Incorporating Piecewise-Linear Variables into an Empirical Model of Non-Current Asset Impairment Timeliness*

KEISHI FUJIYAMA†

Research Institute for Economics and Business Administration,
KOBE UNIVERSITY

ABSTRACT

While prior research employs linear stock returns as a proxy for economic losses, this study uses piecewise-linear stock returns to separate positive and negative stock returns. It also examines the relationships between non-current asset impairments and changes in sales and cash flows from operations, which can be viewed as short-term indicators of economic impairments. Consistent with prior research, I find a negative relationship between non-current asset impairments and negative stock returns in five years before their recognition. Contrary to prior research, I also find such a relationship in the recognition years. The results indicate that th e relationships are stronger one or two years before their recognition than in the recognition years and three years before their recognition. These results suggest that the non-current asset impairment losses reported by Japanese firms are consistent with the Japanese accounting standard, although such losses are not necessarily reported in a timely manner. In addition, I find evidence suggesting that changes in sales and cash flows from operations in recognition years are short-term indicators of non-current asset impairments. Overall, incorporating piecewise-linear variables improves the empirical model of non-current asset impairment timeliness.

JEL Classification: M41
Keywords: Non-Current Asset Impairment; Timeliness; Piecewise-Linear Regression

1. Introduction

This study investigates whether incorporating piecewise-linear stock returns and short-term indicators improves the empirical model of non-current asset impairment timeliness. Prior research suggests that a non-current asset impairment is subject to management discretion and reflects management incentives such as "big bath," income smoothing, and management turnovers in Japan (e.g., Enomoto 2008; Obinata and Okada 2008; Hu and Kurumado 2012; Fujiyama 2014a, 2014c; Kimura 2015). Consistently, using data on Japanese firms, Fujiyama (2014b) finds that non-current asset impairments are not correlated with linear returns in the years of their recognition, but that such relationships exist in the period from one year to four (or five) years before their recognition, suggesting that Japanese firms can record non-current asset impairments in a less timely manner than expected by accounting standards.[1] Moreover, the timeliness of non-current asset impairment is particularly controversial in Japan. In general, the degree of loss recognition timeliness, or conditional conservatism, is lower in Japan than in common law countries such as the U.S. and the U.K. (Ball et al. 2000). Non-current asset impairment losses are a major component of accounting conservatism (Beaver and Ryan 2005). Therefore, non-current asset impairment timeliness is of great concern to practitioners and researchers and it is important to improve the empirical models used in prior research, such as Fujiyama (2014b), and construct a better model.

While Fujiyama (2014b) employs linear stock returns as a proxy for economic losses to investigate non-current asset impairment timeliness in Japan, Banker et al. (2017) recommend piecewise-linear stock returns and short-term indicators.[2] Non-current asset impairment losses reflect only economic losses or bad news, as accounting standards prohibit recording upward valuation profits. Thus, separating positive (good news) from negative stock returns (bad news) is expected to better reflect the asymmetric timeliness of profit and loss accounting. Accordingly, prior research on accounting conservatism captures the asymmetric timeliness of gains and losses using piecewise-linear stock returns (e.g. Basu, 1997). However, studies on asset impairments employ linear stock returns to capture economic losses (e.g., Riedl 2004; Lapointe-Antunes et al. 2009; Fujiyama 2014b; Albersmann and Quick 2020), which may result in estimation bias. An exception is Iatridis et al. (2021), who employ piecewise-linear stock returns only for year t but not for the years before impairment recognition. Moreover, Banker et al. (2017) suggest that different indicators, such as stock returns and changes in sales and cash flows from operations, predict cash flows over varying time horizons and have different impacts on asset classes. Stock returns capture changes in cash flows over the long-term, and changes in sales and operating cash flows capture such changes over the short-term. Thus, changes in sales and operating cash flows are expected to indicate non-current asset impairments incremental to stock returns. As tangible assets have a finite useful life and goodwill has an indefinite future life, goodwill impairments are more strongly

---

[1] Prior research investigates the timeliness of asset impairments using other models and provides mixed evidence regarding the timeliness of the impairment losses of assets, such as non-current assets and goodwill (Chen et al. 2008; Choi 2008; Li and Sloan 2017). The timeliness of goodwill impairment losses is affected by narrative disclosure quality (Iatridis et al. 2021), CEO overconfidence (Chung and Hribar 2021), and audit quality (Albersmann and Quick 2020). André et al. (2016) show that goodwill impairment practices differ in the U.S. and European countries from the viewpoint of timeliness. Glaum et al. (2018) find that country-level enforcement determines goodwill impairment timeliness.

[2] Note that some argue that a piece-wise linear regression of earnings on stock returns provides an estimation bias in the presence of the skewness of stock returns (Jarva and Lof 2021; Obinata 2021).

correlated with stock returns than are tangible asset impairments. Note that stock returns are a more important impairment indicator even for tangible assets than operating cash flows and sales changes (Banker et al. 2017). Consistently, Banker et al. (2017) show that Riedl's (2004) results change when the empirical model incorporates piecewise-linear stock returns and piecewise-linear short-term indicators of asset impairments. Therefore, it is important to investigate whether the new empirical model alters Fujiyama's (2014b) results.

In this study, I re-examine the timeliness of non-current asset impairments based on Fujiyama (2014b) and using piecewise-linear stock returns, as suggested by Banker et al. (2017). In addition, I examine the relationships between non-current asset impairments and changes in sales and cash flows from operations (CFO), which Banker et al. (2017) suggest can be viewed as short-term indicators of economic loss. Using data on Japanese firms during 2007–2019, I find a negative relationship between non-current asset impairments (positive values) in year t and negative stock returns in year t–5, consistent with Fujiyama (2014b). Second, non-current asset impairments are negatively correlated with negative stock returns in year t, which is inconsistent with Fujiyama (2014b), who does not observe any correlation between impairments and linear stock returns in year t. Third, the relationships between non-current asset impairments and negative stock returns are strongest in years t–1 and t–2. These results suggest that consistent with the "probability criterion" of the impairment recognition employed by the Japanese standard, contrary to the "economic criterion" employed by International Financial Reporting Standards, the relationship between impairments and negative stock returns is stronger in years t–1 and t–2 than in year t.[3] Meanwhile, the negative relationships from years t–5 to t–3 indicate that Japanese firms do not necessarily recognize non-current asset impairments in a timely manner. Fourth, I find statistically significant correlations between non-current asset impairments and negative changes in sales and CFO, suggesting that changes in sales and CFO are short-term indicators of economic losses. Finally, additional analyses reveal that using non-zero thresholds for non-current asset impairment triggers provides a minor improvement in the explanatory power of the empirical model of non-current asset impairment timeliness.

This study contributes to the literature in two ways. First, it improves the findings of Fujiyama (2014b). While the finding of a negative relationship between non-current asset impairments and stock returns in year t–5 is consistent with Fujiyama (2014b), here I present a statistically significant relationship between impairments and negative stock returns in year t. Moreover, the adjusted R-squared is higher for the models employed in this study. My findings suggest that piecewise-linear stock returns better reflect the asymmetric timeliness of non-current asset impairments and that

---

[3] For the recognition of non-current asset impairments, the Japanese standard and the U.S. GAAP employ "probability criterion," which requires a firm to recognize an impairment loss "only if it is considered probable that the carrying amount of an asset cannot be fully recovered" (IAS 36, APPENDIX B, B81); IFRS employs "economic criterion," which requires a firm to recognize an impairment loss "whenever the recoverable amount of an asset is below its carrying amount" (IAS 36, APPENDIX, B88). Further, see Gordon and Hsu (2018) for the difference in the recognition criteria for asset impairments. The Japanese standard requires a firm to test the impairment of an asset when the signs of a non-current asset impairment, including operating losses or cash flows in two consecutive years or more, are observed and compare the undiscounted future cash flows with the carrying amount of an asset. IAS 36 provides several examples of asset impairment indications, including a significant decline in an asset's market value, the ratio of the carrying amount of a firm's net asset over its market capitalization, and unfavorable internal reporting. It requires a firm to compare value in use, such as discounted future cash flows, with the carrying amount of an asset when some indicators are observed.

piecewise-linear changes in sales and CFO capture the existence of non-current asset impairments. In addition, my findings suggest using statistical tests that the largest economic losses occur one or two years prior to their accounting recognition.

Second, this study contributes to the research on the determinants of non-current asset impairments. Prior research on the determinants of non-current asset impairments often employs the model developed by Riedl (2004) (e.g., Enomoto 2008; Hu and Kurumado 2012; Fujiyama 2014c). Although this study does not replicate Riedl's (2004) model with piecewise-linear indicators such as stock returns, sales, and CFO, as implemented by Banker et al. (2017), my findings indicate that non-current asset impairments have non-linear relationships with those indicators, suggesting that piecewise-linear variables better control for the economic determinants of non-current asset impairments. Moreover, the findings suggest that research on accounting conservatism and the timeliness of earnings can better reflect differences in the time horizons of cash flows among accounting items by incorporating piecewise changes in sales and cash flows from operations.

2. Timeliness Models for Non-Current Asset Impairments in Prior Research

Prior research has investigated the timeliness of non-current asset impairment losses, especially goodwill impairments, using several empirical models. In this section, I review the empirical models used in prior research. The most frequently used model employs the amount or recognition of impairment losses as the explained variable and stock returns as the explanatory variable (Lapointe-Antunes et al. 2009; Glaum et al. 2018; Albersmann and Quick 2020; Iatridis et al. 2021). Lapointe-Antunes et al. (2009) estimate the following OLS regression:

$$GoodwillImpairment_{i,t} = \alpha_0 + \alpha_1 Ret_{i,t} + \alpha_2 Ret_{i,t-1} + \alpha_3 Ret_{i,t-2} + \varepsilon_{i,t} \qquad (1),$$

where $GoodwillImpairment_{i,t}$ is the reported goodwill and $Ret_{i,t}$ is firm i's annual stock return in year t.[4] Glaum et al. (2018) employ a recognition dummy as the explained variable, include only linear stock returns in years t and t–1, and compare the magnitude of these two coefficients; Albersmann and Quick (2020) employ a recognition dummy as the explained variable and examine its relationships with linear stock returns in years t, t–1, and t–2; Iatridis et al. (2021) investigate only the relationship between the reported goodwill impairments and stock returns in year t but incorporate piecewise-linear stock returns. In line with this stream of research, Fujiyama (2014b) incorporates linear stock returns from years t to t–6. Similarly, Chen et al. (2008) use earnings before extraordinary items but after impairment charges as the explained variable, and incorporate an interaction term between linear stock returns and impairment recognition as an explanatory variable. Another timeliness model employs stock returns as the explained variable and impairment losses as an explanatory variable, controlling for reported earnings (Choi 2008; Chen et al. 2008).

The following two studies identify signs of economic goodwill impairment. André et al. (2016) define impairment indicators as [market value of equity − book value of equity] < book goodwill, market-to-book ratio less than one, or EBITDA less than zero. Further, they compare the recognition of goodwill impairments by the EU and U.S. firms when observing each indicator. Li

---

[4] As the purpose of this section is to explain the overview of the empirical models used in prior research, I do not discuss the details of the definitions of the variables employed.

and Sloan (2017) consider the following two indicators. One is a book-to-market ratio of more than one in year t–1. The other takes the value of one if [book goodwill / total assets] is more than 10% and the return on assets (ROA) is less than zero, the negative value of one if [book goodwill / total assets] is less than 5% and ROA is more than 5%, and zero otherwise in year t–1. A negative value of one indicates that firms are unlikely to experience economic impairment in book goodwill. Then, they regress the goodwill impairment dummy in year t on these two indicators in year t–1. They interpret goodwill impairments as less timely if these indicators in year t–1 predict them in year t.

Chung and Hribar (2021) employ the Cox proportional hazards model to investigate the relationship between non-impairment duration and CEO overconfidence.

Overall, prior research has investigated the timeliness of non-current asset impairments, especially goodwill impairments, by (1) using stock returns as an explanatory variable, (2) using stock returns as the explained variable, (3) identifying impairment indicators, and (4) employing a hazard model. As my focus is on non-current assets and not only on goodwill, the use of (3) impairment indicators and (4) a hazard model has some limitations. Specifically, a frequently used indicator of goodwill impairment, the book-to-market ratio, is not suitable for non-current assets such as fixed assets (e.g., property, plant, and equipment). For example, if a firm without book goodwill experiences a more than one BTM ratio, there lies a possibility that its inventories are economically impaired; they are not subject to accounting for non-current asset impairments in Japan. A hazard model may not be suitable for non-current asset impairments. As the U.S. Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards require a non-amortization method for goodwill, book goodwill is expensed only for goodwill impairment. This allows for a study to identify the timing of expensing book goodwill. However, a proportion of non-current assets are subject to periodic depreciation and amortization, which complicates identifying the duration between the economic existence and recognition timing of non-current asset impairments. Moreover, the use of stock returns as the explained variable makes it difficult to control for the economic losses that occur in other fiscal years. Therefore, using stock returns as an explanatory variable is a better model for investigating the timeliness of non-current asset impairments. This study aims to improve the model that uses stock returns as an explanatory variable by introducing piecewise-linear stock returns and considering the years before impairment recognition in a setting of non-current asset impairments.

3. Empirical Models

Following Lapointe-Antunes et al. (2009), Fujiyama (2014b) estimates the following OLS regression:

$$Imp_{i,t} = a_0 + a_1 R_{i,t} + a_2 R_{i,t-1} + a_3 R_{i,t-2} + a_4 R_{i,t-3} + a_5 R_{i,t-4} + a_6 R_{i,t-5} + a_7 R_{i,t-6}$$
$$+ \Sigma \text{Year} + \varepsilon_{i,t} \tag{2},$$

where $Imp_{i,t}$ is the positive value of the reported non-current asset impairment losses in year t, deflated by market capitalization at the end of year t–1, and $R_{i,k}$ is firm i's buy-and-hold annual stock return. k denotes the observed year (i.e., year t, year t–1…year t–6). Fujiyama (2014b) assumes a linear relationship between non-current asset impairments and stock returns.

However, Banker et al. (2017) point to different relationships between non-current asset impairments and positive and negative stock returns. Thus, they propose incorporating a dummy variable, $Dec_{i,k}$, which takes the value of one if firm i's stock return is negative and zero otherwise, and its interaction with $R_{i,k}$. Accordingly, I estimate the following OLS regression model incorporating these variables:

$$
\begin{aligned}
Imp_{i,t} = {} & b_0 + b_1 R_{i,t} + b_2 R_{i,t-1} + b_3 R_{i,t-2} + b_4 R_{i,t-3} + b_5 R_{i,t-4} + b_6 R_{i,t-5} + b_7 R_{i,t-6} \\
& + b_8 R_{i,t} \times Dec_{i,t} + b_9 R_{i,t-1} \times Dec_{i,t-1} + b_{10} R_{i,t-2} \times Dec_{i,t-2} + b_{11} R_{i,t-3} \times Dec_{i,t-3} \\
& + b_{12} R_{i,t-4} \times Dec_{i,t-4} + b_{13} R_{i,t-5} \times Dec_{i,t-5} + b_{14} R_{i,t-6} \times Dec_{i,t-6} + b_{15} Dec_{i,t} \\
& + b_{16} Dec_{i,t-1} + b_{17} Dec_{i,t-2} + b_{18} Dec_{i,t-3} + b_{19} Dec_{i,t-4} + b_{20} Dec_{i,t-5} \\
& + b_{21} Dec_{i,t-6} + \Sigma Year + \Sigma Industry + \varepsilon_{i,t} \qquad\qquad (3).
\end{aligned}
$$

Note that in this study, I compute $R_{i,k}$ by adjusting dividends and stock splits and $Imp_{i,t}$ by adjusting the stock splits.[5] Equation (3) also controls for industry-fixed effects in addition to year-fixed effects.

In addition, following Ball and Shivakumar (2006) and Banker et al. (2017), I estimate the following OLS regression model incorporating short-term indicators:

$$
\begin{aligned}
Imp_{i,t} = {} & c_0 + c_1 R_{i,t} + c_2 R_{i,t-1} + c_3 R_{i,t-2} + c_4 R_{i,t-3} + c_5 R_{i,t-4} + c_6 R_{i,t-5} + c_7 R_{i,t-6} \\
& + c_8 R_{i,t} \times Dec_{i,t} + c_9 R_{i,t-1} \times Dec_{i,t-1} + c_{10} R_{i,t-2} \times Dec_{i,t-2} + c_{11} R_{i,t-3} \times Dec_{i,t-3} \\
& + c_{12} R_{i,t-4} \times Dec_{i,t-4} + c_{13} R_{i,t-5} \times Dec_{i,t-5} + c_{14} R_{i,t-6} \times Dec_{i,t-6} + c_{15} \Delta Sales_{i,t} \\
& + c_{16} \Delta Sales_{i,t} \times DecSales_{i,t} + c_{17} DecSales_{i,t} + c_{18} \Delta CFO_{i,t} \\
& + c_{19} \Delta CFO_{i,t} \times DecCFO_{i,t} + c_{20} DecCFO_{i,t} + c_{21} Dec_{i,t} + c_{22} Dec_{i,t-1} \\
& + c_{23} Dec_{i,t-2} + c_{24} Dec_{i,t-3} + c_{25} Dec_{i,t-4} + c_{26} Dec_{i,t-5} + c_{27} Dec_{i,t-6} \\
& + \Sigma Year + \Sigma Industry + \varepsilon_{i,t} \qquad\qquad (4),
\end{aligned}
$$

where $\Delta Sales_{i,t}$ is the adjusted per-share change in sales in year t and $\Delta CFO_{i,t}$ is the adjusted per-share change in CFO in year t. Both $\Delta Sales_{i,t}$ and $\Delta CFO_{i,t}$ are deflated by a dividend and share-split adjusted stock price. $DecSales_{i,t}$ and $DecCFO_{i,t}$ take the value of one if $\Delta Sales_{i,t}$ and $\Delta CFO_{i,t}$ are negative, respectively. I also estimate models incorporating $\Delta Sales_{i,k}$ and $\Delta CFO_{i,k}$ from year t to $t–6$ to confirm that they are short-term indicators of economic impairment.

As stock returns capture long-term changes in cash flows, they can be assumed to overlap with short-term changes in future cash flows, which are captured by changes in operating cash flows and sales. Nevertheless, the incorporation of these short-term indicators is important in two respects. First, short-term indicators are likely to capture management and auditor decision processes. Operating cash flow forecasts are a major basis for impairment tests for non-current assets, and sales forecasts are a major input for operating cash flow forecasts. Referring to Chase (2013), Banker et al. (2017) argue that because a sales forecast is based on the projection of a recent sales trend, a current sales change is an important determinant of a cash flow forecast by accountants. Thus, the

---

[5] I use the cumulative adjustment coefficients B and A from NEEDS-FinancialQuest 2.0 for $R_{i,k}$ and $Imp_{i,t}$, respectively. Cumulative adjustment coefficients A and B adjust share splits, share consolidation, and so on, excluding and including dividends, respectively.

incorporation of short-term indicators partly controls for managers' and auditors' impairment testing processes, which are expected to affect the timeliness of non-current asset impairments. Second, research on non-current asset impairment determinants generally does not control for lagged stock returns. The use of piecewise short-term indicators can improve empirical models of non-current asset impairment determinants to the extent that lagged stock returns can capture a part of the economic losses captured by short-term indicators.

4. Data

Financial and price data are obtained from the NEEDS-FinancialQUEST 2.0. I obtain data on firms with fiscal year ends in March for the period 2007–2019. I exclude the firms whose accounting period is not 12 months, whose accounting standards are not Japanese GAAP, that belong to financial industries, and whose necessary data are not available.[6] As a result of this sample selection, the final sample size is 25,860 firm-year observations. Each continuous variable is winsorized at the upper and bottom 1st percentile by year. $Imp_{i,t}$ is winsorized at the upper 1st percentile value by year.

5. Empirical Results

5.1. Descriptive Statistics and Correlation Matrix

Table 1 presents the descriptive statistics. The mean value of $Imp_{i,t}$ is 0.0068 and its median value is 0.0000, indicating that most firms do not record impairment losses. The second row of Table 1 presents the descriptive statistics of $Imp_{i,t}$ for only impairment firms. The mean and median values are 0.0147 and 0.0037, respectively, whereas the 75th percentile value is 0.0121. Thus, a small proportion of impairment firms record large impairment losses.

Table 2 reports the correlation matrix. Stock returns are not highly correlated each year. $\Delta Sales_t$ is not highly correlated with $\Delta CFO_{i,t}$. However, $\Delta CFO_{i,t}$ is relatively highly correlated with $\Delta CFO_{i,t-1}$, (coefficient = −0.3627; untabulated). $\Delta CFO_{i,t}$ is not highly correlated with $\Delta CFO_{i,t-2}$ (coefficient = −0.0231; untabulated).

5.2. Timeliness of Non-Current Asset Impairment Losses

Table 3 presents the results of the timeliness test of non-current asset impairments. Panel A in Table 3 reports the regression results. Column (1) reports the results for Fujiyama (2014b). Column (2) presents the results of Fujiyama's (2014b) replication. These results are similar, suggesting that the sample used in this study is similar to that of Fujiyama (2014b).

Columns (3) to (5) present the results obtained after using dividend- and share-split-adjusted returns but not employing the piecewise regression method. These results are similar to those of Fujiyama (2014b), except for the results of $R_{i,t}$ in Columns (3) and (4). In Column (5), the coefficient of $R_{i,t}$ is negative but not statistically significant (coefficient = −0.0022; t = −1.29). The difference between Columns (4) and (5) is the standard error adjustment. As Fujiyama (2014c) shows that non-current asset impairment losses are correlated with the changes in gross domestic product in Japan, macroeconomic conditions, such as years, are factors affecting firms' non-current asset impairments. Moreover, stock returns are also affected by the macroeconomic conditions.

---

[6] This study does not exclude observations with multiple impairment losses recorded in year t and other years (from year t–1 to year t–6), assuming that impairment losses in years t–1 to t–6 are not correlated to those in year t.

The Japanese Accounting Review, 12 (2022), 1–21

TABLE 1. DESCRIPTIVE STATISTICS (n =25,860)

	Mean	SD	25P	Median	75P
Imp_t	0.0068	0.0228	0.0000	0.0000	0.0030
Imp_t (only $Imp_t > 0$)	0.0147	0.0319	0.0010	0.0037	0.0121
R_t	0.0679	0.3857	-0.1663	0.0218	0.2252
R_{t-1}	0.1076	0.4096	-0.1398	0.0533	0.2715
R_{t-2}	0.1093	0.4164	-0.1406	0.0524	0.2733
R_{t-3}	0.1491	0.4843	-0.1373	0.0640	0.3197
R_{t-4}	0.1455	0.4939	-0.1450	0.0614	0.3181
R_{t-5}	0.1197	0.5103	-0.1719	0.0338	0.2843
R_{t-6}	0.0974	0.5180	-0.1917	0.0112	0.2599
$\triangle Sales_t$	-0.0231	0.6088	-0.0762	0.0233	0.1230
$\triangle Sales_{t-1}$	-0.0285	1.0326	-0.0793	0.0251	0.1301
$\triangle Sales_{t-2}$	-0.0164	1.9183	-0.0837	0.0260	0.1357
$\triangle Sales_{t-3}$	-0.0067	2.1041	-0.0857	0.0296	0.1471
$\triangle Sales_{t-4}$	-0.0197	2.2240	-0.0941	0.0295	0.1521
$\triangle Sales_{t-5}$	0.0117	3.4337	-0.1153	0.0236	0.1476
$\triangle Sales_{t-6}$	0.0603	3.0436	-0.1187	0.0216	0.1444
$\triangle CFO_t$	0.0068	0.1863	-0.0460	0.0022	0.0546
$\triangle CFO_{t-1}$	0.0065	0.2118	-0.0485	0.0028	0.0575
$\triangle CFO_{t-2}$	0.0058	0.2236	-0.0508	0.0029	0.0593
$\triangle CFO_{t-3}$	0.0080	0.2453	-0.0541	0.0027	0.0625
$\triangle CFO_{t-4}$	0.0098	0.2645	-0.0565	0.0035	0.0672
$\triangle CFO_{t-5}$	0.0103	0.2747	-0.0593	0.0030	0.0689
$\triangle CFO_{t-6}$	0.0119	0.2628	-0.0609	0.0020	0.0685

Notes: $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year t–1. $R_{i,k}$ is the adjusted stock return in year k. $\triangle Sales_{i,k}$ is the change in sales in year k, deflated by the adjusted stock price at the end of fiscal year k–1. $\triangle CFO_{i,k}$ is the change in cash flows from operations in year k, deflated by the adjusted stock price at the end of fiscal year k–1. The number of firm-year observations with impairment losses is 11,868 (row 2).

Thus, it may be better to adjust standard errors by clustering by year instead of using White's (1980) method in addition to year-fixed effects.

The results in Columns (6) and (7) are my main interests and are obtained by estimating piecewise-linear regression models. $R_{i,k} \times Dec_{i,k}$ is statistically significant from year t–4 to year t, indicating the asymmetric relationship of non-current asset impairments with positive and negative stock returns. In addition, the use of the piecewise-linear regression model improves the explanatory power of the estimation model; that is, the adjusted R^2 in Column (5) is 3.42% and that in Columns (6) and (7) is 7.23% and 8.52%, improving 3.81% and 5.10% of the explanatory

TABLE 2. PEARSON CORRELATION MATRIX (n =25,860)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Imp_t	1.0000								
(2) R_t	-0.0111	1.0000							
(3) R_{t-1}	**-0.1225**	**-0.0381**	1.0000						
(4) R_{t-2}	**-0.1011**	**-0.1182**	0.0022						
(5) R_{t-3}	**-0.0500**	**-0.1120**	-0.0008	**0.0199**	1.0000				
(6) R_{t-4}	**-0.0236**	**-0.0757**	**-0.1540**	0.0011	**-0.0255**	1.0000			
(7) R_{t-5}	**0.0143**	**-0.0884**	**-0.0922**	**-0.1749**	**-0.0502**	-0.0029	1.0000		
(8) R_{t-6}	**0.0247**	**0.0675**	**-0.0993**	**-0.1100**	**-0.1945**	**-0.0269**	-0.0026	1.0000	
(9) $\triangle Sales_t$	**-0.1206**	**0.0581**	**0.1658**	**0.0963**	**0.0384**	**-0.0421**	**-0.0711**	**-0.1285**	1.0000
(10) $\triangle CFO_t$	0.0019	**0.0976**	**-0.0564**	-0.0196	0.0122	0.0124	-0.0053	**0.0191**	**0.0527**

Notes: $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year $t–1$. $R_{i,k}$ is the adjusted stock return in year k. $\triangle Sales_{i,t}$ is the change in sales in year t, deflated by the adjusted stock price at the end of fiscal year $t–1$. $\triangle CFO_{i,t}$ is the change in cash flows from operations in year t, deflated by the adjusted stock price at the end of fiscal year $t–1$. Bold letters indicate statistical significance at the 5% level.

power, respectively. The coefficients of $R_{i,k}$ are negative and statistically significant for years t-1 to t–6, suggesting that impairment firms experience a smaller increase in their stock prices even when these prices increase before their impairment recognition.

Panel B of Table 3 presents the coefficients of stock returns for observations with negative stock returns (i.e., $R_{i,k} + R_{i,k} \times Dec_{i,k}$) and compares these coefficients. The coefficients for observations with negative stock returns are statistically significant at least at the 5% level from year t–5 to year t in Columns (6) and (7) and at the 10% level in year t–6 in Column (6). This suggests that non-current asset impairments occur gradually approximately five years before their recognition. Contrary to Fujiyama (2014b), I find a statistically significant association between non-current asset impairments and stock returns for observations with negative stock returns in year t (coefficient = −0.0179 and −0.0186; t = −4.49 and −4.67 in Columns 6 and 7, respectively). These results suggest that economic impairments occur gradually for several years before recognition.

Comparing the coefficients for observations with negative stock returns, the difference between those for years t and t–1 is 0.0116 and statistically significant at the 1% level (t = 3.13 and 3.26 in Columns 6 and 7, respectively), indicating that the coefficients for year t–1 are smaller than those for year t. While the difference between those for years t–1 and t–2 is insignificant, the differences between those for years t–2 and t–3 are −0.0091 and −0.0092, respectively, and statistically significant at the 10% level in Columns (6) and (7), respectively. In addition, the difference between years t–1 and t–3 is statistically significant at the 1% level (untabulated). These results suggest that the economic impairments of non-current assets occur to a greater extent in years t–1 and t–2, consistent with the accounting standard that employs the "probability criterion" instead of the "economic criterion." An example of the signs of non-current asset impairments under the Japanese GAAP is to record negative CFO or operating losses for a cash-generating unit

TABLE 3. TEST OF TIMELINESS OF NON-CURRENT ASSET IMPAIRMENT LOSSES

Panel A: OLS Regression Results

Dep. = Imp_t	(1) Fujiyama (2014b)		(2) Sample period and research design of Fujiyama (2014b)		(3) Sample period same as Fujiyama (2014b)		(4) Full sample period		(5) Full sample period		(6) Full sample period		(7) Full sample period	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Constant	0.0134***	12.74	0.0127***	13.76	0.0115***	16.56	0.0098***	19.66	0.0098***	6.07	0.0042***	5.28	0.0051***	3.95
R_t	0.0008	0.44	-0.0012	-0.89	-0.0033***	-2.93	-0.0022***	-3.52	-0.0022	-1.29	0.0006	1.29	0.0006	1.30
R_{t-1}	-0.0098***	-8.47	-0.0094***	-9.74	-0.0097***	-12.46	-0.0067***	-16.35	-0.0067***	-3.93	-0.0042***	-4.88	-0.0042***	-4.73
R_{t-2}	-0.0075***	-7.56	-0.0076***	-9.26	-0.0075***	-11.23	-0.0054***	-13.86	-0.0054***	-3.69	-0.0044***	-9.19	-0.0045***	-8.81
R_{t-3}	-0.0003***	-4.28	-0.0026***	-4.01	-0.0036***	-7.33	-0.0033***	-9.73	-0.0033***	-3.12	-0.0038***	-3.36	-0.0038***	-3.31
R_{t-4}	-0.0025***	-3.12	-0.0023***	-2.99	-0.0036***	-6.10	-0.0024***	-6.31	-0.0024***	-3.13	-0.0032***	-4.29	-0.0032***	-4.27
R_{t-5}	-0.0019**	-2.10	-0.0014*	-1.71	-0.0023***	-3.54	-0.0018***	-4.44	-0.0018***	-3.43	-0.0030***	-4.31	-0.0031***	-4.58
R_{t-6}	0.0005	0.52	0.0005	0.60	-0.0003	-0.51	-0.0005	-0.99	-0.0005	-0.98	-0.0013*	-1.87	-0.0014*	-1.97
$R_t \times Dec_t$											-0.0185***	-4.87	-0.0191***	-5.07
$R_{t-1} \times Dec_{t-1}$											-0.0253***	-6.78	-0.0260***	-6.66
$R_{t-2} \times Dec_{t-2}$											-0.0168***	-3.51	-0.0174***	-3.80
$R_{t-3} \times Dec_{t-3}$											-0.0084***	-3.00	-0.0089***	-3.61
$R_{t-4} \times Dec_{t-4}$											-0.0044*	-1.90	-0.0045*	-1.92
$R_{t-5} \times Dec_{t-5}$											-0.0024	-1.48	-0.0023	-1.37
$R_{t-6} \times Dec_{t-6}$											-0.0016	-1.03	-0.0010	-0.56
Dec_t											-0.0002	-0.25	-0.0002	-0.30
Dec_{t-1}											-0.0011*	-1.79	-0.0012	-1.78
Dec_{t-2}											-0.0007	-1.64	-0.0008	-1.58
Dec_{t-3}											0.0001	0.24	0.0000	0.11
Dec_{t-4}											0.0002	0.59	0.0002	0.50
Dec_{t-5}											-0.0002	-0.42	-0.0002	-0.39
Dec_{t-6}											-0.0001	-0.24	-0.0001	-0.18
Year	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry	No		No		No		No		No		No		Yes	
SE adjustment	Robust		Robust		Robust		Robust		Year-clustered		Year-clustered		Year-clustered	
# of observations	14,094		13,998		13,998		25,860		25,860		25,860		25,860	
adj-R²	0.0195		0.0242		0.0365		0.0342		0.0342		0.0723		0.0852	

TABLE 3. (continued)

Panel B: Coefficients for Observations with Negative Stock Returns and Their Comparisons

	(6) Full sample period		(7) Full sample period	
	Coef./Diff.	t-value	Coef./Diff.	t-value
[1] $R_t + R_t \times Dec_t$	-0.0179***	-4.49	-0.0186***	-4.67
[2] $R_{t-1} + R_{t-1} \times Dec_{t-1}$	-0.0295***	-7.69	-0.0302***	-7.53
[3] $R_{t-2} + R_{t-2} \times Dec_{t-2}$	-0.0213***	-4.36	-0.0219***	-4.64
[4] $R_{t-3} + R_{t-3} \times Dec_{t-3}$	-0.0122**	-4.74	-0.0127***	-5.58
[5] $R_{t-4} + R_{t-4} \times Dec_{t-4}$	-0.0076***	-3.49	-0.0077***	-3.47
[6] $R_{t-5} + R_{t-5} \times Dec_{t-5}$	-0.0054**	-3.13	-0.0054**	-2.97
[7] $R_{t-6} + R_{t-6} \times Dec_{t-6}$	-0.0028*	-2.16	-0.0024	-1.58
[1] - [2]	0.0116***	3.13	0.0116***	3.26
[2] - [3]	-0.0082	-1.66	-0.0083	-1.76
[3] - [4]	-0.0091*	-1.90	-0.0092*	-2.05
[4] - [5]	-0.0046	-1.16	-0.0050	-1.30
[5] - [6]	-0.0022	-0.87	-0.0023	-0.88
[6] - [7]	-0.0026	-1.13	-0.0030	-1.20

Notes: Panel A presents the OLS regression results of the timeliness test of non-current asset impairments. Panel B reports the coefficients of stock returns for observations with negative stock returns and their comparisons between years k and $k-1$. $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year $t-1$. $R_{i,k}$ is the adjusted stock return in year k. $Dec_{i,k}$ takes the value of one if R_k is negative. Column (1) shows the results of Fujiyama (2014b) using market capitalization to compute stock returns. Column (2) employs the same regression model as Fujiyama (2014b) and estimates it using my sample. Columns (3)-(7) use dividend- and share-split-adjusted stock prices to compute stock returns. In Columns (1) to (4), standard errors are adjusted based on White (1980) as in Fujiyama (2014b). In Columns (5) to (7), standard errors are clustered by year. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

for two consecutive years.

Overall, the use of piecewise-linear regression is likely to improve the tests of non-current asset impairment timeliness. In addition, the results suggest that the reported impairment losses are timelier than Fujiyama (2014b) finds; however, such losses are not necessarily recorded in a timely manner as they gradually occurred five years before their recognition.

5.3. Test of the Short-Term Indicators of Non-Current Asset Impairments

Table 4 reports the results incorporating changes in sales and CFO as the short-term indicators of non-current asset impairments. In Panel A, only results for the observations with negative stock returns and/or changes in sales and/or CFO are presented. Only changes in sales and CFO in year t are incorporated in Column (1) while those for years t to $t-6$ are incorporated in Columns (2) to (6). In Column (1), the coefficients of $\Delta Sales_{i,t} \times DecSales_{i,t}$ and $\Delta CFO_{i,t} \times DecCFO_{i,t}$ are negative and statistically significant at the 1% level (coefficient = −0.0081 and −0.0218; t = −4.28 and −5.74 for $\Delta Sales_{i,t} \times DecSales_{i,t}$ and $\Delta CFO_{i,t} \times DecCFO_{i,t}$, respectively). The negative coefficients of $\Delta Sales_{i,t} \times DecSales_{i,t}$ and $\Delta CFO_{i,t} \times DecCFO_{i,t}$ are consistently presented in Columns (2) to (6). These coefficients for year $t-1$ are negative but insignificant in Columns (2) to (6). The coefficients of $\Delta Sales_{i,k} \times DecSales_{i,k}$ and $\Delta CFO_{i,k} \times DecCFO_{i,k}$ before year $t-1$ are insignificant, while the coefficient of $\Delta CFO_{i,t-6} \times DecCFO_{i,t-6}$ is negative and statistically significant at the 10% level in Column (5), but not in Columns (4) and (6). Thus, positive and negative changes in sales and CFO, which are expected to be short-term indicators of non-current asset impairments, have asymmetrical relationships with reported non-current asset impairment losses only in year t.

Panel B of Table 4 presents the coefficients of stock returns and changes in sales and cash flows from operations for observations with negative returns or changes in sales or CFO. Columns (1), (2), (3), and (6) show that the combined coefficients of $\Delta Sales_{i,t}$ and $\Delta Sales_{i,t} \times DecSales_{i,t}$ are consistently negative and statistically significant at the 1% level. In Columns (1), (4), (5), and (6), the combined coefficients of $\Delta CFO_{i,t}$ and $\Delta CFO_{i,t} \times DecCFO_{i,t}$ are consistently negative and statistically significant at the 1% level. The combined coefficients of both $\Delta Sales_{i,k}$ and $\Delta Sales_{i,k} \times DecSales_{i,k}$, and $\Delta CFO_{i,k}$ and $\Delta CFO_{i,k} \times DecCFO_{i,k}$ are insignificant for years $t-6$ to $t-1$. The combined coefficients of $\Delta CFO_{i,t-4}$ and $\Delta CFO_{i,t-4} \times DecCFO_{i,t-4}$ are positive and statistically significant. However, the sign is opposite to that of the prediction and is not interpretable.

The results for negative stock returns are consistent with those in Table 3. The difference in the combined coefficients of $R_{i,k}$ and $R_{i,k} \times Dec_{i,k}$ between years t and $t-1$ is consistently and statistically significant at the 5% level, even when controlling for changes in sales and CFO. The difference between years $t-2$ and $t-3$ is statistically significant at the 10% level in Column (1) but not in Columns (3), (5), and (6). Note that the difference between years $t-1$ and $t-3$ is consistently statistically significant at the 1% level in all the columns (untabulated). Assuming that changes in operating cash flows and sales partly control for the non-current asset-impairment testing processes of managers and auditors because they are major impairment test inputs, the effectiveness of the timeliness model holds even after undertaking such management and auditor decision processes.

Interestingly, the combined coefficients of $R_{i,k}$ and $R_{i,k} \times Dec_{i,k}$ in Column (1) of Panel B of Table 4 are slightly different from those in Column (7) of Panel B of Table 3. Specifically, those in Tables 3 and 4 are −0.0186 and −0.0169 for year t, −0.0302 and −0.0241 for year $t-1$, −0.0219 and −0.0180 for year $t-2$, −0.0127 and −0.0100 for year $t-3$, −0.0077 and −0.0064 for year $t-4$, and −0.0054 and −0.0042 for year $t-5$, respectively. The differences are 0.0017 for year t, 0.0061 for year $t-1$, 0.0039 for year $t-2$, 0.0027 for year $t-3$, 0.0013 for year $t-4$, and 0.0012 for year $t-5$. The

TABLE 4. SHORT-TERM INDICATORS OF NON-CURRENT ASSET IMPAIRMENT LOSSES

Panel A: OLS Regression Results

Dep. = Imp_t	(1) Changes in sales and CFO in year t		(2) Only changes in sales		(3) Stock returns and changes in sales		(4) Only changes in CFO		(5) Stock returns and changes in CFO		(6) Stock returns and changes in sales and CFO	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
$R_t \times Dec_t$	-0.0162***	-5.02			-0.0162***	-4.83			-0.0179***	-4.99	-0.0159***	-4.75
$R_{t-1} \times Dec_{t-1}$	-0.0203***	-7.31			-0.0208***	-7.25			-0.0230***	-6.61	-0.0196***	-7.19
$R_{t-2} \times Dec_{t-2}$	-0.0141***	-3.33			-0.0139***	-3.19			-0.0150***	-3.16	-0.0133***	-2.88
$R_{t-3} \times Dec_{t-3}$	-0.0067***	-3.01			-0.0069***	-3.14			-0.0073***	-3.04	-0.0064**	-2.85
$R_{t-4} \times Dec_{t-4}$	-0.0036*	-1.84			-0.0040*	-2.06			-0.0036	-1.66	-0.0037	-1.84
$R_{t-5} \times Dec_{t-5}$	-0.0014	-1.00			-0.0015	-1.03			-0.0017	-1.09	-0.0015	-0.99
$R_{t-6} \times Dec_{t-6}$	-0.0001	-0.03			0.0006	0.34			-0.0007	-0.45	0.0003	0.17
$\Delta Sales_t \times DecSales_t$	-0.0081***	-4.28	-0.0153***	-8.02	-0.0116***	-8.57					-0.0094***	-7.28
$\Delta Sales_{t-1} \times DecSales_{t-1}$			0.0019	1.21	0.0016	1.29					0.0016	1.15
$\Delta Sales_{t-2} \times DecSales_{t-2}$			0.0007	0.68	0.0004	0.44					0.0004	0.35
$\Delta Sales_{t-3} \times DecSales_{t-3}$			0.0004	0.62	0.0002	0.30					0.0003	0.37
$\Delta Sales_{t-4} \times DecSales_{t-4}$			0.0002	0.41	-0.0002	-0.47					-0.0003	-0.77
$\Delta Sales_{t-5} \times DecSales_{t-5}$			-0.0004	-0.98	-0.0005	-1.18					-0.0003	-0.79
$\Delta Sales_{t-6} \times DecSales_{t-6}$			0.0004	0.79	0.0003	0.49					0.0006	0.92
$\Delta CFO_t \times DecCFO_t$	-0.0218***	-5.74					-0.0447***	-9.04	-0.0274***	-7.37	-0.0202***	-5.56
$\Delta CFO_{t-1} \times DecCFO_{t-1}$							-0.0070	-1.80	-0.0030	-0.82	0.0001	0.02
$\Delta CFO_{t-2} \times DecCFO_{t-2}$							-0.0006	-0.24	-0.0005	-0.23	-0.0007	-0.24
$\Delta CFO_{t-3} \times DecCFO_{t-3}$							0.0003	0.20	-0.0006	-0.33	-0.0002	-0.11
$\Delta CFO_{t-4} \times DecCFO_{t-4}$							0.0032**	2.79	0.0022*	2.11	0.0035***	3.09
$\Delta CFO_{t-5} \times DecCFO_{t-5}$							0.0000	0.02	-0.0020	-1.27	-0.0018	-1.00
$\Delta CFO_{t-6} \times DecCFO_{t-6}$							-0.0013	-0.70	-0.0039*	-2.01	-0.0027	-0.90
Year	Yes		Yes		Yes		Yes		Yes		Yes	
Industry	Yes		Yes		Yes		Yes		Yes		Yes	
Other variables	Yes		Yes		Yes		Yes		Yes		Yes	
SE adjustment	Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered	
# of observations	25,860		25,860		25,860		25,860		25,860		25,860	
adj-R²	0.0997		0.0674		0.0979		0.0538		0.0947		0.1020	

TABLE 4. (continued)

Panel B: Coefficients for Observations with Negative Stock Returns or Changes in Sales or CFO and Their Comparisons

	(1) Changes in sales and CFO in year t		(2) Only changes in sales		(3) Stock returns and changes in sales		(4) Only changes in CFO		(5) Stock returns and changes in CFO		(6) Stock returns and changes in sales and CFO	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
$\Delta Sales_t + \Delta Sales_t \times DecSales_t$	-0.0033**	-2.44	-0.0072***	-4.87	-0.0049***	-4.72					-0.0042***	-4.30
$\Delta Sales_{t-1} + \Delta Sales_{t-1} \times DecSales_{t-1}$			-0.0015	-1.50	-0.0005	-0.54					-0.0002	-0.23
$\Delta Sales_{t-2} + \Delta Sales_{t-2} \times DecSales_{t-2}$			-0.0004	-0.63	0.0001	0.21					0.0002	0.25
$\Delta Sales_{t-3} + \Delta Sales_{t-3} \times DecSales_{t-3}$			0.0000	-0.08	0.0004	0.98					0.0004	1.05
$\Delta Sales_{t-4} + \Delta Sales_{t-4} \times DecSales_{t-4}$			0.0001	0.31	0.0002	0.89					0.0001	0.62
$\Delta Sales_{t-5} + \Delta Sales_{t-5} \times DecSales_{t-5}$			-0.0004	-1.11	-0.0004	-1.05					-0.0003	-0.68
$\Delta Sales_{t-6} + \Delta Sales_{t-6} \times DecSales_{t-6}$			0.0001	0.37	0.0001	0.18					0.0004	0.85
$\Delta CFO_t + \Delta CFO_t \times DecCFO_t$	-0.0121***	-5.31					-0.0246***	-7.23	-0.0163***	-5.63	-0.0121***	-4.54
$\Delta CFO_{t-1} + \Delta CFO_{t-1} \times DecCFO_{t-1}$							-0.0048*	-1.93	-0.0027	-1.27	-0.0014	-0.97
$\Delta CFO_{t-2} + \Delta CFO_{t-2} \times DecCFO_{t-2}$							-0.0014	-0.73	-0.0007	-0.37	-0.0009	-0.38
$\Delta CFO_{t-3} + \Delta CFO_{t-3} \times DecCFO_{t-3}$							-0.0009	-0.72	-0.0006	-0.50	-0.0005	-0.35
$\Delta CFO_{t-4} + \Delta CFO_{t-4} \times DecCFO_{t-4}$							0.0012*	2.03	0.0016**	2.27	0.0022**	2.56
$\Delta CFO_{t-5} + \Delta CFO_{t-5} \times DecCFO_{t-5}$							-0.0001	-0.09	-0.0002	-0.16	-0.0002	-0.14
$\Delta CFO_{t-6} + \Delta CFO_{t-6} \times DecCFO_{t-6}$							-0.0016	-1.23	-0.0024*	-1.79	-0.0017	-0.87
[1] $R_t \times Dec_t$	-0.0169***	-4.91			-0.0165***	-4.65			-0.0180***	-4.71	-0.0164***	-4.60
[2] $R_{t-1} \times Dec_{t-1}$	-0.0241***	-8.58			-0.0244***	-8.19			-0.0268***	-7.62	-0.0228***	-8.18
[3] $R_{t-2} \times Dec_{t-2}$	-0.0180***	-4.18			-0.0177***	-3.98			-0.0191***	-3.91	-0.0169***	-3.56
[4] $R_{t-3} \times Dec_{t-3}$	-0.0100***	-4.95			-0.0102***	-4.93			-0.0108***	-4.83	-0.0096***	-4.50
[5] $R_{t-4} \times Dec_{t-4}$	-0.0064***	-3.37			-0.0068***	-3.66			-0.0066***	-3.16	-0.0064***	-3.26
[6] $R_{t-5} \times Dec_{t-5}$	-0.0042***	-2.88			-0.0042**	-2.73			-0.0048***	-2.78	-0.0043**	-2.58
[7] $R_{t-6} \times Dec_{t-6}$	-0.0016	-1.15			-0.0008	-0.60			-0.0022	-1.62	-0.0012	-0.87
[1] - [2]	0.0072***	2.84			0.0079***	3.09			0.0088***	2.82	0.0064**	2.57
[2] - [3]	-0.0061	-1.42			-0.0067	-1.57			-0.0077	-1.51	-0.0059	-1.25
[3] - [4]	-0.0080*	-1.86			-0.0075	-1.69			-0.0083	-1.75	-0.0073	-1.54
[4] - [5]	-0.0036	-1.10			-0.0034	-1.02			-0.0042	-1.12	-0.0032	-0.91
[5] - [6]	-0.0023	-0.98			-0.0026	-1.14			-0.0019	-0.75	-0.0021	-0.89
[6] - [7]	-0.0026	-1.21			-0.0034	-1.61			-0.0025	-1.13	-0.0031	-1.45

Notes: Panel A presents the OLS regression results of the timeliness test of non-current asset impairments incorporating changes in sales and cash flows from operations. Panel B reports the coefficients of stock returns and changes in sales and CFO for observations with negative stock returns or changes in sales or CFO and their comparisons between years k and $k-1$. $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year $t-1$. $R_{i,k}$ is the adjusted stock return in year k. $Dec_{i,k}$ takes the value of one if $R_{i,k}$ is negative. $\Delta Sales_{i,k}$ is the change in sales in year k, deflated by the adjusted stock price at the end of fiscal year $k-1$. $DecSales_{i,k}$ takes the value of one if $\Delta Sales_{i,k}$ is negative. $\Delta CFO_{i,k}$ is the change in cash flows from operations in year k, deflated by the adjusted stock price at the end of fiscal year $k-1$. $DecCFO_{i,k}$ takes the value of one if $\Delta CFO_{i,k}$ is negative. Standard errors are clustered by year. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

difference in the combined coefficients in Tables 3 and 4 is largest in year t–1 and decreases afterwards. This result is consistent with the view that lagged stock returns capture long-term cash flow changes, which are partly captured by short-term indicators. It is useful to recognize the trade-off between the control for impairment testing processes and the overlap between short-term indicators and lagged stock returns when future research on non-current asset impairment timeliness employs the full model, that is, Equation (4).

Overall, the results suggest that changes in sales and CFO are short-term indicators of non-current asset impairments. To the extent that changes in sales and CFO are short-term indicators of non-current asset impairments, a model incorporating sales and CFO variables only for year t can better reflect short-term changes in firms' economic conditions.

6. Additional Analysis

As Banker et al. (2017) suggest that an impairment trigger is different from the value of zero for all the three indicators, that is, stock return, sales change and operating cash flow change, I analyze the timeliness of non-current asset impairments by using different impairment trigger thresholds. Although Banker et al. (2017) employ a censored regression model, I employ an OLS regression model because the purpose of this study is to improve Fujiyama's (2014b) impairment-timeliness model. Moreover, while they use grid search, I use certain thresholds of $Dec_{i,k}$, $DecSales_{i,t}$, and $DecCFO_{i,t}$: 0.1, 0.05, −0.05, −0.1, −0.15, −0.2, −0.25, and −0.3, because the optimal value changes as the sample changes.

Table 5 presents the results for different stock return thresholds. The adjusted R^2 is the highest for the threshold of −0.1, improving the adjusted R^2 by 0.12% compared with the zero threshold (Panel A). Panel B reports the results of the coefficients of stock returns for observations with negative stock returns (i.e., $R_{i,k} + R_{i,k} \times Dec_{i,k}$) and compares the coefficients. For all thresholds, the coefficients for observations below the thresholds are the largest in year t–1, which is consistent with the main result. Although there are some differences for $Dec_k < −0.25$ and $Dec_k < −0.3$, the results are qualitatively similar to those of $Dec_k < 0$ in the case of other thresholds.

Panels A and B of Table 6 present the results of the different thresholds for changes in sales and CFO, respectively. In Panel A, the coefficients of sales changes for all thresholds are similar to those of the main analysis except for those of $DecSales_{i,t} < −0.25$ and −0.3. In Panel B, the coefficients of CFO changes for all the thresholds are similar to those of the main analysis. Moreover, the adjusted R^2 for changes in sales and CFO are the highest for the thresholds of −0.1 and −0.05, respectively. However, minor improvements in explanatory power are observed (0.05% and 0.01% for changes in sales and CFO, respectively).

Overall, although a non-zero threshold would improve the model of non-current asset impairment timeliness, the improvement appears to be minor for both the long- and short-term indicators. Therefore, if one sets a non-zero threshold, it is better to justify the threshold by comparing it with other thresholds.

7. Conclusions

This study re-examines the timeliness of non-current asset impairment losses, which Fujiyama (2014b) investigates, by using the piecewise-linear regression model proposed by Banker et al. (2017). Similar to Fujiyama (2014b), I find a negative relationship between non-current asset impairments (positive values) and negative stock returns in year t–5. However, contrary to Fujiyama

TABLE 5. IMPAIRMENT TRIGGER THRESHOLDS FOR STOCK RETURNS

Panel A: Regression Results

Dep. = Imp_t	$Dec_{it} < 0.1$ Coef.	t-value	$Dec_{it} < 0.05$ Coef.	t-value	$Dec_{it} < 0$ Coef.	t-value	$Dec_{it} < -0.05$ Coef.	t-value	$Dec_{it} < -0.1$ Coef.	t-value	$Dec_{it} < -0.15$ Coef.	t-value	$Dec_{it} < -0.2$ Coef.	t-value	$Dec_{it} < -0.25$ Coef.	t-value	$Dec_{it} < -0.3$ Coef.	t-value
Constant	0.0034**	2.74	0.0041***	3.06	0.0051***	3.95	0.0057***	4.88	0.0061***	5.29	0.0068***	5.80	0.0071***	5.97	0.0073***	6.19	0.0076***	6.09
R_t	0.0014**	2.90	0.0010*	2.06	0.0006	1.30	0.0001	0.30	-0.0003	-0.69	-0.0005	-1.16	-0.0008*	-1.87	-0.0012**	-2.53	-0.0014*	-2.93
R_{t-1}	-0.0036***	-4.01	-0.0039***	-4.30	-0.0042***	-4.73	-0.0045***	-5.03	-0.0046***	-5.46	-0.0049***	-5.79	-0.0049***	-6.11	-0.0053***	-6.21	-0.0053***	-6.83
R_{t-2}	-0.0041***	-6.89	-0.0044***	-7.64	-0.0045***	-8.81	-0.0045***	-9.13	-0.0045***	-8.92	-0.0047***	-8.18	-0.0047***	-8.47	-0.0046***	-8.34	-0.0050***	-7.37
R_{t-3}	-0.0038***	-3.35	-0.0039***	-3.34	-0.0038***	-3.31	-0.0038***	-3.35	-0.0038***	-3.52	-0.0040***	-3.48	-0.0040***	-3.51	-0.0040***	-3.53	-0.0039***	-3.60
R_{t-4}	-0.0030***	-4.06	-0.0032***	-4.09	-0.0032***	-4.27	-0.0033***	-4.37	-0.0034***	-4.70	-0.0034***	-4.75	-0.0034***	-4.68	-0.0034***	-4.78	-0.0033***	-4.74
R_{t-5}	-0.0029***	-5.27	-0.0028***	-4.48	-0.0031***	-4.58	-0.0032***	-4.87	-0.0031***	-4.33	-0.0032***	-4.67	-0.0032***	-4.49	-0.0032*	-4.20	-0.0031***	-4.42
R_{t-6}	-0.0013*	-1.85	-0.0013	-1.71	-0.0014*	-1.97	-0.0014*	-1.97	-0.0014*	-1.79	-0.0014*	-1.81	-0.0014	-1.77	-0.0014*	-1.80	-0.0015*	-2.21
$R_t \times Dec_t$	-0.0175***	-5.47	-0.0182***	-5.28	-0.0191***	-5.07	-0.0202***	-4.84	-0.0218***	-4.82	-0.0226***	-4.58	-0.0236***	-4.44	-0.0236***	-4.29	-0.0228***	-4.37
$R_{t-1} \times Dec_{t-1}$	-0.0219***	-5.79	-0.0236***	-6.01	-0.0260***	-6.66	-0.0289***	-7.38	-0.0320***	-7.79	-0.0358***	-8.68	-0.0382***	-7.39	-0.0472***	-9.50	-0.0503***	-12.87
$R_{t-2} \times Dec_{t-2}$	-0.0146***	-3.98	-0.0160***	-3.90	-0.0174***	-3.80	-0.0184***	-3.61	-0.0191***	-3.36	-0.0209***	-3.06	-0.0196***	-2.82	-0.0161**	-2.30	-0.0174**	-2.36
$R_{t-3} \times Dec_{t-3}$	-0.0084***	-3.42	-0.0089***	-3.58	-0.0089***	-3.61	-0.0092***	-3.73	-0.0089***	-3.19	-0.0102***	-3.43	-0.0098***	-5.09	-0.0083***	-5.01	-0.0058	-1.59
$R_{t-4} \times Dec_{t-4}$	-0.0041*	-1.85	-0.0048**	-2.21	-0.0045*	-1.92	-0.0045	-1.78	-0.0046	-1.69	-0.0054*	-1.85	-0.0031	-0.89	-0.0030	-0.81	-0.0009	-0.18
$R_{t-5} \times Dec_{t-5}$	-0.0023*	-1.86	-0.0016	-1.04	-0.0023	-1.37	-0.0029	-1.51	-0.0025	-1.06	-0.0041*	-1.80	-0.0049	-1.64	-0.0043	-1.07	-0.0035	-0.75
$R_{t-6} \times Dec_{t-6}$	-0.0011	-0.68	-0.0007	-0.40	-0.0010	-0.56	-0.0010	-0.51	-0.0003	-0.11	-0.0006	-0.24	0.0005	0.17	0.0010	0.28	-0.0027	-0.80
Dec_t	0.0012**	2.81	0.0006	1.16	-0.0002	-0.30	-0.0011	-1.12	-0.0022**	-2.07	-0.0027*	-1.92	-0.0036**	-2.30	-0.0041**	-2.45	-0.0041**	-2.42
Dec_{t-1}	0.0008**	2.28	0.0000	0.06	-0.0012	-1.78	-0.0027***	-2.88	-0.0042***	-3.36	-0.0061***	-4.30	-0.0073***	-3.28	-0.0124***	-6.49	-0.0141***	-8.45
Dec_{t-2}	0.0006	1.61	-0.0002	-0.52	-0.0008	-1.58	-0.0012	-1.68	-0.0016	-1.53	-0.0028	-1.49	-0.0023	-1.00	-0.0006	-0.21	-0.0020	-0.70
Dec_{t-3}	0.0001	0.30	-0.0001	-0.20	0.0000	0.11	-0.0001	-0.23	-0.0001	-0.10	-0.0009	-1.31	-0.0008	-0.90	-0.0001	-0.10	0.0011	0.48
Dec_{t-4}	0.0005*	2.05	0.0000	0.01	0.0002	0.50	0.0002	0.37	0.0001	0.12	-0.0004	-0.47	0.0008	0.81	0.0010	0.76	0.0021	0.95
Dec_{t-5}	0.0000	0.01	0.0005	1.07	-0.0002	-0.39	-0.0005	-0.98	-0.0001	-0.11	-0.0009	-1.41	-0.0013	-1.11	-0.0008	-0.49	-0.0001	-0.07
Dec_{t-6}	0.0000	-0.12	0.0003	0.94	-0.0001	-0.18	-0.0001	-0.15	0.0004	0.74	0.0003	0.37	0.0009	0.82	0.0012	0.89	-0.0010	-0.80
Year	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
SE adjustment	Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered	
# of observations	25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860	
adj-R²	0.0834		0.0845		0.0852		0.0860		0.0865		0.0863		0.0864		0.086		0.0844	

TABLE 5. (continued)

Panel B: Coefficients for Bad News Observations

	$Dec_k < 0.1$		$Dec_k < 0.05$		$Dec_k < 0$		$Dec_k < -0.05$		$Dec_k < -0.10$		$Dec_k < -0.15$		$Dec_k < -0.2$		$Dec_k < -0.25$		$Dec_k < -0.3$	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
[1] $R_t + R_t \times Dec_t$	-0.0161***	-4.85	-0.0172***	-4.71	-0.0186***	-4.67	-0.0201***	-4.56	-0.0221***	-4.65	-0.0231***	-4.51	-0.0244***	-4.45	-0.0247***	-4.38	-0.0242***	-4.52
[2] $R_{t-1} + R_{t-1} \times Dec_{t-1}$	-0.0254***	-6.58	-0.0274***	-6.81	-0.0302***	-7.53	-0.0334***	-8.17	-0.0367***	-8.47	-0.0407***	-9.31	-0.0431***	-8.03	-0.0525***	-10.04	-0.0556***	-13.62
[3] $R_{t-2} + R_{t-2} \times Dec_{t-2}$	-0.0187***	-4.72	-0.0204***	-4.71	-0.0219***	-4.64	-0.0229***	-4.44	-0.0237***	-4.14	-0.0256***	-3.71	-0.0243***	-3.50	-0.0207*	-2.99	-0.0223***	-3.07
[4] $R_{t-3} + R_{t-3} \times Dec_{t-3}$	-0.0122***	-5.48	-0.0128***	-5.70	-0.0127***	-5.58	-0.0130***	-5.62	-0.0127***	-4.97	-0.0141***	-5.05	-0.0138***	-7.89	-0.0123***	-7.39	-0.0097***	-2.75
[5] $R_{t-4} + R_{t-4} \times Dec_{t-4}$	-0.0072***	-3.35	-0.0080***	-3.88	-0.0077***	-3.47	-0.0078***	-3.16	-0.0080***	-3.03	-0.0088***	-3.09	-0.0065*	-1.89	-0.0063	-1.76	-0.0043	-0.83
[6] $R_{t-5} + R_{t-5} \times Dec_{t-5}$	-0.0053***	-4.04	-0.0045**	-2.83	-0.0054**	-2.97	-0.0061**	-2.98	-0.0056**	-2.29	-0.0073***	-3.14	-0.0081**	-2.75	-0.0074*	-1.86	-0.0066	-1.39
[7] $R_{t-6} + R_{t-6} \times Dec_{t-6}$	-0.0024	-1.74	-0.0020	-1.29	-0.0024	-1.58	-0.0024	-1.30	-0.0016	-0.71	-0.0020	-0.81	-0.0008	-0.26	-0.0004	-0.10	-0.0043	-1.23
[1] - [2]	0.0093**	2.97	0.0102*	2.91	0.0116***	3.26	0.0134***	3.52	0.0145***	3.88	0.0175***	4.50	0.0187***	4.85	0.0278***	6.70	0.0314***	5.97
[2] - [3]	-0.0067*	-1.99	-0.0070	-1.73	-0.0083	-1.76	-0.0105*	-2.07	-0.0130*	-2.34	-0.0151*	-2.16	-0.0188**	-2.37	-0.0318**	-3.97	-0.0333***	-4.77
[3] - [4]	-0.0065	-1.64	-0.0076*	-1.83	-0.0092*	-2.05	-0.0099*	-2.13	-0.0109*	-2.00	-0.0115	-1.77	-0.0106	-1.47	-0.0084	-1.04	-0.0126	-1.36
[4] - [5]	-0.0051	-1.38	-0.0047	-1.31	-0.0050	-1.30	-0.0052	-1.30	-0.0047	-1.13	-0.0053	-1.29	-0.0073*	-1.94	-0.0060*	-1.80	-0.0055	-1.28
[5] - [6]	-0.0019	-0.92	-0.0036	-1.53	-0.0023	-0.88	-0.0017	-0.52	-0.0024	-0.62	-0.0015	-0.36	0.0016	0.32	0.0011	0.17	0.0024	0.27
[6] - [7]	-0.0029	-1.49	-0.0025	-1.09	-0.0030	-1.20	-0.0037	-1.29	-0.0040	-1.08	-0.0053	-1.45	-0.0073	-1.49	-0.0071	-1.29	-0.0024	-0.45

Notes: $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year $t-1$. $R_{i,k}$ is the adjusted stock return in year k. $Dec_{i,k}$ takes the value of one if $R_{i,k}$ is below a threshold. Standard errors are clustered by year. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 6. IMPAIRMENT TRIGGER THRESHOLDS FOR CHANGES IN SALES AND OPERATING CASH FLOWS

Panel A: Results for Sales Changes

Dep. = Imp_t	$DecSales_t < 0.1$ Coef.	t-value	$DecSales_t < 0.05$ Coef.	t-value	$DecSales_t < 0$ Coef.	t-value	$DecSales_t < -0.05$ Coef.	t-value	$DecSales_t < -0.1$ Coef.	t-value	$DecSales_t < -0.15$ Coef.	t-value	$DecSales_t < -0.2$ Coef.	t-value	$DecSales_t < -0.25$ Coef.	t-value	$DecSales_t < -0.3$ Coef.	t-value
R_t	-0.0007	-1.17	-0.0006	-1.44	-0.0006	-1.50	-0.0007	-1.53	-0.0007	-1.58	-0.0007	-1.58	-0.0007	-1.57	-0.0007	-1.56	-0.0006	-1.54
$R_t × Dec_t$	-0.0167	-10.96	-0.0166	-5.14	-0.0162	-5.02	-0.0161	-5.14	-0.0161	-5.35	-0.0162	-5.39	-0.0163	-5.50	-0.0166	-5.43	-0.0166	-5.44
Dec_t	-0.0003	-0.69	-0.0003	-0.52	-0.0003	-0.52	-0.0003	-0.49	-0.0003	-0.47	-0.0003	-0.44	-0.0002	-0.42	-0.0002	-0.41	-0.0002	-0.39
$ΔSales_t$	0.0049	7.42	0.0049	3.94	0.0048	4.18	0.0048	4.54	0.0046	4.36	0.0042	4.05	0.0039	4.16	0.0033	4.12	0.0031	3.64
$ΔSales_t × DecSales_t$	-0.0084	-11.14	-0.0084	-4.40	-0.0081	-4.28	-0.0078	-4.18	-0.0073	-3.95	-0.0068	-3.74	-0.0063	-3.59	-0.0057	-3.54	-0.0054	-3.31
$DecSales_t$	0.0011	2.80	0.0013	2.98	0.0016	3.96	0.0023	4.21	0.0027	4.40	0.0028	4.26	0.0031	3.81	0.0026	2.07	0.0029	2.17
$ΔCFO_t$	0.0098	7.37	0.0098	5.18	0.0097	5.24	0.0095	5.39	0.0095	5.44	0.0096	5.57	0.0097	5.63	0.0101	5.86	0.0101	5.97
$ΔCFO_t × DecCFO_t$	-0.0221	-10.40	-0.0221	-5.63	-0.0218	-5.74	-0.0213	-5.92	-0.0213	-6.05	-0.0215	-6.19	-0.0216	-6.34	-0.0225	-6.63	-0.0226	-6.82
$DecCFO_t$	0.0001	0.44	0.0001	0.54	0.0001	0.44	0.0001	0.56	0.0001	0.63	0.0002	0.77	0.0002	0.85	0.0002	0.85	0.0002	0.81
Other variables	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Year	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
SE adjustment	Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered	
# of observations	25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860	
adj-R²	0.0993		0.0994		0.0997		0.1002		0.1003		0.1000		0.0999		0.0989		0.0989	
$R_t + R_t × Dec_t$	-0.0173	-5.10	-0.0172	-5.03	-0.0169	-4.91	-0.0167	-5.02	-0.0168	-5.22	-0.0169	-5.28	-0.0170	-5.37	-0.0172	-5.30	-0.0173	-5.32
$ΔSales_t + ΔSales_t × DecSales_t$	-0.0035	-2.66	-0.0034	-2.57	-0.0033	-2.44	-0.0030	-2.24	-0.0028	-2.09	-0.0027	-2.00	-0.0024	-1.85	-0.0024	-1.76	-0.0023	-1.63
$ΔCFO_t + ΔCFO_t × DecCFO_t$	-0.0123	-5.23	-0.0123	-5.23	-0.0121	-5.31	-0.0118	-5.38	-0.0117	-5.49	-0.0118	-5.58	-0.0119	-5.75	-0.0124	-6.02	-0.0125	-6.20

TABLE 6. (continued)

Panel B: Results for CFO Changes

Dep. = Imp_t	$DecCFO_t < 0.1$		$DecCFO_t < 0.05$		$DecCFO_t < 0$		$DecCFO_t < 0.05$		$DecCFO_t < 0.1$		$DecCFO_t < 0.15$		$DecCFO_t < 0.2$		$DecCFO_t < 0.25$		$DecCFO_t < 0.3$	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
R_t	-0.0006	-1.33	-0.0006	-1.47	-0.0006	-1.50	-0.0006	-1.49	-0.0006	-1.45	-0.0006	-1.42	-0.0006	-1.38	-0.0005	-0.97	-0.0005	-1.20
$R_t × Dec_t$	-0.0163***	-5.00	-0.0162***	-5.01	-0.0162***	-5.02	-0.0162***	-5.08	-0.0164***	-5.02	-0.0165***	-5.01	-0.0165***	-5.01	-0.0166***	-10.86	-0.0166***	-5.01
Dec_t	-0.0003	-0.53	-0.0003	-0.55	-0.0003	-0.52	-0.0003	-0.50	-0.0003	-0.45	-0.0003	-0.45	-0.0003	-0.45	-0.0003	-0.60	-0.0002	-0.41
$ΔSales_t$	0.0050***	4.44	0.0049***	4.19	0.0048***	4.18	0.0048***	4.17	0.0050***	4.38	0.0052***	4.59	0.0053***	4.73	0.0055***	9.49	0.0056***	5.00
$ΔSales_t × DecSales_t$	-0.0084***	-4.47	-0.0082***	-4.31	-0.0081***	-4.28	-0.0082***	-4.31	-0.0084***	-4.45	-0.0086***	-4.56	-0.0088***	-4.64	-0.0090***	-13.10	-0.0091***	-4.76
$DecSales_t$	0.0016***	3.99	0.0016***	3.98	0.0016***	3.96	0.0016***	3.90	0.0017***	4.04	0.0018***	4.17	0.0018***	4.22	0.0019***	5.53	0.0019***	4.23
$ΔCFO_t$	0.0099***	4.92	0.0091***	5.08	0.0097***	5.24	0.0093***	5.39	0.0075***	6.70	0.0061***	6.54	0.0054***	6.19	0.0043***	4.30	0.0040***	3.98
$ΔCFO_t × DecCFO_t$	-0.0199***	-5.38	-0.0208***	-5.50	-0.0218***	-5.74	-0.0202***	-6.17	-0.0190***	-5.58	-0.0182***	-5.09	-0.0168***	-4.48	-0.0171***	-5.58	-0.0152***	-3.16
$DecCFO_t$	0.0008	1.34	0.0000	0.07	0.0001	0.44	0.0005	1.02	-0.0003	-0.51	-0.0010	-1.12	-0.0007	-0.56	-0.0020	-1.43	-0.0010	-0.38
Other variables	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Year	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Industry	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
SE adjustment	Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered		Year-clustered	
# of observations	25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860		25,860	
adj-R²	0.0993		0.0996		0.0997		0.0998		0.0992		0.0988		0.0986		0.0981		0.0981	
$R_t + R_t × Dec_t$	-0.0168***	-4.87	-0.0169***	-4.89	-0.0169***	-4.91	-0.0169***	-4.98	-0.0170***	-4.91	-0.0171***	-4.90	-0.0171***	-4.89	-0.0171***	-4.87	-0.0171***	-4.86
$ΔSales_t + ΔSales_t × DecSales_t$	-0.0034**	-2.47	-0.0033**	-2.46	-0.0033**	-2.44	-0.0033**	-2.45	-0.0034**	-2.45	-0.0034**	-2.46	-0.0034**	-2.47	-0.0035**	-2.48	-0.0035**	-2.48
$ΔCFO_t + ΔCFO_t × DecCFO_t$	-0.0100***	-5.06	-0.0116***	-5.33	-0.0121***	-5.31	-0.0109***	-4.74	-0.0116***	-4.20	-0.0121***	-4.18	-0.0114***	-3.70	-0.0128***	-3.15	-0.0112**	-2.48

Notes: $Imp_{i,t}$ is non-current asset impairment losses per share in year t, deflated by the adjusted stock price at the end of fiscal year t–1. $R_{i,t}$ is the adjusted stock return in year t. $Dec_{i,k}$ takes the value of one if $R_{i,k}$ is negative. $ΔSales_{i,t}$ is the change in sales in year t, deflated by the adjusted stock price at the end of fiscal year t–1. $DecSales_{i,t}$ takes the value of one if $ΔSales_{i,t}$ is below a threshold for Panel A and negative for Panel B. $ΔCFO_{i,t}$ is the change in cash flows from operations in year t, deflated by the adjusted stock price at the end of fiscal year t–1. $DecCFO_{i,t}$ takes the value of one if $ΔCFO_{i,t}$ is negative for Panel A and below a threshold for Panel B. Standard errors are clustered by year. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

(2014b), I find a negative relationship between non-current asset impairments and negative stock returns in year t. The negative relationship is stronger in years $t–1$ and $t–2$ than it is in years t and $t–3$. These results suggest that while the reported non-current asset impairments are not necessarily timely, the recognition of impairment losses is consistent with the "probability criterion" employed by the accounting standard for non-current asset impairment in Japan. In addition, I find a relationship between non-current asset impairments and changes in sales and cash flows from operations (CFO) in year t, suggesting that changes in sales and CFO can be short-term indicators of non-current asset impairments. Therefore, future research on non-current asset impairments and possibly accounting conservatism can better observe the timeliness of losses and control for the economic factors of losses by employing the piecewise-linear regression model recommended by Banker et al. (2017). Moreover, it can control for economic factors using piecewise-linear variables of changes in sales and CFO.

This study has at least two limitations. First, the model becomes complicated when a study focuses on two factors. Because the model uses a piecewise interaction term, one needs to incorporate a four-variable interaction term when adding two factors. In this case, the model that uses stock returns as the explained variable may be the better, introducing a three-variable interaction term, that is, an interaction term among an impairment variable, factor 1, and factor 2. Or, it may be better to use linear stock returns as an explanatory variable and introduce an interaction term between factor 1 and factor 2. Second, the piecewise interaction term may not be suitable for non-linear regression models, as questioned by Ai and Norton (2003) in the context of probit and logistic regression models. For example, Riedl (2004) and Glaum et al. (2018) employ the Tobit and logistic regression models, respectively, while Ramanna and Watts (2012) employ the OLS regression model. Thus, one needs to pay attention to model specification when using a piecewise-linear stock return.

REFERENCES

Ai, C., and E. C. Norton. 2003. Interaction terms in logit and probit models. *Economics letters* 80 (1): 123-129.

Albersmann, B. T., and R. Quick. 2020. The impact of audit quality indicators on the timeliness of goodwill impairments: Evidence from the German setting. *Abacus* 56 (1): 66-103.

André, P., A. Filip, and L. Paugam. 2016. Examining the patterns of goodwill impairments in Europe and the US. *Accounting in Europe* 13 (3): 329-352.

Ball, R., S. P. Kothari, and A. Robin. 2000. The effect of international institutional factors on properties of accounting earnings. *Journal of Accounting and Economics* 29 (1): 1-51.

Ball, R., and L. Shivakumar. 2006. The role of accruals in asymmetrically timely gain and loss recognition. *Journal of Accounting Research* 44 (2): 207-242.

Banker, R. D., S. Basu, and D. Byzalov. 2017. Implications of impairment decisions and assets' cash-flow horizons for conservatism research. *The Accounting Review* 92 (2): 41-67.

Basu, S. 1997. The conservatism principle and the asymmetric timeliness of earnings. *Journal of Accounting and Economics* 24 (1): 3-37.

Beaver, W. H., and S. G. Ryan. 2005. Conditional and unconditional conservatism: Concepts and modeling. *Review of Accounting Studies* 10 (2-3): 269-309.

Chase, C. W. 2013. *Demand-Driven Forecasting: A Structural Approach to Forecasting*. Hoboken, NJ: Wiley.

Chen, C., M. Kohlbeck, and T. Warfield. 2008. Timeliness of impairment recognition: Evidence from the initial adoption of SFAS 142. *Advances in Accounting* 24 (1): 72-81.

Choi, T. H. 2008. Asset write-offs: An empirical investigation of timeliness. *Asia-Pacific Journal of Accounting and Economics* 15 (1): 11-27.

Chung, B. H., and P. Hribar. 2021. CEO overconfidence and the timeliness of goodwill impairments. *The Accounting Review* 96 (3): 221-259.

Enomoto, M. 2008. Selection of the adoption year of accounting standards for impairment of fixed assets and accounting behavior. *JAA Accounting Progress* 9: 23-38 (in Japanese).

Fujiyama, K. 2014a. Management turnover and asset impairment recognition decision (Genson sonshitsu keijo no ishikettei ni oyobosu keieisha kotai no eikyo). *Sangyo Keiri* 74 (2): 157-168 (in Japanese).

Fujiyama, K. 2014b. An examination of timeliness of fixed asset impairment losses: Evidence of Japan. *Journal of Investor Relations* 8: 3-25 (in Japanese).

Fujiyama, K. 2014c. The influence of informal institutions on impaired asset write-offs: Securing future and current pies for payouts in Japan. In *International Perspectives on Accounting and Corporate Behavior*, edited by K. Ito and M. Nakano, 161-186. Tokyo: Springer.

Glaum, M., W. R. Landsman, and S. Wyrwa. 2018. Goodwill impairment: The effects of public enforcement and monitoring by institutional investors. *The Accounting Review* 93 (6): 149-180.

Gordon, E. A., and H. T. Hsu. 2018. Tangible long-lived asset impairments and future operating cash flows under US GAAP and IFRS. *The Accounting Review* 93 (1): 187-211.

Hu, D., and Y. Kurumado. 2012. An examination of impairment of assets: Evidence from Japan. *JAA Accounting Progress* 13: 43-58 (in Japanese).

Iatridis, G. E., K. Pappas, and M. Walker. 2021. Narrative disclosure quality and the timeliness of goodwill impairments. *The British Accounting Review* 54 (2): 100978.

Jarva, H., and M. Lof. 2021. *Identifying Accounting Conservatism in the Presence of Skewness.* Available at SSRN: https://ssrn.com/abstract=3151365 (accessed on July 5, 2021).

Kimura, A., 2015. An individual firm difference in frequency and timing of impairment loss recognition. *Yokohama Business Review* 36 (1): 105-132 (in Japanese).

Lapointe-Antunes, P., D. Cormier, and M. Magnan. 2009. Value relevance and timeliness of transitional goodwill-impairment losses: Evidence from Canada. *The International Journal of Accounting* 44 (1): 56-78.

Li, K. K., and R. G. Sloan. 2017. Has goodwill accounting gone bad? *Review of Accounting Studies* 22 (2): 964-1003.

Obinata, T. 2021. Fallacy in Basu measure of the asymmetric timeliness test: An examination of the bias from skewed return. *The Economic Review* 195 (2): 147-162 (In Japanese).

Obinata, T., and T. Okada. 2008. Accounting behavior of firms recognizing impairment losses. *The Journal of Economics* 74 (1): 2-75 (In Japanese).

Ramanna, K., and R. L. Watts. 2012. Evidence on the use of unverifiable estimates in required goodwill impairment. *Review of Accounting Studies* 17 (4): 749-780.

Riedl, E. J. 2004. An examination of long-lived asset impairments. *The Accounting Review* 79 (3): 823-852.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48 (4): 817-838.