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Enterprise Information Mining of Corporate Adaptive Behavior Impacting on Business Performance under Drastic Changing Social Environment

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Abstract

In the midst of changes in the social environment, there are companies that adapt well to the changes and increase their business performance and that can't adapt to the changes and suffer from poor performance. This is especially true in times of major discontinuous changes in the social environment such as Covid-19 pandemic. It is important to clarify the differences in corporate behavior and their impact on corporate performance in times of discontinuous changes in the social environment. We will collect the disclosure materials of all listed companies in XBRL format, which is considered to be suitable for machine processing, and extract the financial performance information and text information necessary for analysis as basic data from them, taking into account the differences in accounting standards. From the financial performance information, a group of companies that show different performance trends from other companies in each industry can be extracted, and corporate adaptive behavior can be estimated from the text information part of the companies. The effectiveness of this method was confirmed by applying it to multiple industries.

Keywords: Corporate Disclosure Documents, Corporate Securities Reports, XBRL, COVID-19 Pandemic

1 Introduction

In a phase of major changes in the social environment, some companies are able to adapt well with changes in the social environment, while others are unable to adapt and perform poorly. The COVID-19 infection is spreading rapidly around the world, and is having a variety of effects on socioeconomic activities. The impact on domestic companies is immeasurable, and it is important to study the effects of such changes in the social environment on the adaptive behavior of companies and their business performance.

Studies on the impact of the COVID-19 pandemic on businesses are beginning to be reported. For example, Neise et al. conducted an online survey of 623 owners and managers to determine how they were responding to the impact of COVID-19 pandemic on the restaurant and bar industry [1]. Sunthornpan et al. conducted a telephone survey of 100 people to determine how the restaurant industry was affected by the COVID-19 pandemic, and found that 51% of restaurant owners were severely affected by the COVID-19 pandemic and 71% of restaurants expanded their sales channels [2]. However, these studies were based on online surveys and telephone

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interviews, and did not analyze the actual information disclosed by the companies, such as annual securities reports, consolidated reports, and so on. As a study using corporate disclosure information, Alisyah et al. used financial statement to analyze how the COVID-19 pandemic affected the performance of listed Indonesian health care companies [3]. Zhou et al. also analyzed 30 firms in the waste-to-energy and waste-to-material industry in China using quarterly financial data [4]. However, these studies are limited to specific industry, and we have not found out any study which can apply broad cross-industry analysis. On the other hand, Kawanami et al. proposed an enterprise information mining method that attempts to mechanically extract useful information from corporate disclosure information (mainly textual information) with the aim of understanding the influence spillover mechanism of management policies [5], but the method does not assume a time of major changes in the social environment.

Using the COVID-19 pandemic as an example, this study aims to propose an enterprise information mining method to analyze a wide range of information that provides clues to corporate adaptive behavior and its impact on business performance during social environmental changes, based on corporate disclosure information, without being limited to specific industries.

2 Research Method and Procedure

Since the impact of the COVID-19 pandemic will affect multiple industries, we would like to conduct the analysis for multiple industries. Therefore, at first, we will analyze data for a specific industry to clarify the analytical method and identify issues of analysis. Then, the requirements for the mining method are clarified and implemented. The data to be handled are corporate disclosure information in XBRL (Extensible Business Reporting Language) format [6], which is considered suitable for machine processing. The proposed mining method is applied to multiple industries to confirm its effectiveness.

3 Identification of Issues Through Analysis in Specific Industries

First, specific industries that were significantly affected by the COVID-19 pandemic will be analyzed to clarify the issues and effective method. A financial analysis is conducted to separate firms that performed exceptionally well from those that did not perform well within the same industry. Next, we use text analysis to extract information on firms' adaptive behavior. Finally, we apply them to multiple industries to clarify firms' adaptive behavior and its impact on business performance when the social environment changes.

In the financial analysis, companies in the same industry would be separated into a few groups based on the trends of commonly used financial indices such as operating profit or ordinary profit. Those groups are typically those whose business performance deteriorated severely and those whose did not. In the text analysis, keywords that are considered to be newly emerging adaptive behavior when the social environment changes are extracted. Then, we analyze the differences in newly appearing keywords among groups separated by financial analysis, and we assume that this analysis method be able to clarify the effects of companies' adaptive behavior in changes in the social environment on business performance.

3.1 Issues of the method identified through analysis of the izakaya industry

The izakaya industry (Japanese-style pub) would be considered easy to analyze because of the large impact of the COVID-19 pandemic, such as the ban on serving alcoholic beverages and

shortened business hours. The analysis targets the top companies operating izakaya industry, which are (1) HUB CO., LTD., (2) DAISYO CORPORATION, (3) CHIMNEY CO., LTD., (4) MARCHE CORPORATION, (5) SFP Holdings Co., Ltd., (6) Torikizoku Holdings Co., Ltd., (7) KUSHIKATSU TANAKA HOLDINGS CO., and (8) WATAMI CO., LTD. Various issues of the method became apparent when the study proceeded.

3.1.1 Consideration of fiscal year end

In order to analyze the performance of a company at the time of social environmental changes, it is necessary to consider the accounting period of each company. For example, the annual securities report of SFP Holdings, the subject of this analysis, covers the period from March 1 to February 28 of the following year, while that of WATAMI covers the period from April 1 to March 31 of the following year. Assuming that the full impact of the COVID-19 pandemic on companies began in March 2020, SFP Holdings would be affected by the COVID-19 pandemic one month earlier than WATAMI. In this case, it is difficult to analyze under the same conditions. Since the impact of the COVID-19 pandemic on a company can vary significantly from month to month, it is necessary to conduct a detailed analysis by using information disclosed by the company for as short a period of time as possible.

3.1.2 Difficulty of XBRL financial data comparison

It is generally believed that financial status data can be easily extracted from XBRL format which is based on XML (Extensible Markup Language) and suitable for machine processing and easily compared among companies, but trials have revealed various issues in practice.

(1) Mixture of financial reporting standards and comprehensive tag issues

In Japan, three accounting standards, JA-GAAP (Japan Generally Accepted Accounting Principles), IFRS (International Financial Reporting Standard), and US-GAAP (U.S. Generally Accepted Accounting Principles), are in use. Under JA-GAAP, XBRL tags are assigned to financial data included in securities reports, but under IFRS and US-GAAP, comprehensive tag style is also permitted. In the comprehensive tag style, for example, the entire consolidated balance sheet is treated as a single textual entry and described as an HTML (Hypertext Markup Language) table within the specified range of the comprehensive tag, and detailed tags are not assigned to each piece of financial data. Therefore, it is not easy to extract individual financial data. The majority of securities reports using IFRS and U.S. GAAP use the comprehensive tag, and detailed tags are assigned to only a few limited financial data.

(2) Extensibility of XBRL tag names

There are some cases where different tag names are assigned to financial indicator items that do not need to be distinguished from each other for the analysis. For example, the following tag names are used for financial indicator items that correspond to operating revenue or net sales in JA-GAAP.

```
<jpcrp_cor:NetSalesSummaryOfBusinessResults>
<jpcrp_cor:OperatingRevenue1SummaryOfBusinessResults>
<jpcrp_cor:OrdinaryIncomeSummaryOfBusinessResults>
```

In addition, different detail tags are used in US-GAAP and IFRS. In some cases, companies add their own detailed tags. For this reason, it is necessary to correspond financial indicator items to detail tags in detail.

For the limitation of (1) and (2) above, the analysis in this study targets only companies that assign detailed tags to financial data in their securities reports in accordance with JA-GAAP.

3.1.3 Consideration of financial indices

In analyzing the financial condition of a company, we have dealt with commonly used financial indices, such as operating profit margin or ordinary profit margin, and attempted to confirm the company's performance trends. However, for example, in the first quarter report of 2021 for CHIMNEY, there were cases in which ordinary income exceeded net sales. A review of the profit and loss statement reveals that non-operating income related to the COVID-19 pandemic, such as subsidy for infection prevention cooperation was accounted. In another case, subsidy for employment adjustment was mixed in as both non-operating income and extraordinary income. The effects of differences in accounting treatment were too large to analyze the performance trends by commonly used financial indices.

3.1.4 Consideration of appearing section of textual description

As initially assumed, we considered that words appearing only in corporate disclosures from January 2020 onward would include corporate adaptation behavior. We examined the quarterly occurrence of new nouns after January 2020, and found that "take-out" and "delivery" were the most prominent keywords in the izakaya industry (Table 1), and these words can be considered as part of the companies' adaptive behavior. However, we found no difference between the initial appearance of these words in groups by business performance trends.

Table 1: Examples of description and corresponding XBRL tag name

Descriptive part of Annual Securities Reports and Quarterly Reports (upper part) Corresponding XBRL tag name (bottom)	Example of description
【経営方針，経営環境及び対処すべき課題等】 (Management policy, management environment and issues to be addressed) BusinessPolicyBusinessEnvironmentIssuesToAddressEtcTextBlock	《今後対処すべき課題の文脈で》具体的に、営業面では、当社直営店及び加盟店におけるテイクアウト販売やランチ営業店舗の拡充、デリバリーを推進してまいります。 《In the context of issues to be addressed going forward》 Specifically, on the sales front, we will promote take-out sales at our directly managed and franchised restaurants, expansion of lunch stores, and delivery services.
【経営者による財政状況，経営成績及びキャッシュフローの状況の分析】 (Analysis of financial status, operating results and cash flow status by management) ManagementAnalysisOfFinancialPositionOperatingResultsAndCashFlowsTextBlock	新型コロナウイルスによる影響の削減策としては、お客様や従業員の安全を第一に考え、衛生管理や感染拡大防止に取り組んで営業するとともに、テイクアウトやデリバリーの拡充を進めてまいりました。 As measures to reduce the impact of the covid-19 pandemic, we have put the safety of our customers and employees first, operating through hygiene management and efforts to prevent the spread of infection, while expanding our takeout and delivery services.
【注意事項】（追加情報） [Notes] (Additional information) NoteAdditionalInformationQuarterlyConsolidateFinancialStatementsTextBlock	繰延税金資産の回収可能性の判断や固定資産の減損損失の判断において、新型コロナウイルス感染拡大の影響は2020年11月期末にかけて、徐々に収束し回復に向かうが、2020年12月以降はイートインにおいては完全に回復することはないものの、テイクアウトやデリバリー等の売上追加により例年並みの売上高が見込まれることを前提としております。 In judging the recoverability of deferred tax assets and impairment losses on fixed assets, it is assumed that the impact of the spread of the covid-19 infection will gradually subside and begin to recover toward the end of the fiscal year ending November 2020, but that after December 2020, sales are expected to be on par with previous years due to additional takeout and delivery sales, although they will not fully recover at Eat-in.

When we looked at the context in which the keywords appeared, we found a mixture of descriptions of planned measures (e.g., we will promote delivery in the future) and descriptions of actual

results of measures (e.g., we have expanded delivery). This difference can be inferred from the description parts in which the word appearing. As shown in Table 1, the description parts in the disclosure information can be separated by using XBRL tags. Therefore, we attempted to extract adaptive behavior from the text by narrowing the survey target to the appearance of words only in the [Management's Analysis of Financial Condition, Operating Results, and Cash Flows] section, where results are mainly observed.

4 Enterprise Information Mining Method Proposed

Based on the issues identified in the process of analyzing the izakaya industry, the proposed mining method is presented below.

(1) The analysis uses annual securities reports and quarterly reports in XBRL format, which is considered suitable for machine processing.

(2) We define and use an original business performance index to approximate the transition of business performance by taking into account subsidy incomes and combining financial indices that can be extracted commonly from annual and quarterly securities reports. Both non-operational income and extraordinary income are subtracted from income before taxes, which is not easily affected by accounting methods, and divided by the average value of sales before drastic changing social environment to normalize the results to facilitate comparisons within companies in the same industry.

$$Adjusted\ profit\ margin\ rate = \frac{(income\ before\ taxes - nonoperating\ income - extraordinary\ income)}{average(net\ sales\ before\ drastic\ changing\ social\ environment)}$$

(3) Based on the trends of the *adjusted profit rate*, companies in the industry are classified.

(4) We limit the section [Management's analysis of financial condition, operating results, and cash flow status], which mainly describes measures that have already been implemented. Words are extracted applying MeCab [7], then identify keywords which are newly appear every quarter from 2020. Those keywords would contain the words of adaptive behaviors.

(5) The results obtained from the financial and text analysis are manually judged, and meaning is assigned and interpreted.

5 Results of Applying Proposed Method

To confirm the effectiveness of the method proposed in this study, we applied the method to the three industries such as izakaya industry, hotel industry and men's wear industry, those seem to be underperforming industries under the COVID-19 pandemic.

Izakaya industry contains (1) HUB CO., LTD., (2) DAISYO CORPORATION, (3) CHIMNEY

CO., LTD., (4) MARCHE CORPORATION, (5) SFP Holdings Co., Ltd., (6) Torikizoku Holdings Co., Ltd., (7) KUSHIKATSU TANAKA HOLDINGS CO., and (8) WATAMI CO., LTD. Hotel industry also contains (1) RESORTTRUST, INC., (2) FUJITA KANKO INC., (3) THE ROYAL HOTEL, LIMITED, (4) IMPERIAL HOTEL, LTD. And Men's wear industry contains (1) AOYAMA TRADING Co., Ltd., (2) AOKI Holdings Inc., (3) KONAKA CO., LTD., (4) Haruyama Holdings Inc. In order to confirm the changes in business performance and firms' adjustment behavior by the COVID-19 pandemic, we used the XBRL documents from June 2019 to December 2021, those are able to be accessed from EDINET.

Results of applying proposed method in izakaya industry are shown in Figure 1 and Figure 2. Trends of adjusted profit margin rate in izakaya industry are shown in Figure 1. The companies shown in the right chart are improve business performance at second emergency declaration from first one. On the other hand, the companies in the left chart are not. Adaptive behavior terms extracted by text analysis in the izakaya industry are shown in Figure 2. The keyword "delivery" as an adaptive behavior is appeared earlier in three companies of right chart than left in Figure1.

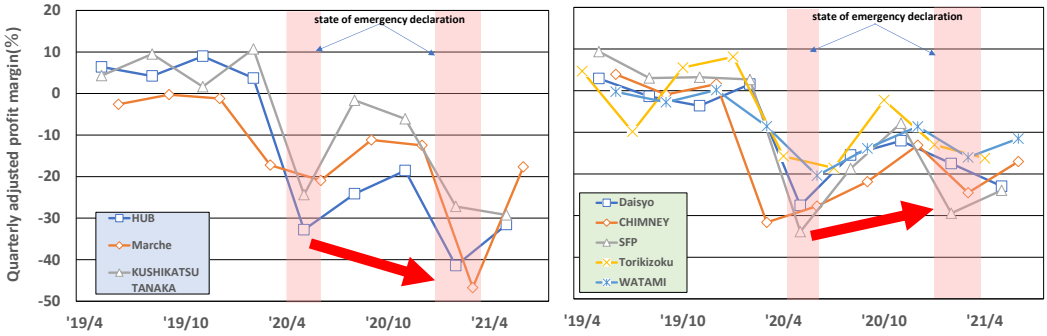

Figure 1: Performance trends in the izakaya industry

	3/20	4/20	5/20	6/20	・・・	9/20	・・・	11/20	12/20
Marche				デリバリー (delivery)					
KUSHIKATSU TANAKA								デリバリー (delivery)	
Daisyo			デリバリー (delivery)						
CHIMNEY	デリバリー (delivery)								
SFP			デリバリー (delivery)						
WATAMI						デリバリー (delivery)			
HUB									
Torikizoku									

: No description of what appears to be adaptive behavior

Figure 2: Adaptive behavior terms in the izakaya industry

Results of applying proposed method in hotel industry are shown in Figure 3 and Figure 4, also results in men's wear industry are shown in Figure 5 and Figure 6. From those results, it seems like that "long stay plan" might be an effective adaptive behavior in hotel industry, and also "teleworking and shared office", "online wedding", "pajama suits" might be effective adaptive behaviors in men's wear industry.

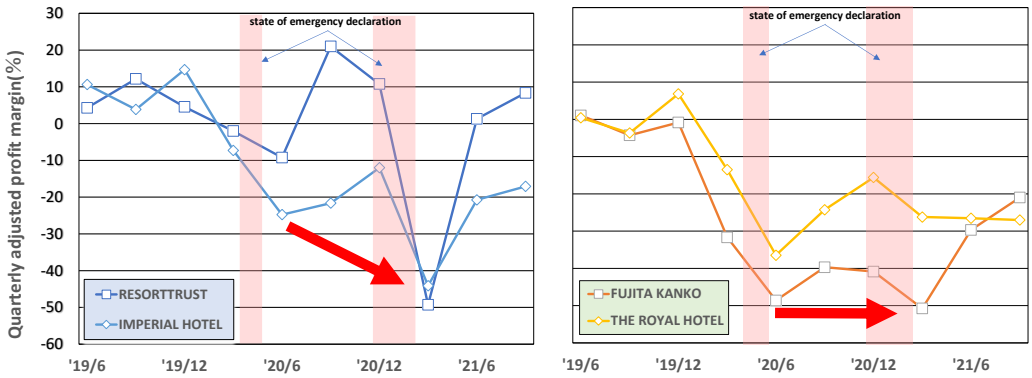

Figure 3: Performance trends in the hotel industry

	3/20	・・・	3/21	6/21	9/21
RESORTTRUST				長期滞在プログラム (Long Term Stay Program)	
FUJITA KANKO			長期滞在プラン販売等 (Sales of long stay plans, etc.)		
THE ROYAL HOTEL			長期滞在プラン (Long Stay Plan)		
IMPERIAL HOTEL			サービスアパートメント事業 (Serviced Apartment Business)		

：No description of what appears to be adaptive behavior

Figure 4: Adaptive behavior terms in the hotel industry

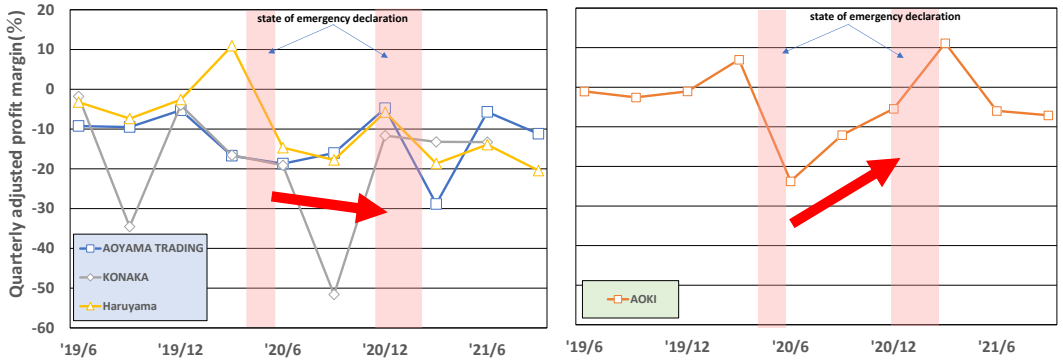

Figure 5: Performance trends in the men's wear industry

	3/20	6/20	9/20	12/20	3/21	6/21
AOYAMA TRADING						
AOKI		テレワーク・シェアオフィス ＳＴＡＦＦＳＴＡＲＴ ＥＣ オンラインウエディング (Telework and Shared Office STAFFSTART EC Online Wedding)	ＷＥＢカメラ 会議用アプリケーション等 (Web Cameras Conference applications, etc.)	デジタルアプローチ スタッフスナップ パジャマスーツ (Digital Approach Staff Snapshot Pajama Suit)	デジタル接客 アクティブワークスーツ テレワーク・テレスタディ需要 リモートスタイリングサービス フォトウエディング (Digital Customer Service active work suits Telework and Telestudy Demand remote styling services photo weddings)	
KONAKA		立体マスク (Dimensional mask)	イージーオーダー (easy order)			
Haruyama		クールプレストマスク オンラインショップ (Cool Presto Mask Online Shop)	ファッション・コンシェルジュ WEBカメラ接客サービス (Fashion Concierge Web camera customer service)		オンラインショップサイト (Online Shop Site)	

：No description of what appears to be adaptive behavior

Figure 6: Adaptive behavior terms in the men's wear industry

6 Conclusion

By analyzing the izakaya industry as an example, we found issues in the analysis and clarified the requirements for a machine processing method to obtain corporate adaptive behavior at the time of social environment change. We implemented the enterprise information mining method. Then we applied it into the izakaya industry, the hotel industry and the men's wear industry, and confirmed its effectiveness.

Although the grouping of business performance trends obtained from financial analysis and the keyword information that is considered to be adaptive behavior obtained from text analysis are only clues, and human insight and interpretation would be ultimately important. However, it can be seen that machine processing using XBRL provides more efficient suggestions than examining all information from scratch. As a further development of this study, the method may be adapted to more industries, and a wider range of analysis may become possible by improving the completeness of the method.

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