The Macroeconomic Impact of Dividend Pressure on Low-Capital-Efficiency Firms*

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Abstract

This paper analyzes the macroeconomic impact of minimum dividend requirements on low-capital-efficiency firms by constructing a dynamic general equilibrium model that incorporates firm heterogeneity and capital structure choices. Our findings reveal two key insights: First, the economic effects of minimum dividend requirements vary substantially depending on their intensity. Moderate requirements have limited negative impacts, while stringent requirements increase firm exits and significantly disrupt the real economy. Second, dividend requirements disproportionately constrain firms in their growth stages, as these firms benefit from setting dividends to zero and building internal reserves. These results underscore potential risks in applying uniform shareholder return policies, such as those recommended in the Ito Report, which may overlook differences in firm characteristics like growth stage and capital efficiency. This study contributes a novel analytical framework for evaluating shareholder return policies by incorporating firm heterogeneity and capital structure decisions, offering fresh insights into the implications of dividend regulations on investment behavior and market dynamics within Japan.

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1 Introduction

In 2024, following the launch of Japan's new NISA tax-free small investment program, the stock market reached a historic high in July, attracting significant interest from both individual and institutional investors. With the role of trust between corporations and investors becoming increasingly pivotal in corporate finance, shareholder returns have gained prominence as a critical factor in enhancing corporate value. To remain competitive on a global scale, Japanese companies must secure investor support and adopt a management approach that prioritizes shareholder value.

The Ministry of Economy, Trade and Industry (2014), commonly referred to as the 'Ito Report' and led by Professor Kunio Ito, emphasized the importance of increasing capital efficiency in Japanese companies by setting an 8% return on equity (ROE) as a benchmark for competitiveness and sustainable growth. It recommended that companies consider using retained earnings for dividends or share buybacks if they were unable to effectively reinvest those funds for growth. This guidance has prompted Japanese companies to focus on improving cash flow while aiming to boost both corporate value and capital efficiency. Additionally, the 2022 restructuring of the Tokyo Stock Exchange has encouraged listed companies to emphasize metrics like ROE and ROIC, contributing to a growing awareness of shareholder value across Japanese corporations

However, there remains a significant difference between Japanese and U.S. & European companies in their approach to shareholder returns as shown in Figure 1. U.S. and European firms prioritize shareholder benefits through dividends and buybacks, frequently achieving total shareholder return ratios that surpass 100%. In contrast, Japanese companies' shareholder return ratios remain lower, generally staying below 80%. This is partly due to Japanese companies' tendency to accumulate retained earnings and adopt a more conservative approach to capital allocation rather than focusing heavily on maximizing shareholder returns. In fact, data from the Ministry of Finance Japan (2024) shows an upward trend in retained earnings since 2019. Especially the low-capital-efficiency firms, characterized by limited ability to generate returns from their invested capital, face unique challenges in balancing shareholder expectations and growth investments. As these firms struggle to reinvest earnings effectively, they become increasingly sensitive to dividend pressures, which may hinder their capital accumulation and, consequently, their long-term sustainability.

This disparity in return policies and its impact on sustained corporate value growth and investor interest is a key issue for the future of Japan's economy. In response, this paper presents a model to observe the economic effects of dividend policies in low-capital-efficiency companies. It analyzes how companies can enhance long-term corporate value by balancing shareholder returns with growth investments. By simulating various policy scenarios, the model enables an in-depth examination of how minimum dividend requirements, tax policies, and capital alloca-

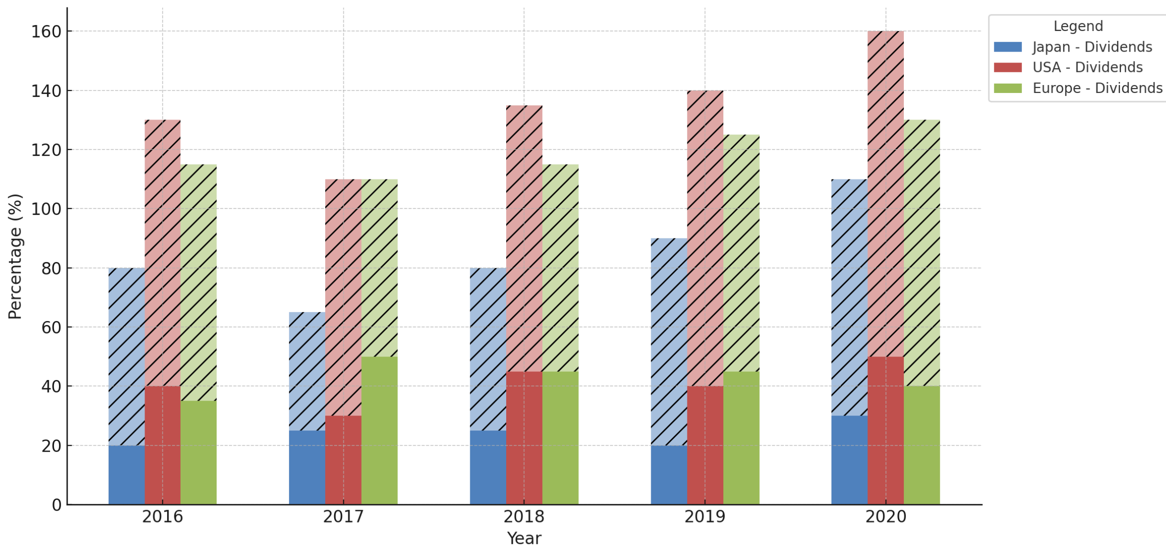

Figure 1: Breakdown of shareholder returns

tion decisions interact to influence firm behavior and economic stability. This approach provides valuable insights that can guide policymakers in formulating strategies that promote both shareholder value and sustainable growth.

In light of the varied perspectives on dividend policies, this study contextualizes its model within established research. "Dividend irrelevance theory" by Modigliani and Miller (1961), which provides the most fundamental theoretical framework for understanding the relationship between firm value, dividend policy, and retained earnings. The core of this proposition states that in perfect capital markets, a firm's choice between retaining earnings or paying them out as dividends does not affect firm value. Black (1976) termed the difficulty in finding a clear answer to the basic question of why firms pay dividends as the "dividend puzzle." From a tax perspective, he pointed out that while it would be rational for firms to avoid dividend payments since dividends are taxed at higher rates than capital gains, many firms continue to pay dividends.

To address this puzzle, theoretical advancements emerged through research on information asymmetry. For instance, the signaling hypothesis (e.g., Bhattacharya (1979)) suggests that dividend policy serves as an information transmission mechanism from managers to investors, while the free cash flow hypothesis (Jensen (1986)) was also proposed. These studies attempted to theoretically explain the role of dividend policy from the perspective of market imperfections, which could not be explained by the MM theory predicated on perfect capital markets. Adding to the tax perspective, Poterba and Summers (1984) demonstrated that dividend taxation has an inhibitory

[1]Figure 1 Source: Japan Securities Dealers Association, "Stakeholder Capitalism: A New Capitalism that Redistributes Corporate Value" (April 2022)

effect on investor behavior, creating distortions in firms' capital allocation and ultimately affecting investment decisions. Later, Chetty and Saez (2005) provided emprical evidence that the 2003 dividend tax cut in the United States significantly increased corporate dividend payments, demonstrating that tax policy changes have direct and substantial effects on corporate dividend policy.

Further empirical studies have examined how corporate lifecycle stages affect dividend policies. H. DeAngelo, L. DeAngelo, and Stulz (2006) empirically demonstrated that the ratio of retained earnings to total equity (RE/TE ratio) plays a crucial role in determining dividend policy as an indicator of firms' financial maturity. This lifecycle hypothesis shows that the RE/TE ratio has strong explanatory power for the probability of dividend payments, even after controlling for traditional factors such as profitability and growth.

Moreover, this perspective provided a new understanding of the "disappearing dividends" phenomenon identified by Fama and French (2001)which can be attributed to the rising number of firms with negative retained earnings. Building on these insights from corporate finance research, the field of macroeconomics has developed models that consider firm heterogeneity. Hopenhayn and Rogerson (1993) and Gomes (2001) established the foundation for general equilibrium models with endogenous firm entry and exit. Developing this further, Hennessy and Whited (2007) revealed that under financing costs and dividend taxation, firms whose fixed costs of equity issuance exceed the marginal gains from issuance experience periods where they neither pay dividends nor issue equity. Furthermore, Macnamara (2019), using Katagiri's (2014) model that enables endogenous capital structure choice, showed that firms with moderate levels of internal equity tend to accumulate retained earnings by setting dividends to zero, which can be explained by the balance between tax systems and equity issuance costs.

Our research analyzes an economy where low-productivity firms find it difficult to accumulate retained earnings due to increased pressure for shareholder returns on low-capital-efficiency firms, as indicated in the Ito Report. Specifically, we extend Katagiri (2014) model by introducing minimum dividend requirements to theoretically reproduce this situation and simulate its impact on the overall economy. This research enables quantitative evaluation of the economic effects of shareholder return promotion policies, as represented by the Ito Report, while considering firm heterogeneity.

The rest of the paper is organized as follows. Section 2 develops the model, detailing the structure of firms, including production technology, dividend policy, exit and entry conditions, and optimal investment strategies. The section also introduces the financial intermediary, household behavior, and the aggregation process in the economy. Section 3 presents the numerical methods, focusing on the identification of state variables and the calibration process. Section 4 is the results, including an analysis of the baseline model, examining firm behavior across productivity levels. It explores the effects of minimum dividend requirements and dividend tax elimination with the discussion of broader policy implications. Section 5 concludes.

2 The Model

Our model is based on the dynamic stochastic general equilibrium framework of Gomes (2001), which incorporates firm heterogeneity, firm-level financing constraints, and entry-exit dynamics, along with the extensions by Katagiri (2014) and Macnamara (2019), which enable endogenous capital structure determination. This approach allows our model to define financial metrics such as Return on Equity (ROE), Return on Asset (ROA) and financial leverage. The economy in this model is composed of three types of agents: firms, households, and financial intermediaries.

2.1 Firms

In this model, firms are characterized as agents that seek to maximize their firm value within a dynamic economic environment. Firms are heterogeneous in their productivity, capital stock, and capital structure, which evolve over time. They face complex, interrelated decisions regarding production, investment, financing methods including internal funds, debt, and equity, as well as market entry and exit choices. Firms must also navigate uncertainty, responding to potential future productivity shocks and changing market conditions when selecting their optimal policies. Furthermore, they operate under various constraints, including tax regulations and financial market frictions, which influence their decision-making.

2.1.1 Production Technology and Profit

We assume a large number of firms that produce homogeneous consumption goods using predetermined levels of capital stock k and labor l. The production technology is characterized by a Cobb-Douglas production function: $y = \varepsilon k^{\alpha} l^{\gamma}$, where $\alpha > 0, \gamma > 0$, and $\alpha + \gamma < 1$. The condition $\alpha + \gamma < 1$ ensures decreasing returns to scale in production.

Firms' idiosyncratic productivity, ε, follows a AR(1) process in logs. The process is defined as: $\log(\varepsilon') = \rho \log(\varepsilon) + u'$, where $|\rho| < 1$ is the autoregressive coefficient and $u' \sim N(0, \sigma)$ is a white noise process.

After experiencing the productivity shock, firms choose the optimal level of labor to maximize their profits. The firm's problem can be expressed as:

$$l^*(k; \varepsilon, w) = \arg\max_{l \geq 0} \{\varepsilon k^{\alpha} l^{\gamma} - wl\}, \tag{1}$$

where w represents the wage.

Given the optimal labor input, the firm engages in production. The firm's profits before interest and taxes payment and depreciation (EBITDA) can be defined as:

$$\pi(k;\varepsilon,w) = \varepsilon k^{\alpha} l^{*\gamma} - wl^{*} - \xi, \tag{2}$$

where ξ represents fixed operating costs. As explained in Katagiri (2014), the fixed operating costs term serves two key purposes: it replicates economy of scale that benefits firms with larger capital stocks, and it allows for the possibility of negative profits, thereby providing an exit incentive for low-productivity firms.

At the beginning of the period, the firm has assets k and equity n. Debt is defined as $k-n$, with $k = n$ indicating that the firm is debt-free. Given these financial positions, the firm's net income after depreciation, interest payments, and corporate taxes is:

$$\widehat{\pi}(k,n;\varepsilon,w,r) = (1-\tau_c)[\pi(k;\varepsilon,w) - \delta k - r(k-n)], \tag{3}$$

where $\delta \in [0,1]$ represents the depreciation rate, r is the interest rate on debt, and τ_c is the corporate tax rate. This formulation incorporates the tax shield effect by reflecting the fact that corporate taxes are levied after interest payments.

Finally, the firm's equity after production is determined as follows:

$$e = \widehat{\pi}(k,n;\varepsilon,w,r) + n. \tag{4}$$

Using the variables defined so far, we can define key financial metrics. Return on Assets (ROA) is given by $\widehat{\pi}(k,n;\varepsilon,w,r)/k$, Return on Equity (ROE) by $\widehat{\pi}(k,n;\varepsilon,w,r)/n$, and financial leverage by k/n.

2.1.2 Dividend Policy

After determining the post-production equity e through equation (4), firms choose their next-period capital level k' and its financing method (i.e., n') with dividends determined as the residual.

A key feature of our model is the introduction of minimum dividend requirements for firms with low capital efficiency. Specifically, firms with expected ROE: $E[ROE|\varepsilon]$ below a threshold $\overline{ROE}$ are required to pay out a minimum dividend of θn, which represents a fixed fraction θ of their equity. Taking into account that firm productivity changes over time, we calculate this expected ROE as follows:

$$E[ROE|\varepsilon] = \frac{\sum_{\varepsilon'} \widehat{\pi}(k',n';\varepsilon',w',r') f(\varepsilon'|\varepsilon)}{n'}, \tag{5}$$

where $f(\varepsilon'|\varepsilon)$ is the conditional probability density function of future productivity ε' given current productivity ε.

To formulate the dividend policy incorporating this minimum dividend requirement, we first define the minimum dividend requirement $\theta(\varepsilon)$ based on expected ROE:

$$\theta(\varepsilon) = \begin{cases} \theta, & E[ROE|\varepsilon] < \overline{ROE}. \\ 0, & E[ROE|\varepsilon] \geq \overline{ROE}. \end{cases} \tag{6}$$

Next, we define $\tilde{e}$ as the funds available for dividend payments, where $\tilde{e} = e - \theta(\varepsilon)n$. The dividend $\tilde{d}(k', n'; \tilde{e})$ based on these available funds takes the following form:

$$\tilde{d}(k', n'; \tilde{e}) = \tilde{e} + \frac{k' - n'}{1 + r'} - k'. \tag{7}$$

The term $\frac{k'-n'}{1+r}$ represents the present value of debt discounted at the interest rate r'. the dividend $\tilde{d}(k', n'; \tilde{e})$ can take both positive and negative values. Thus, when funds are insufficient, the firm may issue additional equity rather than pay dividends to meet its capital needs. Considering this context, the final dividend policy can then be expressed as:

$$d(k', n'; e) = (1 - \tau_d)[\theta(\varepsilon)n + \max\{\tilde{d}(k', n'; \tilde{e}), 0\}] + (1 + \lambda)\min\{\tilde{d}(k', n'; \tilde{e}), 0\}, \tag{8}$$

where τ_d is the tax rate applied to positive dividends, and λ is the cost associated with issuing equity when the dividends become negative. This formulation captures both the minimum dividend requirement and the potential for issuing additional dividends or equity.

2.1.3 Exit Conditions

As shown in Figure 2, a firm with given capital k and pre-production equity n observes the current period productivity ε. At this point, since the firm knows its capital, pre-production equity, and productivity, it can perfectly forecast the profits from the production. Firms that anticipate negative profits choose to exit to avoid paying fixed operating costs.

This decision can be formalized as:

$$\hat{v}(n, k, \varepsilon) = \max\{v(n, k, \varepsilon), d(0, 0; n), 0\} \tag{9}$$

where $v(n, k; \varepsilon)$ represents the firm's value when it chooses to continue operations, and $d(0, 0; n)$ represents the firm's value when it chooses to exit. When a firm decides to exit, it does not engage in production, so pre-production equity equals post-production equity ($n = e$). The firm sells all its remaining capital after depreciation $(1 - \delta)k$, uses the proceeds to repay its debt to financial intermediaries, and distributes any remaining amount as a final dividend to shareholders. If the proceeds from selling capital are insufficient to repay the debt, the firm chooses to default. Due to the limited liability rule, shareholders and firms are not obligated to repay debt beyond their invested amount, so the firm's value in case of default does not become negative but is set to 0.

This model assumes that even after a firm decides to continue operations, it may face an exogenous exit shock with probability χ, forcing it to exit due to unforeseen events. Thus, $v(n,k;\varepsilon)$ is defined as:

$$v(n,k;\varepsilon) = (1-\chi) * \tilde{v}(n,k;\varepsilon) + \chi * d(0,0;n), \tag{10}$$

where $\tilde{v}(e,k;\varepsilon)$ represents the firm value without the exogenous exit shock. As Katagiri (2014) explains, this shock is included to account for large firm exits in a model where productivity and firm size are strongly correlated.

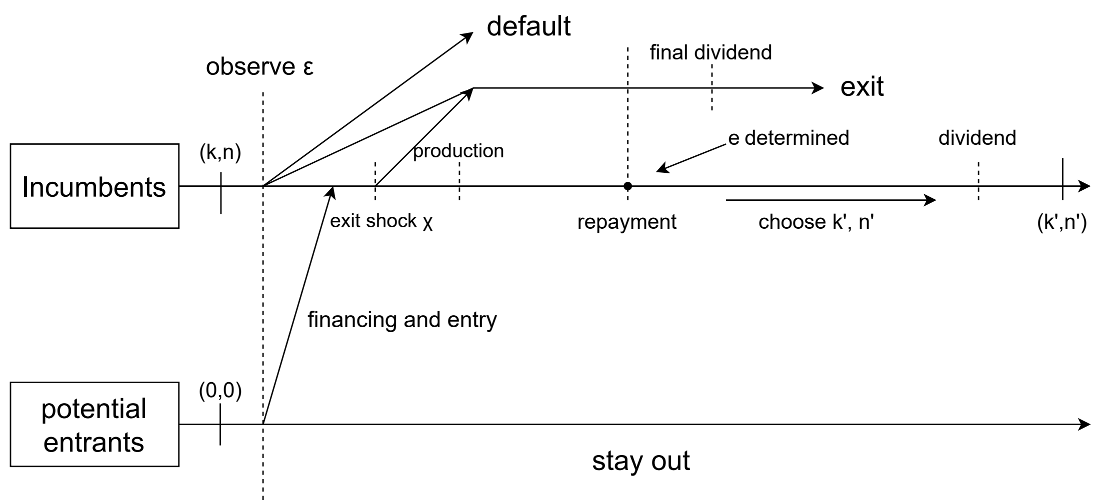

Figure 2: Timing within a period

2.1.4 Optimal Investment

Firms that survive exogenous exit shocks and continue production optimize their asset levels k' and their financing method (i.e., the amount of equity n') for the next period to maximize firm value. The firm value is the sum of current dividends and the discounted present value of future dividends, and the value function is expressed as follows:

$$\tilde{v}(n,k;\varepsilon) = \max_{n' \geq 0, k'} d(k',n';e) + \beta \cdot E_{\varepsilon'|\varepsilon}[\hat{v}(n',k';\varepsilon')] \,, \tag{11}$$

where $E_{\varepsilon'|\varepsilon}[\hat{v}(n',k';\varepsilon'))]$ represents the expected value of the firm in the next period, and β is the discount factor.

Additionally, The optimal capital stock k' can be used to formulate a traditional investment function:

$$i(k,k') = k' - (1-\delta)k. \tag{12}$$

2.1.5 Entry Conditions

There are potential entrants, and they enter the economy if the following condition is satisfied: $\varepsilon \geq \bar{\varepsilon}$, where $\bar{\varepsilon}$ is the threshold for entry. Specifically, $\bar{\varepsilon}$ is the productivity level at which a firm's value becomes positive when initial state $k = 0$ and $e = 0$. Following similar assumptions as in Macnamara (2019), new entrants' initial productivity (ε) is drawn from the cumulative distribution function $G(\varepsilon)$ of a log-normal distribution that corresponds to the invariant distribution of idiosyncratic productivity (i.e., mean 0 and standard deviation $\sigma/\sqrt{1-\rho^2}$). Therefore, the actual number of entrants is given by the following integral:

$$\int_{\varepsilon > \bar{\varepsilon}} dG(\varepsilon), \tag{13}$$

where $G(\varepsilon)$ is the cumulative distribution function of the log-normal distribution described above. This specification of productivity distribution allows us to properly model the selection mechanism of productivity through firm entry process.

2.2 Financial Intermediary

Financial intermediaries are assumed to operate in a competitive market. Their business model consists of raising funds and extending loans to firms. The loan contract is a one-period debt contract where the financial intermediary (FI) charges an interest rate r' on the net borrowing amount $(k' - n')$, while raising funds from households at the risk-free interest rate r_f. The interest rate is determined by the following zero-profit condition:

$$(1+r_f)(k'-n') = \int_{\underline{\varepsilon}}^{\infty} (1+r')(k'-n') f(\varepsilon'|\varepsilon) d\varepsilon' + \int_0^{\underline{\varepsilon}} [(1-\delta)(1-\kappa)k'] f(\varepsilon'|\varepsilon) d\varepsilon'. \tag{14}$$

The left-hand side of this equation represents the FI's funding cost, while the right-hand side captures expected returns. The first term on the right-hand side represents returns when firms repay their loans, and the second term represents the recovery value in the event of default. When a firm defaults, the FI liquidates the firm's assets and recovers $(1-\delta)(1-\kappa)k'$, where $\kappa \in [0,1]$ represents the discount rate in fire sales and serves as a default cost. A higher value of κ implies a larger discount in the fire sale. Due to this fire sale discount, the liquidation value falls below the depreciated value of assets."

The default threshold $\underline{\varepsilon}$ is endogenously determined by:

$$\hat{v}(n,k;\underline{\varepsilon}) = 0. \tag{15}$$

This condition implies that when the productivity equals $\underline{\varepsilon}$, the firm's value becomes zero. When the productivity falls below this threshold, the firm defaults; when it exceeds the threshold, the firm continues operations and services its debt. Thus, firm defaults are endogenously determined, with the probability of default depending on the conditional distribution of productivity. As firms experience declining productivity, their default probability increases, which in turn constrains their borrowing capacity as FIs demand higher interest rates to compensate for the increased risk.

2.3 Household

A representative household supplies labor, consumes, and saves. The household earns income from both labor supply and dividends from firm ownership. The household's optimization problem is:

$$\max_{L_t, S_{t+1}} E_0 \sum_{t=0}^{\infty} \beta^t [\log(C_t) - \eta L_t^s], \tag{16}$$

subject to the budget constraint:

$$C_t + S_{t+1} = (1 + r_f) S_t + w_t L_t^s + D_t, \tag{17}$$

where C_t represents consumption, L_t^s is labor supply, S_t denotes savings held with financial intermediaries at the risk-free rate r_f, and D_t is dividend income. Here, η represents the preference parameter for labor disutility.

As noted in Gomes (2001), since the exact specification of preferences is not crucial for our analysis, we take a minimalist approach with logarithmic utility in consumption and linear disutility in labor supply as in Hopenhayn and Rogerson (1993) and Gomes (2001).

The first-order conditions with respect to labor supply L_t^s and savings S_{t+1} characterize the household's optimal choices.

Differentiating with respect to L_t^s gives:

$$\frac{\partial}{\partial L_t^s} : -\eta + \frac{w_t}{C_t} = 0, \tag{18}$$

This result implies a relationship between the wage w_t and consumption C_t, given by $w_t = \eta C_t$. In the stationary equilibrium, this simplifies to $w = \eta C$.

Similarly, the first-order condition with respect to savings S_{t+1} is:

$$\frac{\partial}{\partial S_{t+1}} : -\frac{1}{C_t} + \beta(1+r_f)E\left[\frac{1}{C_{t+1}}\right] = 0.\text{[2]} \tag{19}$$

In the stationary equilibrium, where expected future consumption is equal to current consumption, this condition simplifies to the familiar Euler equation: $\beta = \frac{1}{1+r_f}$

The equations derived here play an important role in capturing general equilibrium effects within this model. In particular, household choices regarding labor supply and consumption impact the overall economic equilibrium through the labor market.

2.4 Aggregation

With the firm decision rules and household behavior defined, we can now aggregate across all firms to characterize the structure of the stationary equilibrium. First, we define the **stationary distribution μ^* as the distribution of firms that satisfies $\mu_{t+1} = \mu_t$. This distribution ensures that all prices and aggregate variables in the stationary equilibrium remain constant over time, resulting in a steady economic state.

As discussed in Chapter 3.1, the state of each firm in this model is represented by its post-production equity e and productivity ε. The distribution of firms at each state (e,ε) is given by $\mu(e,\varepsilon)$.

The dynamics of the firm distribution can be expressed as follows:

$$\begin{aligned}\mu_{t+1}(e',\varepsilon') = &\int_{(e,\varepsilon)} \left[\mathbb{1}_{\{e'=e^*(e,\varepsilon')\}} \cdot \mathbb{1}_{\{\hat{v}(e,\varepsilon)>d(0,0;n)\}} \cdot (1-\chi)\right] \cdot \mu_t(e,\varepsilon) \cdot f(\varepsilon' \mid \varepsilon)\, d\varepsilon\, de \\ &+ \int_{\varepsilon'} \mathbb{1}_{\{e'=e^*(0,\varepsilon')\}} \cdot \mathbb{1}_{\{\varepsilon' \geq \bar{\varepsilon}\}}\, dG(\varepsilon'),\end{aligned} \tag{20}$$

where $\mathbb{1}$ is an indicator function that returns 1 if the condition inside braces is true, and 0 otherwise, and $e^*(e,\varepsilon')$ denotes the optimal equity level when the firm is in state (e,ε').

Based on the stationary distribution μ^*, aggregate variables such as total assets K, total equity N, total dividends D, labor demand L_d, total output Y, and default cost G can be calculated. These values yield the following equilibrium conditions across markets:

- $C = Y - \delta K - G$
- $S = K - N$
- $L_s = L_d$

[2] See Appendix A for detailed derivations.

3 Numerical Methods

To solve the model numerically, we first restricted the model by specifying forms of the functions. Then we determined parameters by matching them to Japanese data by using existing empirical evidence. However, due to the limited availability of similar studies on the Japanese economy, we also utilized parameters from U.S.-based research and those commonly accepted in the literature. Following parameterization, we obtained the approximate stationary competitive equilibrium using value function iteration, and performed simulations by computing the stationary distribution and deriving aggregate variables.

3.1 Identification of State Variables

In Chapter 2, we described the model primarily using capital k, equity before and after production n and e, and productivity ε for ease of exposition. However, the state variables that fully characterize a firm's state can be reduced to productivity ε and equity e. This is for the following reasons:

First, firms face two key decisions. One is the entry/exit decision, and the other is the choice of capital structure and investment (the choice of k' and n'). For the entry/exit decision in equation (9), the comparison between continuation value and liquidation value appears to require capital k, equity n, and productivity ε. However, equations (3) and (4) show that equity after production e is uniquely determined by capital k and equity before production n, and giving (k, n) is equivalent to giving e. Therefore, productivity ε and equity e are sufficient to characterize this decision. For the capital structure and investment choices after continuation, productivity ε determines the expected value of future cash flows and affects the optimal investment level k', while equity e acts as an internal funding constraint and determines the optimal capital structure n'.

Second, since this model focuses on dividend policy and capital structure decisions, unlike Katagiri (2014)[3], we do not introduce capital adjustment costs. Thus, there is no dynamic friction in capital adjustment, and we do not need to keep capital k as an independent state variable. All information from capital k and equity before production n is reflected in equity after production e.

This reduction in the dimension of state variables reduces the computational burden and enables more efficient numerical analysis.

[3]In Katagiri (2014), downward adjustment costs representing investment irreversibility acted as a constraint on firm borrowing and capital allocation decisions.

3.2 Calibration

We specify the functional forms of our model as described in Chapter 2, with one period corresponding to one year. Following Hopenhayn and Rogerson (1993) and Gomes (2001), we set the household's instantaneous utility function as $U(C, L^s) = \log(C) - \eta L^s$. For firms, we adopt a Cobb-Douglas production function $y = \varepsilon k^{\alpha} n^{\gamma}$, and assume that firm-specific productivity shocks follow a mean-zero AR(1) process $\log(\varepsilon') = \rho \log(\varepsilon) + u'$ where $u' \sim N(0, \sigma^2)$.

We calibrate these functions using parameters based on Japanese economic data and previous literature. Table 1 presents the complete list of parameters used in this study. Many of these parameters are drawn from Khan and Senga (2019), who analyze how increased firm-level uncertainty contributed to the rise in cash holdings by Japanese firms since 2000 using a general equilibrium model.

Specifically, we set the labor share γ to 0.64 based on the average ratio of employee compensation to national disposable income from 1994 to 2016. The persistence of productivity shocks ρ is set to 0.90, with a standard deviation σ of 0.0335. Given Japan's low interest rate environment since 2000, we set the household discount factor β to 0.99, corresponding to a risk-free rate of 1%. The depreciation rate δ of 0.089 is taken from Hayashi and Prescott (2002), representing the average value for the Japanese economy during 1984-1989. Due to limited availability of Japanese data, we adopt the U.S. estimate of 0.41 from Hennessy and Whited (2007)for the capital discount rate in fire sales κ, and the exogenous exit rate χ is set to 0.02 following Katagiri (2014). For the equity funding cost λ, we set it to 0.08, reflecting the Ito Report's finding that global institutional investors expect an average cost of capital exceeding 7% from Japanese firms. For tax rates, we use Japanese statutory rates: the corporate tax rate τ_c and dividend tax rate τ_d are set to their respective legal values in Japan.

The remaining parameters are calibrated by minimizing the distance between model-generated moments and actual data moments. Specifically, we calibrate the capital share α to match the capital-output ratio of 1.98 from Khan and Senga (2019), the labor disutility η to match their average hours worked of 0.33, and the fixed cost ξ to match the total exit rate of 7% from Katagiri (2014). Table 2 presents the results of this moment matching exercise.

[4]Parameters are calibrated to match moments in Japanese data and previous studies.

Table 1: Model Calibration[4]

Parameter	Value	Calibration Target / Description
Panel A: Preferences and Technology		
Discount rate (β)	0.99	Risk-free rate = 0.01
Labor disutility (η)	2.29	Average hours worked = 0.33
Labor share (γ)	0.64	Khan and Senga (2019))
Capital share (α)	0.25	capital-output ratio = 1.98
Depreciation rate (δ)	0.089	Hayashi and Prescott (2002)
Panel B: Financial Frictions		
Equity funding cost (λ)	0.08	Ministry of Economy, Trade and Industry (2014)
Discount rate in fire sale (κ)	0.41	Hennessy and Whited (2005)
Exogenous exit rate (χ)	0.02	Katagiri (2014)
Fixed cost (ξ)	0.06	Total exit rate = 0.07
Panel C: Productivity Process		
AR(1) coefficient (ρ)	0.9	Khan and Senga (2019)
Std. dev. productivity shock (σ)	0.335	Khan and Senga (2019)
Panel D: Tax Rates		
Corporate tax (positive profit) (τ_c^h)	0.232	Japanese statutory tax rate
Corporate tax (negative profit) (τ_c^l)	0	no corporate tax for negative profit
Dividend tax (τ_d)	0.203	Japanese statutory tax rate

Table 2: Model Fit: Targeted Moments[5]

	Target	Model
Capital-output ratio	1.98	1.98
Average hours worked	0.33	0.33
Labor share	0.64	0.66
Total exit rate	0.07	0.065
Risk-free rate (%)	1.00	1.01

4 Results

This section presents our quantitative analysis of how minimum dividend requirements affect firm behavior and aggregate economic outcomes. We compare three scenarios with varying intensities of dividend requirements: an economy without minimum dividend requirements (baseline, $\theta = 0$), one with moderate requirements ($\theta = 0.15$), and one with more stringent requirements ($\theta = 0.3$) for firms with expected ROE below 8%, following the Ito Report's benchmark. This comparison allows us to understand how different levels of pressure on low-capital-efficiency

[5]Target moments are from Japanese data, Khan and Senga (2019) and Katagiri (2014).

firms to increase shareholder returns affects their investment decisions, capital structure, and ultimately, the aggregate economy. After examining the effects across these three regimes, we conduct a policy experiment where we set the dividend tax to zero. Through this experiment, we attempt to understand the impact of dividend taxation on firm behavior and the interaction between minimum dividend requirements and the tax system.

4.1 Analysis of the Baseline Model

The baseline model reveals several important patterns regarding firm behavior and economic outcomes across different levels of productivity and equity. Figure 3 visualizes the firm value function corresponding to levels of productivity ε and post-production equity e, while Figure 4 shows the equilibrium distribution of firms. Analysis of the firm value function demonstrates that firm value exhibits a monotonically increasing relationship with both productivity and equity. Moreover, we observe a clear threshold in productivity, below which firm value drops sharply. This feature is consistent with the exit conditions specified in our model. The firm distribution reveals a concentration of firms with moderate levels of capital and productivity, forming the core of the market structure. Additionally, we observe a positive correlation between productivity and post-production equity. This suggests a mechanism whereby highly productive firms can more easily accumulate internal funds, consequently maintaining higher levels of equity.

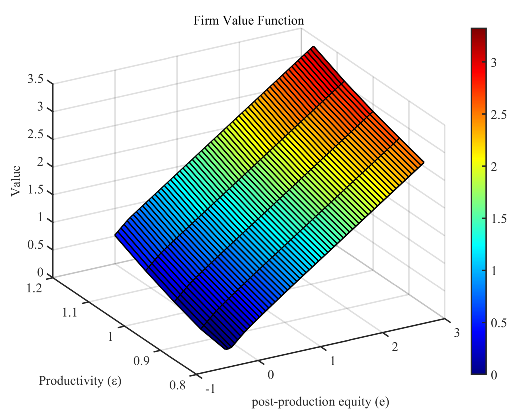

Figure 3: Visualizing Firm Value Function

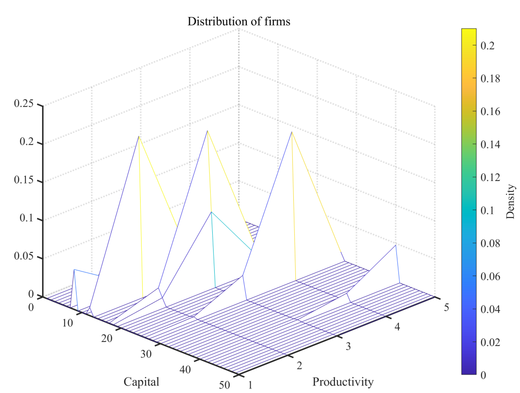

Figure 4: Distribution of Firms

To better understand firm characteristics obtained from the model, we examine differences in indicators across productivity levels. Figure 5 shows changes in input factors and financial conditions corresponding to firms' post-production equity positions. Focusing on dividend policy and financing choices, our model demonstrates results consistent with pecking order theory. Firms with limited cash first set dividends negative (i.e., issue equity), then choose debt financing, and finally prioritize internal funds as they accumulate. Furthermore, as observed in Hennessy and Whited (2007) and Macnamara (2019), our model confirms that firms with moderate equity levels set dividends to zero and accumulate internal reserves. In this model, debt financing plays a crucial role. As shown in Figure 6, high-productivity firms maintain big debt financing capacity even with no equity, while low-productivity firms can access risk-free rate financing after accumulating some equity to improve their leverage.

Examining productivity differences, high-productivity firms (blue line) tend to hold more capital and employ more labor. These firms achieve higher Return on Equity (ROE) and Return on Assets (ROA), enabling more aggressive dividend policies. Interestingly, the behavior of high-productivity firms in the right half of the figure provides insights into optimal capital structure. Despite having access to favorable debt financing conditions due to their high productivity, these firms maintain equity above certain levels, suggesting the importance of internal funds as a buffer against future uncertainty.

The dynamic changes in leverage are particularly noteworthy. Low-productivity firms initially show extremely high leverage ratios but rapidly reduce them as equity increases. In contrast, high-productivity firms maintain relatively stable leverage levels. This difference clearly demonstrates how productivity differences affect firms' optimal capital structure.

These observations indicate that differences in firm productivity systematically affect both input factor choices and financial policies. In particular, they suggest that dividend requirements for low-productivity firms may further constrain their ability to accumulate capital.

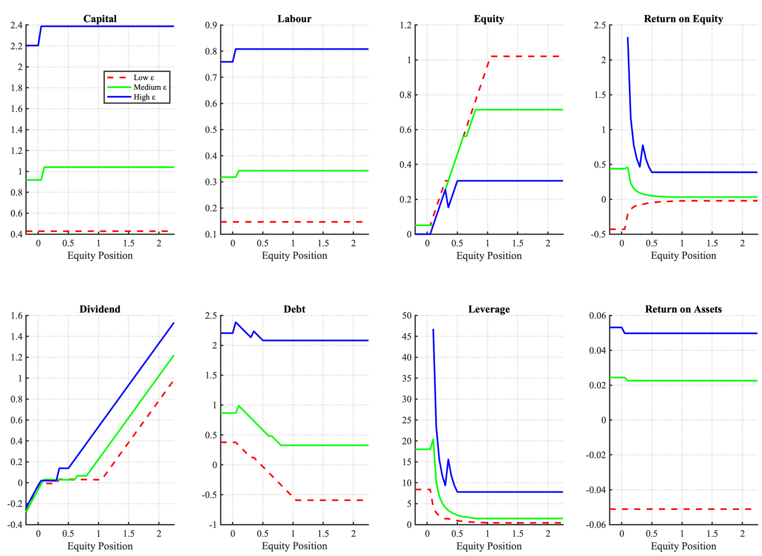

Figure 5: Firm Characteristics by Productivity Level and Equity Position[6]

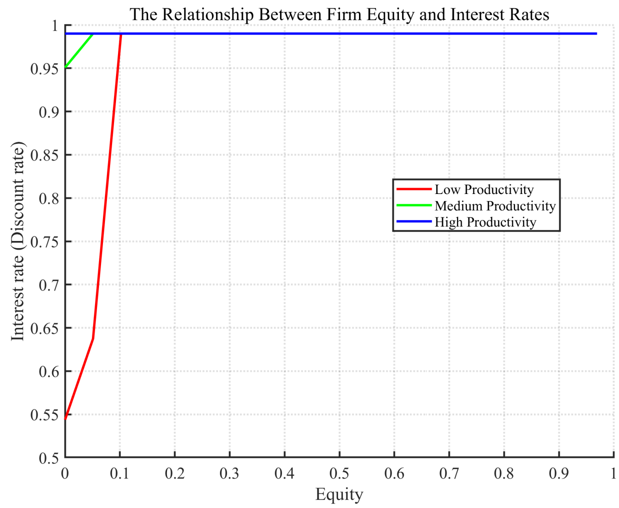

Figure 6: The Relationship Between Firm Equity and Interest Rates

4.2 The Effects of Minimum Dividend Requirements

Our baseline analysis reveals that firms' financial and investment decisions systematically differ across productivity levels, with firms holding moderate levels of equity setting dividends to zero and accumulating internal reserves. Building on these findings, we examine how minimum dividend requirements affect firm behavior and aggregate economic outcomes. Specifically, we analyze three scenarios: a baseline economy without dividend requirements ($\theta = 0$), and economies with moderate ($\theta = 0.15$) and stringent ($\theta = 0.3$) requirements, focusing on firms with expected ROE below 8%.

Comparing Figure 5 and Figure 7, we observe no significant differences in the behavior of high-productivity firms (High ε). This suggests that firms above the ROE threshold can maintain optimal behavior regardless of the minimum dividend requirement. On the other hand, low-productivity firms that do not reach the ROE threshold are forced to pay dividends in proportion to their equity position. While the model allows firms to issue additional equity to cover any funding shortfall after mandatory dividend payments, firms avoid this option due to its high cost. Consequently, firms need to maintain higher equity positions to meet the mandatory dividend requirements. This is particularly evident in Figure 7, where low-productivity firms maintain higher levels of equity positions. Although the mandatory dividend requirement makes equity financing more challenging, the figures do not show a notable suppression in capital accumulation.

[6] The slight fluctuations observed in the figures are technical artifacts arising from our numerical computation method. Specifically, these are phenomena associated with calculations using discrete grids and linear interpolation approximations, and do not affect the economic interpretation of our results.

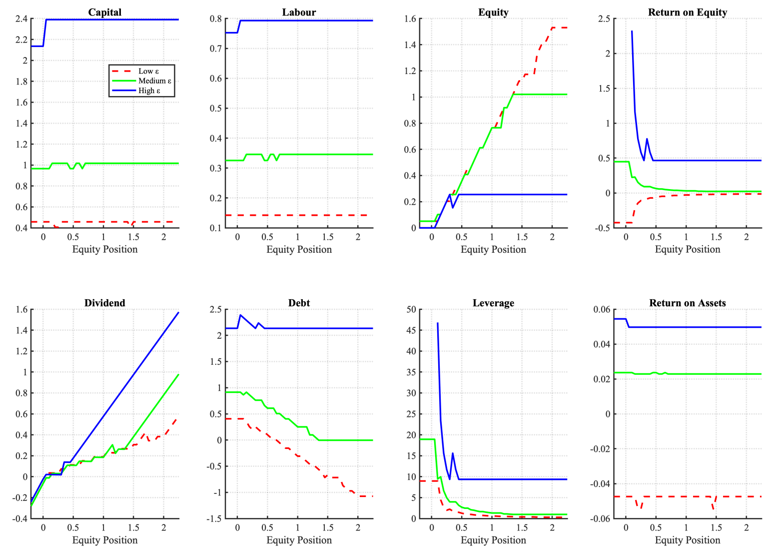

Figure 7: Firm Characteristics by Productivity Level and Equity Position ($\theta = 0.3$)

Table (3) shows the impact of mandatory dividend requirements (θ) on economic indicators. When θ=0.15, we observe only minor negative effects on most economic indicators. Changes in aggregate variables are limited to around -0.3%, and the decrease in the number of firms is minimal at -0.1%.

On the other hand, when θ=0.3, we observe significant economic impacts. First, there is a notable 4.9% decrease in the number of firms. This decline suggests that mandatory dividend requirements affect the viability of low-productivity firms. In other words, some low-productivity firms are forced to exit the market due to mandatory dividend payment requirements.

This decrease in the number of firms is the main factor driving the decline in aggregate variables: a 5.9% decrease in GDP, a 6.5% decrease in investment, a 6.3% decrease in capital, and a 6.0% decrease in labor input. Looking at profitability and dividend indicators, aggregate ROE increases with rising θ (17.1%→19.9%→21.5. However, average ROE initially increases (25.6%→26.9%) but then significantly decreases (20.2%). This difference reflects changes in the composition of surviving firms as low-productivity firms are forced to exit under stricter dividend requirements.

ROA also shows interesting patterns. While aggregate ROA slightly decreases (2.58%→2.57%→2.55%), average ROA ultimately increases (1.80%→1.80%→2.08%). This suggests that firms with inefficient capital utilization exit the market due to stricter dividend requirements, leaving more efficient firms to survive.The increase in average payout ratio (53.7%→60.7%→60.9%) reflects that fewer firms, particularly low-productivity ones, are able to maintain zero dividend payments under the mandatory dividend requirements. Meanwhile, the stable aggregate payout ratio suggests that because low-productivity firms need more equity than when θ=0 to actively pay div-

Table 3: Impact of Minimum Dividend Requirement (θ) on Economy

Variable	$\theta = 0$	$\theta = 0.15$	Change(%)	$\theta = 0.3$	Change(%)
Aggregate Variables					
GDP	0.504	0.502	-0.3	0.474	-5.9
$Conumption$	0.413	0.412	-0.3	0.389	-5.8
$Invenstment$	0.091	0.090	-0.3	0.085	-6.5
$Capital$	0.998	0.995	-0.3	0.936	-6.3
$Labor$	0.333	0.332	-0.3	0.313	-6.0
Economic Ratios					
Capital-Output Ratio	1.981	1.981	0.000	1.973	-0.008
Investment Rate(%)	18.0	18.0	0.0	17.9	-0.1
TFP	1.216	1.216	0.000	1.218	0.002
Returns and Payout Ratios					
Aggregate ROE(%)	17.1	19.9	2.8	21.5	4.4
Average ROE(%)	25.6	26.9	1.3	20.2	-5.4
Aggregate ROA(%)	2.58	2.57	-0.01	2.55	-0.03
Average ROA(%)	1.80	1.80	0.00	2.08	0.28
Aggregate Payout Ratio(%)	54.2	53.4	-0.8	52.4	-1.8
Average Payout Ratio(%)	53.7	60.7	7.0	60.9	7.2
Firm Values					
Aggregate Firm Value	0.583	0.555	-4.8	0.505	-13.4
Total Number of Firms	0.935	0.934	-0.1	0.890	-4.9

idends under the requirements, the total amount of dividends in the economy remains largely unchanged.Regarding firm value, increasing θ leads to a significant decrease in aggregate firm value (13.4% decrease at θ=0.3), suggesting, consistent with previous studies, that dividend taxation destroys firm value.

4.3 Policy Experiment: Zero Dividend Tax

According to the Modigliani and Miller (1961), dividend policy does not affect firm value in perfect capital markets. This is because dividends and internal reserves are perfect substitutes. Specifically, investors can obtain funds by selling shares as needed, and firms can access capital markets without friction, meaning that the timing of dividends does not affect value.

In the previous section, we analyzed the effects of minimum dividend requirements on firm behavior and the overall economy in a setting that assumes real-world market conditions. The results showed negative impacts from strengthening dividend requirements (increase in θ), including a substantial decrease in firm value (13.4% decrease at $\theta = 0.3$) and a reduction in the number of firms (4.9% decrease).

In this section, we analyze minimum dividend requirements in a setting closer to perfect capital markets to identify whether these negative effects stem from market imperfections or are

Table 4: Impact of Minimum Dividend Requirement (θ) when $\tau_d = 0$

Variable	$\theta = 0.0$	$\theta = 0.3$	Change
Total Output (GDP)	0.523	0.529	+1.1%
Aggregate ROE (%)	39.6	41.2	+1.6pp
Aggregate Payout Ratio (%)	69.9	69.9	0.0pp
Average Payout Ratio (%)	73.4	73.3	-0.1pp
Firm Value	0.686	0.672	-1.9%

inherent to the minimum dividend requirements themselves. Specifically, we examine the impact of minimum dividend requirements in an environment where dividend tax is eliminated ($\tau_d = 0$).

Table 4 shows the impact of minimum dividend requirements ($\theta = 0.3$) in an environment without dividend taxation ($\tau_d = 0$). The first key finding is that the introduction of minimum dividend requirements has a relatively small effect on firm value, showing only a 1.9% decrease. This is significantly smaller than the impact observed in the presence of dividend taxation (13.4% decrease). This result supports the Modigliani and Miller (1961) dividend irrelevance theorem, suggesting that dividend policy has limited impact on firm value in an environment closer to perfect capital markets. Second, in the baseline case ($\theta = 0.0$), the payout ratio is already high at around 70% and remains virtually unchanged after the introduction of minimum dividend requirements. This indicates that in an environment without dividend taxation, firms can make neutral decisions between dividends and retained earnings. Comparison between Tables 3 and 4 reveals that dividend taxation itself substantially reduces firm value. Moreover, imposing dividend requirements on firms with moderate equity levels in the presence of dividend taxation significantly affects the decision-making of firms aiming to maximize their value. This can be attributed to the interaction between dividend taxation and minimum dividend requirements severely restricting firms' financial flexibility and hindering optimal capital allocation.

4.4 Policy Implication

The following policy implications can be drawn from the model results. While this model analyzes dividend requirements, these requirements can be interpreted as a simplified representation of various dividend pressures in reality, including demands from institutional investors, corporate governance reforms, and social expectations. The destruction of firm value due to dividend taxation clearly exists. Shareholder return pressure on firms with moderate equity—those still in the process of investment, accumulating internal reserves, and optimizing their capital structure—reduces overall social firm value. However, dividend pressure may be justified when positive effects, such as signaling effects from shareholder returns, outweigh the reduction in firm value.

Careful attention should be paid to the intensity of such pressure, as evidenced by the differential impacts of θ values. Under moderate dividend pressure, the negative impact on the overall economy remains limited, and assuming positive effects from shareholder returns, the overall firm value may increase and capital efficiency metrics such as ROE and ROA may improve. However, when pressure becomes excessive, many low-productivity firms exit the market, new entry is suppressed, and significant economic costs are incurred.

These model results also suggest potential risks of government-led uniform shareholder return policies (such as capital efficiency targets and corporate governance reforms outlined in the Ito Report), as opposed to market-driven pressure from stock markets and investors. As this study shows, the effects of dividend pressure vary significantly depending on firm productivity and growth stage, and excessive pressure can have serious economy-wide implications through the exit of growing firms and suppression of new entry. Therefore, rather than imposing uniform shareholder return pressure with numerical targets, the government should establish a flexible policy framework that considers firm heterogeneity and growth stages.

5 Conclusion

This paper analyzes the impact of minimum dividend requirements on firm behavior and aggregate economic outcomes. Specifically, we construct a dynamic general equilibrium model that incorporates firm heterogeneity and capital structure choices, extending Katagiri (2014) framework to quantitatively evaluate the effects of dividend requirements on firms with low capital efficiency.

Our analysis yields two key findings. First, the impact of minimum dividend requirements varies significantly with their intensity. While moderate requirements have limited negative effects on the economy, more stringent requirements promote firm exits and significantly affect the real economy. Second, dividend requirements particularly affect firms in their growth stage. While it is optimal for these firms to set dividends to zero and accumulate internal reserves, dividend requirements potentially constrain their growth opportunities.

These results suggest potential risks in uniform shareholder return policies as represented by the Ito Report. Policies that do not account for firm heterogeneity and growth stages may have unintended consequences. Rather, it appears more desirable to allow market mechanisms to determine appropriate shareholder returns while maintaining a proper corporate governance framework.

This study makes two main contributions. First, it provides a novel analytical framework for quantitatively evaluating shareholder return policies by explicitly incorporating firm heterogeneity and capital structure choices. Second, by theoretically analyzing how minimum dividend requirements affect firm investment behavior and market structure, it offers new perspectives on the evaluation of recent shareholder return promotion policies in Japan.

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Appendices

A Household Optimization Problem and First-Order Conditions

Utility function:

$$\max_{L_t, S_{t+1}} E_0 \sum_{t=0}^{\infty} \beta^t \left[\log(C_t) - \eta L_t^s\right]$$

Budget constraint:

$$C_t + S_{t+1} = w_t L_t^s + (1 + r_f) S_t$$

Lagrangian:

$$\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t \left[\log(C_t) - \eta L_t^s + \lambda_t \left(w_t L_t^s + (1 + r_f) S_t - C_t - S_{t+1}\right)\right]$$

First-order conditions:

1. First-order condition with respect to consumption C_t:

$$\frac{\partial \mathcal{L}}{\partial C_t} = \frac{1}{C_t} - \lambda_t = 0 \Rightarrow \lambda_t = \frac{1}{C_t}$$

2. First-order condition with respect to labor supply L_t^s:

$$\frac{\partial \mathcal{L}}{\partial L_t^s} = -\eta + \lambda_t w_t = 0 \Rightarrow w_t = \eta C_t$$

3. First-order condition with respect to savings S_{t+1}:

$$\frac{\partial \mathcal{L}}{\partial S_{t+1}} = -\lambda_t + \beta E_t[\lambda_{t+1}(1 + r_f)] = 0 \Rightarrow \frac{1}{C_t} = \beta(1 + r_f) E_t \left[\frac{1}{C_{t+1}}\right]$$