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ABSTRACT

Over the last decade, educators, administrators, and policy makers increasingly focus on corporate social responsibility. However, no studies examine the relationships among corporate social responsibility, brand equity, and firm performance. This study uses quantile regression and structural equation modeling to explore the causal linkages among these factors in Taiwanese high-tech companies over the period 2010–2013.

The results of quantile regression analysis show that the economic dimension of corporate social responsibility and the prestige driver of brand equity are positive and significant for all the quantiles. The brand extension driver provides a significant positive effect at the higher quantiles of firm performance. However, the findings indicate a significant negative effect on firm performance for the brand loyalty driver. The findings of structural equation modeling suggest that corporate social responsibility and brand equity positively affect firm performance. This study provides useful insights on brand equity and corporate social responsibility.

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1. Introduction

In today's global world, corporate social responsibility (CSR) increases public demand of firms' transparency regarding disclosure of information to meet stakeholders' expectations. Firms that engage in business with a large public-interest component commit themselves to promoting business activities that bring economic, social, and environmental benefits to the society.

Previous research suggests that CSR brings about employee's ethical behaviors, which in turn enhance organizational efficiency (Laczniaik & Murphy, 1991; Preston & O'Bannon, 1997; Sims & Kroeck, 1994). Maignan, Ferrell, and Ferrell (2005) find that firms fulfill their CSR obligations to improve corporate image and strengthen marketing tactics effects, thus positively affecting firm performance. Torres, Bijmolt, Tribó, and Verhoef (2012) find that CSR toward all stakeholders positively affects brand equity.

Lai, Chiu, Yang, and Pai (2010) investigate the effects of CSR on brand performance in business-to-business (B2B) markets. The authors apply the qualitative method of questionnaire survey to a sample of Taiwan manufacturing and service companies. Results show that CSR positively affects industrial brand equity and brand performance. However, the qualitative method that study uses may suffer from selection biases and subjective measures vulnerability.

No prior quantitative research explores the relationships among corporate social responsibility, brand equity, and firm performance. Most studies use the ordinary least squares (OLS) regression model to examine the relationships among these factors. This study uses quantile regression, in addition to the OLS model, to examine the heterogeneous effects of CSR and brand equity on firm performance in Taiwan's high-tech industries over the period 2010–2013. Conversely to OLS regression, the quantile regression analysis allows researchers to estimate covariate effects at different points of the distribution. Specifically, quantile regression analysis allows determining whether the factors' elasticities are cross-sectionally different. Furthermore, this study adopts structural equation modeling (SEM) to explore the causal linkages among corporate social responsibility, brand equity, and firm performance. Corporate managers could use the findings to develop effective business strategies.

The remainder of the study proceeds as follows. Section 2: literature review; Section 3: the data and research methods; Section 4: results; and Section 5: discussion and conclusion.

2. Literature review

Lussier (2000) and Ferrell and Geoffrey (2000) define CSR as the corporate behavior in relation to business ethics' fulfillment that includes corporate obligations and commitments to society. Daft (2003) and Vogel (2004) also suggest that CSR is an extension of business ethics and management morality that should not only meet legal regulations, but also respond to public pressure and social expectation. Therefore, CSR could deal with business ethics' principles to maintain the benefits of all company stakeholders.

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Researchers find CSR implementation's effect on firm performance interesting because people perceive firms fulfilling their CSR as socially responsible. Many studies also argue that fulfilling CSR is equivalent to making a socially responsible investment, thus enhancing firm performance (Chu & Yang, 2009; Griffin & Mahon, 1997; Peters & Mullen, 2009; Preston & O'Bannon, 1997; Verschoor, 1998; Wang, Hsu, & Chang, 2012). Laczniak and Murphy (1991) claim that a firm that commits itself to developing the culture of business ethics would avoid incurring individual, organizational, and social costs, thus leading to a better firm performance. Sims and Kroeck (1994) suggest that a firm following the principles of business ethics could enhance employees' satisfaction and corporate identity, both of which are beneficial to organizational performance. Preston and O'Bannon (1997) demonstrate that socially responsible firms build a more complete managerial system, which could improve firm performance. Furthermore, Verschoor (1998) examines the financial data of the S&P 500 firms and concludes that CSR has a causal relationship with firm performance.

Several studies on CSR (Chu & Yang, 2009; Maignan & Ferrell, 2004; Maignan et al., 2005) examine CSR's linkage with business marketing, suggesting that when a firm fulfills its CSR, that firm greatly strengthens corporate image, thus improving firm performance. Both Maignan and Ferrell (2004) and Maignan et al. (2005) argue that CSR fulfillment would enhance marketing advantages and reinforce stakeholders' corporate identity. Lai et al. (2010) investigate CSR's effects on brand performance in business-to-business (B2B) markets. The authors find that CSR positively affects industrial brand equity and brand performance. Torres et al. (2012) use a panel data comprising 57 global brands original of 10 countries for the period 2002–2007 and find that CSR toward all stakeholders positively affects brand equity. Sweetin, Knowles, Summey, and McQueen (2013) show that consumers dealing with socially irresponsible corporate brands are more likely to punish and less likely to reward than consumers in the other three treatment conditions.

In sum, the literature review shows that a positive correlation exists among CSR, brand equity and firm performance. Building on the literature review, this study provides testable hypotheses that a causal relationship exists among corporate social responsibility, brand equity, and firm performance.

3. Methods

This study follows Wang et al. (2012) to construct the CSR variable, which uses the conceptual scheme of Dow Jones Sustainability Index (DJSI). The CSR variables comprise economic, social, environmental, and corporate governance dimensions. The economic dimension consists of corporate contributions to stockholders and creditors. The social dimension comprises corporate contributions to the government, employees, and suppliers. Two variables form the environmental dimension: the number of penalty notices and the amount of fines owing to environmental hazards. The corporate governance dimension consists of board size and external share ownership, which represent internal governance and external governance, respectively. Because no previous research suggests the weighting method, this study uses an equal weighting scheme in the measurement of the overall CSR index.

The computation formula for the nine measures, four dimensions, and the combined index of CSR appears below:

- (1) Contribution to stockholders (*SHCI*)
SHCI is the percentile ranking of earnings per share (*EPS*):

$$SHCI = Score(EPS) = Score\left[\frac{NI-PSD}{OS}\right]$$

where *Score* represents the percentile ranking of *EPS*, *EPS* is earning per share, *NI* is net profit after tax, *PSD* is dividend of preferred stocks, and *OS* is the weighted average outstanding shares of common stock.

- (2) Contribution to creditors (*CCI*)
CCI is the result of the percentile ranking of total interest expense (*IE*) scaled by total debt (*Debt*):

$$CCI = Score(IE) = Score\left[\frac{IE}{Debt}\right]$$

where *IE* is the ratio of total interest expense, *IE*, to total debt, *Debt*.

- (3) Contribution to government (*GCI*)
GCI is the percentile ranking of total tax expense scaled by sales revenues:

$$GCI = Score(TE) = Score\left[\frac{TE}{Sales}\right]$$

where *TE* is the ratio of total tax expense, *TE*, to company sales, *Sales*.

- (4) Contribution to employees (*ECI*)
ECI is the percentile ranking of total salary and benefits expenses per employee scaled by sales:

$$ECI = Score(ASER) = Score\left[\frac{SE/EN}{Sales}\right]$$

where *ASER* stands for salary and benefit expenses, *SE*, divided by the number of employees, *EN*, scaled by sales.

- (5) Contribution to suppliers (*SCI*)
SCI is the percentile ranking of annual purchases scaled by sales:

$$SCI = Score(PCR) = Score\left[\frac{PC}{Sales}\right]$$

where *PCR* denotes the ratio of annual purchases, *PC*, to sales.

- (6) Environmental variable 1 (*EDI*)
EDI is the inverse percentile ranking of the number of penalty notices (*ED*) owing to environmental hazards in a year scaled by the industry average (*IED*). This means that the less damage a firm causes to environment, the higher the *EDI* is.

$$EDI = Score'\left[\frac{ED}{IED}\right]$$

where *Score'* stands for the inverse percentile ranking of the number of times (*ED*) that a firm causes environmental hazards in a year, scaled by the industry average (*IED*).

- (7) Environmental variable 2 (*FED*)
FED is the inverse percentile ranking of the dollar amount that a firm pays in fines to the environment protection agency for causing environmental hazard. Similar to *EDI*, *FED* increases as the dollar amount of fines (*EF*) gets smaller.

$$FED = Score'\left[\frac{EF}{IEF}\right]$$

where *Score'* stands for the inverse percentile ranking of the dollar amount of fines (*EF*) scaled by the industry average (*IEF*).

- (8) Board size (*BOS*)
BOS is the percentile ranking of the natural logarithm of the total number of board members denoted by *BM*.

$$BOS = Score(BM)$$

- (9) External share ownership (*ESO*)
ESO is the percentile ranking of the sum of all external shareholdings with large equity holdings (greater than 5%).

$$ESO = Score\left[\frac{EXT}{TCC}\right]$$

where *EXT* is the sum of total external shareholding scaled by total corporate capital (*TCC*).

- (10) The economic dimension (*Eco*)
Eco is the average of corporate contribution to stockholders (*SHCI*) and creditors (*CCI*):

$$Eco = \frac{SHCI + CCI}{2}$$

- (11) The social dimension (*Soc*)
Soc is the average of corporate contributions to government (*GCI*), employees (*ECI*) and suppliers (*SCI*).

$$Soc = \frac{GCI + ECI + SCI}{3}$$

- (12) The environmental dimension (*Env*)
Env is the average of the number of penalty notices (*EDI*) and the amount of fines (*FED*) owing to environmental hazards.

$$Env = \frac{EDI + FED}{2}$$

- (13) The corporate governance dimension (*Gov*)
Gov is the average of board size (*BOS*) and external share ownership (*ESO*).

$$Gov = \frac{BOS + ESO}{2}$$

- (14) CSR index
The index of CSR is the equally weighted of *Eco*, *Soc*, *Env* and *Gov*.

$$CSR = w_1 * Eco + w_2 * Soc + w_3 * Env + w_4 * Gov$$

Various types of marketing and/or financial paradigms contemplate brand equity. However, [Chu and Keh \(2006\)](#) characterize the marketing or integrated model, like the Interbrand model, by its proprietary analytic framework and various subjective parameters. Japan's Ministry of Economy, Trade, and Industry develops the Hirose model, which determines brand equity drawing on public financial data and is usually more objective than other appraisal methods ([Hirose, 2002](#)). This study applies the Hirose model in valuation analysis. The study assumes the brand value (*BV*) as a function of three key factors:

$$BV = f(PD, LD, ED, r) = \frac{PD}{r} * LD * ED.$$

The factors in the valuation model are prestige driver (*PD*), loyalty driver (*LD*), and extension driver (*ED*); *r* is the risk-free interest (discount) rate.

PD is the cash flows attributable to the price advantage or excess value of the brand. The proportion of advertising expense and promotion cost, or brand management cost, to total operation expenses is the brand-attribution rate.

$$PD = \frac{1}{5} \sum_{i=-4}^0 \left\{ \left[\frac{S_i - S_i^*}{C_i - C_i^*} * \frac{AD_i}{OE_i} \right] * C_0 \right\}$$

where *S* = sales of firms; *C* = cost of sales of firms; *S** = sales of a benchmark company; *C** = cost of sales of a benchmark company; *AD* = advertising expense and promotion cost; *OE* = total operation expenses.

LD refers to the capability of a brand for maintaining stable sales over a long period thanks to customer loyalty and repeating business. The *LD* is the stability of the cost of sales:

$$LD = \frac{\mu_c - \sigma_c}{\mu_c}$$

where μ_c = five-year average of firms' cost of sales; σ_c = five-year standard deviation of firms' cost of sales.

ED determines the brand's expansion capability, which represents a famous brand's capability to stretch across industry sectors and geographical areas. This study therefore measures *ED* by focusing on the non-core and overseas businesses of firms:

$$ED = \frac{1}{2} \sum_{i=-1}^0 \left[\frac{SX_i - SX_{i-1}}{SX_{i-1}} + 1 \right]$$

where *SX* = sales from non-core and overseas businesses.

As for dependent variable of firm performance (*PERF*), this study uses return on asset (*ROA*), return on equity (*ROE*) and Tobin's *Q* (*Tobinq*) as proxies for firm performance. (1) *ROA* is earnings before interest and tax (*EBIT*) divided by total assets; (2) *ROE* is the result of dividing net income (*NI*) by total equity; (3) *Tobinq* is total market value of outstanding stocks and total liabilities divided by total assets.

After measuring the corporate social responsibility, brand equity, and firm performance, the study assesses the relationship among the three factors. First, an ordinary least squares (*OLS*) regression tests the relationship:

$$PERF_{it} = \alpha_0 + \alpha_1 Eco_{it} + \alpha_2 Soc_{it} + \alpha_3 Env_{it} + \alpha_4 Gov_{it} + \alpha_5 PD_{it} + \alpha_6 LD_{it} + \alpha_7 ED_{it} + \varepsilon_{it}.$$

Although scholars commonly use *OLS* regression to measure and analyze brand performance, that technique cannot account for the heterogeneous variability across firms. Thus, the use of *OLS* regression may provide misleading estimates if the homogeneity assumption does not hold. This study additionally applies the quantile regression model to measure the marginal effects of the hypothetical relationships. Quantile regression is an increasingly important empirical tool that estimates the quantiles of a conditional distribution. The model analyzes various quantiles of the dataset instead of simply providing the mean response. Because quantile regression simultaneously estimates multiple rates of change, this method can depict a more complete picture of relationships between variables than *OLS* regression method does ([Koenker & Bassett, 1978](#)). [Wang, Yu, and Liu \(2013\)](#), [Yu \(2011\)](#), and [Yu, Wang, and Wu \(2015\)](#) apply quantile regressions to provide better analysis results for R&D spending, ICT adoption, and health expenditure.

4. Data and results

This study investigates the relationship among corporate social responsibility, brand equity, and firm performance in Taiwan's high-tech companies appearing in the Taiwan Stock Exchanges. This study gathers the data from the high-tech industry sector in the Taiwan Stock Exchange; specifically, from firms with R&D expenditures over 3% of their operating income between 2010 and 2013. The sample firms appear in the Taiwan Economic Journal database and consist of 1086 firm-year observations. This study collects all the necessary data for the variables in the models from the Taiwan Economic Journal database and the Environmental Protection Administration, Executive Yuan, Taiwan.

[Tables 1 and 2](#) present the descriptive statistics and correlation matrix for the model variables. The dataset reveals that the means of all variables, except the brand prestige driver, are positive. The mean of the prestige driver shows that cash flows usually attributable to the price advantage are negative for the sample firms. [Grunenwald and](#)

Table 1
Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Eco	1086	0.50	0.18	0.06	0.89
Soc	1086	0.49	0.12	0.14	0.74
Env	1086	0.01	0.00	0.01	0.01
Gov	1086	0.22	0.20	0.00	0.89
PD	1086	-4.26	0.79	-6.70	-2.66
LD	1086	0.79	0.16	0.14	0.98
ED	1086	0.58	0.20	0.50	2.11
ROA	1086	8.36	5.94	0.32	27.94
ROE	1086	12.45	8.90	0.20	46.45
Tobinq	1086	1.54	0.85	0.14	4.86

Eco = economic dimension, Soc = social dimension, Env = environmental dimension, Gov = governance dimension, PD = prestige driver, LD = loyalty driver, ED = extension driver, ROA = return on asset, ROE = Return on equity, Tobinq = Tobin's Q.

Vernon (1988) argue that the economic, technological, and competitive factors affect the firm's objectives and suggest certain factors for special consideration in the pricing decision. Therefore, high-tech marketers may consider lowering prices to strengthen their competitiveness. The results of correlation matrix indicate no significant linear correlation of variable combinations (no value greater than 0.8).

To explore in more detail the relationship among the key variables, this study performs the OLS regression analyses for the ROA. The OLS results in Table 3 show that the economic dimension of CSR and the prestige driver of brand equity have a positive correlation with firm performance. The findings are consistent with previous research (e.g. Ackerberg, 2001; Chaudhuri, 2002; Chu & Yang, 2009; Griffin & Mahon, 1997; Ho, Keh, & Ong, 2005; Mizik & Jacobson, 2003; Peters &

Mullen, 2009; Preston & O'Bannon, 1997; Verschoor, 1998). However, the results report a negative significant effect of the brand loyalty driver on firm performance. The OLS results (not in the appendix) of the other two proxy variables for firm performance, ROE, and Tobin's Q, also indicate similar findings. Villas-Boas (2004) argues that forward-looking firms like high-tech companies realize the future benefits of having a higher market share in the present; therefore, these companies compete more aggressively in prices. Hence, the brand-loyalty driver may negatively affect firm performance.

Descriptive statistics (Table 1) show that part of the sample data presents high volatility. Koenker and Bassett (1978) argue that the conventional OLS regression model, using conditional means of the variables, does not consider heterogeneity among sample firms. Therefore, this study additionally adopts conditional quantile regressions to re-examine the relationships. Quantile regression allows examining the whole distribution of sample firms rather than a single measure of the central tendency in the sample distribution. Consequently, this method allows evaluating the relative importance of firm performance's explanatory variables at different points of the distribution.

Table 3 presents the quantile regression results for the ROA. The findings show that the coefficients for the economic dimension of CSR and the prestige driver of brand equity are positive and significant for all the quantiles; these quantiles remain the same as in the OLS model. However, the extension driver of brand equity has a significant positive effect on firm performance in some quantiles, especially in the higher quantiles, which are different from the OLS results. The result implies that the extension driver is more effective for high-profit companies. Finally, the results of quantile regression for the other two proxy variables for firm performance, ROE and Tobin's Q, provide similar findings.

Table 2
Correlation matrix.

	Eco	Soc	Env	Gov	PD	LD	ED	ROA	ROE	Tobinq
Eco	1.00									
Soc	0.06*	1.00								
Env	0.06*	0.01***	1.00							
Gov	-0.02**	-0.00***	-0.00***	1.00						
PD	0.00***	0.00***	-0.08*	0.00***	1.00					
LD	-0.01***	-0.14	0.06*	0.00***	-0.07*	1.00				
ED	0.05**	0.01***	-0.00***	-0.00***	0.01***	-0.01***	1.00			
ROA	0.39	0.07*	-0.03**	-0.02**	0.13	-0.11	0.08*	1.00		
ROE	0.50	0.06*	-0.03**	-0.02**	0.11	-0.09*	0.07*	0.93	1.00	
Tobinq	0.19	0.02**	-0.07*	-0.01***	0.11	-0.06*	0.07*	0.58	0.50	1.00

Eco = Economic Dimension, Soc = Social Dimension, Env = Environmental Dimension, Gov = Governance Dimension, PD = Prestige Driver, LD = Loyalty Driver, ED = Extension Driver, ROA = Return on Asset, ROE = Return on Equity, TOBINQ = Tobin's Q.

*** p ≤ 0.01.
** p ≤ 0.05.
* p ≤ 0.1.

Table 3
Results of OLS and quantile regression analyses for ROA.

ROA	OLS		5%		25%		50%		75%		95%	
	Coef.	p	Coef.	p	Coef.	p	Coef.	p	Coef.	p	Coef.	p
_cons	11.63	0.00***	-3.25	0.01***	-4.22	0.47	6.35	0.32	27.99	0.01***	58.23	0.00***
Eco	12.80	0.00***	9.79	0.00***	10.29	0.00***	11.41	0.00***	14.30	0.00***	15.50	0.00***
Soc	2.25	0.12	1.20	0.23	3.85	0.00***	4.68	0.00***	1.71	0.50	-4.92	0.27
Env	-746.77	0.12	212.88	0.21	619.68	0.52	-377.69	0.72	-2827.04	0.09*	-5861.91	0.00***
Gov	0.31	0.72	0.87	0.09*	0.65	0.39	0.92	0.27	0.84	0.54	-0.13	0.96
PD	0.88	0.00***	0.28	0.02**	0.53	0.00***	0.78	0.00***	1.20	0.00***	1.69	0.01***
LD	-3.32	0.00***	-0.93	0.10*	-0.66	0.50	-2.86	0.01***	-5.15	0.00***	-10.87	0.00***
ED	-0.00	0.88	0.32	0.54	0.68	0.40	0.61	0.46	2.54	0.03**	11.39	0.00***
Number of obs.	1086		1086		1086		1086		1086		1086	
Pseudo R ²			0.13		0.12		0.11		0.09		0.15	

Eco = economic dimension; Soc = social dimension; Env = Environmental Dimension; Gov = governance dimension; PD = prestige driver; LD = Loyalty Driver; ED = extension driver; ROA = return on asset; ROE = return on equity; Tobinq = Tobin's Q.

*** p ≤ .01.
** p ≤ .05.
* p ≤ .1.

Table 4
Results of the SEM.

		Estimate	S.E	C.R.	P	Label
BV	← CSR	105.61	1996.33	0.05	.96	par_8
PERF	← CSR	448,144.58	173,531.87	2.58	.01***	par_9
PERF	← BV	13.68	4.92	2.78	.01***	par_14
PD	← BV	1.00				
LD	← BV	-0.16	0.06	-2.82	.01***	par_1
ED	← BV	0.03	0.05	0.62	.53	par_2
Eco	← CSR	9203.67	3421.43	2.69	.01***	par_3
Soc	← CSR	727.94	361.74	2.01	.04**	par_4
Env	← CSR	1.00				
ROE	← PERF	1.00				
ROA	← PERF	0.78	0.02	45.15	.00***	par_5
Gov	← CSR	-307.46	437.20	-0.70	.48	par_6
Tobinq	← PERF	0.10	0.02	6.46	.00***	par_7

*** p ≤ .01, ** p ≤ .5, * p ≤ .1.

ECO = economic dimension, soc = social dimension, ENV = environmental dimension, GOV = governance dimension, PD = prestige driver, LD = loyalty driver, ED = extension driver, ROA = return on asset, ROE = return on equity, tobinq = Tobin's Q.

Theoretical underpinnings from previous research suggest a causality framework is the best method to examine the variables. This study therefore adopts structural equation modeling (SEM) to explore the interrelationships among corporate social responsibility, brand equity, and firm performance. SEM is an application of the multi-regression model scholars use to analyze sequential variables and to compare how prior variables affect later variables. In this way, SEM is different from other linear equation models that examine mediated pathways.

Table 4 shows the results for the SEM analysis. The findings report that the path coefficients for the links of the CSR and brand equity to firm performance are positively significant at the 0.01 level. However, no significant relationship exists between CSR and brand equity. The result implies that brand equity in high-tech companies does not play a mediating role in the relationship between the CSR and firm performance. The findings also indicate that the economic dimension and the social dimension have significant positive effects on corporate social responsibility. However, the loyalty driver has a negative significant effect on brand equity, which is similar to the results of OLS and quantile regression analyses for firm performance.

Table 5 displays the indices to assess the goodness of fit of the model for the SEM analysis. The indices indicate that the model achieves the goodness of fit to the data.

5. Discussion and conclusion

This research presents a comparison of quantile and OLS regression for the relationships among corporate social responsibility, brand equity, and firm performance in Taiwan's high-tech sector. The empirical results reveal that data analysis using quantile regression allows a more in-depth examination than ordinary regression. The findings imply that high-tech firms in Taiwan should continuously engage in CSR and brand management to maximize their firm values. The quantile analysis in this study provides significant insight into CSR and brand management.

Previous research argues that scholars consider CSR and brand equity as intangible corporate assets that create wealth for shareholders. However, literature lacks empirical evidence on the nexus of CSR and brand performance in the high-tech sector. This study therefore fills that gap. These findings suggest that CSR and brand equity, in general,

Table 5
Goodness of fit statistics for SEM.

Fit Index	χ ² ratio	GFI	AGFI	RMSEA	CFI
Fit Value	2.27	0.99	0.98	0.03	0.99
Results	Ideal	Ideal	Ideal	Ideal	Ideal

can enhance firm value. Consequently, CSR and branding could become one of the critical parameters for differentiation and success in the increasingly competitive high-tech industries.

Further, this study is one of a few employing the SEM analysis for CSR and brand performance. The findings show that CSR and brand equity positively affect firm performance. This implication can help high-tech firms in managing their CSR and brand equity to maximize their firms' value.

The major limitation of this study is that, although the Hirose valuation model overcomes the lack of objectivity and arbitrariness in brand valuation, the model has difficulties in evaluating firms with interdisciplinary programs like high-tech conglomerates. The limitation provides opportunities for further research on CSR and brand equity's value relevance in contemporary high-tech organizations.

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