporate effects might have been distorted since this simple selection process excluded a large number of corporations from the data set.[9]

Although previous studies used databases and statistical techniques that were not completely equivalent, McGahan and Porter (2002) used a broad database -- the compustat dataset -- and employed a simultaneous ANOVA method, based on less restrictive assumptions than VCA and ANOVA, to analyze the variance of accounting profitability. Their results showed that business-specific effects had the greatest influence on firm profitability. Industry effects were found to be the second most important and that year effects were found to be unimportant. The influence of corporate effects on firm profitability varied by subject in relation to the different statistical and sample screening methods adopted.[10] Because of the differences in economic development between Taiwan and the U.S., we use the variance components analysis to decompose the variance of Taiwan business unit profitability. Accordingly, our study seeks to explore whether results may differ between the U.S. and Taiwan.

Table 1
Studies on the decomposition of variance in business unit accounting profit

	(1) Schmalensee (1985)[a]	(2) Rumelt (1991)[b]	(3) Roquebert et al. (1996)[c]	(4) McGahan & Porter (1997a)[d]		(5) McGahan & Porter (2002)[f]
Data base	FTC LOB	FTC LOB	Compustat	Compustat		Compustat
Dependent variable (annual data)	ROA per business unit	ROA per business unit	ROA per business segment	ROA per business segment		ROA per business segment
Years included	1975	1974-1977	1985-1991	1981-1994		1981-1994
Statistical technique	COV	COV	COV	COV		simultaneous ANOVA
Types of industries	Manufacturing only	Manufacturing Only	Manufacturing Only	All (Non-financial)	Manufacturing only	All (Non-financial)
Number of observations	1,775	6,931	16,596	58,132	18,298	72,742
Industry effect	19.59	8.32	10.20	18.68 (17.32)[e]	10.81 (7.20)	9.6
Corporate effect	N/A	0.80	17.90	4.33 (6.96)	0.00 (2.05)	12.0
Segment-specific effect	N/A	N/A	37.10	31.71 (N/A)	35.45 (N/A)	37.7
Business unit effect	N/A	46.37	N/A	N/A (29.57)	N/A (33.79)	N/A
Year effect	N/A	N/A	0.5	2.39 (0.37)	2.34 (0.40)	0.8
Industry-year	N/A	7.84	2.30	N/A (4.39)	N/A (4.44)	N/A
Market share effect	0.62	N/A	N/A	N/A (N/A)	N/A (N/A)	N/A
Industry-market-share covariance	-0.62	N/A	N/A	N/A (N/A)	N/A (N/A)	N/A
Corporate-industry covariance	N/A	N/A	N/A	-5.51 (-5.37)	-2.27 (-1.42)	N/A
Model	19.59	63.33	68.0	51.60 (54.23)	46.33 (46.46)	60.1
Error	80.41	36.87	32.0	48.40 (46.77)	53.67 (53.54)	39.9
Total	100.00	100.00	100.00	100.00	100.00	10.00

[a] Results from Schmalensee (1985, Table 1, p.348).
[b] Results from Rumelt (1991, Table3, p.178) and Rumelt (1991, Sample A as reported in Table2,:p.177). Rumelt's Sample A excludes the small business unit.
[c] Results from Roquebert et al. (1996, Table4, p.661).
[d] Results from McGahan and Porter (1997a, Table3, p.25) and McGahan and Porter (1997a, Table5, p.28).
[e] Results from McGahan and Porter (1997a, Table3, p.25) are in parentheses. These results apply to Rumelt's model and are based on data from McGahan and Porter.
[f] Results from McGahan and Porter (2002, Table3, p.844)

III. RESEARCH METHOD

A. Data and Sample

We used the *Taiwan Economic Journal* (TEJ) database to perform a variance decomposition analysis. The TEJ reports the complete financial information at the corporate level in Taiwan. The TEJ database does not report information on business units; rather, it provides a sales value and a production value for each product owned by the listed corporations of Taiwan. We further converted product data into business unit data. Since service firms do not report their production values, such values are usually available only from manufacturing firms. Thus, we included only corporations whose main products were manufacturing items according to the TEJ reports. The processes of compiling and converting the primary data are described below.

Taking into consideration both data completeness and comparability with previous research, we selected as our sample all publicly-listed corporations in Taiwan for the period between 1994 and 2000 whose main product items resulted from manufacturing. We drew 12,755 preliminary records for product data, of which we omitted 1,751 records because these product items were not produced as a result of manufacturing processes (for example, engineering construction, chemical products, IC distribution channel, merchandising, lease, and processing processes). We also omitted 16 additional corporations, 12 of which had delisted their stock during the selected period 1994-2000 because of breach-of-trust of operating principle. We believed the reported results of these 12 corporations were not credible. The four other corporations were omitted because the TEJ included no product information on their sales and production values due to their being acquired by another corporation or for other unspecified reasons. After the omissions, 10,614 records of product data remained.

Rumelt (1991: 170) stated that the FTC collected data on the domestic operations of large U.S corporations in each of 4-digit FTC manufacturing industry categories. In his study, the business unit data were available from these operations. Since the TEJ database did not report information on business units, we used the 4-digit TSIC level as a definition of industry and then attached each screened product's records to a 4-digit TSIC code (CODES 0810-3199). We further lumped together the product data of a corporation attached to the same industry in a particular year. In the lumping process, we excluded some product items that could not be assigned to a manufacturing TSIC category or that did not contain product data on sales or production values. After merging, the data set contained 4,982 observations, each representing a single business line of a firm in a particular year between 1994 and 2000.

After obtaining data on the business unit, we screened the data set and performed the following actions to select our final sample.

- First, since we selected only corporations for which we had data for the entire period between 1994 and 2000, we excluded 367 observations on 55 corporations which lacked data for some of the years.
- Second, we excluded 51 observations because we selected only business lines for which there were data for at least two time periods in our database.
- Finally, we eliminated 15 observations where the returns were greater than four

standard deviations from the mean so that extreme values would not have undue influence on our analysis.

The final sample consisted of 4,549 observations for 325 corporations that participated in 733 different business units. These corporations, operating in 156 different industries, were defined by a 4-digit TSIC code. (See Appendix 1 for a detailed explanation of the processes used to deal with the research data)

B. Performance Measures

Since our TEJ database gave us a sales value and a production value for each product of each corporation, we attached each product's records to a 4-digit TSIC code and then obtained a sales value and a production value for each business line. The sales value for a product is the product of its sales volume and sales price per unit, that is, the sales revenue. The production value is the product of production volume and product cost per unit, a value equivalent to the cost of goods sold.[11]We used the gross profit rate (the ratio of gross profit divided by sales revenue) as the measure of business performance, because the ratio -- sales value minus production value, divided by sales value -- is equivalent to the gross profit rate.[12]

Since the gross profit rate is the initial element of all profitability ratio measures, such as ROA, it is an important indicator of performance. In terms of the connection between the two indicators, the gross profit rate is strongly associated with ROA in terms of its own results. According to the calculation of this ratio, the gross profit rate is determined mainly by sales revenue and cost of goods sold. Sales revenue hinges on the competitiveness of the product; if a firm's products are distinctive, they can be priced higher, enabling the firm to enhance both sales revenue and market share. In addition, if a firm succeeds in having an effective purchasing function or manufacturing products in a low-cost manner, it will be able to reduce its cost of goods sold. Thus, we think that when a firm develops products with a competitive advantage to raise its sales revenue and exploits effective management strategies to lower its costs of purchasing and production, its competitiveness will be strengthened and it will be profitable. Thus, the empirical results from our analysis of gross profit rate can provide valuable information on a firm's profitability.

Table 2
Descriptive statistics for each year

Year	Number of BU	Average profit[a]	Median pofit	S.D. profit	Minimum profit	Maximum profit
1994	629	8.75	16.42	72.99	-1288.63	90.25
1995	645	9.70	15.75	63.25	-1215.09	99.03
1996	651	9.13	16.32	62.63	-875.54	99.48
1997	651	10.46	16.61	59.56	-885.61	99.86
1998	660	8.23	14.17	69.50	-1047.99	99.37
1999	670	7.65	15.01	76.43	-1188.57	99.53
2000	643	8.76	14.41	72.80	-1162.60	99.87

[a] Average ratio in percent of gross profit to sales revenue.

C. Model and Methodology

In this study, we examine the importance of year, industry, corporate, and business effects on profitability in Taiwan. Roquebert et al. (1996) had argued that total industry effects (the sum of stable and transient industry effects) obtained in Rumelt's (1991) study were in line with Schmalensee's (1985) research, with no differences found. For this reason, our study separately explores the variance components associated with the stable and transient industry effects of the total industry effects. Thus, our mathematical model below is similar to Rumelt's (1991):

$$r_{ikt} = \mu + \alpha_i + \beta_k + \gamma_t + \delta_{it} + \phi_{ik} + \varepsilon_{ikt} \quad (1)$$

where r_{ikt} denotes the accounting profit in time period t of corporation k's business unit in industry i; μ is a mean, α_i are industry effects, β_k are corporate effects, γ_t are year effects, δ_{it} are the industry - year interaction effects, ϕ_{ik} are business unit effects, and ε represent error. The classes of effects in this model are dummy variables.

In order to compare our results directly with those of the relevant studies (Schmalensee, 1985; Rumelt, 1991; Roquebert et al., 1996; and McGahan and Porter, 1997a), we used variance components analysis under the random-effects assumption as our statistical methodology. The random-effects assumption means that all effects in the model, such as the error term, are drawn randomly from an underlying population distribution with mean zero and unknown variance. Once drawn, each effect is regarded as fixed. Therefore, our data set does not require including the whole population in the random effects model. We can still make an inference about a population of effects from samples in the data that are considered to be random (Sear, 1971: 383). Furthermore, the random-effects assumption assumes that random processes independently generate each effect, so each effect is not correlated with other effects. Thus, each of the effects in Equation (1) has a variance in its own right, and the variance of an observation is the sum of the variance of each effect. The variances of various effects are accordingly called Variance Components (Sear, 1971: 379). We can identify the relative importance of various effects by estimating their variance components.

We used the PROC VARCOM procedure in SAS software[13] to decompose the total variance σ^2_r of profitability into the different variance components as follows:

$$\sigma^2_r = \sigma^2_\alpha + \sigma^2_\beta + \sigma^2_\gamma + \sigma^2_\delta + \sigma^2_\phi + \sigma^2_\varepsilon \quad (2)$$

In Equation (2), the total variance of business unit returns (σ^2_r) is expressed as the sum of the population variances in industry (σ^2_α), corporate (σ^2_β), year (σ^2_γ), industry-year interaction (σ^2_δ), and business unit effects (σ^2_ϕ). Regarding the covariance term between corporate and industry effects, there were different views among the authors as to whether the term should be included in the analysis. Schmalensee (1985), Rumelt (1991), and McGahan and Porter (1997a) all allowed for the covariance term between

corporate and industry effects and treated the term as an exception to the independence assumption.[14] On the other hand, Chang and Singh (2000: 745) argued that "if a firm uses its dominant position in industry to leverage this advantage in a second industry, then the distinction between corporate and industry effects becomes blurred." Moreover, Rumelt found that the covariance term between firm and industry was insignificant. Based on Chang and Singh's view and Rumelt's results, we did not include the covariance term in our analysis.

III. EMPIRICAL RESULTS

Table 3 shows the variance components analysis estimation of Equation (2) based on our sample. These results are expressed as a percent of the total variance. The results in Table 3 indicate that the model explains 51.03 percent of the total variance in business unit profitability. Business unit effects explain 36.15 percent of the total variance, which is much larger than any other effects. Stable and transient industry effects explain 3.14 percent and 11.28 percent of total variance, respectively. Corporate effects explain only 0.71 percent. Year effects explain –0.25 percent, a result that can be considered equal to zero,[15] and the error term accounts for 48.97 percent of the total variance.

Table 3
COV results

	Percent of total variance
Industry (σ^2_{α})	3.14
Corporate (σ^2_{β})	0.71
Business unit (σ^2_{ϕ})	36.15
Year (σ^2_{γ})	-0.25
Industry-year (σ^2_{δ})	11.28
Model	51.03
Error (σ^2_{ε})	48.97
Total (σ^2_{r})	100.00

Table 4 compares the results of the variance components analysis of profitability from the previous studies to our estimates. As can be seen from Table 4, Rumelt (1991) reported that total industry effects accounted for 16.16 percent of variance in profits, and McGahan and Porter (1997a) found that total industry effects accounted for 10.81 percent of variance.[16] Comparing our estimates to the previous results, we do not find much difference, with 14.42 percent due to total industry effects. It is noteworthy that we find that only 3.14 percent of this variance is due to stable effects. The remainder of this variance, 11.28 percent, is attributed to transient industry effects. Transient industry effects are thus four times as large as stable industry effects. However, it is interesting to note that stable industry effects in the U.S. were larger than transient industry effects. McGahan and Porter's (1997a: 29) argued that industry effects were significant because

they found that industry effects were more persistent over time than business or corporate effects, consistent with the view that industry structure changed relatively slowly. We find that transient industry effects are more important to profitability in Taiwan; except for the influence of macroeconomic factors,[17] this may be attributable to the rapid change of Taiwan's manufacturing industry structure between 1994 and 2000.

Table 4
Comparison of COV Results (percent of total variance by various effects)

	Schmalensee[a]	Rumelt Sample A[b]	Rumelt Sample B[c]	Roquebert et al.[d]	McGahan and Porter[e]	This study
Data base	FTC LB	FTC LB	FTC LB	Compustat	Compustat	TEJ
Industry (σ^2_α)	19.46	8.32	4.03	10.20	10.81	3.14
Corporate (σ^2_β)	N/A	0.80	1.64	17.90	0.00	0.71
Business unit (σ^2_ϕ)	N/A	46.37	44.17	37.10	35.45	36.15
Year (σ^2_γ)	N/A	N/A	N/A	0.5	2.25	-0.25
Industry-year (σ^2_δ)	N/A	7.84	5.38	2.30	N/A	11.28
Corporate-industry	N/A	N/A	N/A	N/A	-2.27	N/A
Market share	0.63	N/A	N/A	N/A	N/A	N/A
Industry-market-share covariance	-0.62	N/A	N/A	N/A	N/A	N/A
Model	19.46	63.13	55.21	68.00	46.33	51.03
Error (σ^2_ε)	80.54	36.87	44.79	32.00	53.67	48.97
Total (σ^2_τ)	100.00	100.00	100.00	100.00	100.00	100.00

[a] Results from Schmalensee (1985, Table 1, p.348). [b] Results from Rumelt (1991, Table3, p.178). Rumelt's Sample A excludes the small business unit. [c] Results from Rumelt (1991, Table3, p.178). Rumelt's Sample B includes the small business unit. [d] Results from Roquebert et al. (1996, Table4, p.661). [e] Results from McGahan and Porter (1997a, Table4, p.27). These results are based on McGahan and Porter manufacturing data.

Taiwan manufacturing in the past was based mainly on labor-intensive industries, such as textile and plastic products manufacturing. Due to increasing labor and land costs in addition to a shortage of labor, these labor-intensive industries have transferred their production facilities overseas, especially to Mainland China, in recent years. Capital- and technology-intensive industries, such as electronics manufacturing, have replaced these industries. According to the statistics released by the Ministry of Economic Affairs in Taiwan, Taiwan's manufacturing industry is currently accelerating its rate of investment in Mainland China on a year-by-year basis. Taiwan's livelihood industries are first transferred abroad. Next petrochemical and metal-machinery industries are relocated, and lastly high-tech industries are moved to Mainland China. However, high-tech industries, such as semi-conductor industries, were prohibited by the Taiwan Government to invest in Mainland China for many years. Thus, the industry structure of high-tech industries might not be changing as rapidly as the labor-intensive industries.

To support this proposition, we further divide the entire sample into a labor-intensive sample and a high-tech sample to investigate how transient industry effects differ between these two industries.[18] The empirical results from variance components analysis indicate that stable and transient industry effects account for –0.28 percent and 9.92 percent of variance in labor-intensive industries, respectively. In high-tech industries, however, stable and transient industry effects account for 10.00 percent and –0.85 percent of variance, respectively. The values obtained offer evidence that labor-intensive industries were transferred overseas due to gradually decreasing competitiveness, resulting in significant changes in industrial structures. Thus, transient industry effects have a significant impact on business unit profitability in Taiwan's labor-intensive industries. On the other hand, the total industry effects in high-tech industries are almost entirely attributable to stable industry effects. A possible reason for this result is that the profitability of the high-tech industries have led to recent sustained growth, and furthermore, that high-tech industries were restricted by the Taiwan Government to invest in Mainland China.[19] Thus, the industry structure changed relatively slowly in Taiwan's high-tech industries. These findings provide additional evidence to our finding that transient industry effects explain 11.28 percent of the variance of profitability in Taiwan between 1994 and 2000, inasmuch as all Taiwanese manufacturing faced operating environment changes, as industrial investment was transferred to Mainland China during the 1990s. This transfer resulted in the Taiwanese industry structure changing rapidly and its profitability being affected.[20]

On the other hand, we find corporate effects to be very small. Although Roquebert et al. (1996) reported vary large corporate effects, others researchers discovered smaller corporate effects. McGahan and Porter (2002) reconciled the different findings regarding corporate effects among the relevant literature and found that the choice of screens on the data influenced the estimates of corporate effects; when the data were screened to include single-business corporations, corporate effects were minimized. McGahan and Porter (2002) explained that this finding might have been due to the fact that corporate effects could not be distinguished from business segment effects for these undiversified corporations, and so the corporate effects were defined to be zero. Thus, we conclude that the relatively smaller size of corporate effects on profitability in Taiwan may have been due to the fact that single-business corporations account for over one-third of all corporations in our sample, whereas the corporate effects are constrained to be zero for these corporations.

Additionally, we find that business unit effects explain 36.15 percent of total variance, a much larger percentage than of any other effects. However, business unit effects account for a smaller proportion of the total effects when compared with prior studies. This may be because the Taiwan manufacturing sector faced an acceleration of its operating environment during the 1990s, giving our model smaller explanatory power. Nevertheless, since we find that stable industry effects and corporate effects explain a smaller proportion of variance in this study than in other studies, we may be able to conclude that business unit effects have a relatively larger influence on firm profitability in Taiwan than in the U.S.

The year effects account for –0.25 percent of the variance in profitability. In

Rumelt's (1991) view, small negative estimates can be treated as zero. Thus, year-to-year fluctuations in macroeconomic conditions have a relatively small influence on overall movement of gross profit rate in Taiwan equally. However, fluctuations in macroeconomic conditions may have generated transient effects.[21] McGahan and Porter (1997a: 18) indicated that "the model would be over-specified if we represented transient year, corporate, and business unit effects." Thus, we do not explore these transient effects further.

In our study, the error term accounts for 48.97 percent of the total variance. Previous studies indicated that the error term explains the percentage of variance between 36.87 percent and 53.67 percent; therefore, the error term in our study is somewhat larger. This finding may indicate that fluctuations in Taiwanese operating conditions also affect corporate and business units, generating higher intransient corporate and business unit effects.

V. CONCLUSIONS

This study examines the relative importance of year, industry, corporate, business unit, and transient industry effects on Taiwan business unit profitability by using the manufacturing data drawn from the *Taiwan Economic Journal* (TEJ) database from 1994 to 2000. The results indicate that our mathematical model explains 51.03 percent of the total variance in business unit profit, with business unit effects explaining the largest percentage (36.15 percent) of the total variance. Stable and transient industry effects explain 3.14 percent and 11.28 percent of the total variance, respectively. Corporate effects explain only 0.71 percent. Year effects explain –0.25 percent, a result that is indistinguishable from zero. The error term accounts for 48.97 percent of the total variance. Based on our results, we find business unit effects in Taiwan to be considerably more important to profitability than any other effects. Similar studies have found that business unit effects are also the greatest influences on profitability in the U.S., and may be equally important in other countries.

Unlike in the U.S., we find that transient industry effects are four times as large as stable industry effects in Taiwan. Transient industry effects were most important to profitability in Taiwan between 1994 and 2000, when Taiwan manufacturing faced management environment changes due to industrial investment transfer to Mainland China during the 1990s. The end result was a rapid change in industry structure which affected profitability. An interesting observation is that transient industry effects are stronger in labor-intensive industries than in high-tech industries. A possible reason is that labor-intensive industries were transferred overseas due to increased labor costs, resulting in significant changes in industrial structures. Nevertheless, the high-tech industries that replaced labor-intensive industries have recently experienced sustained growth, and furthermore, high-tech industries have been restricted by the Taiwan Government to invest in Mainland China. Thus, the high-tech industry structure changes relatively slowly in Taiwan. When compared to the U.S., stable industry effects explain a relatively small proportion of variances. This finding may indicate that Taiwanese firms cannot control the structural factors of industry because of the rapid changes in operating environment during the 1990s. Thus, the competitive advantages

of business units have a larger influence on firm profitability in Taiwan than in the U.S.

There are some limitations on the conclusions of this study. First, previous studies used ROA as the measure of business performance, whereas we used gross profit rate. Thus, it was impossible to compare between the U.S. and Taiwan completely on all levels. Furthermore, due to data limitations, we only explored manufacturing industries. Finally, we used the variance components analysis to decompose the variance of profitability, but those results may have been limited by the independence assumption. Future research should explore additional data on business profitability in Taiwan and use or develop other indicators as the measure of business performance so as to analyze all sectors of the Taiwan economy even more specifically.

ENDNOTES

1. There are a few exceptions to this and only two studies, Khanna and Rivkin (2001) and Chang and Hong (2002), mainly explored the magnitude of business groups on firm performance in 14 emerging markets and Korea respectively. Both of their studies regarded business group and affiliate company-specific effects as corporate and business unit effects, respectively. However, it is difficult to compare the results of corporate and business unit effects between the U.S. and these other countries directly due to differences in institutional settings.
2. Please see website for http://www.dgbas.gov.tw/public/data/dgbas03/bs7/yearbook/ch8/8-3.xls#a2.
3. Some studies used other measures of firm performance, such as Tobin's q (Wernerfelt and Montgomery 1988, McGahan 1999), market share (Chang and Singh 2000), advertising and R&D ratio (Mauri and Michaels 1998), and value-based measures of performance (Hawawini et al. 2003). This study reviewed only the literature in which accounting profit was incorporated.
4. Rumelt's (1991) results in business unit effects explained the variance that was a large part of the error term in Schmalensee's model.
5. The units of analysis of the two databases differed: The FTC database reports data at the business unit level, while the Compustat database contains information on firm profits at the business segment level. The two databases have different advantages and disadvantages (Roquebert et al., 1996). The FTC database provides more detailed information, while the Compustat data covers more comprehensive and recent data. McGahan and Porter (1997a: 16) concluded that the average business segment covers several business units. Due to the Standard Industrial Classification (SIC) being overly broad, the industry effects tended to diminish when McGahan and Porter used the SIC code for industry classification.
6. Rumelt (1991) decomposed the variance of accounting profitability using both analysis of variance (ANOVA) and variance components analysis (VCA). The VCA results indicated that corporate effects explained only 0.8 percent of the variance in business unit returns and thus had little influence on firm profitability. However the ANOVA results found substantial corporate effects.
7. The FTC database contained a higher number of business units per corporation than the Compustat database; thus, the corporate effects were smaller when the

FTC database was used.

8. As McGahan and Porter (1997a: 18) noted, "In Rumelt's view, an asymmetry in treatment of industry effects is justified when the data cover a relatively short period because corporate-parent and business-specific effects will not change much." In this study, we analyze manufacturing data for a 7-year period (1994-2000). This time period is shorter than the 14-year period (1981-1994) analyzed by McGahan and Porter (1997a).
9. The compiled *Taiwan Economic Journal* data indicated that single-business corporations account for over one-third of the total corporations in our sample. In order to avoid spurious estimates, we did not exclude corporations having a single business unit from our data set.
10. McGahan and Porter (2002) re-analyzed the diversified manufacturers in Roquebert et al.'s (1996) analysis and exposed deeper limitations in order to reconcile their results related to corporate effects with those of Roquebert et al. (1996). They found that the data screen choices truly affected the estimates related to corporate effects. The corporate effects were particularly minimized when the data was screened to include single-business corporations.
11. For a manufacturer, the cost of goods sold is computed by adding the beginning finished goods inventory and the cost of the goods manufactured and subtracting the ending finished goods inventory. Based on the going concern assumption in accounting, we assumed that the beginning finished goods inventory is equal to the ending finished goods inventory, and therefore, the cost of goods sold is equal to the cost of goods manufactured (i.e. production values). In addition, we found that the production value for products is equivalent to the cost of goods sold by collating the various Prospectus tables of production and sales value and tables of Cost of Goods Sold for the product. These tables were provided by Taiwan's listed corporations.
12. The gross profit rate neglects selling and administration expenses and thus may overestimates the performance of firms. However, the nature of the *Taiwan Economic Journal* (TEJ) data set implies that it does not provide business-level selling and administration expenses. To explore both corporate and business unit effects in the framework of our research, we used gross profit rate -- the only available measure of profitability at the business level for manufacturers in the TEJ.
13. As did Chang and Singh (2000), we selected the Type I procedure for the variance components analysis.
14. Schmalensee (1985: 344) thought that efficient firms have the ability to choose profitable industries in which to operate.
15. There is nothing intrinsic in the COV method to prevent negative estimates (Sear, 1971: 379). Rumelt (1991: p 167) thought that the normal practice is to replace small negative estimates with zero and take large negative estimates as an indication of specification error.
16. McGahan and Porter (1997a) reported results for only the stable portions of effects through first-order differencing. Thus, McGahan and Porter's (1997a) results in total industry effects were attributable to stable industry effects.

17. During the 1998 Asian Financial Crisis, a portion of the Taiwan industries that were export-oriented experienced declining gross profit rates, which rose again in 1999. This abnormal macroeconomic circumstance might have increased transient industry effects on the variance in profitability.
18. Since it was difficult to divide our sample definitively into two sub-samples, a labor-intensive and a high-tech sample, we separated information-electric industries from the entire sample and defined them as high-tech industries. The remainders of our sample were identified as labor-intensive industries.
19. During the period 1989 to 1997, the real GDP growth rate of all Taiwan manufacturing industries was 4.3 percent on average. The average growth rate of the information and electronics industries was 11.15 percent a year during that period, and the average for the metal machinery and petrochemical industries was 5.58 percent and 4.21 percent, respectively. However, the average for the livelihood industry was –1.1 percent (Liu and Xue, 2001).
20. We acknowledge and thank anonymous referees for suggesting this proposition regarding our analysis.
21. McGahan (1999: 390) argued that very small year effects did not mean that macroeconomic circumstances were unimportant in other ways. He suggested that "shifts in macroeconomic conditions that affected industries and firms differently may have generated transient industry, corporate-focus and firm effects."

APPENDIX 1

The processes of dealing with data (by way of illustration)

The TEJ reports the complete financial information at the corporate level in Taiwan. Despite the TEJ database not reporting information on business units, the TEJ does provide sales value and production value for each product owned by the listed and OTC corporations. We further converted that product data into business unit data. Thereafter, we illustrated the processes for converting the primary data using ACER Company as an example.

First, we used the 4-digit TSIC level as a definition of industry and then attached each product record for ACER Company to a 4-digit TSIC code. Next, we merged the product data of ACER Company attached to the same industry in a particular year. During the merging process, we excluded the product items of computer peripherals. Since the computer peripherals did not contain production value, they had influence on the profitability ratio calculation. After merging, the data set contained 20 observations with each representing a single business line of ACER Company in a particular year between 1994-2000.

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