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Cash shortfalls and capital structure adjustments: Evidence from Japanese manufacturing firms

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Abstract

This study empirically examines the financing behavior of Japanese firms using the analytical framework of the funding-horizon theory. Using an unbalanced panel of Japanese manufacturing firms for 2000–2024, we estimate a multinomial logit model to identify the determinants of external financing decisions under cash shortfalls. Three main findings emerge. First, under Immediate Depletion, the probability of debt issuance increases substantially, whereas the effects on dual and pure equity issuance remain limited, indicating that Japanese firms strongly prioritize bank borrowing and treat equity issuance as a last resort. Notably, baseline predicted probabilities indicate that external financing events are relatively rare, especially dual and pure equity issuance, which occur in only a small fraction of firm-years. Second, the term spread significantly suppresses debt issuance, while its effect on equity issuance is limited, in contrast to U.S.-based evidence where such effects are often insignificant. Third, higher leverage increases the probability of both debt and equity issuance, suggesting a complementary rather than substitutive financing pattern. These findings are robust to alternative definitions of cash depletion, financing thresholds, and model specifications. Overall, the results highlight the central role of Japan's bank-centered financial system and firms' strong aversion to equity dilution in shaping capital structure adjustments.

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1. Introduction

This study empirically examined the financing behavior of Japanese firms by applying the analytical framework of the funding-horizon theory proposed by Huang and Ritter (2021). Specifically, we aimed to re-examine the evidence obtained for U.S. firms in the context of Japan's institutional environment and clarify how the choice of financing instruments under a cash shortfall differs between the two countries.

There are two reasons for focusing on Japan: First, Japan's financial system remains bank-centered, and firms facing cash shortfalls tend to rely on bank borrowing while treating equity issuance as a "last resort" (Hoshi et al. 1991; Peek and Rosengren 2005). This contrasts with the market-based financial system in the U.S. Second, Japanese firms generally maintain high cash holdings during normal times, which reduces the frequency of external financing (Bremer and Pettway 2002). These institutional characteristics make Japan a valuable case study for testing the universality of the capital structure theory.

Theories of capital structure have long been developed around two major frameworks: trade-off theory and pecking order theory. The former posits that an optimal capital structure exists based on a balance between the tax shield of debt and the costs of financial distress (Modigliani and Miller 1958; Kraus and Litzenberger 1973). The latter emphasizes that under asymmetric information, firms prefer financing in the order of internal funds, debt, and equity (Myers 1984; Myers and Majluf 1984). Empirical studies often cross the boundary between these two theories, and which framework better explains firm behavior depends heavily on country-specific and institutional contexts.

Huang and Ritter (2021) proposed funding-horizon theory, which argues that corporate financing decisions are primarily driven by the necessity of funding, particularly cash shortfalls, and that the persistence of these funding needs plays a key role in determining whether firms choose debt or equity financing. They classified U.S. listed firms' cash shortfall situations into Immediate, Medium, and Near Depletion and analyzed financing decisions by estimating a multinomial logit model using robust standard errors corrected for heteroskedasticity and clustering at the firm level. Their results showed that, in Immediate Depletion situations, the probability of debt issuance decreases, while the probability of equity issuance increases. Moreover, short-term shortfalls are typically financed by debt, whereas long-term shortfalls are more likely to be financed by equity. These findings support the implications of dynamic trade-off theory, which suggests that the marginal cost of debt rises under financial constraints, increasing the relative attractiveness of equity.

However, few empirical analyses have been conducted for Japanese firms. This study reproduced the estimation approach of Huang and Ritter (2021) using panel data on Japanese manufacturing firms from 2000–2024. By examining financing behavior in Immediate Depletion as well as the effects of term spread and leverage, we aimed to identify the institutional determinants underlying capital structure adjustments in Japan.

The remainder of this paper is organized as follows: Section 2 reviews the related literature and presents the framework for this study. Section 3 describes the data and methodology used in the study. Section 4 presents the empirical results. Section 5 concludes with implications and directions for future research.

2. Related Literature and Research Framework

2.1 Related Literature

Theoretical studies on capital structure have been developed primarily around two major frameworks: the trade-off theory and the pecking order theory. The trade-off theory emphasizes that an optimal capital structure exists as a balance between the tax benefits of debt and the costs of financial distress (Kraus and Litzenberger 1973), while the pecking order theory highlights the financing hierarchy of "internal funds → debt → equity" under asymmetric information (Myers and Majluf 1984). The empirical evidence varies across countries. In the U.S., Fama and French (2002), Frank and Goyal (2003, 2009), and Lemmon, Roberts, and Zender (2008) provided evidence of the determinants of financing decisions and the persistence of leverage. Rajan and Zingales (1995), using data from G7 countries, demonstrated the importance of institutional environments in shaping capital structures. Shyam-Sunder and Myers (1999) provided a direct test of the pecking order hypothesis in U.S. firms, showing deviations between theoretical predictions and actual firm behavior.

Huang and Ritter (2021) classified U.S. firms' cash shortfalls into Immediate, Medium, and Near Depletion, and estimated financing behavior using a multinomial logit model. Their findings support the implications of the dynamic trade-off theory: short-term shortfalls are mainly financed by debt, whereas long-term shortfalls are financed by equity.

In contrast, studies on Japanese firms emphasize distinctive institutional features. Hoshi, Kashyap, and Scharfstein (1991) compared the investment behavior of keiretsu[1] and non-keiretsu firms and showed that Tobin's Q is the primary determinant of investment for keiretsu firms, whereas cash flow is more important for non-keiretsu firms. This indicates that keiretsu firms are less financially constrained because of main bank and group financing, whereas non-keiretsu firms rely heavily on internal funds. Aoki and Dore (1994) provided a theoretical framework for institutional complementarity, arguing that Japan's corporate finance is grounded in a bank-centered system. Through a U.S.–Japan comparison, Anderson and Makhija (1999) demonstrated that Japanese firms can obtain additional bank loans, even at high leverage levels, implying that leverage is less restrictive in Japan. Peek and Rosengren (1997, 2000, 2005) and Bremer and Pettway (2002) further examined how banking crises and dependence shape corporate financing in Japan.

Research on corporate cash holdings is closely related to capital structure analysis. Opler et al. (1999) identified growth opportunities, cash flow uncertainty, and access to external financing as key determinants of cash ratios in U.S. firms. The cross-country evidence indicates that Japanese firms tend to have higher cash levels. Pinkowitz and Williamson (2001) argued that banks' market power contributes to high cash balances in Japan. Subsequent studies revealed that, while governance improvements have led the valuation of cash in Japanese firms to converge toward U.S. levels, Japanese firms still hold relatively high levels of cash once

[1] Keiretsu refers to a network of interlinked Japanese companies, typically centered around a main bank, that maintain close business relationships and share cross-shareholdings. These corporate groups coordinate their activities through long-term partnerships, mutual trust, and financial ties. The keiretsu system facilitates stable business operations by providing member firms with preferential access to financing, technology, and markets, while also promoting collaboration and risk-sharing within the group. This structure contrasts with more market-oriented corporate systems and plays a significant role in shaping corporate governance and financing decisions in Japan.

firm characteristics are controlled for (Kato et al. 2017). At the macroeconomic level, the IMF (2014, 2023) documented that Japanese non-financial firms have accumulated savings in the form of cash and deposits since the 2000s rather than through investment or dividend payouts, further supporting the view of persistently high cash holdings in Japan.

2.2 Research Framework

This study applied Huang and Ritter's (2021) analytical framework to Japanese firm-level data to examine how institutional differences shape financing behavior. In particular, we focused on Japan-specific factors, such as the bank-centered financial system, main bank relationships, and strong aversion to equity dilution, and how these factors influence firms' capital structure adjustments.

The expected contrast can be summarized as follows: For U.S. firms, short-term cash shortfalls tend to be financed by debt, whereas long-term shortfalls are more likely to be financed by equity. In contrast, Japanese firms rely heavily on bank borrowing during normal times, while equity issuance is generally avoided. However, when facing severe cash shortfalls, Japanese firms may resort to a combination of debt and equity financing, with equity serving as a "last resort" and playing a complementary role.

By empirically documenting these financing behaviors, this study reassessed the explanatory power of trade-off and pecking order theories within Japan's institutional environment.

3. Data, Summary Statistics, and Univariate Sorts

3.1 Data

This study uses financial and stock price data for Japanese manufacturing firms from 2000 to 2024. We focus on manufacturing firms because the industry provides relatively homogeneous financial structures and is commonly used in the capital structure literature. While the analysis focuses on manufacturing firms to maintain sample comparability, the financing mechanisms examined in this study are likely to be relevant for other industries as well.

The data were obtained from the Nikkei NEEDS Financial Quest 2.0 database, and the key variables were constructed based on firms' cash flow statements, balance sheets, and income statements. Financial Quest 2.0 provides both consolidated and unconsolidated statements. In this study, consolidated financial data are used whenever available, and unconsolidated data are employed only when consolidated statements are missing. This consolidation-priority setting is the default configuration of the database and ensures consistency across firms with different reporting scopes. To ensure comparability in fiscal periods and maintain consistency in the time-series analysis, the sample is restricted to firms whose fiscal years end in March. The final sample is an unbalanced panel consisting of 21,461 firm-year observations for 1,004 firms. The observation period for each firm ranges from 3 to 25 years.

The definition of external financing follows Huang and Ritter (2021), with different thresholds for debt and equity issuance. Specifically, (i) debt issuance occurs when net debt issuance amounts to at least 5% of beginning-of-period book assets, and (ii) equity issuance occurs when net equity issuance amounts to at least 3% of beginning-of-period market equity.

The yields of Japanese government bonds with maturities of 1, 10, and 15 years were obtained from daily data published by the Japanese Ministry of Finance. The term spread is defined as the difference between the 15-year and the 1-year government bond yields (lagged one period).

The annual averages of these daily observations were used in the empirical analysis. The consumer price index (CPI) used to deflate nominal variables was obtained from the Statistics Bureau of Japan.

3.2 Summary Statistics and Univariate Sorts

Table I presents the sample distribution according to financing type. Firm years without external financing accounted for approximately 88.7% of the total, while pure debt issuance accounted for 8.5%, equity issuance accounted for 2.4%, and combined debt–equity issuance accounted for 0.3%. This finding indicates that firms undertaking external financing are a minority, suggesting that Japanese firms exhibit relatively low dependence on external funds.

Panel B reports the distribution of financing activities by cash depletion status (≤0 or >0). $Cash\ ex\ post_{i,t}$ represents the cash balance in the absence of external financing and is defined as $Cash_{i,t-1} + NCF_{i,t}$[2]. Here, $Cash_{i,t-1}$ denotes cash holdings in period *t*–1 (cash and deposits plus short-term securities), and $NCF_{i,t}$ is net cash flows, calculated as operating cash flows minus increases in non-cash working capital and dividends. Using the accounting identity "uses of funds = sources of funds," $Cash\ ex\ post_{i,t}$ can also be expressed as $Cash_{i,t} - \Delta D_{i,t} - \Delta E_{i,t}$, where $\Delta D_{i,t}$ is net debt issuance and $\Delta E_{i,t}$ is net equity issuance. Thus, $Cash\ ex\ post_{i,t} \leq 0$ implies that without external financing, the firm's cash balance would be zero or negative.

Table I. Sample distribution

A. Distribution by financing or not financing type

	N	*%*
All firm-years	21,461	100.0%
No external financing	19,041	88.7%
Pure debt issuance	1,831	8.5%
Dual issuance (issuance of both debt and equity)	67	0.3%
Pure equity issuance	522	2.4%

B. Distribution by cash depletion and financing or not

	All firm-year		No issuance		Net debt or equity issuance	
	N	*%*	*N*	*%*	*N*	*%*
$Cash\ ex\ post_{i,t} \leqq 0$	728	3.4%	111	0.6%	617	25.5%
$Cash\ ex\ post_{i,t} > 0$	20,733	96.6%	18,930	99.4%	1,803	74.5%
$Cash\ ex\ ante_{i,t} \leqq 0$	981	4.7%	730	3.8%	251	10.4%
$Cash\ ex\ ante_{i,t} > 0$	20,480	95.3%	18,311	96.2%	2,036	89.6%

[2] Detailed definitions of the variables are provided in Appendix A.

In contrast, $Cash\ ex\ ante_{i,t}$ is defined as $Cash_{i,t-1} + NCF_{i,t-1}$, where $NCF_{i,t-1}$ is used as a proxy for $NCF_{i,t}$. This definition avoids potential endogeneity bias between $NCF_{i,t}$ and external financing (net debt or equity issuance) in period t. Among firm-years without external financing, only 0.6% had $Cash\ ex\ post_{i,t} \leq 0$, while 3.8% had $Cash\ ex\ ante_{i,t} \leq 0$. Moreover, among firm-years with external financing, the proportions with $Cash\ ex\ post_{i,t}$ and $Cash\ ex\ ante_{i,t} \leq 0$ were substantially higher, indicating that firms undertaking financing face a greater risk of cash shortfalls in the absence of external funds.

Table II reports descriptive statistics for the main variables. Equity issuers (Dual and Pure Equity) exhibited higher market-to-book ratios and R&D intensities but were smaller in size and younger compared to debt issuers. In contrast, debt issuers were larger and older. Post-issuance cumulative returns were lower for equity issuers, indicating that these firms are more growth-oriented but provide relatively weaker shareholder payouts.

Table II. Means and medians of variables

Variables		No issuance	Pure debt issuance	Dual issuance	Pure equity issuance
$MTB_{i,t-1}$	Mean	1.02	1.10	1.53	1.51
	Median	0.92	0.98	1.20	1.09
$Return_{i,t-1}$	Mean	0.06	0.08	0.27	0.21
	Median	0.00	0.01	0.04	0.09
$Return_{i,t+1,t+3}$	Mean	0.19	0.20	-0.04	0.14
	Median	0.06	0.06	-0.12	-0.05
$Term\ Spread_{t-1}$	Mean	0.01	0.01	0.01	0.01
	Median	0.01	0.01	0.01	0.01
$ln(Sales)_{i,t-1}$	Mean	10.88	10.95	9.87	10.22
	Median	10.67	10.80	10.04	10.31
$ln(Age)_{i,t}$	Mean	4.13	4.10	3.85	3.89
	Median	4.19	4.18	4.03	4.06
$Leverage_{i,t-1}$	Mean	0.46	0.50	0.56	0.58
	Median	0.46	0.51	0.59	0.60
$R\&D_{i,t-1}$	Mean	0.02	0.02	0.03	0.04
	Median	0.02	0.02	0.02	0.02
$Ind_sig_{i,t-1}$	Mean	0.03	0.03	0.03	0.03
	Median	0.03	0.03	0.03	0.03
$Dividend\ Payer_{i,t-1}$	Mean	0.90	0.90	0.67	0.64

3.3 Empirical Methodology

To analyze the determinants of financing behavior, we estimate a multinomial logit model using robust standard errors corrected for heteroskedasticity and clustered at the firm level. The

dependent variable is the financing type, with the baseline category defined as "no external financing." Three outcome categories are considered: (i) pure debt issuance, (ii) pure equity issuance, and (iii) debt–equity dual issuance.

The primary explanatory variables are two dummy variables capturing cash shortfalls. First, Immediate Depletion equals one if, in the absence of external financing, the end-of-period cash balance is non-positive; that is, $Cash_{i,t-1} + NCF_{i,t} \leq 0$. Second, Near Depletion equals one if $Cash_{i,t-1} + NCF_{i,t} > 0$ but $Cash_{i,t-1} + NCF_{i,t} + NCF_{i,t+1} \leq 0$. The former represents severe cash shortfalls, whereas the latter captures situations in which firms are at risk of falling into a cash shortfall[3].

In addition, leverage (the debt-to-assets ratio), representing the cumulative capital structure, and the term spread, defined as the difference between the 15-year and 1-year Japanese government bond yields, representing macro-financial conditions, are included as key explanatory variables. Control variables include firm size, growth, profitability, as well as industry fixed effects. Following Huang and Ritter (2021), we include macro-financial variables such as the term spread to capture aggregate financing conditions. It should be noted that the term spread varies only over time and is therefore collinear with a full set of year fixed effects. For this reason, the baseline specification does not include year fixed effects, allowing the coefficient on the term spread to be properly identified. In the absence of full year fixed effects, the term spread serves as a time-varying macro-financial control, and the robustness of the main results to alternative time controls, including specifications with year fixed effects, is confirmed in Appendix B.

To facilitate interpretation, we report marginal effects evaluated at the sample means. Following Huang and Ritter (2021), the main economic effects are presented as changes associated with a two-standard-deviation change (from −1σ to +1σ) in each explanatory variable. In addition, for the dummy variables capturing cash shortfalls, we also report the change in predicted probabilities when the indicator shifts from 0 to 1, because this provides a more intuitive measure of their economic magnitude.

4. Regression Results

4.1 Baseline Estimation

Table III reports the results of the multinomial logit estimation of external financing decisions in period *t*, distinguishing between debt and equity issuance. The baseline category was "no external financing". It should be noted that the baseline specification excludes full year fixed effects because the term spread varies only over time and would otherwise be collinear with year fixed effects.

For Japanese firms (2000–2024), the marginal effect of *Immediate Depletion* was +10.00 percentage points for debt issuance and +1.82 percentage points for equity issuance, much smaller than the corresponding figures reported by Huang and Ritter (2021) for U.S. firms (Debt ≈ +63.5 percentage points, Equity ≈ +18.6 percentage points). The effects of *Near Depletion* were also weaker in Japan, suggesting that Japanese firms tend to rely more on

[3] In Huang and Ritter (2021), in addition to *Immediate Depletion* and *Near Depletion*, another dummy variable was included as an explanatory variable, which equals one if $Cash_{i,t-1} + NCF_{i,t} > 0$, $Cash_{i,t-1} + NCF_{i,t} + NCF_{i,t+1} > 0$, and $Cash_{i,t-1} + NCF_{i,t} + NCF_{i,t+1} + NCF_{i,t+2} \leq 0$, and zero otherwise. However, in our dataset, no firm-year observations fell into this category; therefore, this variable was not included in the estimation.

borrowing, particularly from banks, rather than on equity issuance during periods of cash shortfall. This difference likely reflects institutional and behavioral factors such as high precautionary cash holdings and an aversion to equity dilution in Japan.

Table III. Cash depletion and multinomial logit for financing decisions

A. Economic effects based on a two-standard-deviation change

	Pure debt issuance		Dual issuance		Pure equity issuance		Debt issu.	Equity issu.
	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	Econ. effect.
Regression N = 17,422, pseudo R^2 = 0.198								
Immediate Depletion	9.63%	30.64	0.37%	14.20	1.45%	9.05	10.00%	1.82%
Near Depletion	3.66%	15.85	0.19%	5.92	0.70%	5.54	3.85%	0.89%
$MTB_{i,t-1}$	0.99%	2.46	0.01%	0.68	0.83%	4.17	0.99%	0.84%
$Return_{i,t-1}$	-0.64%	-1.31	0.09%	2.41	0.63%	5.12	-0.54%	0.72%
$Return_{i,t+1,t+3}$	1.00%	2.57	-0.28%	-1.98	-0.58%	-1.54	0.71%	-0.87%
$Term\ Spread_{t-1}$	-2.62%	-6.64	-0.04%	-0.92	0.16%	0.06	-2.66%	0.12%
$ln(Sales)_{i,t-1}$	-0.76%	-1.87	-0.25%	-2.82	-0.94%	-3.59	-1.01%	-1.19%
$ln(Age)_{i,t}$	-1.12%	-2.85	-0.13%	-2.83	-0.59%	-3.01	-1.24%	-0.71%
$Leverage_{i,t-1}$	1.75%	5.19	0.29%	3.30	3.25%	9.49	2.04%	3.54%
$R\&D_{i,t-1}$	0.07%	0.30	0.02%	0.48	0.57%	3.06	0.09%	0.58%
$Ind_sig_{i,t-1}$	0.81%	1.26	-0.03%	0.02	1.18%	2.76	0.78%	1.15%
$Dividend\ Payer_{i,t-1}$	1.45%	2.86	-0.04%	-0.28	-0.65%	-2.76	1.41%	-0.69%

B. Economic effects based on a dummy variable change from 0 to 1

	Pure debt issuance		Dual issuance		Pure equity issuance		Debt issu.	Equity issu.
	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	Econ. effect
Immediate Depletion	70.60%	34.60	3.33%	4.24	1.58%	1.89	73.93%	4.91%
Near Depletion	18.71%	9.80	1.20%	2.38	2.42%	2.99	19.91%	3.62%
$Dividend\ Payer_{i,t-1}$	2.14%	3.44	-0.07%	-0.50	-1.18%	-2.69	2.07%	-1.25%

As *Immediate Depletion* and *Near Depletion* are dummy variables, reporting effects based on a change from 0 to 1 is more intuitive than reporting effects based on a two-standard deviation change. We present both but emphasize the former. The 0→1 changes imply that *Immediate Depletion* increases the probability of debt issuance by +73.93 percentage points and equity issuance by +4.91 percentage points. For *Near Depletion*, the effects are +19.91 percentage points for debt issuance and +3.62 percentage points for equity issuance. Thus, while Japanese firms, like their U.S. counterparts, experience a sharp rise in debt issuance during cash

shortfalls, the increase in equity issuance is much smaller. This pattern reflects Japan's bank-dependent financial structure. Prior studies also emphasized the continuing dominance of banks in Japan's financial system (Bremer and Pettway 2002; Peek and Rosengren 2005), which reinforces the tendency of firms to prioritize borrowing over equity issuance.

Building on these findings, we examined how the main explanatory variables differ in their effects between Japan and the U.S. We focused on the role of macro financial conditions captured by $Term\ Spread_{t-1}$[4], and cumulative capital structure as measured by $Leverage_{i,t-1}$.

First, we consider the effects of $Term\ Spread_{t-1}$. In Huang and Ritter's (2021) U.S. sample, $Term\ Spread_{t-1}$ was not statistically significant and did not emerge as a major determinant of financing behavior. In the Japanese estimates, $Term\ Spread_{t-1}$ has a statistically significant negative effect on debt issuance, while its effect on equity issuance is not statistically significant. This suggests that the term spread influences financing decisions primarily through borrowing costs. In particular, an increase in long-term interest rates is likely to raise borrowing costs faced by firms, which discourages debt issuance.

However, the economic magnitude of this effect is relatively modest compared to the impact of cash shortfall variables. Given Japan's bank-centered financial system, where firms rely heavily on bank loans, higher borrowing costs directly constrain debt financing. By contrast, equity issuance does not respond significantly to changes in the term spread, indicating that firms do not actively substitute toward equity financing even when borrowing becomes more expensive.

Next, we consider the effects of leverage ($Leverage_{i,t-1}$). In the U.S., highly leveraged firms are less likely to issue debt and more likely to issue equity. By contrast, the Japanese estimates show that higher leverage increases the likelihood of both debt issuance and equity issuance. While statistically significant, the magnitude of the leverage effect is also relatively small compared to that of cash shortfall variables. This suggests that, in Japan, leverage reflects stronger financing needs rather than binding borrowing constraints. In a bank-centered financial system, firms with high leverage continue to access bank loans, while simultaneously relying on equity issuance when financing pressures intensify. This results in a complementary relationship between debt and equity financing, rather than the substitution pattern observed in the U.S.

To facilitate interpretation of the marginal effects, we report the baseline predicted probabilities for each financing category. At the sample means, the predicted probabilities are approximately 89.0% for no external financing, 8.3% for pure debt issuance, 0.3% for dual issuance, and 2.4% for pure equity issuance. These baseline probabilities indicate that external financing events are relatively rare, particularly for equity issuance, which helps contextualize the magnitude of the estimated marginal effects.

4.2 Robustness Checks

To verify the stability of the baseline results, we conduct several additional robustness checks, reported in Appendix B as follows: (i) subsample analyses based on internal cash flow, (ii) an alternative definition of the term spread, (iii) additional robustness exercises summarized in Table B3, and (iv) a binary logit specification that distinguishes between any external financing

[4] In Huang and Ritter (2021), $Term\ Spread_{t-1}$ was defined as the yield on 10-year government bonds minus the yield on 1-year government bonds. In this study, however, to avoid the influence of the yield curve control policy, $Term\ Spread_{t-1}$ was constructed as the yield on 15-year Japanese government bonds minus the yield on 1-year Japanese government bonds.

and no external financing.

First, Table B1 presents subsample analyses based on the sign of internal cash flow. The results confirm that firms facing cash shortfalls consistently rely on debt financing regardless of their internal liquidity conditions.

Second, Table B2 reports results using an alternative definition of the term spread based on the 10-year minus 1-year government bond yield. The results are consistent with the baseline findings, confirming that the effect of the term spread is not driven by the specific maturity choice.

Third, Table B3 provides a compact summary of additional robustness checks, including alternative definitions of cash depletion using ex-ante measures, relaxed thresholds for defining financing activities, and alternative specifications of time controls. Across these specifications, the results remain qualitatively consistent with the baseline findings. In particular, Immediate Depletion consistently increases the probability of pure debt issuance, while its effects on dual issuance and pure equity issuance remain relatively small. A similar but weaker pattern is observed for Near Depletion.

Because the term spread varies only over time, our baseline specification excludes year fixed effects to identify the term-spread coefficient. In the robustness checks, the specification with year fixed effects excluding the term spread confirms that the cash-shortfall results are not driven by the treatment of time controls. The specification including both year fixed effects and the term spread is reported only as an additional sensitivity check for the cash-shortfall variables, and we do not rely on that specification to interpret the term-spread coefficient.

Finally, Table B4 reports results from a binary logit specification that distinguishes between any external financing and no external financing. Immediate Depletion is omitted due to perfect prediction, indicating that firms facing severe cash shortfalls almost always engage in external financing, while Near Depletion remains positive and statistically significant.

Overall, these results provide strong evidence that the main findings are robust to alternative definitions, sample splits, and model specifications.

5. Conclusion

This study empirically examined the financing behavior of Japanese firms by applying the analytical framework of Huang and Ritter (2021). Using a multinomial logit model with data on Japanese manufacturing firms for 2000–2024, several key findings emerged. First, under Immediate Depletion, the probability of debt issuance increased substantially, while the increase in equity issuance was limited, suggesting that Japanese firms rely less on equity than U.S. firms. Second, the effects of term spread and leverage differed from those observed in the U.S., although their economic magnitudes were relatively modest. In particular, the term spread has a statistically significant negative effect on debt issuance, while its effect on equity issuance is not statistically significant. Similarly, higher leverage is associated with increases in both debt and equity issuance, although the magnitude of this effect is limited. Overall, these results suggest that, while macro-financial variables play a role, financing decisions in Japan are driven primarily by firm-level liquidity conditions. The findings also indicate that Japan's bank-centered financial system leads firms to rely more heavily on debt financing, even under financial stress, with equity issuance continuing to play a secondary role.

The academic implications of this study are summarized as follows: First, the explanatory power of the trade-off theory appears limited in Japan, while the predictions of the pecking order theory are more consistent with the observed behavior. Second, the financial system's institutional characteristics cannot be ignored when understanding financing behavior. In particular, a bank-centered financial system and strong aversion to equity dilution are key

determinants of capital structure adjustments in Japan.

Future research should explicitly incorporate the presence and strength of main bank relationships to more directly measure the impact of bank dependence on firm behavior. Moreover, extending the analysis to include cross-country comparisons is important for systematically assessing how institutional factors shape the dynamic adjustment of capital structure.

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Appendix A. Variables

Variable name	Detailed definition
Immediate Depletion	Dummy variable equal to 1 if the hypothetical cash balance at the end of period t in the absence of external financing is non-positive (≤ 0), and 0 otherwise.
Near Depletion	Dummy variable equal to 1 if the predicted cash balance prior to financing needs is non-positive while the hypothetical end-of-period cash balance without external financing remains positive, and 0 otherwise.
$\Delta D_{i,t}$	Net debt issuance. Defined as the sum of the change in short-term borrowings and bonds, plus the change in long-term borrowings, bonds, and convertible bonds.
$\Delta E_{i,t}$	Net equity issuance. Defined as the sum of proceeds from new share issuance and proceeds from the sale of treasury stock.
$ICF_{i,t}$	Internal cash flow. Measured as cash flow from operating activities reported in the statement of cash flows.
$Investements_{i,t}$	Investment cash flow. Measured as cash flow from investing activities (net of asset purchases and sales).
$Cash\ Dividends_{i,t}$	Cash dividends paid to shareholders.
$Cash_{i,t}$	Cash holdings. Defined as cash and deposits plus short-term marketable securities.
$NCF_{i,t}$	Net cash flow. Defined as $\Delta Cash_{i,t} - \Delta D_{i,t} - \Delta E_{i,t}$
$Cash_{ex\ post}$	Hypothetical cash balance at the end of period t in the absence of external financing. Defined as $Cash_{i,t-1} + NCF_{i,t}$
$Cash_{ex\ ante}$	Predicted cash balance prior to financing needs. Defined as $Cash_{i,t-1} + NCF_{i,t-1}$
$MTB_{i,t}$	Market-to-book ratio. Defined as market value of equity divided by total assets. The market value of equity is measured as the annual average of monthly market capitalization from the Nikkei NEEDS Financial Quest 2.0 database.
$Return_{i,t-1}$	Stock return in period *t*–1.
$Return_{i,t+1,t+3}$	Cumulative stock return from period *t+1* to *t+3*.
$Term\ Spread_{t-1}$	Difference between the 15-year Japanese government bond yield and the 1-year government bond yield, lagged one period.
$ln(Sales)_{i,t}$	Natural logarithm of real sales in period *t*, deflated by the consumer price index.
$ln(Age)_{i,t}$	Natural logarithm of firm age. Defined as the difference between fiscal year-end *t* and the actual founding year of the firm.

$R\&D_{i,t}$	R&D intensity. Defined as R&D expenditures in period *t* divided by lagged total assets.
$Ind_sig_{i,t}$	Industry-level volatility measure. Calculated as follows: (i) compute the standard deviation of firm cash flows over the past 10 years, where cash flow is defined as operating income plus depreciation minus interest payments and corporate taxes, scaled by beginning-of-period total assets; (ii) classify firms according to the middle-industry level of the Nikkei industry classification; (iii) take the industry average of the standard deviations.
$Dividend\ Payer_{i,t}$	Dummy variable equal to 1 if firm *i* paid dividends in period *t*, and 0 otherwise.

Appendix B. Robustness Check

Appendix B reports the key robustness checks discussed in the text. Table B1 presents subsample results based on the sign of internal cash flow (ICF), Table B2 reports results using an alternative definition of the term spread (10-year minus 1-year government bond yield), Table B3 provides a compact summary of the main robustness exercises, and Table B4 reports results from a binary logit specification that distinguishes between any external financing and no external financing. These robustness checks collectively confirm that the main findings are not sensitive to alternative definitions, sample splits, or model specifications.

Table B1 Robustness check: internal cash flow split

A. Economic effects based on a two-standard-deviation change

	Pure debt issuance		Dual issuance		Pure equity issuance		Debt issu.	Equity issu.
	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	Econ. effect.
Regression N = 17,422, pseudo R^2 = 0.218								
Immediate Depletion× $Loss_t$	6.01%	16.20	0.23%	11.16	1.02%	5.49	6.24%	1.25%
Immediate Depletion× $(1 - Loss_t)$	7.48%	27.24	0.27%	11.77	1.12%	7.84	7.75%	1.39%
Near Depletion	3.65%	15.83	0.19%	5.91	0.70%	5.53	3.84%	0.88%
$MTB_{i,t-1}$	0.98%	2.46	0.00%	0.63	0.83%	4.18	0.98%	0.83%
$Return_{i,t-1}$	-0.63%	-1.30	0.09%	2.30	0.63%	5.12	-0.54%	0.72%
$Return_{i,t+1,t+3}$	0.99%	2.51	-0.28%	-1.99	-0.58%	-1.54	0.70%	-0.87%
$Term\ Spread_{t-1}$	-2.63%	-6.63	-0.04%	-0.92	0.16%	0.06	-2.67%	0.12%
$ln(Sales)_{i,t-1}$	-0.68%	-1.72	-0.23%	-2.62	-0.94%	-3.58	-0.92%	-1.17%
$ln(Age)_{i,t}$	-1.14%	-2.91	-0.13%	-2.97	-0.59%	-3.04	-1.27%	-0.72%
$Leverage_{i,t-1}$	1.76%	5.18	0.29%	3.32	3.25%	9.50	2.05%	3.54%
$R\&D_{i,t-1}$	0.07%	0.29	0.02%	0.51	0.57%	3.07	0.08%	0.58%
$Ind_sig_{i,t-1}$	0.85%	1.32	-0.03%	0.07	1.18%	2.76	0.83%	1.16%
$Dividend\ Payer_{i,t-1}$	1.51%	2.94	-0.03%	-0.17	-0.65%	-2.76	1.48%	-0.69%

B. Economic effects based on a dummy variable change from 0 to 1

	Pure debt issuance		Dual issuance		Pure equity issuance		Debt issu.	Equity issu.
	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	Econ. effect.
Immediate Depletion× $Loss_t$	74.70%	23.73	4.06%	2.81	1.39%	0.95	78.76%	5.45%
Immediate Depletion× $(1 - Loss_t)$	67.58%	27.63	2.87%	3.13	1.55%	1.67	70.45%	4.42%
Near Depletion	18.69%	9.79	1.18%	2.38	2.42%	2.98	19.87%	3.60%

Table B2. Robustness check: alternative term spread definition

	Pure debt issuance		Dual issuance		Pure equity issuance		Debt issu.	Equity issu.
	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	z-stat.	Econ. effect	Econ. effect.
Regression N = 17,417, pseudo R^2 = 0.199								
Immediate Depletion	9.65%	30.64	0.37%	14.11	1.44%	9.05	10.02%	1.81%
Near Depletion	3.67%	15.91	0.19%	5.92	0.70%	5.53	3.86%	0.88%
$MTB_{i,t-1}$	1.05%	2.61	0.01%	0.73	0.84%	4.23	1.06%	0.85%
$Return_{i,t-1}$	-0.62%	-1.28	0.09%	2.36	0.62%	5.07	-0.53%	0.71%
$Return_{i,t+1,t+3}$	0.91%	2.30	-0.28%	-2.01	-0.58%	-1.57	0.63%	-0.87%
$Term\ Spread_10Y_{t-1}$	-2.72%	-6.69	-0.02%	-0.73	0.31%	0.57	-2.74%	0.29%
$ln(Sales)_{i,t-1}$	-0.77%	-1.89	-0.25%	-2.82	-0.95%	-3.60	-1.01%	-1.20%
$ln(Age)_{i,t}$	-1.12%	-2.87	-0.12%	-2.79	-0.58%	-2.95	-1.25%	-0.70%
$Leverage_{i,t-1}$	1.79%	5.25	0.29%	3.30	3.23%	9.35	2.08%	3.51%
$R\&D_{i,t-1}$	0.06%	0.28	0.02%	0.51	0.57%	3.09	0.08%	0.59%
$Ind_sig_{i,t-1}$	0.95%	1.41	-0.04%	-0.03	1.11%	2.70	0.91%	1.07%
$Dividend\ Payer_{i,t-1}$	1.47%	2.91	-0.04%	-0.28	-0.65%	-2.77	1.43%	-0.70%

Table B3. Summary of robustness checks: Stability of main results

Specification	*Immediate Depletion*			*Near Depletion*		
	Pure Debt	Dual	Pure Equity	Pure Debt	Dual	Pure Equity
Baseline	9.63%	0.37%	1.45%	3.66%	0.19%	0.70%
	(30.64)	(14.20)	(9.05)	(15.85)	(5.92)	(5.54)
Ex-ante	3.39%	0.19%	0.48%	2.99%	0.14%	0.84%
	(10.57)	(4.71)	(3.11)	(10.24)	(3.42)	(5.98)
Relaxed	17.38%	1.47%	0.57%	6.08%	0.68%	0.23%
Threshold	(24.20)	(9.81)	(17.58)	(17.23)	(6.30)	(5.62)
Year FE	9.58%	0.37%	1.45%	3.63%	0.19%	0.70%
Only	(30.96)	(14.11)	(9.05)	(15.68)	(5.87)	(5.55)
Year FE +	9.44%	0.37%	1.47%	3.69%	0.19%	0.64%
Term spread	(29.88)	(14.00)	(9.13)	(15.75)	(6.05)	(5.39)

Notes: Entries report marginal effects (percentage points). z-statistics are reported in parentheses. Results are qualitatively consistent across all specifications.

Table B4. Robustness check: binary logit specification

Variable	Marginal Effect	z-stat
Immediate Depletion	-	-
Near Depletion	11.25%	14.64

Notes: Entries report marginal effects evaluated at sample means. z-statistics are reported in parentheses. Immediate Depletion is omitted due to perfect prediction.