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Corporate Value Based on the Median-to-Mean Pay Ratio: A Study of Taiwan's Semiconductor Industry

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Abstract

This study empirically examined the relationship between the median-to-mean pay ratio of non-executive employees (hereinafter referred to as "MMR") and the earnings quality in Taiwan's semiconductor industry. It also discussed the moderating effect of the type of accounting firm. The results showed that firms with higher MMRs and fairer distributions of employee pay had higher earnings quality. This phenomenon occurred because an unbiased pay system served to improve employees' morale and productivity, reduce firms' internal conflicts and human costs, and attract and retain talents. Firms audited by the Big 4 accounting firms, which feature rigorous auditing standards and highly effective corporate governance mechanisms, tended to attach more importance to the fairness and transparency of employee pay. This improved their earnings quality. Additionally, the rapid growth of Taiwan's semiconductor industry in 2023 promoted both growth of Taiwan's overall economy and improvement in earnings quality. This revealed firms' healthy pay culture and long-term sustainability. The higher MMRs also indicated good earnings quality, thus revealing firms' healthy pay culture and long-term sustainability. Hence, the study recommend that Taiwan's semiconductor firms attach importance to the fairness of pay distribution and continue to improve corporate governance to ensure the authenticity.

JEL classification numbers: H83, M12, M21.
Keywords: Median-to-mean pay ratio, Median-to-mean pay ratio of non-executive employees, Corporate value, Earnings smoothing.

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1. Introduction

The global semiconductor industry has been restructured dramatically under the impact of the COVID-19 pandemic. In response to supply chain disruptions and demand variations caused by the pandemic, many countries began to reassess their semiconductor production capacities and strategies. Taiwan has adopted effective anti-pandemic measures to stabilize its domestic economy and maintain the important status of its semiconductor industry in the global industrial restructuring. With the rapid advancement of technology and growth of various applications (e.g., artificial intelligence, 5G communications, and electric vehicles), Taiwan's semiconductor industry is confronting an increase in semiconductor demand. This has resulted in an increase in the overall pay levels. With the significant increase in the pay level of semiconductor engineers and technicians, Taiwan's semiconductor industry has attracted large amounts of talents. This, in turn, has increased its global competitiveness. The development of Taiwan's semiconductor industry has produced positive effects on the pay structure of semiconductor talents.

In 2015, the US' Pay Ratio Disclosure Rules requires that firms disclose the median pay levels of all employees except chief executive officers (CEOs), and compare these with the pay levels of CEOs. Therefore, Taiwan's Financial Supervisory Commission (FSC) encourages listed firms to reasonably increase employee pay and share their business gains with employees. Thereby, they can undertake their corporate social responsibility (CSR) and attain sustainable development. Low pay is an issue of wide concern in Taiwan. In particular, executive pay is a matter of social justice and affects the decisions of corporate resource allocation (Lazear and Rosen, 1981; Holmstrom, 1979; Jensen and Meckling, 1976). Many previous studies have shown that executive pay is significantly correlated with corporate performance (Huang, 2016; Lin et al., 2013; Armstrong et al., 2010; Kim, 2010; Sun and Cahan, 2009; Ozkan, 2007).

Owing to the disparity in income distribution, the average pay is likely to be skewed upward by a few exceptionally high figures. Additionally, high pay may be not perceived effectively by employees. As a result, the average pay may fail to effectively reflect the majority of employees' pay level. Hence, many experts recommend using median pay to reflect employees' pay level. The FSC encourages listed firms to moderately increase employee pay and share their business gains with employees. Thereby, these firms can undertake their CSR and attain sustainable development. According to the survey in July 2024 by the Comptroller General's Office, in the first seven months of 2024, the average growth rate of recurring employee pay was 2.60%, the mean recurring employee pay was TWD 46,269, and the median recurring employee pay was TWD 37,111. The median-to-mean pay ratio was 0.802 (attaining a five-year high). This was primarily attributed to the increase in statutory minimum pay. The increasing gender disparity in the median recurring pay may be owing to the fact that male employees are mostly engaged in high-paying hi-tech and manufacturing jobs, whereas female employees are mostly engaged in low-paying retail or catering jobs. However, it is necessary to accord

continuous attention to the differences in pay distribution between industries and ensure a fair and rational pay distribution. Huang (2020) investigated the average pay of non-executive employees. It is likely to be skewed upward by a few exceptionally high figures. This makes it fail to represent the actual pay level of most employees. No specific studies have been conducted on the median-to-mean pay ratio of non-executive employees (hereinafter referred to as MMR). In this context, the MMR was used as a dependent variable in this study.

The Generally Accepted Accounting Principles (GAPP) provides firms the flexibility to select accounting methods for preparing financial statements and determine discretionary accruals. This enables corporate managers to selectively disclose proprietary information related to corporate value (Subramanyam 1996) and manipulate discretionary accruals for intervening in external financial reporting (Schipper 1989). This makes financial statements fail to reflect the actual corporate status and results in frequent financial statement fraud. Frequent financial statement fraud inflicts a significant adverse effect on investor confidence and severely undermines the credibility of corporate financial statements. Hence, corporate earnings quality has received significant attention in society. To address the rapid transformations in the global economic environment, it is necessary to integrate industrial supply chains in a highly competitive business environment. In particular, the semiconductor industry has received more attention. In terms of the growth of emerging firms and degree of technological sophistication, the semiconductor industry remains ahead of other industries. Hence, the semiconductor supply chain is of particular importance in the current highly competitive society. In this age of globalization, enterprise competition no longer focuses only on operating strategies. Rather, it focuses on the strategies of supply chain integration (Christopher and Towill, 2001). In particular, corporate value has received wide attention in this upsurge of competition. The financial information disclosed by firms (particularly the earnings quality) is a focus of public attention. When firms' operating revenue fluctuates substantially, they tend to adjust corporate earnings to reduce the external disturbance (e.g., embellish the earnings in financial statements for earnings smoothing) so that the investors place high confidence in their financial status. However, this approach fails to reflect the firms' real financial status and reduces the reliability of earnings quality. To assess corporate value, this study used the earnings smoothing model (Leuz et al., 2003; Francis et al., 2004) as the proxy variable for earnings quality to identify suspected earnings manipulation. Using Taiwan's listed semiconductor firms in 2020–2023 as the research sample, this study examined the impact of the MMR on the earnings quality in the post-COVID-19 period. It also discussed whether a higher median-to-mean pay ratio (namely, an improvement in the pay structure) resulted in a better earnings quality.

2. Literature Review

During the COVID-19 pandemic, Taiwan's semiconductor firms showed considerable resilience and flexibility by adjusting their production strategies rapidly in response to the variations in market demand. With the transformations in the global economic environment and impact of industrial globalization, enterprise competition no longer focuses only on operating strategies. Rather, it focuses on the competition of value chains (Lewis, 1995) and that of supply chain systems (Christopher and Towill, 2001). The division of labor in industrial supply chains is being increasingly refined with the intensifying firm competition. The management personnel market or labor demand theory contends that 1) to create exceptional business performance, they must pay appropriate payroll costs to the highly effective talents employed by them, and 2) the employee pay level can effectively reflect firms' labor supply–demand situation, thus ensuring the alignment of interest between managers and shareholders (Chalmer et al., 2006).

Senior executive pay has continuously been an issue of concern in capital markets. This is because it is related to social justice and affects executives' decisions of corporate resource allocation (Lazear and Rosen, 1981; Jensen and Meckling, 1976). Moreover, the pay system is the core corporate governance mechanism. Therefore, a highly effective pay system serves to enhance work morale and improve work quality and productivity. This, in turn, would produce positive effects on firms. Senior executives assume firms' top managerial positions and serve as decision-makers in corporate organizations. Senior executive pay was considered by the U.S. Securities and Exchange Commission (SEC) as an important issue of corporate governance in 2006. Meanwhile, the SEC required that listed firms disclose the detailed remuneration information of executives and board directors. Senior executive pay is affected by firms' size and financial performance. In this context, Taiwan's FSC encourages listed firms to reasonably increase employee pay and share their business gains with employees. Thereby, they can fulfill their CSR and attain sustainable development. Since 2019, the Taiwan Stock Exchange (TWSE) and GreTai Securities Market (GTSM) have publicly disclosed the statistics of employee benefits and pay in the "Corporate Governance Column" in the Market Observation Post System (MOPS) to strengthen corporate governance and CSR fulfillment.

Owing to the disparity in income distribution, the average pay is likely to be skewed upward by a few exceptionally high figures. This makes it fail to effectively reflect the actual pay level of most employees. Hence, many experts recommend using median pay to reflect employees' actual pay level. The FSC encourages listed firms to moderately increase employee pay and share their business gains with employees. Thereby, they can undertake their CSR and attain sustainable development. On July 1 of each year, CSR information, employee benefit and pay statistics, and the pay information of full-time non-executive employees are released under the "Corporate Governance Column" of the MOPS. Specifically, the pay information of full-time non-executive employees include the number of full-time non-executive employees,

total amount of employee pay, average pay, and median pay. Owing to the disparity in income distribution, average pay is likely to be skewed upward by a few exceptionally high figures. This makes it fail to reflect the actual pay level of most employees. Hence, many experts recommend using median pay to reflect employees' actual pay level. According to the pay survey statistics in July 2024 released by the Comptroller General's Office, Executive Yuan (Yu and Kuo, 2024)[2] in the first seven months of 2024, the median-to-mean ratio of recurring employee pay increased to 0.802 (a five-year high). The increasing gender disparity in the median recurring pay may be owing to the fact that male employees are mostly engaged in high-paying hi-tech and manufacturing jobs, whereas female employees are mostly engaged in low-paying retail or catering jobs. The increase in statutory minimum pay is also a key reason, which indicates an improvement in the Taiwan's pay level. The median employee pay increased more significantly than the mean employee pay. This also indicated an improvement in the Taiwan's pay level. In late 2011, the FSC required firms to establish compensation committees to supervise the rationality and transparency of pay distribution. Moreover, the Corporate Governance Blueprint (2018-2020) was implemented to extend the culture of corporate governance, strengthen the disclosure of information, and enhance employees' cohesive force and corporate governance level. A reasonable pay system serves to improve corporate governance, promote CSR implementation, and increase the fairness of pay. An analysis of median pay can reflect employees' actual pay level more effectively. Additionally, the pay policies may be optimized continuously to achieve the common development of firms and their employees in the long term. Huang (2020) previously investigated the average pay of non-executive employees. It is is likely to be skewed upward by a few exceptionally high figures. This makes it fail to represent the actual pay level of most employees. No specific studies have been conducted on the MMR. Based on the executive pay data disclosed by the annual reports of listed companies, the MMR was used as a dependent variable in this study.

In Taiwan's semiconductor firms, the MMR is an important indicator. It can reflect the fairness of pay distribution and health status of the internal pay structure. This ratio indicates the relative distribution of pay among different ranks of employees. It affects employees' work morale and performance. Owing to the increasingly intense market competition, semiconductor firms are encountering significant challenges in attracting and retaining talents. Therefore, the relationship between the above ratio and earnings quality has become an important topic of research. Owing to the technological innovation and rapidly varying market demand, the earnings quality of semiconductor firms has a significant influence on investors. The intensity of earnings management is closely related to the quality of information disclosure (Halim et al., 2005; Lobo and Zhou, 2001). That is, when firms manage

[2] Yan-Ci You, Jyun-Lin Guo, September 18, 2024. The Comptroller General's Office released the pay survey statistics for the first seven months of 2024. The gender gap in median recurring pay increased (website: https://csrone.com/news/8770).

their earnings, the information disclosed by them usually cannot reflect the public perception of their financial status. This reduces the external trust in them. Further studies evaluated the correlation between the quality of information disclosure and earnings quality. High-quality information disclosure can improve the earnings quality. It is particularly important to semiconductor firms because the semiconductor industry relies on highly-specialized human resources and is exposed to market volatility (Bartholdson et al., 2011; Noravesh and Hosseini, 2009; Francis et al., 2008). Therefore, firms' unfair pay structure may result in brain drain and low morale. This, in turn, would reduce their operating performance and earnings quality. Additionally, a good practice of corporate information disclosure can reduce the likelihood of earnings manipulation, thus increasing the reliability and stability of share prices (Iatridis and Alexakis, 2012). Hence, a transparent and correct disclosure of financial information can enhance the trust of external investors and improve the earnings quality. The improvement in earnings quality, in turn, promotes firms' sustainable growth and generates more capital input and collaboration opportunities. In particular, the relationship between the MMR and earnings quality in Taiwan's semiconductor industry is an important issue to be addressed. The increase in such median-to-mean pay ratio usually indicates a reasonable distribution of employee pay. This serves to increase employees' job satisfaction, improve their work efficiency, and develop a good atmosphere for teamwork. Therefore, this study made the following hypothesis:

H_1: The MMR is correlated with the earnings quality.

The study attempted to provide insight into the role of the MMR and its effect on the earnings quality in Taiwan's semiconductor industry. In this study, the above hypothesis was tested by empirical results. The aim was to provide theoretical support and practical recommendations for firms' internal pay management and promote their long-term and healthy development. Ultimately, my observation would help firms develop more competitive employee pay strategies and improve their overall earnings quality, thus creating higher value for investors.

3. Research Method

3.1 Sample Description

The FSC encourages listed firms to moderately increase employee pay and share their business gains with employees. Thereby, they can undertake their CSR and attain sustainable development. On July 1 of each year, CSR information, employee benefit and pay statistics, and the pay information of full-time non-executive employees are released under the "Corporate Governance Column" of the MOPS. Specifically, the pay information of full-time non-executive employees include the number of full-time non-executive employees, total amount of employee pay, average pay, and median pay. Using Taiwan's listed semiconductor firms in 2020–2023 as the research sample, this study examined the impact of the MMR on the

earnings quality in the post-COVID-19 scenario. Additionally, it discussed whether a higher median-to-mean pay ratio (namely, an improvement in the pay structure) yielded a better earnings quality. The data herein are cited from the "CSR information and employee benefits and pay statistics" of listed firms in the MOPS, and from the "Employee pay information disclosed in the notes to financial reports" and "Median pay of full-time non-executive employees" disclosed by Taiwan's listed firms. Additionally, accounting firm data and related financial variables are cited from the financial database of Taiwan Economic Journal (TEJ).

3.2 Sample Selection and Analysis

This study investigated the observed values of the MMR in Taiwan's semiconductor industry in the post-COVID-19 period. After removing the observed values with omitted or missing related financial information, the study acquired totally 2,855 observed values of the research sample from 2020 to 2023. Table 1 presents an analysis of the sample data. Panel A describes the distribution of observed values audited by changed accounting firms and unchanged accounting firms. The observed values audited by the Big 4 accounting firms without these firms being changed (i.e., the accounting firms are not replaced in the auditing process) accounted for approximately 90.54% (2,585 ÷ 2,855 = 90.54%) of the total observed values. This may be because the Big 4 accounting firms enjoy an exceptional professional reputation and are considered capable of providing high-quality and reliable audit services. Listed firms rely on such trust to satisfy the expectations of shareholders, investors, and regulatory authorities. Therefore, they tend to develop long-term business connections with the Big 4 accounting firms. They consider it highly inconvenient to change the accounting firms collaborating with them because it is time-consuming and cost-ineffective to develop new auditing teams familiar with their business. Panel B further describes the proportion of observed values audited by the Big 4 accounting firms unchangingly in different years. This proportion continued to increase and attained the highest level (27.46%: 784 ÷ 2,855) in 2023.

Table 1: Sample Distribution

Panel A: Distribution Accounting Firm and Chang Accounting Firm			
Accounting Firm	Big 4 a	Non-Big 4	Total
Chang Accounting Firm	58(2.03%)	19(0.67%)	77(2.70%)
Non-Chang Accounting Firm	2,585(90.54%)	193(6.76%)	2,778(97.30%)
Total	2,643(92.57%)	212(7.43%)	2,855(100.00%)
Panel B: Yearly distribution and distribution of Chang Accounting Firm			
Year	Chang Accounting Firm	Non-Chang Accounting Firm	Total
2020	11 (0.39%)	541 (18.95%)	552 (19.33%)
2021	26 (0.91%)	721 (25.25%)	747 (26.16%)
2022	24 (0.84%)	748 (26.20%)	772 (27.04%)
2023	16 (0.56%)	768 (26.90%)	784 (27.46%)
Total	77 (2.70%)	2,778 (97.30%)	2,855 (100.00%)

[a] The audit market in Taiwan is actually dominated by the local affiliations of the remaining large international audit firms – "Big 4" after the collapse of Arthur Anderson (i.e., Deloitte Touche, Ernst & Young, KPMG, and PricewaterhouseCoopers)

3.3 Research Design: Empirical Models

The overall business environment and corporate ethics have received increasing attention worldwide. Consequently, how firms fulfill their economic, social, and environmental responsibility on an ongoing basis has become a key topic. Therefore, the MOPS released the average and median pay data contained in the "pay information of full-time non-executive employees" disclosed by Taiwan's listed firms. The financial information disclosed by firms (particularly, earnings quality) is a focus of public attention. When firms' operating revenue fluctuates considerably, these tend to adjust corporate earnings to reduce the external disturbance (e.g., embellish the earnings in financial statements for earnings smoothing) so that the investors place high confidence in their financial status. Therefore, regression model (1) was constructed to ascertain the correlation between the MMR and earnings quality. The model is expressed as follows:

$$ESmooth_{i.t} = \beta_0 + \beta_1 MMR_{i,t} + \beta_2 ROA_{\ i,t} + \beta_3 OperRe_{i,t} + \beta_4 SIZE_{i,t} + \beta_5 LR_{i,t} + \beta_6 AgeList_{i,t} + \beta_7 BHolder_{i,t} + \beta_8 BNumber_{i,t} + \varepsilon_{i,t} \quad (1)$$

where

ESmooth= Degree of earnings smoothing during the five years from the (t - 4)-th year to the t-th year (Standard deviation of earnings before extraordinary items in the five years) (standard deviation of cash flow from operating activities in the five years)

MMR = Median-to-mean pay ratio of non-executive employees

ROA = Return on assets

OperRe = Net operating revenue (unit: TWD 1,000)

SIZE = Firm size (Natural logarithm of total corporate assets)

LR = Liabilities ratio (Long-term liabilities ÷ total assets)

AgeList = Firm age

BHolde r= Director shareholdings

BNumber = Number of directors

ε = Residual term

3.4 Related Variables and Operational Definitions

3.4.1 Dependent Variable: Earnings Quality (ESMOOTH)

Earnings quality is a focus of public attention. When firms' operating revenue fluctuates considerably, they tend to adjust corporate earnings to reduce external disturbance (e.g., embellish the earnings in financial statements for earnings smoothing) so that the investors place high confidence in their financial status. However, this approach fails to reflect firms' real financial status and reduces the reliability of earnings quality. Hence, this study used the earnings smoothing model (Leuz et al., 2003; Francis et al., 2004) as the proxy variable for earnings quality (*ESmooth*) to identify the suspected earnings manipulation.

$$ESMOOTH_{i,t} = \frac{\sigma(NIBE_{t,t-4\sim t})}{\sigma(CFO_{t,t-4\sim t})}$$

where

$ESMOOTH_{i,t}$= Degree of earnings smoothing by firm i during the five years from the (t-4)-th year to the t-th year

$\sigma NIBE_{i,t-4\sim t}$ =Standard deviation of earnings before extraordinary items divided by initial total assets

$\sigma CFO_{i,t-4\sim t}$ = Standard deviation of cash flow from operating activities divided by initial total assets

The standard deviation in the earnings smoothing model was calculated based on firms' five-year data. A larger E*SMOOTH* value indicates that a firm adopts earnings smoothing measures infrequently and that its earnings quality is good. Drawing on previous studies (Martinez and Castro, 2010; Myers et al., 2007; Gassen et al., 2006; Burgstahler et al., 2006; Francis et al., 2004; Bhattacharya and Sen, 2004; Leuz et al., 2003), this study used *ESMOOTH* as a proxy variable for earnings quality. It is equal to the standard deviation of net earnings (excluding non-recurring profits and losses) divided by the standard deviation of cash flow from operating activities during the period from the (t-5)-th year to the (t-1)-th year.

3.4.2 Independent Variable: MMR

Notwithstanding the recent increase in Taiwan's median employee pay (i.e., a continued increase in the pay of high-salaried employees), the pay of the majority of employees did not increase. In the context of the non-uniform distribution of employee pay, the average employee pay is likely to be skewed upward by a few exceptionally high figures. This makes it fail to reflect the actual pay level of the majority of employees. Therefore, many experts recommend using median pay to indicate the actual pay level of employees. According to the pay survey statistics for the first seven months of 2024, the average recurring employee pay was TWD 46,269, median recurring employee pay was TWD 37,111, and the median-to-mean ratio was 0.802 (a five-year high). The study can observe that the median employee pay increased more significantly than the mean employee pay. This indicates an improvement in Taiwan's employee pay level. The reengineering of supply chains disrupted by the COVID-19 pandemic emphasizes supply stability and local production capacity. Moreover, the global demand for electronic products and solutions has increased considerably. This has resulted in an increasing expansion of the semiconductor market and the consequent increasing demand for semiconductor professionals. Therefore, this study examined whether a larger MMR value indicates a better earnings quality in Taiwan's semiconductor industry.

3.4.3 Control Variables

Drawing on previous studies (Joseph, 2012; Tucker and Zarowin, 2006; Brav and Gompers, 2003; Frankel et al,. 2002; Jelic et al., 1998; Mandelker and Rhee, 1984; Hamada, 1972), this study introduced the variables including *ROA*, *OperRe*, *SIZE*, *LR*, *AgeList*, *BHolder*, and *BNumber*. The three control variables (*ROA*, *OperRe*, and *LR*) were used to control firms' financial status. The study introduced corporate governance variables (*AgeList*, *BHolder*, and *BNumber*) to control the corporate governance environment (Klein 2002a, b; Dechow et al., 1996; Beasley, 1996). Additionally, *SIZE* was introduced as a control variable (Mohammadi et al., 2012; Logue et al., 1973). This was because the firm size may reflect the earnings quality risk encountered by specific firms.

4. Empirical Results

4.1 Descriptive Statistics

Panel A of Table 2 provides the descriptive statistics of listed firms audited by changed accounting firms (i.e., accounting firms are replaced in the auditing process) and unchanged accounting firms (i.e., accounting firms are not replaced in the auditing process). Compared with the listed firms audited by unchanged accounting firms, those audited by changed accounting firms had large *ESmooth*, *MMR*, *OperRe*, *LR*, and *AgeList* values. The listed firms audited by changed accounting firms had higher earnings quality. This indicates their higher requirements for transparency and accuracy, or the transitions caused by new auditing firms. A larger MMR value indicates that the median employee pay is higher than the average employee pay. This, in turn, likely implies a non-uniform distribution of employee pay. A larger *OperRe* value indicates that firms can earn more revenue from normal business activities. This implies that these have stronger operational capabilities or stronger product or service competitiveness. A larger *LR* value indicates firms' higher reliance on loans to support their business operation and growth. It may reflect a difference in the capital structure. A larger *AgeList* value may indicate higher stability of business and maturity of market presence. It may be related to management decisions including the decision to change accounting firms. The differences in these corporate characteristics provide effective insights, particularly in terms of the variations in accounting policies, corporate governance structure, and capital management strategies, and the effects of such variations on the overall corporate performance.

Table 2: Descriptive Statistics

Distribution of Chang Accounting Firm									
	Total (n=2,855)			**Chang Accounting Firm (n=2,778)**			**Non-Chang Accounting Firm (n=77)**		
Variables[a]	Mean	Median	Std. Dev	Mean	Median	Std. Dev	Mean	Median	Std. Dev
ESnooth	0.65	0.41	1.15	0.71	0.52	0.65	0.65	0.40	1.16
MMR	0.86	0.87	0.08	0.87	0.87	0.09	0.86	0.87	0.07
ROA	0.06	0.05	0.08	0.02	0.02	0.09	0.06	0.06	0.08
OperRe	3,921,254	3,042,863	5.79	6,215,182	5,407,951	5.14	5,082,717	4,341,343	6.19
SIZE	15.52	15.28	1.53	14.84	14.71	1.36	15.54	15.3	1.53
LR	0.41	0.41	0.17	0.42	0.43	0.18	0.41	0.41	0.17
AgeList	18.17	20.00	6.37	18.97	20.00	5.11	18.14	20.00	6.40
BHolder	0.21	0.17	0.16	0.20	0.17	0.15	0.21	0.17	0.16
BNumber	8.02	7.00	1.58	7.60	7.00	1.48	8.04	7.00	1.58

[a] ***ESmooth***: Degree of earnings smoothing; ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

4.2 Correlation Matrix

Table 3 describes the coefficients of Pearson correlation between variables. The correlation analysis between independent variables showed that the *MMR* was significantly positively correlated with the *ESMOOTH*. This indicated that firms with a higher MMR had a fairer distribution of employee pay, higher public trust, and better earnings quality. The correlation analysis involving control variables showed that the *MMR* was significantly negatively correlated with the *ROA*, *OperRe*, *SIZE*, and *LR*. Meanwhile, it was significantly positively correlated with *BNumber*. Among the coefficients of correlation between independent variables, that between the *MMR* and *OperRe* (0.55) was marginally high. Meanwhile, those between the *MMR* and other variables were smaller than 0.4.

Table 3: Correlation Matrix

Variables [a,b]	*ESnooth*	*MMR*	*ROA*	*OperRe*	*SIZE*	*LR*	*AgeList*	*BHolder*	*BNumber*
ESnooth	1.00								
MMR	0.02*	1.00							
ROA	-0.22*	0.25*	1.00						
OperRe	-0.04*	0.55*	0.02	1.00					
SIZE	-0.12*	0.55*	0.22*	0.39*	1.00				
LR	-0.12*	0.07*	-0.14*	0.13*	0.30*	1.00			
AgeList	-0.01	0.13*	-0.11*	0.13*	0.28*	0.11*	1.00		
BHolder	-0.05	-0.12*	-0.01	-0.09*	-0.19*	-0.04*	-0.22*	1.00	
BNumber	0.06*	0.17*	0.07*	0.12*	0.33*	0.08*	0.14*	-0.01	1.00

[a] ***ESmooth***: Degree of earnings smoothing; ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

[b] Pearson correlations in the lower diagonal. * Indicates significance at the 5 percent level.

4.3 Multivariate Analysis

4.3.1 Regression Analysis of MMR and ESmoooth: Distribution of Big 4 and Non-Big 4

In this study, regression analysis was conducted to examine whether a larger *MMR* value implied a larger *ESmooth* value. Table 4 describes the empirical results. The correlation between the *MMR* and *ESmooth* was analyzed among listed firms audited by the Big 4 accounting firms and non-Big 4 accounting firms, respectively. The empirical results showed that among the listed firms audited by the Big 4 accounting firms, the estimated *MMR* coefficient was 0.34 (t = 1.11; positive and significant), and the adjusted R^2 value was 42.90%. This indicated that the explanatory variable selected in this study had a considerable explanatory power for *ESmooth*. According to pay survey statistics released by the Comptroller General's Office of Executive Yuan in September 2014, the median-to-mean ratio of recurring employee pay was 0.802 (a five-year high). The study can observe that the median employee pay increased more significantly than the mean employee pay. This

indicated an improvement in Taiwan's employee pay level. Moreover, the median employee pay increased more significantly than the mean employee pay in both manufacturing and service industries. The survey data also verified that in Taiwan's semiconductor industry, a higher MMR usually reflects a fairer distribution of employee pay. This indicates that firms attached more importance to the fairness and transparency of pay distribution. This pay culture is usually associated with good corporate governance because a fair pay system can reduce firms' internal pressures. Equality in pay structure can increase employees' job satisfaction and support for corporate financial management. This, in turn, would reduce unwarranted earnings manipulation and improve the earnings quality. Moreover, firms' emphasis on the balance in the pay structure implies a more rigorous internal control system. Audits conducted by the Big 4 accounting firms usually require high standards for financial reporting and compliance. This further increases the accuracy and reliability of financial statements. A pay equity strategy helps firms attract and retain highly effective employees, particularly in the knowledge-intensive semiconductor industry. Highly effective employees and management can ensure the authenticity and quality of earnings by implementing more responsible financial management policies.

In terms of control variables, audits by the Big 4 accounting firms (*Big 4*) ensure the accuracy and reliability of financial statements. This may help investors and managements make correct business decisions, thus resulting in a higher ROA. A smaller *LR* value usually indicates that firms have a stable profitability and rely on in-house resources rather than external financing for business growth. A smaller *BHolder* value indicates a clear division of labor between firms' management and owners. This effectively prevents the management's pursuit of short-term earnings and personal interests, and increases the transparency of corporate governance. Semiconductor firms audited by the Big 4 accounting firms showed better business performance and good financial performance.

Table 4: Regression Analysis of MMR and ESnooth-Distribution of Big 4 and Non-Big 4

Variables [a]	Pred. Sign	Total		Big 4		Non-Big 4	
		Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		2.22	5.81***	2.12	5.20***	3.35	2.83***
MMR	−/+	-0.48	-1.66**	0.34	1.11*	-1.54	-2.03
ROA	−/+	-3.29	-12.52***	3.35	12.09***	-2.42	-2.96***
OperRe	−/+	-4.35	-0.63	-4.92	-0.55	-3.09	-0.52
SIZE	−/+	-0.02	-0.96	-0.01	-0.78	-0.08	-1.15
LR	−/+	-0.99	-7.55***	-1.14	-8.20***	0.68	1.85**
AgeList	−/+	-0.00	-1.44*	-0.00	-1.09	0.00	0.02
BHolder	−/+	-0.49	-3.57***	-0.49	-3.44***	-0.61	-1.20
BNumber		-0.01	-0.89	-0.01	-0.92	-0.03	-0.60
Adj. R^2		37.60%		42.90%		40.43%	
Nobs.		2,850		2,638		212	

[a] ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

4.3.2 Regression Analysis of MMR and ESmooth: Distribution of Chang Accounting Firm and Chang CPA

For semiconductor firms audited by the Big 4 accounting firms, the larger the MMR value, the larger is the *ESmooth* value (as shown in Table 4). Therefore, this study further analyzed the effects of changing accounting firms and CPAs in the auditing process. The empirical results in Panel A of Table 5 shows that for semiconductor firms audited by changed accounting firms, the estimated *MMR* coefficient was 1.36 (t = 1.42; positive and significant at the 10% level). This indicates that they achieved certain improvement in corporate governance and may evaluate and optimize their pay structure. A larger *MMR* value indicates a fair distribution of employee pay and small disparity in employee pay. These serve to increase employee loyalty and improve employee's work efficiency, thus enhancing the authenticity of earnings. Semiconductor firms audited by changed accounting firms usually tended to reassess their internal control and business processes and establish higher requirements for the quality of financial reports. This further improved the earnings quality. Moreover, new accounting firms may provide new perspectives and recommendations to the audited semiconductor firms, thus impelling their management to maintain high transparency of earnings data in financial reports and assume higher accountability for earnings quality.

The empirical results in Panel B of Table 5 shows that for semiconductor firms audited by changed accounting firms, the estimated *MMR* coefficient was -0.71 (t = -1.65; negative and significant at the 5% level). This indicates that not changing CPAs may cause them to maintain the inertia of internal control systems (i.e., fail to adjust and improve their internal control systems in a timely manner). Hence, they may fail to evaluate and improve their employee pay structure, thus weakening their supervision of financial statements and reducing the authenticity and transparency of earnings data. Moreover, not changing CPAs may result in such firms' deficiency in risk management. This would expose them to the unnecessary risk of earnings manipulation and ultimately deteriorate their earnings quality.

Table 5: Regression Analysis of MMR and ESnooth-Distribution of Chang Accounting Firm and Chang CPA

Panel A: Distribution of Chang Accounting Firm					
Variables [a]		**Chang Accounting Firm**		**Non-Chang Accounting Firm**	
	Pred. Sign	**Coef.**	***t*-value** [b]	**Coef.**	***t*-value**
CONSTANT		-1.89	-1.16	2.18	5.23***
MMR	−/+	1.36	1.42*	-0.37	-1.19
ROA	−/+	0.13	0.16	-3.43	-12.12***
OperRe	−/+	-5.09	-0.81	-4.82	-0.53
SIZE	−/+	0.04	0.49	-0.01	-0.73
LR	−/+	-0.16	-0.40	-1.16	-8.20***
AgeList	−/+	-0.01	-0.40	-0.00	-1.00
BHolder	−/+	-0.97	-2.21**	-0.48	-3.19***
BNumber	−/+	0.15	3.16***	-0.02	-1.12
Adj. R^2		16.37%		8.07%	
Nobs.		58		2,580	
Panel B: Distribution of Chang CPA and Non-Chang CPA					
Variables [a]		**Chang CPA**		**Non-Chang CPA**	
	Pred. Sign	**Coef.**	***t*-value** [b]	**Coef.**	***t*-value**
CONSTANT		1.29	2.41***	2.56	4.49***
MMR	−/+	0.35	0.87	-0.71	-1.65**
ROA	−/+	-2.12	-5.30***	-3.87	-10.59***
OperRe	−/+	-4.81	-0.45	-4.41	-0.34
SIZE	−/+	-0.01	-0.42	-0.02	-0.65
LR	−/+	-1.02	-5.58***	-1.20	-6.22***
AgeList	−/+	-0.00	-0.80	-0.00	-0.72
BHolder	−/+	-0.53	-2.62***	-0.46	-2.38***
BNumber	−/+	-0.01	-0.55	-0.02	-0.80
Adj. R^2		6.28%		8.61%	
Nobs.		978		1,660	

[a] ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

4.3.3 Regression Analysis of MMR and ESmooth: Distribution of 2020–2023

After the outbreak of the COVID-19 pandemic, Taiwan adopted effective anti-pandemic measures to gain the international community's trust. This accorded prominence to Taiwan's role in the global supply chain system. In particular, Taiwan's semiconductor industry plays a key role in the global semiconductor market. The empirical results in Table 6 show that in a subsample, the estimated *MMR* coefficient was 1.12 (t = 1.75; positive and significant at the 5% level) in 2023. This indicates a more significant trend by 2023. The higher expansion of Taiwan's semiconductor industry in 2023 (compared with 2020–2022) was owing to the continuous increase in the global demand for electronic products and the consequent increase in the demand for semiconductors. In this context, the *MMR* became an important indicator of the pay structure in a semiconductor firm. The larger the *MMR* value, the closer is the pay level of non-executive employees to that of the average employee in the firm. This indicates that the firm's employee pay is distributed more fairly and uniformly. A larger *MMR* value indicates that a firm has better earnings quality. This is because a fairer distribution of employee pay results in higher employee job satisfaction and stability. This, in turn, increases the productivity and reduces the human costs. Increased employee satisfaction and loyalty serve to reduce employee turnover and related costs, thus increasing firms' profitability and financial stability. The rapid growth of Taiwan's semiconductor industry in 2023 promoted the growth of Taiwan's overall economy. A larger *MMR* value was also an indicator of the good earnings quality of Taiwan's semiconductor firms. It reflected their healthy pay culture and sustainable development prospect.

Table 6: Regression Analysis of MMR and ESnooth--Distribution of 2020~2023

Variables [a]	Pred. Sign	2020		2021		2022		2023	
		Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		0.63	0.72	2.74	4.79***	1.62	2.32***	3.04	4.01***
MMR	−/+	0.54	0.79	-0.79	-1.85	-0.33	-0.64	1.12	1.75**
ROA	−/+	-0.93	-1.42*	-1.04	-2.58***	-7.21	-15.46***	-2.64	-4.38***
OperRe	−/+	-4.96	-0.50	-6.27	-0.47	-4.91	-0.62	5.01	0.07
SIZE	−/+	-0.01	-0.36	-0.08	-2.88***	0.07	2.18**	-0.06	-1.56*
LR	−/+	-0.92	-3.09***	-0.29	-1.46*	-1.61	-6.64***	-0.87	-2.96**
AgeList	−/+	0.00	0.50	0.00	0.56	-0.02	-3.16***	-0.00	-0.06
BHolder	−/+	-0.22	-0.71	-0.44	-2.15**	-0.52	-2.01**	-0.59	-1.88**
BNumber	−/+	0.02	0.74	0.00	0.09	-0.03	-0.95	-0.03	-0.99
Adj. R^2		11.27%		3.10%		26.48%		4.72%	
Nobs.		551		746		770		783	

[a] ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

4.4 Additional test

This study further examined whether the audits by Big 4 accounting firms influenced the effect of the *MMR* on managerial anomalies. Table 7 presents the empirical results. For semiconductor firms audited by the Big 4 accounting firms, the estimated *MMR* coefficient was 0.24 ($t = 1.31$, $p < 0.1$; positive and significant). This indicated that such semiconductor firms usually conducted rigorous financial management and established a transparent pay structure. A median employee pay close to the average employee pay in a firm usually shows that the pay level of most employees does not differ significantly from the firm's overall pay level. That is, the firm has a wide range of rewards, and its bottom-level and middle-level employees are paid at a higher level than the market average level. This maintains employee satisfaction and reduces employee turnover. That is, the larger the *MMR* value, the more uniformly is the pay distributed among non-executive employees. A relatively high pay for senior executives may exert pressure on them because they are required to maintain a high job performance to validate their high pay.

Table 7: Regression Analysis of MMR and CEOTurnover Big 4 and Non-Big 4

Variables [a]		Total		Big 4		Non-Big 4	
	Pred. Sign	Coef.	*t*-value [b]	Coef.	*t*-value	Coef.	*t*-value
CONSTANT		0.34	1.43**	-0.08	-0.34	3.83	3.05***
MMR	−/+	0.13	0.74	0.24	1.31*	-0.54	-0.67
ROA	−/+	-0.83	-5.01***	-0.57	-3.46***	-3.15	-3.61***
OperRe	−/+	4.08	0.74*	7.69	0.14	5.43	0.62
SIZE	−/+	-0.00	-0.02	0.02	1.87**	-0.19	-2.61***
LR	−/+	-0.16	-1.91**	-0.19	-2.34***	-0.01	-0.03
AgeList	−/+	0.01	2.81***	0.01	2.50***	-0.00	0.04
BHolder	−/+	0.10	1.11	0.11	1.29*	0.53	0.99
BNumber		-0.01	-1.17	-0.01	-1.11	0.00	-0.04
Adj. R^2		1.32%		0.82		13.64%	
Nobs.		2850		2,638		212	

[a] ***MMR***: = Median-to-mean pay ratio of non-executive employees; ***ROA***: Return on assets; ***OperRe***: Net operating revenue (unit: TWD 1,000); ***SIZE***: Firm size (Natural logarithm of total corporate assets); ***LR***: Liabilities ratio (Long-term liabilities/total assets) ; ***AgeList***: Firm age ; ***BHolder***: Director shareholdings ; ***BNumber***: Number of directors.

[b] Asterisks *, **, *** indicate two-tailed significance at the 0.10, 0.05, and 0.01 levels, respectively.

5. Conclusion

This study examined the relationship between the MMR and earnings quality in Taiwan's semiconductor industry. Additionally, it analyzed the effect of factors such as the type of accounting firm. My observation would provide a strong empirical basis for pay policy-making and corporate governance in Taiwan's semiconductor industry. The study results showed that the *MMR* was positively correlated with *ESmooth*. This verified the aforementioned hypothesis (i.e., firms with a smaller MMR value and fairer pay distribution had better earnings quality). This is owing to the following reasons. First, a fair and reasonable pay system can effectively enhance employees' work efficiency, thus improving corporate productivity and reducing labor costs. Second, a fair pay structure can reduce internal conflicts, enhance employees' loyalty to firms, reduce the likelihood of unwarranted earnings manipulation, and enhance the authenticity and reliability of financial statements. Finally, a good pay system can help firms attract and retain highly effective talents and increase their competitiveness and long-term profitability. Further analysis showed that firms audited by the Big 4 accounting firms attached more importance to the fairness and transparency of pay distribution and thus had better earnings quality. This may be owing to the rigorous auditing standards and highly effective corporate governance mechanisms of these accounting firms.

Considering the influence of time factors, this study also conducted an analysis on an annual basis. The results showed that the positive correlation between the MMR and ESmooth was more significant in 2023. This phenomenon may be related to the expansion of Taiwan's semiconductor industry in 2023 and the consequent rapidly increasing demand for hi-tech talents. To attract and retain highly effective talents, Taiwan's semiconductor firms actively improved their pay structure. This, in turn, improved the operating performance and earnings quality. However, the continuance and sustainability of this phenomenon need to be verified in subsequent studies.

This study demonstrated that the MMR played a certain role in improving the earnings quality. However, this role was affected by the interaction of diverse factors including accounting firm type, year, and other corporate governance factors. Therefore, Taiwan's semiconductor firms should value the fairness of pay distribution, actively improve their pay structure, and improve corporate governance. This would ensure the authenticity and reliability of financial statements and help attain sustainable development. The study recommend that future studies focus on the following aspects: 1) expand the research sample to address more industries or countries, thus increasing the general applicability of the conclusions; 2) consider more potential influencing factors (e.g., the industry characteristics, firm size, and technological innovation) to construct a better theoretical model; and 3) adopt more refined research methods (e.g., event study) to more extensively evaluate the relationship between the MMR and earnings quality. The purpose is to gain a more comprehensive understanding of the pay policy and corporate governance in Taiwan's semiconductor industry, and provide more specific and effective policy recommendations.

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