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DETERMINANTS OF LONG-TERM COMPETITIVE ADVANTAGE AND ASSET EFFICIENCY IMPROVEMENT: UNRAVELING A KEY COMPONENT OF DUPONT ANALYSIS

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Data Availability Statement

The financial data for this study were obtained from a licensed database at Keio University and may be subject to access restrictions. For further details, please contact the corresponding author. A data use agreement may be required.

Declaration of Generative AI Use

ChatGPT assisted with translation, proofreading, and phrasing. The authors retain full responsibility for the content and originality.

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Abstract

This study investigates the determinants of changes in asset turnover, a key component of DuPont analysis and a crucial indicator of long-term competitive advantage. The findings reveal that managerial investment behavior drives improvements in asset turnover across different time horizons. Capital intensity and intangible assets, though initially limited in impact, enhance asset efficiency over time. However, the impact of goodwill is complex, highlighting the challenges of realizing mergers and acquisitions (M&A) synergies in asset efficiency. Using a sample based on Japanese GAAP, which exclude non-controlling interests in goodwill calculations, this study offers a precise analysis of goodwill's impact on changes in asset turnover. The results highlight the importance of time horizons in evaluating how managerial behavior and asset composition affect dynamics in asset turnover. These findings contribute to financial statement analysis literature and offer practical guidance for firms pursuing operational efficiency and sustainable competitive advantage. Future research should explore the role of unrecorded intangible assets in shaping changes in asset turnover.

JEL classification: G32, M41

Keywords: Financial Statement Analysis; Asset Turnover; DuPont Analysis; Intangible Assets; Goodwill.

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1 Introduction

This study analyzes the determinants of future changes in asset turnover, a key component of DuPont analysis and a crucial indicator of long-term competitive advantage. Prior research indicates that each component of DuPont analysis offers explanatory power for future earnings and stock returns beyond aggregated financial metrics (Nissim & Penman, 2001; Fairfield & Yohn, 2001; Soliman, 2008; Anderson, Hyun, Muslu, & Yu, 2023). In particular, changes in asset turnover have shown significant predictive power for these outcomes. However, limited research has directly examined the factors influencing changes in asset turnover, despite its recognized importance in assessing managerial efficiency for both corporate valuation and business practices.

Since Ohlson (1995) has sparked renewed interest in accounting-based valuation models, forecasting future earnings has become essential. Nissim and Penman (2001) present a theoretical framework that applies the concepts of DuPont analysis to financial ratio analysis, using the residual income model as its theoretical foundation. Their framework separates operating and financing activities to improve earnings forecast accuracy. Operating activities are captured by Return on Net Operating Assets ($RNOA$), which decomposes into Profit Margin (PM) and Asset Turnover (ATO).

Soliman (2008) suggests that DuPont components provide additional explanatory power for future earnings and stock returns compared to aggregated financial metrics. PM and ATO reflect distinct performance aspects—while PM captures pricing strategies and cost structures, ATO reflects asset utilization efficiency, which can serve as a sustainable competitive advantage. Although higher PM can attract competition, ATO improvements achieved through optimized operations are more challenging to imitate. These distinctions demonstrate the importance of examining ATO changes in financial analysis (Nissim & Penman, 2001; Fairfield & Yohn, 2001).

Building on this background, this study focuses on identifying the drivers of asset turnover. While the relevance of asset turnover is widely acknowledged, more research is needed to better understand its dynamics. This study explores how managerial investment behavior and operating asset composition influence changes in asset turnover.

This study's focus on goodwill as a key explanatory variable makes the selection of the Japanese sample particularly meaningful because the partial goodwill method under Japanese GAAP allows us to isolate goodwill's impact more precisely. While differences in accounting standards across jurisdictions can complicate the analysis of changes in asset turnover—U.S. GAAP, for instance, employs the full goodwill method (including non-controlling interests), and IFRS allows managerial discretion—the partial goodwill method in Japan excludes non-controlling interests. This distinction enables a clearer evaluation of goodwill's direct effect on changes in asset turnover, providing insights that may not emerge under other accounting environments.

The results provide several key insights into the drivers of changes in asset turnover over different time horizons. Firms reinvesting cash from operations into new investments show positive changes in asset turnover in both the short and longer term[1], supporting the idea that strategic investment enhances asset efficiency over time. Capital-intensive firms see improvements only in the longer term, suggesting that these investments require time to yield benefits. Similarly, intangible assets influence efficiency positively over time, while goodwill initially reduces asset turnover before contributing positively. However, goodwill growth from mergers and acquisitions (M&A) continues to show negative effects even in the longer term, highlighting the challenges of achieving synergy on asset efficiency. These findings emphasize the need to consider varying time horizons when assessing the effectiveness of managerial decisions and investment strategies on asset efficiency.

Building on these findings, this study makes significant contributions to both academic research and managerial practice. It clarifies the drivers behind changes in asset turnover, a crucial indicator of long-term competitive advantage, underscoring the importance of evaluating both immediate and delayed effects of managerial decisions and asset composition. The nuanced analysis of goodwill reveals the difficulties firms face in achieving asset efficiency synergies from M&A, compared to the more attainable cost synergies. This study deepens the understanding of asset efficiency, providing valuable insights for firms pursuing sustained competitive advantage.

2 Hypothesis Development

As identified by Nissim and Penman (2001), *PM* and ATO, components of *RNOA*, capture different aspects of corporate operations. While *PM* reflects the ability to adjust product pricing and cost structures, ATO measures how efficiently assets are utilized. Moreover, ΔATO, changes in asset turnover, represents the growth rate of sales relative to the growth rate of operating assets, making ΔATO a critical metric for assessing improvements in asset efficiency.

Given these characteristics, managerial investment behavior is expected to influence changes in asset turnover. Investments that enhance asset efficiency through factors such as innovation and productivity improvements, leading to higher sales, drive positive changes in asset turnover.

Hypothesis 1 *Firms that actively reinvest cash flows from operations into growth opportunities expe-*

[1] In this study, the term "longer term" refers to the three-year horizon used in the calculation of the dependent variable, ΔATO. It denotes a period extending beyond the immediate short-run (one-year horizon) without implying a genuinely "long-term" perspective, such as 10- or 20-year periods. By contrast, the term "long term," as used in this study, reflects findings from prior research (Nissim & Penman, 2001; Soliman, 2008), suggesting that asset turnover captures more persistent operational trends compared to profit margins, offering insights into structural efficiency changes over extended periods.

rience positive changes in asset turnover, indicating sustained improvements in asset efficiency over time.

Another key factor is the balance between capital and labor, which is expected to affect changes in asset turnover. Capital investment tends to yield greater marginal effects on sales growth compared to labor investment, as technology and equipment improve efficiency and expand production capacity. In contrast, labor investments face scalability limitations. For example, automation or technological advancements are likely to generate more substantial sales growth than investments in employee training.

Hypothesis 2 *Capital-intensive firms are more likely to experience positive changes in asset turnover compared to labor-intensive firms.*

The next hypothesis examines intangible assets, which are increasingly significant within operating assets. These assets, including software, intellectual property, and goodwill, likely enhance asset efficiency and contribute to positive changes in asset turnover. However, goodwill, typically recognized with M&A synergies in mind, requires time for these synergies to materialize and affect sales. Based on these considerations, two hypotheses are formed to analyze the influence of intangible assets on changes in asset turnover.

Hypothesis 3-1 *The higher the proportion of substantive intangible assets, such as software and intellectual property, the greater the positive effect on changes in asset turnover.*

Hypothesis 3-2 *Goodwill contributes little substantive value immediately following M&A, causing a decline in asset efficiency in the short term. However, as synergies gradually materialize over the longer term, asset turnover is expected to improve.*

3 Research Design

3.1 Sample and Variable Definitions

The initial sample includes firm-year observations from 2012 to 2021. These observations are limited to cases where the financial data necessary for generating variables are available from the Nikkei NEEDS database. Since ATO calculations are sensitive to differences in accounting standards, particularly the recognition of goodwill, the sample is restricted to firm-years applying Japanese GAAP. Financial firms, including banks, securities, and insurance companies, are excluded due to their distinct accounting practices. Additionally, firm-years with negative Net Operating

Assets (*NOA*) are excluded, as *NOA* is used as the deflator for key variables. After these exclusions, the final sample comprises 2,970 firms and 23,697 firm-year observations.

3.2 Variables and Model Definitions

Table 1 presents the descriptive statistics and correlation matrix for the key variables.

ΔATO, changes in asset turnover, is the dependent variable in this study, and its calculation process excludes the effects of non-controlling interests to ensure more accurate analysis. To determine ΔATO, ATO is first calculated by dividing sales by *NOA*. *NOA* is defined as the difference between operating assets and operating liabilities, where operating liabilities are defined by subtracting financial liabilities from total assets.

Table 1: Descriptive Statistics and Correlation Coefficient Matrix

Panel A: Descriptive statistics of main variables

	Mean	Std	Min	25%	50%	75%	Max
ΔATO_{t+1}	0.0177	2.4589	-12.8591	-0.2409	0.0049	0.2462	13.4142
$ActiveINV_t$	0.1978	0.3984	0.0000	0.0000	0.0000	0.0000	1.0000
$LaborEQUIP_t$	2.3509	1.0514	0.1137	1.7494	2.3704	2.9615	5.6339
$Intangible_t$	0.0241	0.0413	0.0000	0.0048	0.0108	0.0240	0.2864
GW_t	0.0143	0.0410	0.0000	0.0000	0.0000	0.0064	0.2893
$GWGrowth_t$	0.1167	0.3211	0.0000	0.0000	0.0000	0.0000	1.0000
PM_t	0.0348	0.0588	-0.3058	0.0135	0.0318	0.0568	0.2358
BTM_t	1.1787	0.7537	0.0743	0.6078	1.0368	1.5809	4.4072
ΔWC_t	0.0006	0.0494	-0.1497	-0.0194	-0.0007	0.0187	0.8802
ΔNCO_t	0.0002	0.0510	-0.1619	-0.0200	-0.0014	0.0178	0.9590
ΔFIN_t	0.0077	0.0820	-0.2781	-0.0253	0.0098	0.0424	1.8997

Panel B: Correlation coefficient matrix

	ΔATO_{t+1}	$ActINV_t$	$LaborE_t$	$Intang_t$	GW_t	GWG_t	PM_t	BTM_t	ΔWC_t	ΔNCO_t	ΔFIN_t
ΔATO_{t+1}		-0.2365	-0.0442	0.0174	-0.0203	-0.0889	-0.0645	-0.0198	-0.4211	-0.1733	0.5778
$ActiveINV_t$	-0.0950		0.0933	0.0394	0.0512	0.1098	-0.0778	0.0383	0.1799	0.2612	-0.3821
$LaborEQUIP_t$	-0.0248	0.0994		-0.2739	-0.1651	-0.0867	0.0819	0.2267	0.0097	0.0409	-0.0181
$Intangible_t$	0.0054	0.0344	-0.2899		0.2680	0.1390	0.0585	-0.2499	-0.0310	-0.0018	-0.0057
GW_t	-0.0432	0.0551	-0.2220	0.2674		0.4982	0.0161	-0.2542	-0.0121	-0.0101	-0.0472
$GWGrowth_t$	-0.0737	0.1098	-0.0871	0.1069	0.3457		0.0155	-0.1271	-0.0042	0.1536	-0.1313
PM_t	-0.0560	-0.0201	0.0970	0.0462	-0.0258	0.0063		-0.3074	-0.0051	-0.0017	0.1348
BTM_t	-0.0109	0.0410	0.1946	-0.2374	-0.2060	-0.1189	-0.1973		0.0186	0.0378	-0.0358
ΔWC_t	-0.2828	0.1020	-0.0020	-0.0407	-0.0204	-0.0025	0.0061	0.0010		-0.0563	-0.5003
ΔNCO_t	-0.1751	0.2461	0.0231	0.0398	0.0924	0.1809	0.0210	-0.0034	-0.0889		-0.2349
ΔFIN_t	0.3194	-0.2768	-0.0222	-0.0162	-0.0739	-0.1302	0.0989	-0.0400	-0.4229	-0.3108	

Notes:

- The lower left diagonal presents Pearson correlation coefficients, while the upper right diagonal presents Spearman rank correlation coefficients.
- *ActiveINV* is a dummy variable indicating firm-years with investment exceeding cash inflows from operating activities; *LaborEQUIP* is defined as the capital intensity, measured as the total Property, Plant, and Equipment (PP&E) per employee; *Intangible* is the ratio of intangible assets (excluding goodwill) to operating assets; *GW* is the ratio of goodwill to operating assets; *GWGrowth* is a dummy variable indicating firm-years with an increase in goodwill; *PM* is the profit margin based on NOPAT; *BTM* is the industry-adjusted book-to-market ratio; ΔWC is the change in working capital; ΔNCO is the change in net operating assets; ΔFIN is the change in net financial assets.

Because the last part of this calculation removes non-controlling interests from *NOA*, only the assets controlled by the parent company's shareholders are captured in the denominator. Similarly, sales, the numerator in the *ATO* calculation, are adjusted to exclude the effects of non-controlling interests. This consistent treatment ensures that *ATO* reflects asset utilization efficiency from the perspective of controlling interests.

To analyze the determinants of changes in asset turnover, two dependent variables are used: changes in asset turnover from the current period to the next, ΔATO_{t+1}, and to three periods ahead, ΔATO_{t+3}. These two time horizons allow the examination of both immediate and delayed effects on asset efficiency.

Several key explanatory variables are defined to test the hypotheses. *ActiveINV* is a dummy variable indicating firm-years with positive operating cash flows but negative free cash flow, highlighting active reinvestment behavior. It reflects a strategic approach where firms actively allocate cash generated from operations to pursue growth opportunities through new investments, sustaining a cycle of proactive capital deployment. *LaborEQUIP* captures capital intensity, measured as the total Property, Plant, and Equipment (PP&E) per employee. Additional variables include *Intangible*, the ratio of intangible assets (excluding goodwill) to total operating assets, *GW*, the ratio of goodwill to total operating assets, and *GWGrowth*, a dummy variable indicating firm-years with an increase in goodwill compared to the previous year.

Other factors influencing changes in asset turnover, such as the operating profit margin (*PM*) and the book-to-market ratio (*BTM*), are also controlled for. Control variables are also incorporated to capture accrual-related and fundamental factors. Following Soliman (2008), the RSST_Controls by Richardson, Sloan, Soliman, and Tuna (2005) and the AB_Controls by Abarbanell and Bushee (1997) are included. Table 2 provides detailed definitions of all variables.

Using these variables, the following model tests the hypotheses. The Hausman and Breusch-Pagan tests confirm the use of a fixed-effects model:

$$\Delta ATO_{i,t+k} = \alpha_1 ActiveINV_{i,t} + \alpha_2 LaborEQUIP_{i,t} + \alpha_3 Intangible_{i,t} + \alpha_4 GW_{i,t} + \alpha_5 GWGrowth_{i,t} + \sum \alpha_j \text{Controls}_{j,i,t} + u_i + \varepsilon_{i,t}, \quad (1)$$

where t denotes the fiscal year, i the firm, and k the time horizons. Controls refers to the required control variables, including the RSST_Controls and the AB_Controls, u_i represents firm-specific effects, and $\varepsilon_{i,t}$ is the error term for each firm-year. All variables, except for dummy variables, are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers.

If the estimated coefficients for *ActiveINV*, *LaborEQUIP*, and *Intangible* are significantly positive, then this model supports Hypotheses 1, 2, and 3-1. In contrast, if *GW* and *GWGrowth* show significant negative coefficients at k = 1, followed by significant positive coefficients at k = 3, then

Table 2: Definition of Variables

Variable	Definition	Data Source
Dependent Variables		
ΔATO	The difference between *ATO* in the current period and *ATO* in either the next period or three periods ahead.	Nikkei NEEDS
Key Explanatory Variables		
ActiveINV	A dummy variable equal to 1 for firm-years with positive operating cash flows and negative investing cash flows that exceed the positive operating cash flows, and 0 otherwise.	Nikkei NEEDS
LaborEQUIP	The capital intensity, measured as the total Property, Plant, and Equipment (PP&E) per employee.	Nikkei NEEDS
Intangible	The ratio of intangible assets excluding goodwill to total operating assets.	Nikkei NEEDS
GW	The ratio of goodwill to total operating assets.	Nikkei NEEDS
GWGrowth	A dummy variable equal to 1 indicating firm-years with an increase in goodwill compared to the previous year, and 0 otherwise.	Nikkei NEEDS
Control Variables		
PM	Operating profit margin: the ratio of NOPAT-based operating profit to sales.	Nikkei NEEDS
BTM	Industry-adjusted book-to-market ratio: calculated by subtracting the average *BTM* of firms within the same middle category of the Nikkei Industry Classification system from the individual firm's *BTM*.	Nikkei NEEDS
RSST_Controls		
ΔWC	The change in working capital (current operating assets minus current operating liabilities), scaled by the average total assets during the period.	Nikkei NEEDS
ΔNCO	The change in net operating assets (non-current operating assets minus non-current operating liabilities), scaled by the average total assets during the period.	Nikkei NEEDS
ΔFIN	The change in financial assets minus financial liabilities, scaled by the average total assets during the period.	Nikkei NEEDS
AB_Controls		
AB_INV	The change in inventory from the previous year minus the change in sales from the previous year, scaled by the average total assets during the period.	Nikkei NEEDS
AB_REC	The change in accounts receivable from the previous year minus the change in sales from the previous year, scaled by the average total assets during the period.	Nikkei NEEDS
AB_CAPEX	The change in capital expenditures from the previous year minus the industry average change, scaled by the average total assets during the period.	Nikkei NEEDS
AB_GM	The change in sales from the previous year minus the change in gross margin from the previous year, scaled by the average total assets during the period.	Nikkei NEEDS
AB_ETR	The value calculated by subtracting the current effective tax rate from the three-year average effective tax rate, then multiplying by the change in net income attributable to parent company shareholders from the previous year.	Nikkei NEEDS

(*continued on next page*)

Table 2 (continued)

Variable	Definition	Data Source
AB_AQ	A dummy variable equal to 0 indicating firm-years with an unqualified audit opinion, and 1 otherwise.	Nikkei NEEDS
AB_SandA	The change in selling, general, and administrative expenses (SG&A) from the previous year minus the change in sales from the previous year, scaled by the average total assets during the period.	Nikkei NEEDS
AB_LF	The change in sales per employee from the previous year, divided by the previous year's sales per employee.	Nikkei NEEDS

Note:
- All variables are calculated based on financial data obtained from Nikkei NEEDS.
- *ATO* is calculated by dividing sales by the beginning balance of *NOA*, where *NOA* is computed by subtracting operating liabilities from operating assets. Operating assets are calculated by subtracting financial assets from total assets, while operating liabilities are calculated by subtracting financial liabilities from total liabilities. Financial assets include cash and cash equivalents, marketable securities, and both short- and long-term loans. Financial liabilities include both short- and long-term borrowings and bonds.
- *ActiveINV* focuses on firm-years where positive operating cash flows are reinvested through investments exceeding those cash flows. The dummy variable excludes cases where negative free cash flows arise from factors unrelated to active reinvestment, ensuring the analysis targets firms with balanced investment behavior.
- For RSST_Controls, current operating assets are calculated by subtracting cash and cash equivalents and trading securities from total current assets, and current operating liabilities are calculated by subtracting short-term borrowings and bonds payable from total current liabilities. Non-current operating assets are equal to total non-current assets, and non-current operating liabilities are calculated by subtracting current liabilities, long-term borrowings, bonds payable, and convertible bonds from total liabilities.
- The effective tax rate for *AB_ETR* is calculated by dividing total tax expense by pre-tax income.

Hypothesis 3-2 is supported, indicating that goodwill influences changes in asset turnover positively but with a time lag.

Thus, this research design offers a comprehensive analysis of the determinants of changes in asset turnover, providing valuable insights into how managerial decisions and asset composition enhance asset efficiency across different time horizons.

4 Results

Table 3 shows the estimation results from equation (1), with different combinations of dependent and control variables. Columns (1) and (3) use ΔATO_{t+1}, while columns (2) and (4) use ΔATO_{t+3}, with AB_Controls included in both columns (3) and (4). Variance Inflation Factor (VIF) checks confirmed no multicollinearity issues. Using the Hausman test and other diagnostics, we estimate a fixed-effects model with firm and time effects to control for unobserved heterogeneity, applying cluster-robust standard errors to address heteroscedasticity and autocorrelation across both firms and fiscal years.

Regarding Hypothesis 1, which examines the effects of managerial investment behavior, the estimated coefficient for *ActiveINV* is significantly positive across all columns. As shown in columns

Table 3: Factors Contributing to Asset Turnover Growth

	Pred Sign	FE MODEL			
		(1)	(2)	(3)	(4)
Dependent Variable		ΔATO_{t+1}	ΔATO_{t+3}	ΔATO_{t+1}	ΔATO_{t+3}
$ActiveINV_t$	+	0.1302**	0.1448***	0.1686***	0.1345*
		(0.021)	(0.006)	(0.004)	(0.074)
$LaborEQUIP_t$	+	−0.0912	0.4985***	−0.1602	0.8589***
		(0.475)	(0.001)	(0.332)	(0.000)
$Intangible_t$	+	0.7708	11.8644***	−0.0927	9.1758***
		(0.191)	(0.000)	(0.934)	(0.000)
GW_t	− /+	−5.1528***	6.0387***	−5.3211***	5.5370***
		(0.000)	(0.000)	(0.000)	(0.007)
$GWGrowth_t$	− /+	−0.1354*	−0.3520***	−0.1131	−0.1448
		(0.052)	(0.003)	(0.152)	(0.250)
PM_t	−	−5.4608***	−7.7908***	−5.9445***	−6.7835***
		(0.000)	(0.000)	(0.000)	(0.000)
BTM_t	+	−0.1056**	0.3428***	−0.1252**	0.3352***
		(0.023)	(0.008)	(0.018)	(0.002)
ΔWC_t	−	−11.7980***	−8.5147***	−11.7115***	−7.7642***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔNCO_t	−	−7.1143***	−7.4297***	−6.4838***	−6.7102***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔFIN_t	+	4.9641***	1.6430*	5.4327***	2.7539***
		(0.000)	(0.059)	(0.000)	(0.001)
AB_Controls				Yes	Yes
Observations		23,697	17,605	20,433	14,723
R^2 (Witnin)		0.159	0.062	0.165	0.074

Note:
- The results are derived from a fixed-effects model (FE model) with firm and time effects, supported by the Hausman test (p-value = 0.000) and the Breusch-Pagan test (p-value = 0.000).
- Cluster-robust standard errors are applied to address heteroscedasticity and autocorrelation across both firms and fiscal years, following the methodology validated by Petersen (2009).
- P-values are reported in parentheses, and ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.
- *ActiveINV* is a dummy variable indicating firm-years with investment exceeding cash inflows from operating activities; *LaborEQUIP* is defined as the capital intensity, measured as the total Property, Plant, and Equipment (PP&E) per employee; ***Intangible*** is the ratio of intangible assets (excluding goodwill) to operating assets; *GW* is the ratio of goodwill to operating assets; ***GWGrowth*** is a dummy variable indicating firm-years with an increase in goodwill; *PM* is the profit margin based on NOPAT; *BTM* is the industry-adjusted book-to-market ratio; *ΔWC* is the change in working capital; *ΔNCO* is the change in net operating assets; *ΔFIN* is the change in net financial assets.
- AB Controls are variables controlling for fundamental factors based on Abarbanell and Bushee (1997).

(1) and (2), the effect remains significantly positive in both the short and longer term. This effect also holds robust even when including fundamental factors through AB_Controls, supporting Hypothesis 1. These results suggest that firms reallocating cash from operations to new investments achieve positive changes in asset turnover, indicating that active investments enhance asset efficiency over time[2].

[2] Since *ActiveINV* is defined as a dummy variable, it lacks information regarding the magnitude of cash flows, which could potentially have a significant impact on the results. To address this concern, robustness tests were conducted by analyzing interaction terms between continuous cash flow variables and dummy variables. The results support the findings of the analyses for *ActiveINV*.

For Hypothesis 2, which examines the effect of capital intensity, the coefficient for *LaborEQUIP* is significantly positive only in columns (2) and (4), indicating significance for longer-term changes in asset turnover but not for short-term ones. Although these findings partially support Hypothesis 2, they indicate that capital investments need time to enhance asset efficiency. Importantly, from a longer-term perspective, after controlling for firm-specific effects and other factors, the results indicate that firms with lower labor intensity than their competitors are better positioned to achieve sustainable competitive advantages.

Hypothesis 3-1 examines the effects of intangible assets excluding goodwill. The coefficient for *Intangible* is not significant in the short term but becomes significantly positive in the longer term. This pattern, similar to the findings for capital intensity in Hypothesis 2, indicates that intangible assets take time to positively influence asset efficiency.

However, interpreting the results regarding goodwill in testing Hypothesis 3-2 presents complexities. The coefficient for GW (the goodwill ratio) aligns with the hypothesis, showing a significant negative effect on ΔATO_{t+1}, followed by significant positive effect on ΔATO_{t+3}. In contrast, the coefficient for *GWGrowth* (the goodwill growth dummy) indicates a persistent negative effect, even over the longer term. This result suggests that synergies expected from M&A do not materialize in terms of asset efficiency within at least three periods[3]. Further discussion of these results regarding goodwill will follow in Section 5.

The other control variables also provide meaningful insights. The coefficient for *PM* is significantly negative over both the short and longer term, indicating a trade-off between profitability and asset efficiency. This trade-off reflects the distinct characteristics of *PM* and *ATO*, as highlighted by Nissim and Penman (2001) and Soliman (2008). Additionally, the positive and significant coefficient for *BTM* in the longer term indicates that firms with higher *BTM* tend to experience positive changes in asset turnover in the longer term, aligning with the value premium observed in high-*BTM* firms (Fama & French, 1992).

5 Conclusion

This study analyzed the determinants of changes in asset turnover, a key component of DuPont analysis and a crucial indicator of long-term competitive advantage. The findings emphasize the importance of evaluating these factors across different time horizons to understand how managerial decisions and asset composition contribute to improving asset efficiency. While some factors,

[3] To ensure the robustness of the findings, additional analyses were conducted to address two potential concerns: (1) the impact of the COVID-19 pandemic on ΔATO and (2) the potential sample selection issue regarding goodwill. Specifically, the models were re-estimated by restricting the sample to pre-pandemic observations (fiscal year-end dates of $t + k$ falling up to March 2020) and to firm-years with $GW > 0$. Despite the reduced sample size, the results across these additional tests remain consistent with the main findings, with the fundamental patterns and directional influences of key explanatory variables preserved. These results suggest that the study's conclusions are not substantially affected by these factors.

such as managerial investment behavior, are less sensitive to time horizons, the results reveal that capital intensity and intangible assets require more time to manifest their impact on efficiency.

Meanwhile, the analysis of goodwill offers complex yet valuable insights. Goodwill rates toward operating assets initially show a negative impact but gradually contribute positively over time, reflecting the delayed realization of synergy effects. In contrast, the goodwill growth dummy, closely associated with M&A activities, negatively affects asset efficiency even in the longer term.

This distinction arises because the goodwill growth dummy captures only the increase in goodwill recognized during the current period, primarily from M&A, while the goodwill rate reflects the cumulative accumulation of past goodwill. The positive impact of strategic M&A initiatives with a long-term perspective on asset efficiency may be reflected in a higher goodwill rate. Furthermore, the unique treatment of goodwill amortization under Japanese GAAP shapes these results, as amortization gradually improves asset turnover by reducing the denominator over time.

In contrast, the initial increase in goodwill deteriorates asset efficiency by inflating the denominator. Additionally, the persistent negative impact on asset efficiency suggests that post-merger integration (PMI) takes time to generate synergies, particularly for companies pursuing long-term strategic alignment. This outcome aligns with the idea that M&A synergies are more likely to emerge as cost savings in profit margins, while improvements in asset efficiency take longer to materialize. Another possibility is that PMI efforts in Japanese firms may underperform specifically in achieving asset efficiency synergies. Future research could focus on examining the timeframe required for M&A to generate asset efficiency synergies, providing deeper insights into the dynamics of PMI.

Finally, while this study focuses on intangible assets and goodwill, unrecorded intangible assets remain a critical area for future research. Prior research emphasizes the economic significance of R&D expenditures, which are expensed immediately rather than capitalized (Amir & Lev, 1996; Francis & Schipper, 1999). Firms with substantial R&D investments often encounter extended payback periods, and immediate expensing may distort ATO calculations. Future research exploring the impact of unrecorded intangible assets on asset turnover could provide deeper insights into their contribution to asset efficiency.

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Appendix

Table 4: Potential Impact of the COVID-19 Pandemic

	Pred Sign	FE MODEL			
		(1)	(2)	(3)	(4)
Dependent Variable		ΔATO_{t+1}	ΔATO_{t+3}	ΔATO_{t+1}	ΔATO_{t+3}
$ActiveINV_t$	+	0.1221**	0.1579***	0.1597**	0.1853*
		(0.048)	(0.003)	(0.013)	(0.055)
$LaborEQUIP_t$	+	−0.2282	0.3552*	−0.2094	0.9554***
		(0.146)	(0.089)	(0.327)	(0.001)
$Intangible_t$	+	2.6070**	15.8814***	1.7854	9.3796**
		(0.026)	(0.000)	(0.331)	(0.018)
GW_t	− /+	−6.0014***	4.8891	−6.8096***	5.7424*
		(0.000)	(0.164)	(0.000)	(0.078)
$GWGrowth_t$	− /+	−0.1058	−0.3103**	−0.0961	−0.0677
		(0.171)	(0.011)	(0.288)	(0.565)
PM_t	−	−6.5269***	−6.7966***	−7.2793***	−6.5050***
		(0.000)	(0.000)	(0.000)	(0.000)
BTM_t	+	−0.0790	0.4272**	−0.0898	0.5352***
		(0.180)	(0.022)	(0.235)	(0.000)
ΔWC_t	−	−11.3774***	−7.7029***	−11.4577***	−5.7445***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔNCO_t	−	−7.0928***	−6.5104***	−6.6919***	−5.2891***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔFIN_t	+	5.1602***	1.7162*	5.7403***	3.6031***
		(0.000)	(0.087)	(0.000)	(0.001)
AB_Controls				Yes	Yes
Observations		18,715	12,991	15,616	10,281
R^2 (Witnin)		0.156	0.055	0.166	0.068

Note:
- The results are derived from a fixed-effects model (FE model) with firm and time effects, supported by the Hausman test (p-value = 0.000) and the Breusch-Pagan test (p-value = 0.000).
- The analysis presented in this table is conducted under the same conditions as those described in Table 3 of the manuscript, except that the sample period is restricted to pre-pandemic observations (fiscal year-end dates of $t + k$ falling up to March 2020).

Table 5: Censored Data for GW

	Pred Sign	FE MODEL			
		(1)	(2)	(3)	(4)
Dependent Variable		ΔATO_{t+1}	ΔATO_{t+3}	ΔATO_{t+1}	ΔATO_{t+3}
$ActiveINV_t$	+	0.1301	0.2405**	0.1172	0.0585
		(0.160)	(0.029)	(0.198)	(0.567)
$LaborEQUIP_t$	+	−0.0566	0.7781***	−0.3677	1.1209***
		(0.610)	(0.000)	(0.221)	(0.005)
$Intangible_t$	+	3.5823*	13.2017***	1.7973	12.4825***
		(0.062)	(0.000)	(0.462)	(0.000)
GW_t	− /+	−4.9984**	5.9879**	−6.7059***	2.7823
		(0.014)	(0.034)	(0.000)	(0.321)
$GWGrowth_t$	− /+	−0.1104	−0.3137*	−0.1091	−0.1345
		(0.187)	(0.080)	(0.281)	(0.525)
PM_t	−	−7.9269***	−11.1126***	−7.0691***	−9.7137**
		(0.000)	(0.000)	(0.000)	(0.013)
BTM_t	+	−0.4258***	0.1415	−0.4751***	0.2134
		(0.000)	(0.537)	(0.000)	(0.208)
ΔWC_t	−	−12.5374***	−9.8122***	−13.0460***	−9.7722***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔNCO_t	−	−9.9983***	−9.6553***	−9.1604***	−8.4310***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔFIN_t	+	5.2731***	1.1741	5.7945***	0.9865
		(0.000)	(0.466)	(0.000)	(0.565)
AB_Controls				Yes	Yes
Observations		8,861	6,384	7,630	5,347
R^2 (Witnin)		0.148	0.073	0.156	0.075

Note:

- The results are derived from a fixed-effects model (FE model) with firm and time effects, supported by the Hausman test (p-value = 0.000) and the Breusch-Pagan test (p-value = 0.000).
- The analysis presented in this table is conducted under the same conditions as those described in Table 3 of the manuscript, except that the sample is restricted to firm-years with recorded goodwill ($GW > 0$).

Table 6: Why is ActiveINV a dummy variable?

	Pred Sign	FE MODEL			
		(1)	(2)	(3)	(4)
Dependent Variable		ΔATO_{t+1}	ΔATO_{t+3}	ΔATO_{t+1}	ΔATO_{t+3}
OCF_t	+	1.7777	-3.0326***		
		(0.159)	(0.000)		
$negativeFCF_t$	?	0.1730	-0.1107		
		(0.166)	(0.274)		
$OCF_t \times negativeFCF_t$	+	-2.4918**	2.2471***		
		(0.036)	(0.003)		
FCF_t	?			-0.7544*	-0.0999
				(0.059)	(0.898)
$PositiveOCF_t$	+			0.3916***	0.1178
				(0.002)	(0.392)
$FCF_t \times PositiveOCF_t$	−			2.5092***	-1.8781***
				(0.000)	(0.097)
$LaborEQUIP_t$	+	-0.0557	0.5174***	-0.0635	0.4621***
		(0.661)	(0.001)	(0.635)	(0.002)
$Intangible_t$	+	0.8652*	11.2263***	1.2076***	11.3955***
		(0.079)	(0.000)	(0.002)	(0.000)
GW_t	− /+	-4.7005***	5.5328***	-5.0206***	5.7080***
		(0.001)	(0.002)	(0.000)	(0.001)
$GWGrowth_t$	− /+	-0.1468**	-0.3155***	-0.1294*	-0.3380***
		(0.043)	(0.006)	(0.064)	(0.005)
PM_t	−	-5.8244***	-5.7500***	-6.3133***	-7.3109***
		(0.000)	(0.000)	(0.000)	(0.000)
BTM_t	+	-0.0867*	0.3218**	-0.0848*	0.3357**
		(0.083)	(0.011)	(0.078)	(0.011)
ΔWC_t	−	-11.4186***	-10.0401***	-10.6820***	-9.0181***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔNCO_t	−	-6.9358***	-7.1192***	-6.5378***	-8.0944***
		(0.000)	(0.000)	(0.000)	(0.000)
ΔFIN_t	+	4.5850***	2.1041***	4.1260***	2.1531***
		(0.000)	(0.009)	(0.000)	(0.002)
Observations		23,697	17,605	23,697	17,605
R^2 (Witnin)		0.162	0.066	0.163	0.064

Note:
- The results are derived from a fixed-effects model (FE model) with firm and time effects, supported by the Hausman test (p-value = 0.000) and the Breusch-Pagan test (p-value = 0.000).
- *OCF* represents the operating cash flow normalized by operating assets; *negativeFCF* is a dummy variable for firm-years with negative free cash flows; *FCF* is the sum of operating cash flow and investing cash flow, normalized by operating assets; *PositiveOCF* is a dummy variable for firm-years with positive operating cash flows.
- The analysis presented in this table is conducted under the same conditions as those described in Table 3 of the manuscript, except that *ActiveINV* is replaced with the variables and their interactions described above.