

AN ANALYSIS FOR BUSINESS CONDITION OF SMALL AND MEDIUM-SIZED TAXI COMPANIES IN LOCAL AREAS OF JAPAN —SITUATION UNDER COVID-19 CRISIS AND ROLE OF TAXI SUBSIDY SCHEME—

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Taxi is an important means of transportation that forms local public transportation. However, the declining trend of users in the long-term did not change, in addition to this, taxi business is facing various challenges increasingly during the COVID-19 crisis. In this paper, a survey was conducted to examine the actual condition and perspectives of small and medium sized taxi companies in whole Japan, impact of COVID-19 crisis on business management and the role of Taxi Subsidy Scheme (TSS). As a result, more than 50% of companies are facing the 60% drop on business sale compared to last year caused by the pandemic. As a role of Taxi Subsidy Scheme (TSS) on taxi business, about half of the companies said that TSS is an important service content, especially with small and medium sized companies, and by quantitative analysis of the business sale, we found that TSS has significant effect on the sale for taxi companies with 6 to 10 vehicles.

Key Words : taxi company, COVID-19 crisis, Taxi Subsidy Scheme (TSS), regression model

1. INTRODUCTION

A taxi is a public transportation tool for providing “door-to-door” individual transport service, whereas other public transportation modes such as buses or railways are considered as mass transit. As taxis respond to individual needs or small demand, they are also praised as an environmentally responsible alternative to private car use¹⁾. Taxi industry all around the world are facing similar challenges, which consequently accelerates the promotion of self-regulation and better taxi service in order to stand firmly in this intensive competition. Local authorities have disseminated initiatives to support the taxi industry to boost their competitiveness. Several types of measures are being employed to bring benefits to both sides of taxi operators and taxi users, such as Taxi Subsidy Scheme (TSS), on-demand

ride-sharing taxi or private paid passenger transportation system, as a service for local areas and complement of mass or medium transportation modes. TSS subsidizes the taxi fare by distributing tickets to a limited target group according to certain conditions such as age, driving license, disability, and socio-demographic background. The TSS is a solution that has been widely introduced by local authorities. The local government subsidizes part of the taxi fare by issuing a certain number of tickets to target persons annually, and users can pay part of their taxi fees with this ticket. As a welfare policy, the original target of the system, i.e., people with disabilities, has been expanded to include the elderly and poor.

According to the subsidy amount and number of distributed tickets, the programs in the available areas can differ, according to the local authorities and their own conditions. The range of subsidy tickets

distributed annually varies from 20 to 100 sheets. The subsidy rate can be divided into several cases, e.g., a fixed amount of subsidy per ticket, or a changeable subsidy amount depending on conditions. This paper focus on the business condition of small and medium sized taxi operators, especially the situation under the COVID-19 pandemic, as well as the role and effect of the TSS on the taxi business.

With the revised Road Transport Act of 2002, demand adjustment restrictions on taxi business were mitigated, in large cities, the competition among business operators was promoted by reductions in fares and increases in the number of vehicles²⁾. However, the declining trend of users in the long-term did not change, and as a result, the driver's working environment deteriorated, working hours increased, wages decreased, and accidents increased. For this reason, the "Special Measures Act on the Optimization and Revitalization of General Passenger Vehicle Transportation Business in Specific Areas" was enacted in 2009, also some solutions to "optimize" the business have been made, such as reductions in company numbers and increase in fares³⁾.

Furthermore, in the "Act on Revitalization and Rehabilitation of Local Public Transportation Systems" revised in 2019, local governments are obliged to make efforts to create a "local public transportation plan" which respond to the local transportation needs by fully utilization of local buses, taxis and private transportation.

Looking at the socio-economic situation nationwide, the population and birthrate are declining, but the aging rate is increasing. By 2050, the total population will be 100 million or less, and the aging rate (the ratio of 65 years or older to the population) is estimated to be about 38%. All these factors put pressures on business condition that approximately 74% of regional railway companies and 65% of regional route bus transportation operators are in deficit; it is thus assumed that the condition of local public transportation will become even more severe under rapid population decline in the future. In this way, transportation companies in local areas are in a difficult situation for keeping business sustainable⁴⁾.

Even though taxis are now providing the area with mobility service, low demand for service, high operation cost, needs for rejuvenation on drivers cause difficulties for maintaining the business properly. Even though, some areas are implementing the demand-responsive type shared taxi, because of the individual usage, the sharing ratio is still low and inefficient⁵⁾.

Recently, many studies have pointed that for this type of low and dispersed service demand, it is better to investigate the individual type of transportation

service by taxi which can respond to the individual demand by achieving flexible door-to-door service rather than focusing on the establishment of public transportation according to the characteristic of rural areas. Along with taxi service, Taxi Subsidy Scheme is implemented by considerable number of local governments in order to provide these special groups with proper support by enabling them use taxi more often for their daily life activities so that bring convenience to their daily life. Whether the Taxi Subsidy Scheme has a positive influence on using taxi service need to be considered.

2. EXISTING RESEARCH

Rural transport receives less concern from government in infrastructure and service provision, consequently rural people face many problems related to poor accessibility and mobility. Until now, provision of rural public transport (RPT) service has not been firmly regulated by government. There has no specific regulation that control RPT operation and service like in urban area. Such condition let RPT operation has no strong foundation⁶⁾.

Challenges in public transport provision for rural areas are similar across countries, it is difficult for conventional public transport to meet different accessibility needs of different user groups. Demand-responsive transport is seen as one of the key options to meet public transport challenges in rural areas. There is a clear case for maintaining qualitative regulation in the taxi industry, including vehicle standards, requirements for driver training, safety and minimum service standards. These qualitative regulations should, however, be designed carefully to enable development of innovative services and market structures that benefit from reforms⁷⁾.

Lots of efforts have been made to maintain the taxi industry for securing the mobility of rural area in Japan. In order to improve the service effectiveness, it is advocated to diagnose the real situation. Lots of private bus operators have withdrawn from public services due to the deficit. However, in areas where bus demand was originally low, the number of passengers was small, and due to the low population density, fare revenue could not cover operation costs, it is fairly difficult for operators to continue the business, also sharing type of business is still inefficient. The need for revitalizing and rehabilitating the regional public transportation system have been giving pressure on local government, various situations in different regions require unique and proper policy, to which the problem cannot be solved in a uniform manner.

According to both of our research on the private

paid passenger transportation system (Jikayou Yusho transport system)⁸⁾, and our research on small and medium sized taxi operators⁹⁾, showed that rejuvenation on drivers is the major problem for maintaining the business.

Regarding the Taxi Subsidy Scheme, research by Hayakawa¹⁰⁾ shows that Tatebayashi City, Gunma Prefecture and Omachi City, Nagano Prefecture are examining whether the taxi subsidy ticket that replace the abolition of fixed-route buses can secure the mobility of need of residents. Research done by Suzuki¹¹⁾ in Akita City show that outgoing behaviour of elderly will change by the discount rate of taxi fare, supporting the elderly over 70 years old with 50% of discount rate is recommended. In addition, Kobayashi¹²⁾ focused on corporate subsidies and user subsidies as maintenance measures for public transportation, a proposed model of a subsidy system that combines both of them is examined as a measure for maintaining the social sustainability of public services in depopulated areas. Furthermore, Yoshida¹³⁾ focusing on the introduction of a unlimited ride taxi service in small sized local cities, he describes the case study at Minamisoma City, Fukushima Prefecture introducing the unlimited ride taxi service by using the vehicle allocation data of “min-ataku” to increase the possibility for frequency of taxi utilization. It has been shown that compared to the case where the fixed distance is set only between two predetermined points, an unlimited ride service with fixed monthly fee that allows the user to flexibly select their destination leads to higher taxi demand to some degree.

3. RESEARCH METHOD

(1) Aim of research

The aim of this study is first to examine the business condition for small and medium sized taxi companies in Japan under the disaster of COVID-19. And this study also focuses on the role of Taxi Subsidy Scheme (TSS) as a remedy for the situation. TSS is introduced in many local governments as a support policy to the mobility vulnerable group with certain amount of distributed ticket as a part of taxi fee.

By the analysis of questionnaire survey of taxi companies, existing problems and their perspectives for future business management, also the situation during COVID-19 pandemic are explained, by the comparison on the role of TSS between different sized companies, effects of TSS on business sale were examined.

(2) Content of questionnaire survey

In this study, we design the questionnaire survey

with seven main sections, as it is shown in **Table 1**. The first section is organized with basic information for the structure of company (number of vehicles, staff and changes during the pandemic). The second section is about drivers, this includes age construction, changes on drivers' number and problems about securing drivers number and rejuvenation. The third section is about corona influence on business management. Forth section is corona prevention measures. Fifth section is about taxi subsidy scheme. The sixth and seventh sections are the expectation about future business management and expectation from local government towards taxi business.

(3) Questionnaire survey result

A questionnaire survey was sent to small and medium sized taxi operators in August 2020, when it was a time of recovery situation after emergency status was lifted in Japan. According to the list from National hire taxi companies' directory 2018 version, among 5886 taxi companies, 2993 companies were chosen as target companies with 1 to 20 vehicles, which locates towns or cities except Ordinance-designated cities in Japan.

We mailed the questionnaire to the address listed in directory, as a result, 644 responses were received by mail, 159 responses were received by filling out the online Google form, total responses from 803 companies were obtained, the response rate is 26.8%. Among them, the valid response of 786 companies were analyzed.

Table 1 Content of Questionnaire Survey.

| Q | Question type |
|---|---------------------------------------------------------|
| 1 | Basic information |
| 1 | Post code |
| 2 | Staff number |
| 3 | Owned vehicles number |
| 4 | Changes on the number of vehicles from last year |
| 2 | About drivers |
| 1 | Age structure |
| 2 | Changes on the number of drivers from last year |
| 3 | Problems about drivers |
| 3 | Corona influence on business management |
| 1 | Business profit comparison ratio from last year |
| 2 | Business sale per car |
| 3 | Business prospect |
| 4 | Corona supporting policy |
| 5 | Future business prospect |
| 4 | Corona prevention measures |
| 5 | Taxi subsidy scheme (TSS) |
| 1 | Introduction status of TSS |
| 2 | Target users |
| 3 | TSS usage ratio |
| 4 | Expectation about TSS |
| 6 | Expectation about future business management |
| 7 | Expectation from local authorities toward taxi business |

(4) Company types by owned vehicles

From this collected data, these companies are divided into three types according to the number of owned vehicles for the competitive analysis on the situation and opinions, that is, type A company with 1~5 vehicles which accounts for 262 samples with 33.3% of respond, type B company with 6~10 vehicles which is 248 samples about 31.6%, and type C company with over 11 vehicles which is 276 samples representing 35.1%.

4. THE SITUATION OF TAXI BUSINESS UNDER THE IMPACT OF COVID-19

(1) Change on the structure of company

During the impact of pandemic, a lot of business industries are faced to close down or narrow the business scale, so we make a comparison about the basic structure of company with last year before the pandemic. As shown in Fig.1 on number of vehicles and Fig.2 on number of drivers, type A company shows stable trend compared to others, like 89% and 84% response respectively with no change.

About drivers situation, type B and C company both shows that it is difficult to increase the number of drivers with more than 55% response, as shown in Fig.3. As for the age construction shown in Fig.4, 60 to 70 years old drivers account for large portion, that is 68%, however, 86% of respond is for difficulty of drivers rejuvenation, the ratio of driver shortages and aging is lower in small companies than in medium-sized companies.

(2) Impact on business sale with COVID-19

With the outbreak of corona virus, not only business industry, but all carriers in different fields have been impacted severely by the decreased outing behaviour, taxi industry is not an exception. We collected the data about the daily business sale per car before COVID-19 as shown in Fig.5, and from this data, the average business sale is estimated to be 15,567 JPY for companies with under 5 vehicles, 19,802 JPY for companies with 6~10, as well as 22,562 JPY for companies over 11.

For all types of company, business sale was dropped severely about 60-80% from last year for more than 60% companies, as it is shown in the Fig.6. If situation goes like this, for all three type of companies, about 40-50% said the business may not be continued shown in Fig.7. Nearly 50% of respondents are concerned about the continuity of management. For this reason, many business operators are applying for various subsidies support system shown in Fig.8.

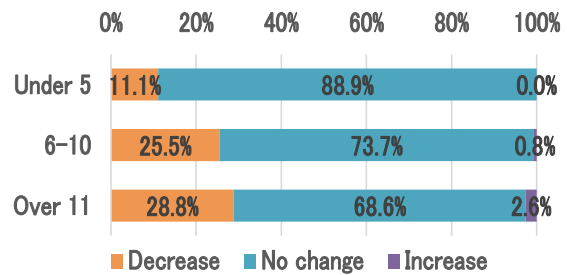


Fig.1 Comparison on the number of vehicles before COVID-19.

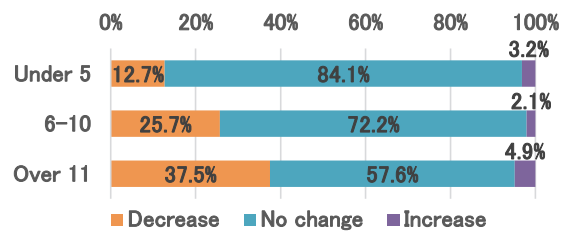


Fig.2 Comparison on the number of drivers before COVID-19.

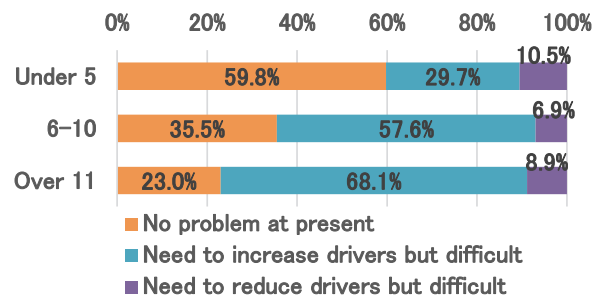


Fig.3 Situation of drivers.

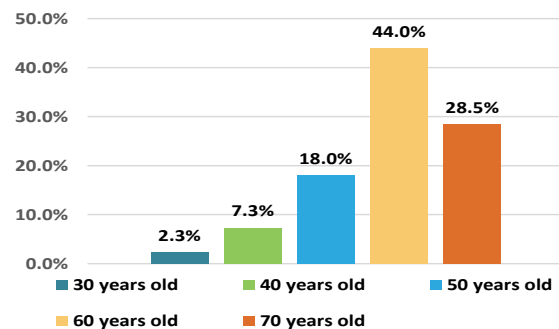


Fig.4 Drivers age construction.

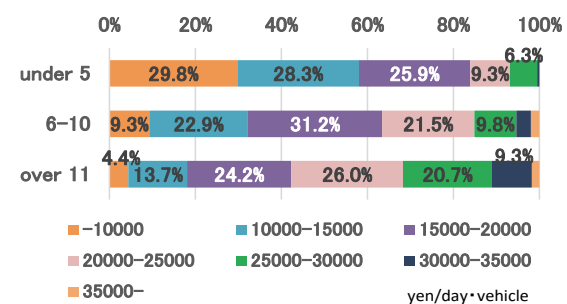


Fig.5 Daily business sale per car before COVID-19.

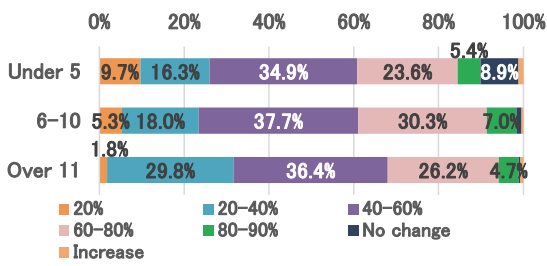


Fig.6 Drops on business sale after COVID-19.

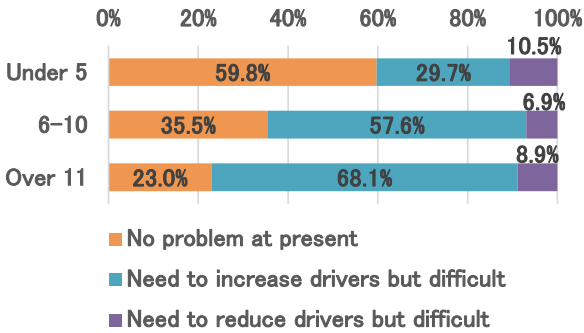


Fig.7 Perspectives about future business continuity.

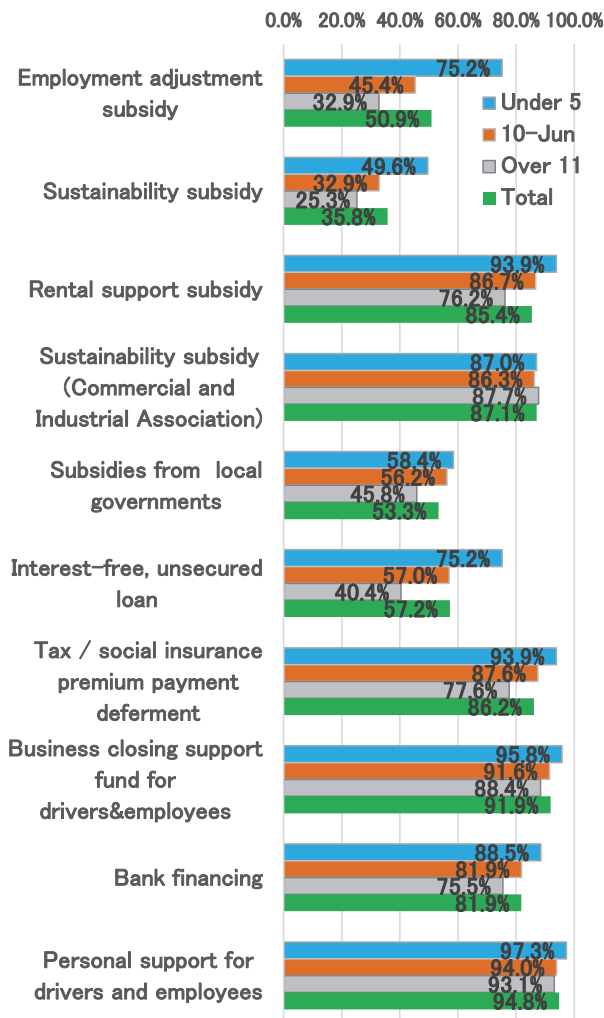


Fig.8 Application level of government support with the impact of COVID-19.

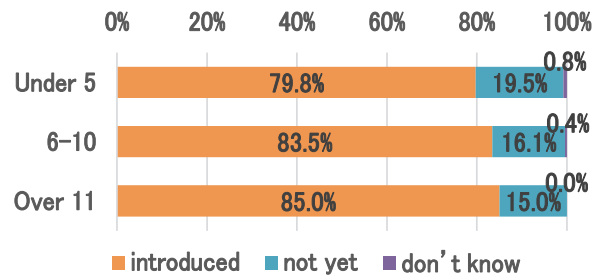


Fig.9 Introduction of TSS.

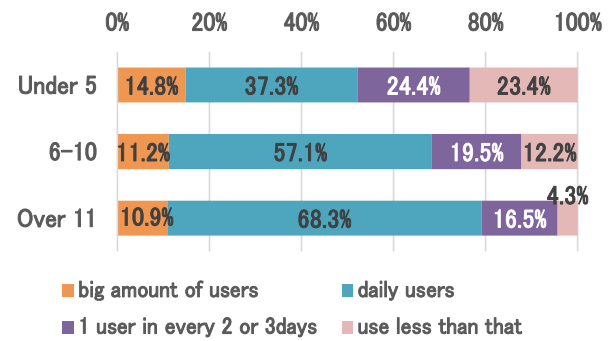


Fig.10 Usage portion of TSS.

(3) Infection prevention infrastructure

When asked about the infection prevention measures, whatever the small or medium sized taxi operators, they all almost well implemented all required measurements for preventing the spread of corona virus.

5. ANALYSIS ON THE ROLE OF TAXI SUBSIDY SCHEME (TSS)

(1) Introduction of Taxi Subsidy Scheme (TSS)

As for the introduction of TSS, 82% of companies said TSS is introduced in their area shown in Fig.9. when asked about the willingness for the introduction of TSS from the part that have not introduced yet, they show high willingness about 72%. Disabled people form the big portion of target users for this policy, elderly stands second.

(2) Contribution of Taxi Subsidy Scheme (TSS)

About the usage of TSS before pandemic situation, from the valid response of 803 company, we squeezed the 645 company who introduced the TSS policy, there is a daily user with high response, 55% shown in Fig.10. Regarding to the contribution of TSS on business before pandemic situation, for all types of company, it has certain amount of contribution with 48% shown in Fig. 11. However, the usage ratio of TSS decreased 35% because of the pandemic.

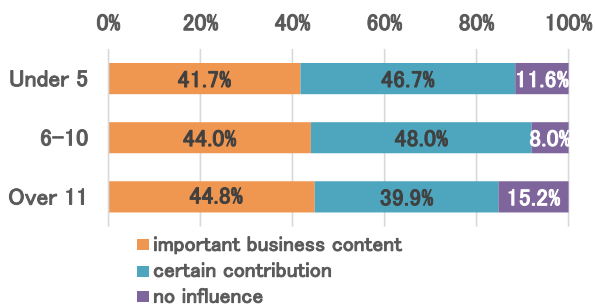


Fig.11 Contribution of TSS on business

(3) Quantitative Analysis on taxi business with TSS

Considering from the position of taxi operators, increasing the profit may be referred as a priority. In each business sector, there will be several different factors contributes to business sale in a different level. To find out what kind of factors in which level have influence on increasing the profit, a stepwise regression model by using SPSS ver25, is conducted in this research⁽¹⁾.

In statistics, stepwise regression is a method of fitting regression models in which the choice of predictive variables is carried out by an automatic procedure. In each step, a variable is considered for addition to or subtraction from the set of explanatory variables based on the prespecified criterion. In this study the p-value of F-statistics is used criterion and threshold of variable addition (PIN) is 0.05 and subtraction (POUT) is 0.10 as the default setting of SPSS. **Table 2** shows the variables added in each step. After the step-by-step iterative construction of a regression model select the independent variables to be used in a final model. The formula for stepwise regression model is as following:

$$Y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} + \varepsilon \quad (1)$$

Where, for i is the number of observations (taxi companies), Y_i is dependent variable, x_i is explanatory variable, β_0 is Y-intercept, β_p is slope coefficients for each variable, and ε is the model's error term.

Variables for this model are chosen as shown in **Table 2**. In this research, data was collected from taxi companies with 1~20 vehicles from whole Japan. As a factor which can influence the business sale as dependent variables of this model, area scale, population density, aging ratio, number of taxi company in each town or city where the responded company locates, number of vehicles and drivers working in the company, and introduction of TSS were chosen as explanatory variables. **Table 2** shows the correlation value of explanatory variables with the dependent variable (sale) as well, which shows

significant relationship. Area scale, population density and aging ratio were obtained from 2015 Census (Statistics Bureau, Ministry of Internal Affairs and Communications). Business sale, number of drivers and number of vehicles is obtained through this survey⁽²⁾. We choose 654 companies according to the valid answer for the column of business sale as sample. Because there is no specific data of number of taxi company for whole region of Japan according to their geographical position, so the number of taxi company in each area which is corresponding to respondent is made by searching the administrative code one by one. As we got to know the status of introduction of Taxi Subsidy Scheme through this survey, the influence of TSS on business operators is also considered as one of the factors whether to promote it if this policy has beneficial effect on both sides, taxi business operators and mobility vulnerable group.

To examine the relationship between business sale and each explanatory variable, stepwise regression model is implemented. The result confirmed that the model variables were selected correctly, this allows to estimate the coefficients of each parameters in the model. In this result, the associated p-value by F-test of ANOVA (Analysis of Variance) for the model is $< 0.000^{***}$. It means the hypothesis that all of parameters of this model might be zero is significantly rejected. R and R square value, however, are not sufficient so that the model explains only 30% of variance of sale. **Table 2** and **Table 3** show the adding variables on each step and the value of VIF (variance inflation factor) in order to check multicollinearity. As all of VIF values show less than 10.0, there would be little concern about multicollinearity.

Each estimated parameter shows the influence level by each explanatory variables, area scale and number of vehicle are automatically deleted.

In this research, we mainly examine the influence of Taxi Subsidy Scheme to business operators whether to promote it as a policy of supporting mobility vulnerable group if it has positive influence on taxi operators. As we selected companies with 1~20 vehicles, considering it may have different result according to different size of business scale, stepwise regression model selected the significant business scale. As a result of this model, population density, aging ratio, number of taxi company, number of staff as well as the Taxi Subsidy Scheme (TSS) for companies with 6 to 10 vehicles turned out to be significant, as it is shown in **Table 3**. It seems that company with under 5 vehicles almost all introduced TSS, so it is difficult to find out the differences.

So, the formula of the multiple regression model can be written as followings:

$$Y_i = \beta_0 + \beta_1 PD_i - \beta_2 AR_i - \beta_3 TC_i + \beta_4 ND_i + \beta_5 TSS_i \quad (2)$$

Where:

Y_i :business daily sale per vehicle (yen/day·vehicle)

β_0 : intercept is 21185 (yen/day·vehicle)

$\beta_1 PD$: 0.970 * population density (person/km²)

$\beta_2 AR$: -207.938 * aging ratio (%)

$\beta_3 TC$: -50.001 * number of taxi company

$\beta_4 ND$: 403.284 * number of drivers

$\beta_5 TSS$: 1838.054 * dummy variable of introduction of TSS (company with 6 to 10 vehicles)

Tabel 2 Variables list of regression model and results.

| Variables (unit) | Explanation (data source) | Correlation with sale/ sig. | Step-wise | VIF (last step) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------|-----------------|
| D Business sale (yen/vehicle·day) | Daily sales/vehicle dependent variable | - | Dependent | |
| 1 N of drivers (n) | Number of drivers in the company (Survey) | 0.494** | in 1 | |
| 2 N of vehicles (n) | Number of vehicles in the company (Survey) | 0.434** | | 3.97 |
| 3 Area Scale (square km) | Area size of town or city where the company locates (Census) | -0.155** | | 1.08 |
| 4 Population density (/square km) | Population density of town or city where the company locates (Census) | 0.313** | in 2 | |
| 5 Aging ratio (%) | Population ratio of over 65 years old of town or city where the company locates (Census) | -0.300** | in 4 | |
| 6 N of taxi company (n) | No. of taxi company in the same town or city where the company locates (Taxi directory) | -0.287** | in 3 | |
| 7 Aged population (n) | Aged (65-) population (Census) | 0.085* | | 4.3 |
| 8 Aged population per company (n) | Aged (65-) population / N of taxi company in the town or city (Census, Taxi directory) | 0.198** | | 1.38 |
| 9 TSS (under 5 vehicles) | Dummy variable of company with TSS introduction status for each type. (Survey) | 0.312** | | 1.84 |
| 10 TSS (6-10 vehicles) | | 0.287** | in 5 | |
| 11 TSS (over 11 vehicles) | | -0.305** | | 1.95 |
| 12 TSS (under 10) | | 0.312** | | 2.31 |
| Survey: Survey of taxi companies Census: Census 2015 statistics Taxi directory: Taxi directory in 2018 VIF: Variance Inflation Factor to check Multicollinearity | | sig.: significant level ** <0.01 * <0.05 stepwise: in or out and step no. | | |

Table 3 Coefficients for each parameter in stepwise regression model.

| Step | Valid variables | Estimate parameter | p-value (t-test) | VIF |
|-----------------------------------------------------------|---------------------|--------------------|------------------|-------|
| | Intercept | 21185.200 | 0.000 | - |
| 1 | N of drivers | 403.284 | 0.000 | 1.237 |
| 2 | Population density | 0.970 | 0.000 | 1.296 |
| 3 | N of taxi company | -50.001 | 0.000 | 1.139 |
| 4 | Aging ratio | -207.940 | 0.000 | 1.450 |
| 5 | TSS (6~10 vehicles) | 1838.050 | 0.006 | 1.027 |
| | R / R square | 0.548 | 0.295 | |
| | ANOVA F value / p- | 55.366 | 0.000 | |
| p-value : significant level of parameter value by t-test | | | | |
| VIF: Variance Inflation Factor to check Multicollinearity | | | | |

Population density, aging ratio, number of taxi company in each area and number of drivers, and Taxi Subsidy Scheme (TSS) turned out to be statistically significant. For one unit increase in population density, there will be 0.97 increase in business sale, which, to some degree, explain the situation of low population density areas that maintaining the taxi business sustainability is much more challenging in depopulated area. Surprisingly, although taxi is considered as a transport mode for elderly people, for one unit increase in aging ratio result in 207.9 decrease in business sale, which shows that the higher the aging ratio in rural areas is, the lower the usage of taxi becomes. Low frequency or short trip of outing behavior of elderly mobility and expensive fare of taxi may cause this result. As we know the current taxi industry is facing a lot of challenges after the deregulation policy, increasing on the number of taxi companies is the direct result of this policy. The model shows that one unit increase on the number of taxi company will result 50.001 decrease on business sale, which may increase the competition severely. From this survey result, while a lot of companies complaining about the difficulty of increasing the number of drivers, the model shows that one unit increase on the number of drivers will increase the business sale 403.284 unit, lack of drivers and staff may be considered as the another hindrance for improving the business sale. As one of the main purpose to be examined, this time, the relationship between taxi business sale and introduction of TSS is also examined, however in stepwise regression model, TSS introduction for companies with 6 to 10 vehicles turned out to be significant, TSS influence on business sale is about 10%, in case of company with 6-10 vehicles. On the other hand, few distributed taxi subsidy ticket and high price for taxi ride may limit the elderly from using taxi, which is turned out to be true in the above result, aging ratio. It means the higher the aging ratio, the fewer the usage of taxi. So, expansion of Taxi Subsidy Scheme on most needed target group with the aim of effective usage is advocated while it is beneficial to both users and operators sides.

6. OPINIONS AND EXPECTATIONS FOR TAXI BUSINESS

(1) Expectation for improving the policy of Taxi Subsidy Scheme (TSS)

When asked about the expectation for TSS by

several items like expansion on targeted people, distributed ticket, service available area, and the discount rate supported by local government, and also reducing the burden of paperwork, simplification for confirmation of user authority, among them the expansion on targeted people and distributed ticket accounted for large portion with 35% and 44% respectively shown in Fig.12. This result to some degree explains the situation that considering it from business operator side, the subsidy amount for this policy is allocated from government side, so taxi companies want more TSS users.

(2) Opinions about future management

Based on the current situation of taxi industry, perspectives, expectation, and opinions on improving of taxi business for future development were also examined. For future improvement measures, we got almost half of the opposite response for introduction of fixed fare policy, private paid passenger system in transport vacant area, nursing care taxi business, welfare taxi business, outsourcing of reservation and dispatch and IT based dispatching, which are considered to not necessary for future business. on the contrary, they show higher desire for items like fuel-efficient vehicles for reducing operation cost, vehicles with safety support system, enhancing work style and benefit for attracting drivers as it is shown in Fig.13.

(3) Expectations from local government towards taxi industry

As an expectation from local government towards taxi industry, we provide several items like guidance and support for expansion of management integration; implementation of private paid passenger transportation; deregulation on operation area; introduction of new fare system like unlimited ride shared taxi; introduction and expansion of TSS; in-car display for emergency broadcasting; supports on IT facilities for outsourcing reservation & allocation; subsidy for purchasing safety support and fuel-efficient vehicles; financial subsidy for dealing with covid infection. Certainly, urgent need for financial support for dealing with corona impact got highest response with 52%, and surprisingly, they show higher desire,45%, for introduction and expansion of TSS, and subsidy for purchasing safety support and fuel-efficient vehicles, introduction of reservation type shared taxi accounts for second and hird high portion, which is shown in Fig.14. Desire for fuel-efficient vehicles for reducing operation cost and vehicles with safety support system is double confirmed in this section.

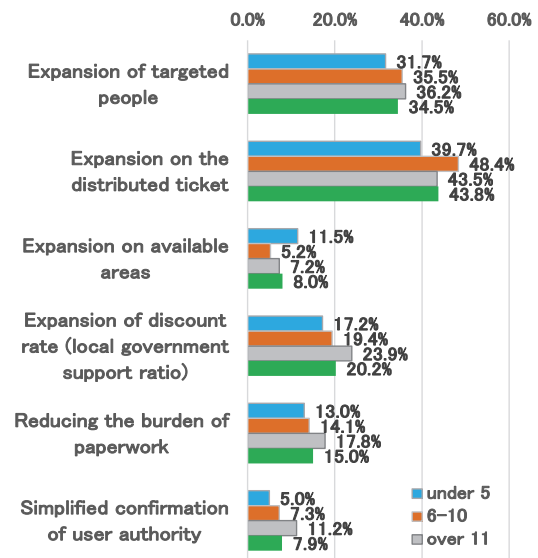


Fig.12 Expectation for improving of TSS.

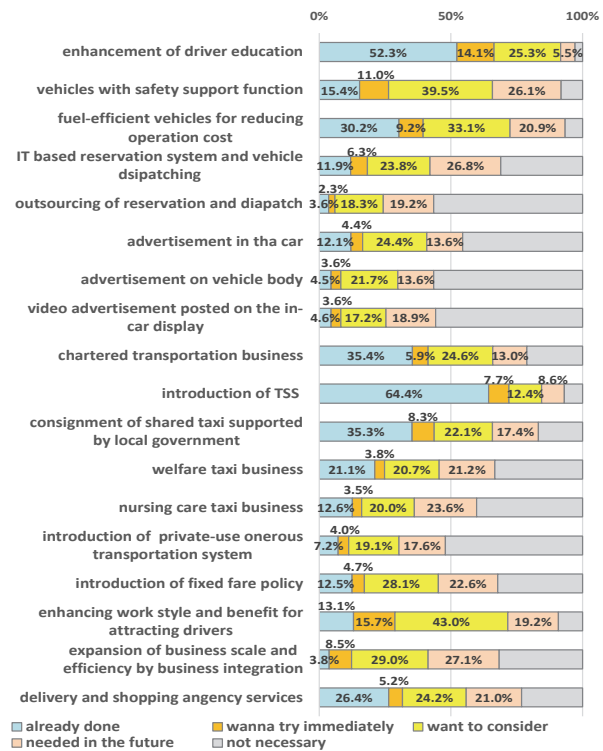


Fig.13 About the future improvement measures.

7. CONCLUSION

Results of COVID-19 impact analysis in this paper showed that small or medium sized taxi companies with under 20 vehicles tend a decreasing trend about the changes on number of vehicles and drivers.

In addition, when the scale of company gets bigger, the burden of management gets severe. More than 50% of all sorts of company are facing the 60% drop on business sale compared to last year because of the COVID-19 pandemic, but they all are committing their effort for preventing the spread of

COVID-19 to keep the business continuous and applying for various financial support system.

About the role of Taxi Subsidy Scheme (TSS), more than 80% companies respond that they have introduced TSS policy, and about half of them said they have daily TSS users, which can be seen as an important service content for taxi industry especially with small sized companies.

By employing of regression model on business sale, TSS with 6 to 10 vehicles turned out to be statistically significant. From population density and aging ratio, it seems that compared to relatively populated area, business sustainability faces more challenges in the area with low and dispersed population. Growth on the number of taxi company and declining on the number of drivers which is the consequence of the deregulation policy in taxi industry shows the negative impact on business.

So, raising on frequency for usage of taxi and securing the mobility of elderly at the same time by popularization of Taxi Subsidy Scheme (TSS) to most needed target group is recommended.

In addition, considering the national policy for the mobility of elderly persons, the Act on Revitalization and Regeneration of Local Public Transport (Transportation Rehabilitation Law) revised in 2020, which point out the obligation for local public organization to create a “Regional Public Transport Plan”. The position of taxis as public transportation has been clarified, calls for securing mobility by integrating various means are popularized but the awareness and efforts for cooperation with taxi operators are delayed. General taxi transportation still has many regulatory barriers, and it is important to properly divide roles with shared transportation.

In order to increase the continuity of the taxi business in local areas, it is important to improve vehicle utilization effectively not only from transport passengers, but also for responding to various needs by creating other service such as shopping agency, hospital transport, food distribution service.

For this purpose, there may be a direction to establish a business of “transportation service vehicle dispatch center” that centrally accepts and dispatches such transportation needs. Furthermore, as a new system to balance the burden and benefits, the factor of intergenerational cost burden such as transportation insurance is also considered important. In that respect, as a policy to support taxi users, it is important for Taxi Subsidy Scheme (TSS) not to expand the number of people covered, but to properly identify people with traffic difficulties and enhance the subsidy for ensuring the mobility of those people.

As mentioned above, in this study, it is clarified that the business condition for small and medium-sized taxi operators has deteriorated due to the

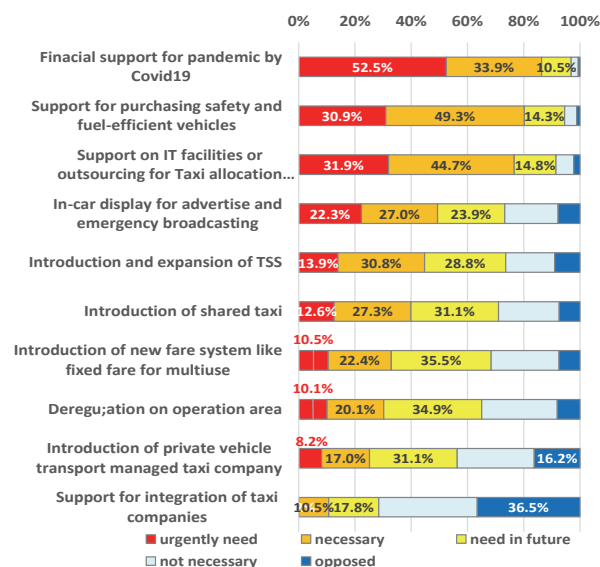


Fig.14 Expectation from local government towards taxi industry.

corona disaster. And from the revealed result of TSS contribution on taxi operators, the direction of improvement on TSS was organized. These measures are not only limited to the situation of corona disaster, but also it is necessary to be considered as one of the important factors in maintaining the management of small and medium-sized taxi operators in local areas in the future.

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APPENDIX

(1) Since stepwise method cannot always select the optimum variable set from the variable group with multicollinearity, Ridge Regression and Lasso regression are proposed to solve this problem. In this study, because the variables we prepared did not show significant multicollinearity and the purpose of this analysis is not to predict the sale price but to understand the impact of introducing of TSS, so simple stepwise method is applied.

(2) Sale are entered in approximate numbers, and many businesses enter in units of 1,000 yen. The other variables are answered by integer value in questionnaire survey.

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