What is the impact of corporate governance on the food industry at different thresholds of internationalization? A review

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Abstract: This research analyzes the dynamic effects of corporate governance, research and development (R&D) innovation, and financial policy on firm business performance under different internationalization threshold structures in Taiwan's food industry during the 2008–2019 period. The results illustrate R&D innovation's negative impact on business performance and the collateralization ratio by directors also has a negative influence. Conversely, the findings reveal that by considering the internationalization threshold effect, at a level of high internationalization, firms have positive influences on R&D innovation, and financial policy has a positive influence on business performance.

Keywords: financial policy; food industry; internationalization threshold; R&D innovation

Taiwan is an island country, and so internationalization is a natural option for most domestic industries and is an important indicator of growth and development, especially for the food industry. Why is the degree of internationalization very important for food industry operations? The answer is because most corporate cultures of the food industry are conservative and closed. The industry's emphasis on the degree of internationalization is already an important global indicator. Likitwongkajon et al. (2020) note that empirical evidence for the impact of internationalization on company performance is unclear, and so re-examining the question of whether internationalization can improve company value and company performance is very important.

Food safety problems have occurred one after another in Taiwan's food industry in recent years, causing panic among many consumers in society. In fact, food company governance malpractices have never

stopped. For the general public, the food industry's actual operations seem to be run behind a veil. Therefore, whether the degree of internationalization has an effect on the food industry's corporate governance is an important breakthrough that needs further exploration.

Corporate governance is important for developing the food industry from the viewpoint of investors and partners, and most often both firm structure and relationships determine corporate direction and performance. While the 20th century might be viewed as the age of management, the early 21st century is predicted to focus more on governance. A corporate governance framework also depends on the community's legal, regulatory, institutional, and ethical environments. Bebchuk et al. (2014) find that long-term investors intervene more intensively than short-term investors. Thus, investors who choose engagement do it to a greater degree, because of concerns about the long-term corporate governance or strategy.

Corporate governance in the food industry is subject to many challenges because independent directors in this industry are unable to meet the expectations of society for engaging in company supervision, and even some food companies employ independent directors that are not independent. On the other hand, under high levels of internationalization, foreign investors have gradually become important participants in domestic ownership structure systems as the degree of internationalization is more likely to focus on value creation and shareholder return. Foreign investors tend to be more independent than managers and other stakeholders. Fernandes et al. (2009) find that firms with a high degree of internationalization have higher firm valuation. In addition to considering the R&D innovation and important financial policy factors in the food industry, unlike previous literature, this study proposes a tenable argument that the internationalization effect of corporate governance may be a vital factor.

This paper thus employs a panel dynamic model to explore the regime-switching of corporate governance, R&D innovation, and financial policy and their impact on firm performance under different internationalization thresholds of Taiwan's food industry from 2008 to 2019. It also examines how relevant variables impact the ratio of R&D innovation. The results show that structural changes in different internationalization thresholds affect the relationships of corporate governance, R&D innovation, and financial policy on firm performance.

LITERATURE REVIEW

Hitt et al. (1997) pointed out that a firm's business activities, such as sales, manufacturing, and R&D, extend from the domestic market to the overseas market, which can be called internationalization. Sullivan (1994) stated that the degree of dependence of enterprises on overseas markets is an indicator of internationalization.

Schultz et al. (2013) utilized a sample of Australian companies over the period 2000–2005. Their empirical findings point to a substitution effect between product market competitiveness and firm-level corporate governance. Overall, internal corporate governance mechanisms produce more efficient boards, and greater chief executive officer (CEO) stock-based compensation is an effective instrument for improving firm productivity. Micco et al. (2007) use a new dataset to reassess the relationship between bank ownership and bank performance, providing separate estimations for developing and industrial countries. They find

that state-owned banks located in developing countries tend to have lower profitability and higher costs than their private counterparts. John and Senbet (1998) argue that the effectiveness of the board of directors is determined by the independence of board members, board composition, and board size and implementation of the board's mandate, such as whether it counterbalances the CEO or provides advice and/or resources.

Bae et al. (2010) show that firms with outstanding management experience can significantly increase the stock price because of equity market liberalization. Following the degree of internationalization in firms with strong corporate governance has become significantly higher than that in firms with weak corporate governance. Belong to outstanding management experience firms also exhibit higher rates of physical capital accumulation.

Fama and Jensen (1983) argue that the board of directors is an important internal control and managerial mechanism for a company. The board can also ease agency problems and costs. Conversely, the composition of the board can impact the board's effectiveness.

Ek and Guerin (2011) identify that there is still great room for most companies to improve their working capital management efficiency. However, if liquidity is too high, it will have an impact on profitability. Liquidity and profit should be well-balanced to maximize the company's value through good working capital management.

In terms of financial policy and R&D innovation, Schumpeter (2000) points out that the core of economic growth lies in innovation, including production technology innovation and change in production methods. Patel and Keith (1995) show that, for organizing innovation performance indicators, one may often use innovative capital targets for R&D expenditure, patent rights, and so on. Many empirical studies have indicated that R&D expenditure, innovation patent output, and business performance exhibit a significant positive correlation. Given that the food industry is an important sector promoted by the government of Taiwan, we explore the potential impacts of corporate governance, R&D innovation, and financial policy on firm performance under different internationalization threshold structures.

MATERIAL AND METHODS

This model by Sullivan (1994) and Hitt et al. (1997) is derived from conventional theory and employs the dynamic data model to estimate correlations among corporate governance, R&D innovation,

the financial policy on firm business performance. This paper set up panel data on 35 food firms during the 2008–2019 period in Taiwan. The change model is an empirical analysis based on the first-order difference, eliminating unobservable individual effects. To avoid any false correlation between the independent variable and the dependent variable, this study considers the time delay and conducts an empirical analysis based on the number of independent variables falling behind for one year as follows:

$$
\begin{aligned}
PER_{it} = \beta_{1i} R \& D_{it-1} + \beta_{2i} FP_{it-1} + \beta_{3i} CG_{it-1} + \\
+ \beta_{4i} DI_{it-1} + \beta_{5i} BS_{it-1} + \beta_{6i} SE_{it-1} + \varepsilon_{it}
\end{aligned}
\tag{1}
$$

where: PER_{it} – business performance; $R\&D_{it}$ – firm research and development; FP_{it} – free cash flow ratio; CG_{it} – corporate governance; DI_{it} – degree of internationalization; BS_{it} – board size; SE_{it} – firm assets; ε – error term; i – total number of firms; t – length of the sample period.

As for business performance (PER_{it}), in Table 1 we use several important variables as independent variables, including firm research ($R\&D_{it}$), free cash flow ratio (FP_{it}), share collateralization by directors and corporate governance (CG_{it}), board size (BS_{it}), firm assets (SE_{it}), and

degree of internationalization (DI_{it}) defined as threshold variable; error term ε, total number of firms i, length of the sample period t. In order to investigate the relationships among corporate governance, degree of internationalization, firm size, financial policy, and business performance, we elaborate the log equation as follows.

In Table 2 we introduce the types of research sample firms. The research sample firms are mainly listed companies with a certain scale in the Taiwan food industry. Furthermore, we use a threshold model[1] that imposes a common regime-switching mechanism while allowing for considerable heterogeneity in the timing of the regime changes across series as follows:

$$
\begin{aligned}
\ln PER_{it} = \beta_{1i} \ln R \& D_{it-1} + \beta_{2i} \ln FP_{it-1} + \\
+ \beta_{3i} \ln CG_{it-1} + \beta_{4i} \ln DI_{it-1} + \beta_{5i} BS_{it-1} + \\
+ \beta_{6i} SE_{it-1} + [\beta_{1i} \ln R \& D_{it-1} + \beta_{2i} \ln FP_{it-1} + \\
+ \beta_{3i} \ln CG_{it-1} + \beta_{4i} \ln DI_{it-1} + \beta_{5i} BS_{it-1} + \\
+ \beta_{6i} SE_{it-1}] g(q_{it}; \gamma, c) + \varepsilon_{it}
\end{aligned}
\tag{2}
$$

where: g – transition function; q_{it} – transition variable; c – the threshold parameter.

We estimate Equation (3) using the panel approach that takes into consideration both firm (i), year (t), and ε_{it},

Table 1. Main variable descriptions

Variable	Description	Calculation
Firm performance (*PER*)	ratio of the firm performance (*ROA* and *ROE*)	return on assets (*ROA*) = net profit/average net assets × 100% return on equity (*ROE*) = after-tax surplus/shareholders' equity × 100%
R&D innovation (*R&D*)	*R&D* expense ratio	*R&D* expense ratio = = *R&D* expense/net operating income × 100%
Finance policy (*FP*)	cash flow ratio (*CA*)	cash flow ratio = net cash flow from operating activities/ current liabilities × 100%
	operating profit ratio (*OPR*)	operating profit ratio – (operating income – cost of goods sold – – operating expenses)/(operating income) × 100%
Corporate governance (*CG*)	pledge ratio of shares held by directors and supervisors	pledge ratio of shares held by directors and supervisors = number of pledged shares held by directors and supervisors/(total number of shares) × 100%
Degree of internationalization (*DI*)	export ratio	export ratio = (firm's export value)/(firm's total value of domestic and foreign sales) × 100%
Board organization (*BS*)	board size includes all directors or supervisors	board size = number of directors and supervisors of each firm
Size (*SE*)	the study uses total assets as the scale proxy variable	ln (firm total assets)

Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

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[1]We adopt the panel smooth transition regression (PSTR) model, which was developed by Gonzalez et al. (2005).

$$\ln PER_{it} = \beta_{1i} \ln R\&D_{it-1} + \beta_{2i} \ln FP_{it-1} + \beta_{3i} \ln CG_{it-1} + \beta_{4i} \ln DI_{it-1} + \beta_{5i} BS_{it-1} + \beta_{6i} SE_{it-1} +$$
$$+ \sum_{j=1}^{r} \Big[\beta_{1i} \ln R\&D_{it-1} + \beta_{2i} \ln FP_{it-1} + \beta_{3i} \ln CG_{it-1} + \beta_{4i} \ln DI_{it-1} + \beta_{5i} BS_{it-1} + \beta_{6i} SE_{it-1} \Big] g(q_{it}^{(j)}; \gamma, c) + \varepsilon_{it} \tag{3}$$

which are fixed effect, deterministic trend, and error term, respectively. A generalization of the threshold model allows for more than two different regimes in the additive model.

Table 2. Sample firm introduction

Number	Full name of firm	Date of establishment	Firm type
1	Wei Chuan Foods Corp.	1953/9/22	listed firm
2	Ve Wong Corp.	1959/7/4	listed firm
3	Great Wall Enterprise Co., Ltd.	1960/12/28	listed firm
4	Oceanic Beverages Co., Inc.	1965/7/24	listed firm
5	Charoen Pokphand Enterprise (Taiwan) Co.	1977/8/22	listed firm
6	Uni-President Enterprises Corp.	1967/8/25	listed firm
7	AGV Products Corp.	1971/6/26	listed firm
8	Taisun Enterprise Co., Ltd.	1960/10/21	listed firm
9	Fwusow Industry Co., Ltd.	1955/2/7	listed firm
10	Tairoun Products Co., Ltd.	1969/3/13	listed firm
11	Formosa Oilseed Processing Co., Ltd.	1986/4/18	listed firm
12	Standard Foods Corp.	1986/6/6	listed firm
13	Lien Hwa Industrial Holding Corp.	1955/7/20	listed firm
14	Lian Hwa Foods Corp.	1970/7/7	listed firm
15	TTET Union Corp.	1982/5/24	listed firm
16	Ten Ren Tea Co., Ltd.	1975/12/11	listed firm
17	Hey-Song Corp.	1969/12/13	listed firm
18	Shin Tai Industry Co., Ltd.	1972/11/15	listed firm
19	Hunya Foods Co., Ltd.	1976/6/14	listed firm
20	Morn Sun Feed Mill Co., Ltd.	1967/2/18	listed firm
21	Sunjuice Holdings Co., Ltd.	2010/1/12	listed firm
22	Kee Song Bio-Technology Holdings Ltd.	2010/5/11	listed firm
23	Tehmag Foods Corp.	1989/6/29	listed firm
24	Namchow Holdings Co., Ltd.	1950/6/30	listed firm
25	Taiyen Biotech Co., Ltd.	1995/7/1	listed firm
26	Feei Cherng Enterprise Co., Ltd.	1993/12/2	listed firm
27	Chung Hwa Food Industrial Co., Ltd.	1980/5/8	listed firm
28	Taiwan Fructose Co., Ltd.	1984/7/25	listed firm
29	DaBomb Protein Corp.	2001/12/28	listed firm
30	Eagle Cold Storage Enterprise Co., Ltd.	1990/5/30	listed firm
31	Tingyi (Cayman Islands) Holding Corp.	1994/1/12	listed firm
32	Want Want China Holdings Ltd.	2007/10/3	public firm
33	Bioray Biotech Co., Ltd.	2005/3/2	listed firm at emerging stock market
34	Flavor Full Foods Inc.	1983/11/8	listed firm at emerging stock market
35	Dukang Distillers Holdings Ltd.	2008/2/12	listed firm

Co. – company; Corp. – corporation; Inc. – incorporated; Ltd. – limited
Source: Authors' own representation based on data provided by the Taiwan Economic Journal (2019)

EMPIRICAL RESULTS

Table 3 shows that the highest average export ratio among the sample firms is 100% and the highest average foreign ownership ratio among them is 72.69%. Most of the sample firms have a degree of internationalization, but there are indeed differences in their degrees.

Table 4 reports the descriptive statistics of the food industry ratios for the variables of a firm's degree of internationalization, firm *R&D* innovation, firm size, and finance policy. Firm performance (*ROE*) is between −27.43% and 47.30%, and the mean is 8.62%, showing that the firms exhibit great differences in terms of revenue performance. The degree of internationalization

Table 3. Sample firm introduction

Number	Full name of firm	Average export ratio (%)	Average foreign ownership ratio (%)
1	Wei Chuan Foods Corp.	0.75	14.82
2	Ve Wong Corp.	7.92	2.88
3	Great Wall Enterprise Co., Ltd.	34.58	9.74
4	Oceanic Beverages Co., Inc.	3.98	0.12
5	Charoen Pokphand Enterprise (Taiwan) Co.	0.01	35.84
6	Uni-President Enterprises Corp.	0.88	46.55
7	AGV Products Corp.	0.56	4.74
8	Taisun Enterprise Co., Ltd.	3.51	1.89
9	Fwusow Industry Co., Ltd.	0.99	4.06
10	Tairoun Products Co., Ltd.	0.73	8.47
11	Formosa Oilseed Processing Co., Ltd.	2.33	5.12
12	Standard Foods Corp.	30.18	5.11
13	Lien Hwa Industrial Holding Corp.	4.77	12.01
14	Lian Hwa Foods Corp.	0.64	2.28
15	TTET Union Corp.	2.39	5.75
16	Ten Ren Tea Co., Ltd.	14.36	6.10
17	Hey-Song Corp.	1.76	5.20
18	Shin Tai Industry Co., Ltd.	0.16	0.17
19	Hunya Foods Co., Ltd.	11.13	0.72
20	Morn Sun Feed Mill Co., Ltd.	0.00	0.13
21	Sunjuice Holdings Co., Limited	2.56	7.82
22	Kee Song Bio-Technology Holdings Ltd.	29.73	72.69
23	Tehmag Foods Corp.	4.13	2.69
24	Namchow Holdings Co., Ltd.	50.98	13.07
25	Taiyen Biotech Co., Ltd.	1.75	7.22
26	Feei Cherng Enterprise Co., Ltd.	83.81	4.29
27	Chung Hwa Food Industrial Co., Ltd.	0.00	0.02
28	Taiwan Fructose Co., Ltd.	0.87	0.22
29	DaBomb Protein Corp.	87.90	6.29
30	Eagle Cold Storage Enterprise Co., Ltd.	0.00	0.02
31	Tingyi (Cayman Islands) Holding Corp.	0.00	14.00
32	Want Want China Holdings Ltd.	100.00	32.00
33	Bioray Biotech Co., Ltd.	0.00	0.03
34	Flavor Full Foods Inc.	68.20	0.13
35	Dukang Distillers Holdings Ltd.	100.00	0.86

Co. – company; Corp. – corporation; Inc. – incorporated; Ltd. – limited

Source: Authors' own representation based on data provided by the Taiwan Economic Journal (2019)

Table 4. Summary statistics of the food industry

2008–2019	Mean	SE	Minimum	Maximum
Return on equity (*ROE*)	8.620	9.980	−27.430	47.300
Return on assets (*ROA*)	5.580	5.810	−13.200	37.050
Innovation (*R&D*)	0.440	6.050	0.000	4.260
Finance policy – cash flow ratio (*CA*)	32.633	47.735	−367.240	277.520
Finance policy – operating profit ratio (*OPR*)	4.429	1.689	−57.250	7.481
Collateralization by director (*CG*)	4.316	14.467	0.000	99.970
Degree of internationalization (*DI*)	11.319	18.396	0.000	100.000
Board size (*BS*)	9.451	16.497	6.000	18.000
Ln size (*SE*) (USD)	5.908	0.432	4.374	6.661

ROA, ROE – ratio of the firm performance; SE – standard error
Source: Authors' own representation based on data provided by the Taiwan Economic Journal (2019)

(export ratio) is between 0.00% and 100%, which also reveals a great difference in internationalization among the firms. The number of members on a board is between 6 and 18, again showing huge differences in board size for the firms. The director ratio of share collateralization is between 0.00% and 99.97%, which explains a great difference between the high and the low indicators and shows a wide diversity in major shareholders' operating attitudes. *R&D* innovation is between 0.00% and 4.26%, which denotes whether a firm exhibits high- or low-business innovation to increase its value. Table 5 shows the sample situation in 2019. The difference from Table 4 (2008–2019) is that the cash flow ratio in 2019 has changed greatly, between –367.24% and 106.68%, while the degree of internationalization has a minimum value of 0.05% and a maximum value of 72.57%.

The endogeneity test. Table 6 points out that each variable rejects the emptiness of a single root. In other words, it shows that the independent variable and the dependent variable are both at significant steady-state levels.

Following Stock et al. (2002), we use the instrument method to observe corporate governance variables. Therefore, this study uses $\ln BS_{it-2}$ as an instrument variable to express the following:

$$
\begin{aligned}
\ln BS_{it-1} = {} & \beta_{1i} \ln BS_{it-2} + \beta_{2i} \ln R\&D_{it-1} + \\
& + \beta_{3i} \ln CA_{it-1} + \beta_{4i} \ln CG_{it-1} + \\
& + \beta_{5i} \ln DI_{it} + \beta_{6i} \ln SE_{it-1} + \varepsilon_{it}
\end{aligned}
\tag{4}
$$

According to Stock et al. (2002), under the tool variable, the null hypothesis is that the instrument variables are equal to zero. When the number of zeros is greater than 8.96, the tool variables used in this study can be rejected. From the verification results at the bottom of Table 7, the sample weak tool variable verification under ordinary least squares (OLS), the *F*-statistic, is 24.93 ($P < 0.01$) and is far greater than 8.96. Moreover,

Table 5. Summary statistics of the food industry

2019	Mean	SE	Minimum	Maximum
Return on equity (*ROE*)	8.457	10.334	−22.870	24.750
Return on assets (*ROA*)	7.171	9.700	−21.500	24.780
Innovation (*R&D*)	0.448	0.644	0.000	2.360
Finance policy – cash flow ratio (*CA*)	10.378	84.256	−367.240	106.680
Finance policy – operating profit ratio (*OPR*)	6.233	7.767	−9.260	24.270
Collateralization by director (*CG*)	8.720	25.909	0.000	97.170
Degree of internationalization (*DI*)	12.310	18.200	0.050	72.570
Board size (*BS*)	9.384	2.299	6.000	15.000
Ln size (*SE*) (USD)	5.319	0.444	4.549	6.661

ROA, ROE – ratio of the firm performance; SE – standard error
Source: Authors' own representation based on data provided by the Taiwan Economic Journal (2019)

Table 6. Panel unit roots

Variable	Panel unit roots			
	LLC	IPS	ADF-Fisher Chi square	PP-Fisher Chi square
Return on equity (*ROE*)	−3.659***	−5.909***	202.041***	126.474***
Return on assets (*ROA*)	−35.890***	−0.155***	78.706***	126.060***
Innovation (*R&D*)	−36.785***	−0.302***	34.021***	112.244***
Finance policy – cash flow ratio (*CA*)	−8.189***	−11.928***	369.938***	123.179***
Finance policy – operating profit ratio (*OPR*)	49.185***	−0.559***	92.878***	128.209***
Collateralization by director (*CG*)	−13.579***	0.368***	68.128***	126.246***
Degree of internationalization (*DI*)	−41.591***	−4.534***	61.965***	132.093***
Board size (*BS*)	−23.699***	−6.312***	56.150***	135.268***
Ln size (*SE*) (USD)	95.480***	−4.672***	87.679***	145.469***

***Statistically significant at 0.01; ADF-Fisher – Dickey and Fuller (1981); IPS – Im et al. (2003); LLC – Levin et al. (2002); PP-Fisher – Pedroni (1999); *ROA, ROE* – ratio of the firm performance
Source: Authors' own representation based on data provided by the Taiwan Economic Journal (2019)

Table 7. Estimation results of weak instruments

Variable	BS_{it-1}	
	coefficient	*P*-value
Constant	−46.106*** (16.715)	0.005
BS_{it-2}	2.827*** (1.041)	0.006
$R\&D_{it-1}$	−2.396* (1.447)	0.097
CA_{it-1}	0.306*** (0.093)	0.001
CG_{it-1}	−0.024 (0.015)	0.125
DI_{it-1}	3.743*** (1.545)	0.000
SE_{it-1}	2.667*** (1.024)	0.009
Adjusted R^2	0.32	
F-statistic	23.999***	
Weak instruments text *F*-statistic	24.093	

***, *Indicate significance at the 0.01, and 0.1 levels, respectively; *BS* – board size; *CA* – cash flow ratio; *CG* – corporate governance; *DI* – degree of internationalization defined as threshold variable; *R&D* – firm research; *SE* – firm assets
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

the coefficients of the instrument variable are positive, reaching statistically significant levels of 1% at a coef-ficient of 2.827. Therefore, the independent variable variables used in this study are consistent with the instrument variables.

Following Hausman (1978), after the weak instrument test the study further uses the Dubin-Wu-Hausman test to observe the instrument variable's exogenous hypothesis. The estimation steps are as follows. First, the endogenous variable is expressed as an exogenous variable, obtaining the residual of the estimated formula. Second, the residual of the estimated formula is substituted into model (5), which is regarded as an explanatory variable, as follows:

$$
\begin{aligned}
\ln ROA_{it-1} = {} & \beta_{1i} \ln R\&D_{it-1} + \beta_{2i} \ln CA_{it-1} + \\
& + \beta_{3i} \ln CG_{it-1} + \beta_{4i} \ln DI_{it} + \\
& + \beta_{5i} \ln SE_{it-1} + \varepsilon_{it}
\end{aligned}
\tag{5}
$$

where: *ROA* – return on assets.

The endogenous test results are listed below in Table 8. The results show that endogenous test results (*res*) BS_{it-1} – *res* (*t* = 0.70) are not significant, indicating that H_0 cannot be rejected. It also shows that the number of BS_{it-1} is not an endogenously significant variable in the sample.

Panel regression model. This paper examines the performance, *R&D* innovation, and degree of internationalization effect by studying a panel of 35 Taiwanese food industry firms over the period 2008–2019. Our main estimates rely on data from Taiwan Economic Journal (2019) sources. We apply the panel regression model, present the results in Tables 9 and 10, and compare the estimates of the pooled model

Table 8. Endogenous estimation results

Variable	ROA_{it}	
	coefficient	*P*-value
Constant	0.078*** (0.025)	0.002
$R\&D_{it}$	−0.396*** (0.108)	0.000
CA_{it-1}	1.276*** (0.375)	0.000
CG_{it}	−3.062*** (0.686)	0.000
DI_{it-1}	1.397*** (0.272)	0.000
SE_{it}	0.038*** (0.011)	0.000
Adjusted R^2	0.265	
F-statistic	51.727***	
Endogenous test (*t*-statistic) $BS_{it-1} - res$	0.70	

***Indicate significance at the 0.01 level; *BS* – board size, *CA* – cash flow ratio; *CG* – corporate governance; *DI* – degree of internationalization defined as threshold variable; *R&D* – firm research; *ROA* – return on assets; *SE* – firm assets
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

Table 9. Parameter estimation results for panel data regression models and (POLS method) robustness analysis

Variable	Panel A	
	ROA	*P*-value
Constant	3.270 (3.357)	0.330
R&D innovation (*R&D*)	−0.004*** (0.001)	0.000
Cash flow ratio (*CA*)	0.031*** (0.005)	0.000
Operating profit ratio (*OPR*)	0.515*** (0.037)	0.000
Corporate governance (*CG*)	−0.001 (0.004)	0.775
Degree of internationalization (*DI*)	0.044*** (0.012)	0.000
Board size (*BS*)	−0.464*** (0.123)	0.000
Size (*SE*)	0.508*** (0.216)	0.000
R^2	0.530	
Adjusted R^2	0.519	

***Indicate significance at the 0.01 level; POLS – pooled odinary least square; *R&D* innovation – firm research; *ROA* – return on assets
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

by OLS. Considering *ROA* and *ROE* as two performance indicators, we also conduct robustness analysis in panel A and panel B.

It is important to observe that degree of internationalization (0.044), finance policy (0.031), and business performance exhibit significant positive correlations from panel A. Degree of internationalization has a positive relationship with firm performance, which means that the participation of export ratio contributes to firm performance and exhibits a professional management mechanism. Our robustness analysis finds that panel A and panel B results are consistent about firm performance and finance policy being significantly positive (0.040), and firm performance and degree of internationalization are also significantly positive (0.161).

Threshold model test. Tables 11 and 12 show how we use the degree of internationalization (*DI*) as the threshold variable. We use several important variables as independent variables, including firm research (*R&D_{it}*), free cash flow ratio (*FP_{it}*), operating profit ratio (*OPR*), share collateralization by directors and board size (*CG_{it}*), board size (*BS_{it}*), firm assets

(SE_{it}), and the degree of internationalization through testing. Next, we apply a series of tests to determine a reasonable threshold number of *r* = 2, which means that there are two regions.

The results of threshold model and robustness analysis. As Table 13 indicates, firm performance, corporate governance, and degree of internationalization of Taiwan's food industry present a non-linear relationship. The different degrees of internationalization threshold attributes of the firms produce completely different firm performances. Therefore, this paper is different from the past literature, as it investigates whether the firm's corporate governance theory is different from the past under different internationalization thresholds in order to understand the structural changes in the relationship between corporate governance and corporate *R&D* innovation and financial policies.

When the dependent variable is *ROE*, the threshold for the degree of internationalization is 23.577. Our finding is that with regard to a low degree of internationalization (< 23.577), *R&D* innovation and firm performance

Table 10. Parameter estimation results for panel data regression (POLS method) models and robustness analysis

Variable	Panel B	
	ROE	*P*-value
Constant	−14.456*** (5.535)	0.009
R&D innovation (*R&D*)	−0.005*** (0.001)	0.000
Cash flow ratio (*CA*)	0.040*** (0.009)	0.000
Operating profit ratio (*OPR*)	0.648*** (0.062)	0.000
Corporate governance (*CG*)	−0.006 (0.004)	0.177
Degree of internationalization (*DI*)	0.161** (0.080)	0.046
Board size (*BS*)	−0.638*** (0.203)	0.000
Size (*SE*)	0.389** (0.212)	0.012
R^2	0.423	
Adjusted R^2	0.419	

***, **Indicate significance at the 0.01, and 0.05 levels, respectively; POLS – pooled odinary least square; *R&D* innovation – firm research; *ROE* – return on equity

Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

have a negative relationship (−0.946), which implies *R&D* innovation has no significant impact on perfor-

mance. However, with regard to a high level of internationalization (> 23.577), *R&D* innovation and firm performance have a significantly positive relationship (4.519). Finance policy and firm performance show a significantly negative relationship (−0.131), indicating that a low degree of internationalization for a firm denotes inadequate financial policy management capacity. However, with regard to a high degree of internationalization, financial policy and firm performance illustrate a significantly positive relationship (0.036).

With regard to firms with low degree of internationalization, the collateralization by directors has a negative influence on firm performance (−0.154) and board size (−0.505), indicating that an excessive size of the board of directors negatively affects firm performance, and an over-pledged ratio of directors and supervisors also has a negative effect on firm performance. With regard to a high level of internationalization, the share collateralization by directors has a negative influence on firm performance (−0.008) and board size (−2.532), explaining that the excessive size of the board of directors and the over-pledged ratio of directors and supervisors cast a negative effect on firm performance.

The robustness analysis in Table 14 shows that when the dependent variable is *ROA*, the threshold for the degree of internationalization is 24.417. With regard to a high level of internationalization (> 24.417), our study reveals that there is a significantly positive relationship between firms' *R&D* innovation (−1.177) and performance. Collateralization by directors (−0.079) and board size (−0.067) have a significantly negative relationship with firm performance.

Table 11. The threshold model test (*ROE*)

	Statistics	*P*-value
Test of linearity		
Wald test (LMW)	110.460	0.000*
Fisher test (LMF)	8.186	0.000*
LRT test (LRT)	136.542	0.000*
Sequence of homogeneity tests for selecting (*m*)		
H_3: $\beta_3 = 0$	$F_3 = 0.255$	0.115
H_2: $\beta_2 = 0 \| \beta_3 = 0$	$F_2 = 0.886$	0.002
H_1: $\beta_1 = 0 \| \beta_2 = \beta_3 = 0$	$F_1 = 6.837$	0.000*
Testing the number of regimes: Test of no remaining non-linearity		
Wald test (LMW)	2.912	0.819
Fisher test (LMF)	0.421	0.865
LRT test (LRT)	2.935	0.817

*Denotes significance at the 0.05 level; LRT – likelihood ratio test; *m* – number of tresholds; *ROE* – return on equity

Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

Table 12. The threshold model test (*ROA*)

	Statistics	*P*-value
Test of linearity		
Wald test (LMW)	88.360	0.000*
Fisher test (LMF)	5.184	0.000*
LRT test (LRT)	93.228	0.000*
Sequence of homogeneity tests for selecting (*m*)		
H_3: $\beta_3 = 0$	$F_3 = 0.116$	0.115
H_2: $\beta_2 = 0 | \beta_3 = 0$	$F_2 = 0.741$	0.767
H_1: $\beta_1 = 0 | \beta_2 = \beta_3 = 0$	$F_1 = 4.287$	0.000*
Testing the number of regimes: Test of no remaining non-linearity		
Wald test (LMW)	2.550	0.863
Fisher test (LMF)	0.367	0.900
LRT test (LRT)	2.560	0.862

*Denotes significance at the 0.05 level; LRT – likelihood ratio test; *m* – number of tresholds; *ROA* – return on assets
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

Table 13. Evaluation results of threshold model estimation: Dependent variable as *ROE*

Variables	Coefficient
Firms with low degree of internationalization (threshold value < 23.577)	
R&D innovation (*R&D*)	−0.946
Cash flow ratio (*CA*)	−0.131***
Operating profit ratio (*OPR*)	0.087
Collateralization by directors (*CG*)	−0.154*
Board size (*BS*)	−0.505*
Size (*SE*)	2.852***
Firms with high degree of internationalization (threshold value > 23.577)	
R&D innovation (*R&D*)	4.519***
Cash flow ratio (*CA*)	0.036***
Operating profit ratio (*OPR*)	3.791***
Collateralization by directors (*CG*)	−0.008
Board size (*BS*)	−2.532
Size (*SE*)	−1.227***

***, *Indicate significance at the 0.01, and 0.1 levels, respectively; *ROE* – return on equity
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

Table 14. Evaluation results of threshold model estimation: Dependent variable as *ROA*

Variables	Coefficient
Firms with low degree of internationalization (threshold value < 24.417)	
R&D innovation (*R&D*)	−1.177
Cash flow ratio (*CA*)	−0.015***
Operating profit ratio (*OPR*)	0.058
Collateralization by directors (*CG*)	−0.079*
Board size (*BS*)	−0.067*
Size (*SE*)	2.149***
Firms with high degree of internationalization (threshold value > 24.417)	
R&D innovation (*R&D*)	0.008***
Cash flow ratio (*CA*)	0.061***
Operating profit ratio (*OPR*)	1.521**
Collateralization by directors (*CG*)	−1.585
Board size (*BS*)	−1.756
Size (*SE*)	−0.227***

***, **, *Indicate significance at the 0.01, 0.05, and 0.1 levels, respectively; *ROA* – return on assets
Source: Authors' own calculations based on data provided by the Taiwan Economic Journal (2019)

The above empirical evidence shows that food industry must strengthen the degree of its internationalization, especially as an improvement in the degree of internationalization can bring more international management capabilities into the enterprise. Corporate governance has played a positive role in the operations of Taiwan's industry. In the future, the food industry can enhance the degree of its internationalization and use international functions to assist in implementing and completing a firm's corporate governance.

CONCLUSION

This paper examines the relationship between corporate governance, degree of internationalization, and firm performance by studying a panel of 35 food industry firms in Taiwan during the period 2008–2019. By analyzing the threshold model results, we find a negative relationship between firm performance and hare collateralization by directors and board size, indicating that a board's appropriate size is an important factor that affects firm performance. The findings further reveal that if directors' collateralization is too large, then a dilemma may occur in firm performance. One things to note is that investors should be careful when investing in the above type of firms.

In addition to research and development on innovative technology, the food industry should set up a complete corporate governance system. For instance, firms can adopt internal control and auditing measures. New food firms are urged to implement sound finance policy and corporate governance mechanisms in order to comply with laws, rules, and regulations while promoting food methods or information about their food products.

The degree of internationalization has a positive and significant effect on firm performance, implying that attracting foreign investment is an important indicator for the food industry. Participating in a proper shareholder structure through a degree of internationalization can help develop a firm's more operational value. The degree of internationalization has a certain level of improvement in corporate governance. It can help develop corporate governance with international standards and is part of a supportive shareholder structure for both firms and external investors.

For a proposal on the food industry, increasing internationalization is an important factor if the food industry wants to break through the business dilemma. Food firms that have an international shareholder background bring forth a global management perspective. This allows such firms to move past a conservative management culture, borrow the professional expertise of foreign shareholders and corporate governance systems, and change management's attitude.

The food industry's safety issues and a lack of corporate governance systems have caused the public to worry more about the food industry and what people are eating. The competent authorities should guide the food firms to increase the number of international shareholders through strengthening of their internationalization, setting up corporate governance systems, and exhibiting corporate transparency attitudes. As one investment indicator, it is recommended that investors choose food firms with a high level of international background. On the one hand, investors can expect a proper governance system with a more global perspective from such food firms. On the other hand, investors can realize potential performance in food firms that exhibit a high degree of internationalization.

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