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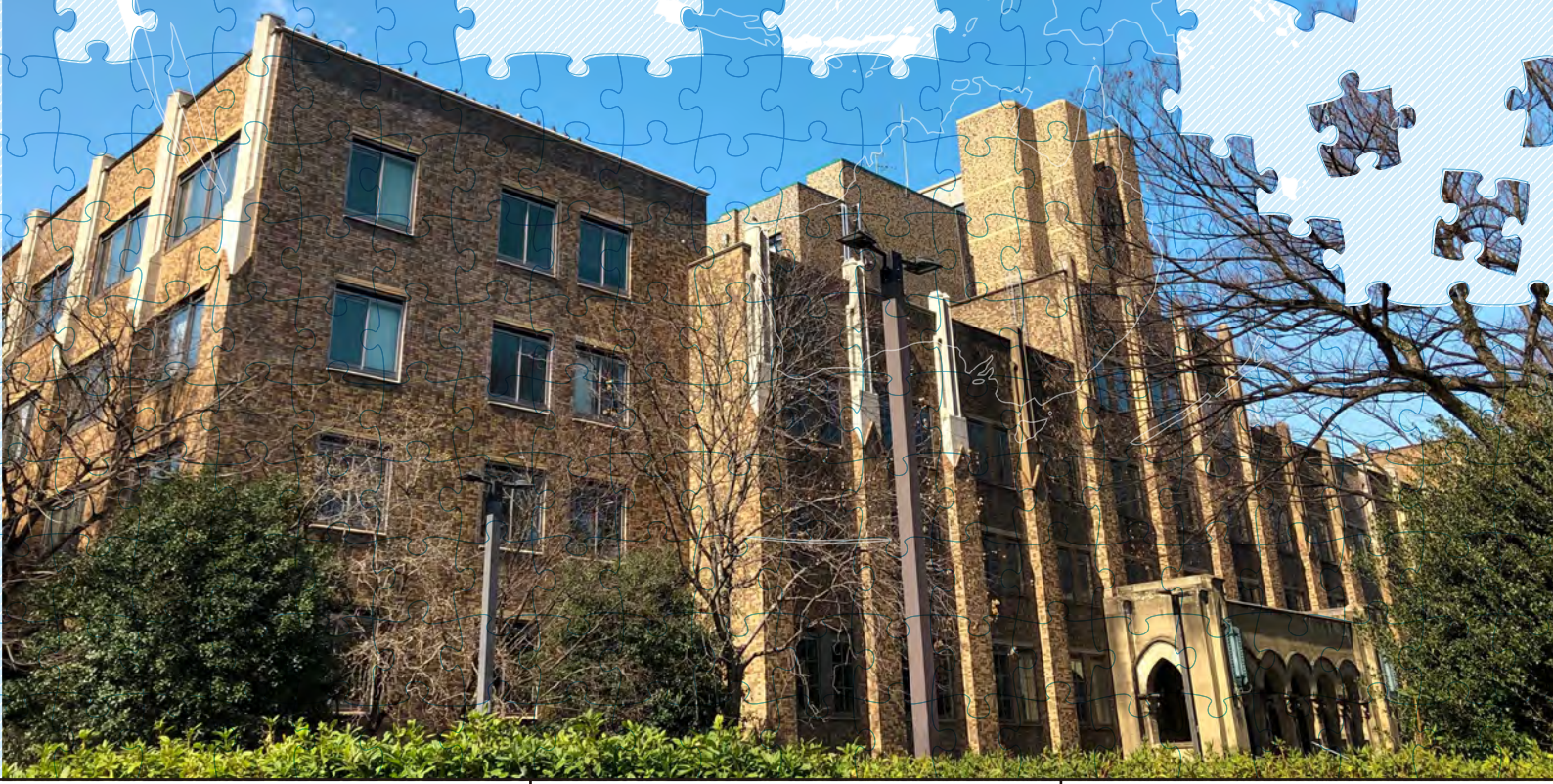
Determinants of Employing Foreign Workers and Introducing Robots at Japanese Long-term Care Industry



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Determinants of Employing Foreign Workers and Introducing Robots at Japanese Long-term Care Industry

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Abstract

This study empirically analyzed what factors influence on employing foreign workers and introducing robots in Japanese long-term care industry. I used office-level data on Japanese long-term care industry at 2019 and sample size is more than 8,000. Many offices answered that they could not employing foreign workers and introducing robots because of they do not have adequate budget. I estimated this data by Probit estimation with explain variables are turnover rate, growing rate of profits of offices, and scale of companies. The results show that turnover rate of offices largely increases both of probability of employing foreign workers and introducing robots. On the other hands, growing rate of profit of offices do not have statistically significance on neither. However, scale of companies largely increases employing foreign workers and partly increases introducing robots. Therefore, it indicates that foreign workers and robots could be substitute production factors for Japanese long-term care workers and mitigate their physical pain and stress. The results show also that growing companies and market competition are necessary for Japanese long-term care industry to be more productively.

Keywords; Long-term care, Foreign workers, Robots, Market competition
JEL codes; F66, I11, L15

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1. Introduction

Demand for long-term care industry is growing by high old rate. Japan is front of this trend. Old rate of Japan is 29.3%[1] at 2024. In Japan, long-term care service is provided by informal care which is mainly female works. The long-term informal care for old people is big stress and disutility for female family members such as wives, daughter, and other female members. On the other hands, formal care which provided by companies may decreases stress and disutility female family members[2]. Hence, free market is needed for Japanese long-term care service.

The market competition of long-term care for old people industry has been aggressively growing from 2000. However, stress and physical pain of workers are serious issue. Hence, to decrease stress and physical pain, robots are developed and introduced. Moreover, to solve the shortage of labor supply, Japanese government progresses acceptance of guest workers from Asia[3]. These are expected for stabilization of labor supply at Japanese long-term care industry.

However, there are no studies what factors influence on and progress these. Therefore, this study analyzes what factors has relationships with employing foreign workers and introducing robots at Japanese long-term care offices. Moreover, this study examines how market competition affect on employing foreign workers and introducing robots. Moreover, this study considers if market competition does not affect on these, how could market competition affect on these.

The contributions of this study are these. First, there are substitute relation between Japanese workers to foreign workers, and robots. Hence, employing foreign workers and introducing robots may decrease stress and physical pain of Japanese workers. This also means that employing foreign workers and introducing robots may contribute to being more effective of Japanese long-term care for old people industry. Moreover, it is uncovered that growing profits of each office also contribute to progress these. However, it is also uncovered that, in nonprofit organizations such as foundations, growing profits does not contribute to these. Therefore, it is considered that to be more effectively of long-term care industry, nonprofit have to improve delivery service refer to profit maximization firms.

The reminder of this study is these. Section 2 describes literature review and point limits of current Japanese long-term care service. Section 3 describes hypothesis, data, and methods. Section 4 describes results and interpretation of these. Section 5 concludes.

2. Literature review

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[1] Statistics Bureau of Japan (2025).

[2] See Fu and Noguchi (2017), Fu, et al (2017, 2023, 2024), Kondo (2019), Mori, et al (2020), Mommaerts (2025).

[3] See, Imrohoroglu, et al (2017).

In Japan, there are many studies on long-term care industry. However, in the backgrounds, there are some serious issues. First, the wage of long-term care workers in Japan is lower than other industry. Moreover, the physical pain of them is large. Therefore, these increase turnover of Japanese long-term care workers[4]. To solve these problems, it is needed to increase revenue of industry and profits of organizations and firms at Japanese long-term care industry. Indeed, from 2000, it has been going entry profit maximization firms[5]. However, in Japanese long-term care industry, there are many regulations on entry and compensation system[6]. Japanese long-term care industry decides compensations based on system of other health and medical industries. However, it is regarded that professional information and skills of long-term care is not so high compared to other health and medical industries. Therefore, regulations and compensation system reduce price of services, and its also reduce workers' wages. To solve these problems, it is needed to regulations and progress entry profit maximization firms and supply many services. These increase revenue of industry and wage of workers, and stabilize labor supply[7]. Moreover, market competition improves productivity of each firms and companies[8]. Hence, it is needed to progress market competition in Japanese long-term care industry[9].

Then, as new important product factors, robots and foreign workers are noticed. Introducing of robots greatly contribute to be effectively (Lukasik, et al. 2020; Nan and Park 2024; McKee, et al. 2024). Moreover, decreasing of working age population, Japanese government aggressively accept foreign workers from many countries of Asia, such as Philippine and Vietnam. There are some critical analyze on these policy[10]. However, these have probability to decrease physical pain of Japanese long-term care workers, and progress of being effectively of services. Therefore, analysis on market competition at Japanese long-term care industry is important and necessary.

3. Hypothesis and method

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[4] See Hanaoka (2009, 2010, 2015), Okubo (2016, 2017, 2018).

[5] Theoretical analysis predict that profit maximization firms supply lower quality service to users than those of nonprofit organizations. However, Noguchi and Shimizutani (2006, 2007, 2009) uncovered that quality of service is higher than prediction of theoretical analysis.

[6] See Campbell and Ikegami (2006).

[7] See Zhou (2009), Ueno and Hamaaki (2017), Yamada and Ishii (2021), Kishida (2022).

[8] On Japanese long-term care industry, Kondo (2019), Kondo and Shigeoka (2013), Suzuki (2020), Suzuki and Zhou (2006) indicate market competition improves productivity. Moreover, these findings are same to other countries (Kessler and McClellan 1999, 2001; Kessler and Geppert, 2005).

[9] There are some studies critic that market competition reduces quality of services (Gaynor and Town 2011; Ghandour 2021). However, market competition makes verifying service, reducing quality does not necessary decrease social welfare Brekke (2007). Moreover, market competition at Japan does not reduce quality Shimizutani and Suzuki (2007).

[10] Introducing robots are criticized from view of ethical points (Sparrow 2016; Maibaum, et al. 2022). On the other hands, accept and employing of foreign workers at long-term care industry is criticized from reducing of quality of services (Cortes and Pan 2014, 2015).

3. 1. Data and Hypothesis

This study uses firm-level data of "Fact-Finding on Survey of Long-term Care Work 2019". This data is annually collected and researched by the Care Labor Stability Centre under the Ministry of Welfare of Labor. The sample firms are randomly chosen from "WAMNET", which is yearbook on Japanese long-term care firms. The survey collected period is October 1 to 31 at 2019. The data asks manager workers on attribution of firms and company, current state of employment, problems of firms, current state on visit long-term care workers and other workers. The number of sample firms is 17,630 and number of valid sample firms is 9,102, and valid response rate is 51.2%. Hence, this data is the most detailed and big data on Japanese long-term care firms and workers.

To understand current state of employing foreign workers, I search the answers by manager workers. Table 1 is results of questionnaire on current state and problems on employing foreign workers.

[Table 1 is here.]

The rate of firms employing foreign workers is 7.74%. Therefore, the most of firms do not employ the foreign workers. Then, answer from management workers on foreign workers, many of firms are tend to have depression on employing foreign workers, in particular, communication with them, skills of them, and difference of life style and habits. On the other hands, the positive such as users pleasant is few.

The next is current state on introducing robots. Table 2 is results of questionnaire from management workers.

[Table 2 is here.]

75.5% of offices do not introduce robots. Therefore, the most of firms do not introduce long-term care robots. The main reason they do not introduce robots is shortage of budget. Moreover, offices could not maintenance and place robots are many. Therefore, budget and ability for maintenance and using are necessary for each offices to introduce robots.

From these results, it is considered that management states, profits of firms, scale of companies effect on employing foreign workers and introducing robots. The firms more tend to be more effectively, the more employ foreign workers, and Japanese workers tend to work at other industry or other firms. While, it is considered the firm more aggregate there profits, the more they tend to employ foreign workers and introduce robots. While, it is considered that more companies aggregate their profits and be bigger, the more they tend to employ foreign workers and introduce robots.

Therefore, I state these hypothesis.

H1: The higher turnover rate of Japanese long-term care workers, the more firms employ foreign workers and introduce robots.

H2: The firms more aggregate their profits, the more they tend to employ foreign workers and introduce robots.

H3: The bigger scale of companies, the more they tend to employ foreign workers and introduce robots.

3.2. Method

To examine mentioned hypothesis, I would like to estimate this equation.

$$Prob(Y_j) = F(\alpha_1 + \alpha_2 \log Turnove\ rate_j + \alpha_2 Profit\ growth\ rate_j + \alpha_3 Scale_{B\,j} + \alpha_4 Scale_{C\,j} + \alpha_5 Scale_{D\,j} + \alpha_6 Scale_{E\,j} + \alpha_7 Scale_{F\,j} + X_{jk}\beta)$$

The term $Prob(Y_j)$ left hand of equation is probability binary variables and $F(\cdot)$ right hand of equation is cumulative distribution function. I would like to estimate two dependent variables. The first is a binary variable on each office j's current state of employ foreign workers. The value takes 1 value if office j applicate to questionnaire "*Employing guest workers is contribute to stabilization labor supply*", and value takes 0 if office j do not applicate. The second variable is a binary variable on each office j's current state of introducing care robots. The value takes 1 value if office j applicate to questionnaire "*On employing foreign workers, there is no problems*", and value takes 0 if office j do not applicate. These variables each overall reflect on employing foreign and introducing robots[11]. Table 3 is described basic statics of these variables.

Key independent variables are these. α_1 is constant term and α_2 to α_7 are marginal effects of each independent variables. The first independent variable $\log Turnove\ rate_j$ is log of turnover rate of office j. This variable means that how many workers did leave their firms or jobs at last year at office j. The raw value of this variable is 0 at the most firms. Hence, I made variables as log after plus 1. If the sign of α_2 is positive and statistically significance, H1 is supported. The second variable $Profit\ growth\ rate_j$ is growth rate of profit in office j. This variable indicates that how is profit of office j at this year compared to it of last year as if it is 100. In this study, I made this variable as percent by minus 100 and divided by 100. If sign of α_3 is positive and statistically significance, H2 is supported. The third to seventh variables $Scale_{B_i}$, $Scale_{C_i}$, $Scale_{D_i}$, $Scale_{E_i}$, $Scale_{F_i}$ are scale

[11] I estimated other items after change into binary variables. The results are mostly consistent to results of this study.

of employee number of company i. This is the variable scaled the number of all employees of companies as 5 levels[12]. This is scaled as these.

A. Under 19.
B. 20 to 49
C. 50 to 99
D. 100 to 299
E. 300 to 499
F. Over 500

If signs of α_4 to α_8 are positive and statistically significance, H3 is supported. Table 4 is statistical description of these variables.

[Table 3 is here.]

The other control variables k terms are these[13]. I used years of operation of office j and years of supply long-term care years of office j. I used each the variables to the power of one and square[14]. Then, I used forms of office j. I used six types of nonprofit organization and one type as public organization[15]. Moreover, I used binary variables if office j places to city or the other region. Moreover, I used mainly service of office j as binary variables, total number of this variables is forty one type[16]. I used probit estimation and white robust standard error.

4. Results and Interpretation

4. 1. Results

[Table 4 is here.]

Table 5 is results of estimation. Column (1) is result of all employees estimation on acceptance state

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[12] I exiled the answer "I don't know (the total number of employees)". The reference group is under 19.
[13] This data could not identify the prefecture of firm j. This is same to previous study used this data (Hanaoka, 2009, 2011, 2015).
[14] In Mincer equation, tenure years and experience years effect on workers' wage. I refer this relation to this study.
[15] In Japan, there are six types of nonprofit organization, such as *Social welfare council, Social welfare associations, Medical foundations, NPO organizations, Foundations*, and *Cooperatives*.
[16] In Japan, there are forty one types of long-term care service detail identified.

on foreign workers. The sign of log of turnover rate is positive and marginal effect α_2 is 0.0208, which has statistically significance at 1%. This result indicates that if turnover rate increases 1% at firm j, the probability of employee guest worker increases 2.1%. Therefore, foreign workers are substitutional factor for Japanese workers. On the other hands, marginal effect of growth rate α_3 is 0.0022, sign is positive, however, this variable does not have statistically significance. Hence, growth of profits does not effect on firm j employ foreign workers or not. This means that firms with higher profit necessary do not more employee foreign workers than firms with lower profit. On the other hands, all of total number of employee of company has statistically significance, values of α_4 is 0.0254, α_5 is 0.0461, α_6 is 0.0588, α_7 is 0.0504, α_8 is 0.0607. Sign of all marginal effects is positive. The reference group is under 19. Hence, the more employee number increases, the more foreign workers are employed. However, marginal effects do not necessary indicate that this is statistically significance[17]. On the other control variables, year of operations, supply long-term care service do not have statistically significance, and many of mainly service also do not have statistically significance. On the other hands, difference of type of nonprofit organizations has statistically significance. This is also indicated at subsample estimations, Column (2) is "For-profits" and Column (3) is "Nonprofits" [18].

[Table 5 is here.]

The next is results of introducing robots. Column (1) is all offices. The value of α_2 marginal effect of log of turnover rate is 0.0316, and sign of is positive and has statistically significance. It indicates that the more workers leave their office, the more office introduce robots. The 1% increase of turnover rate increase 3.2% the probability of introducing robots. Therefore, long-term care robots place as substitute production factor to Japanese long-term care workers. However, on the other hands, α_3 the marginal effect of growth rate of profit is -0.0328, which negatively correlates to dependent variable with statistically significance. Hence, the more office growth their profit 1%, the more they avoid long-term care robots 3.3%. On the other hands, on scale of company employees, value of α_4 is 0.0265, α_5 is 0.0311, α_6 is 0.0266, α_7 is 0.0280, and α_8 is 0.0647, and only α_8 has statistically significance. This indicates that over 500 workers companies employ the more 6.47% introduce robots. Therefore, growing up of company could recover the loss of probability of robots by growth of profits.

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[17] I did statistical test to identify statistically significance of difference of coefficients of variables (Chow, 1960). The results showed that most of the differences do not have statistically significance.

[18] The result shows that not only log of turnover rate, but also growth rate of profit positively correlate to dependent variable at "For-profit" with statistically significance. Therefore, the more profit growing the more office employ foreign workers. On the other hands, growth rate of profit negatively correlates to dependent variable at "Nonprofit" with statistically significance. Therefore, in nonprofit organization, the more office growth their profits, the more they depend to Japanese long-term care workers and exile foreign workers.

The results of control variables are similar to results of foreign workers[19]. However, in subsample estimations, there is difference between “For-profits” which is Column (2) and “Nonprofit” which is Column (3)[20]. Hence, difference of governance and supply style between for-profit firms and nonprofit organizations affect on introducing robots.

4. 2. Interpretation

Both of employing foreign and introducing robots, hypothesis 1 is supported. Therefore, foreign workers and robots are substitutional product factor to Japanese long-term care workers. However, Hypothesis 2 is only supported at employing foreign workers of for-profit companies, but not else others. The object of for-profit companies is maximization of their profits. This paper could not analysis on causal relation. However, it is considered that employing foreign workers and profit maximization has positive correlation, hence, product style to maximize profit is effective to employing foreign workers. On the other hands, Hypothesis 3 is supported at for-profit companies, especially. Therefore, with style to maximize profit, growing of scale of company is effective to employing foreign workers and introduce robots.

It is possible that decreasing the stress and pain of Jpanese long-term care workers by employing foreign workers and using long-term care robots. Moreover, such as giving decision right relative to their profits, it is useful for employing foreign workers and robots to give the incentive each offices to maximize their profits. Therefore, it is important and necessary to growing market competition and to give the incentive to offices to be more productivity and profitable[21]. It is possible for not only for-profit companies, but also nonprofit organizations[22].

5. Conclusion

Information asymmetry largely influence on health industry[23]. However, information asymmetry of long-term care industry is smaller than that of other health industry. Hence, free market could be

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[19] Neither of operation years and supply long-term care service do not have statistically significance. Moreover, mainly service also do not have statistically significance.

[20] In “For-profit”, log of turnover rate does not have statistically significance, but have statistically significance on scale of company. Therefore, it shows that the more companies growing up the more they tend to introduce robots. However, in “Nonprofit”, log of turnover rate has statistically significance, but not scale of organization.

[21] Such as training and education for workers, effective management increase offices’ profits (Bloom and Van Reenan, 2007; Bloom, et al. 2012).

[22] Nonprofit organization can efficiently management similar to profit maximization firms in competitive markets (Glaeser, 2000; Suzuki, 2020).

[23] See Arrow (1963).

introduced to long-term care industry than other health industry[24]. However, there are many regulations on long-term care industry yet. Deregulation is necessary for Japanese long-term care industry. Then, growing of market competition by regulation improves management of the offices, and it increases their productivity[25]. Moreover, market competition makes technological innovations[26].

Change of product factor is needed for improvement of technology and productivity of long-term care industry. Employing foreign workers and introducing robots is important steps. This study find as these. First, foreign workers and robots can be substitute product factors for Japanese long-term care workers. Second, in profit maximization companies, growing their profits contributes to employing foreign workers and introducing robots, but not nonprofit organizations. Finally, growing the scale of companies and organization contributes to employing foreign workers and introducing robots.

The important implications are these. First, in Japanese long-term care industry, it is necessary to growing market competition. For example, deregulation on nursing care fee enhances verify of long-term care service, and it also enhance benefits for users. Moreover, improvements productivity of offices by employing foreign workers and introducing robots increases each offices' profits. Moreover, to growing free market and competition, it is important to collaborate other industries, such as informatics and medical care industries.

There are some limitation in this study. First is sample selection biases[27]. The subject long-term care offices are relatively good management offices. Therefore, it is important to examine on not good management offices. Second, this study uses cross section data. Therefore, it could not examine strictly causal relationships. Future research needs panel data. Final is issue on identifying prefecture. This study did not identify prefecture. Future research needs control on states of each prefectures.

Reference

Amano, A. (1964) "Biased Technical Progress and A Neoclassical Theory of Economic Growth", *Quarterly Journal of Economics*, Vol. 78, No. 1, pp. 129 - 138.

Acemoglu, D., Aghion, P., Lelarge, C., Van Reenen, J. and Zilibotti, F (2007) "Technology, Information, and the Decentralization of the Firm", *Quarterly Journal of Economics*, Vol. 122, No. 4, pp. 1759 - 1799.

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[24] Introducing market competition to long-term care industry is criticized by some studies (Brown and Finkelstein, 2009; Ghandour, 2021). However, from social welfare, some studies suppose market competition at long-term care industry (Brekke, et al. 2017; Kessler and McClellan, 1999, 2001; Kessler and Geppert, 2005).

[25] See Bloom and Van Reenan (2007), Bloom, et al (2017).

[26] See Acemoglu, et al (2003, 2007), Aghion and Howitt (1992), Aghion, et al (2007), Amano (1964).

[27] See Heckman (1979), Mroz (1987), Nawata and Nagase (1996).

Acemoglu, D., Aghion, P., Zilibotti, F. (2003) “Vertical Integration and Distance to Frontier”, *Journal of the European Economic Association*, Vol. 1, No. 2/3, pp. 630 - 638.

Aghion, P. and Howitt, P. (1992) “A Model of Growth through Creative Destruction”, *Econometrica*, Vol. 60, No. 2, pp. 323 - 351.

Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2005) “Competition and Innovation: An Inverted-U Relationship”, *Quarterly Journal of Economics*, Vo. 120, No. 2, pp. 701 - 728.

Arrow, K. J. (1963) “Uncertainty and the Welfare Economics of Medical Care”, *American Economic Review*, Vol. 53, No. 5, pp. 941 - 973.

Auerbach, D. I., Buerhaus, P. I. and Staiger, D. O. (2000) “Implications of an Aging Registered Nurse Workforce”, *Journal of the American Medical Association*, Vol. 283, No. 22, pp. 2948 - 2954.

Bloom, N. and Van Reenen, J. (2007) “Measuring and Explaining Management Practices across Firms and Countries”, *Quarterly Journal of Economics*, Vol. 122, No. 4, pp. 1351 - 1408.

Bloom, N., Sadun, R. and Van Reenen, J. (2012) “The Organization of Firms across Countries”, *Quarterly Journal of Economics*, Vol. 127, No. 4, pp. 1663 - 1705.

Brekke, K. R., Siciliani, L. and Straume, O. R. (2017) “Can Competition Reduce Quality?”, *Journal of Institutional and Theoretical Economics*, Vol. 174, pp. 421 - 447.

Brown, J. R. and Finkelstein, A. (2009) “The Private Market for Long-Term Care Insurance in the U.S.: A Review of the Evidence”, *Journal of Risk and Insurance*, Vol. 76, No. 1, pp. 5 - 29.

Campbell, J. C. and Ikegami, N. (2003) “Japan’s Radical Reform of Long-term Care”, *Social Policy and Administrations*, Vol. 37, No. 1, pp. 21 - 34.

Chow, G. C. (1960) “Tests of Equality between Sets of Coefficients in Two Linear Regressions”, *Econometrica*, Vol. 28, No. 3, pp. 591 - 605.

Cortes, P. and Pan, J. (2014) “Foreign Nurse Importation and the Supply of Native Nurses”, *Journal of Health Economics*, Vol. 37, pp. 164 - 180.

Cortes, P. and Pan, J. (2015) “The Relative Quality of Foreign-Educated Nurses in the United States”, *Journal of Human Resources*, Vol. 50, No. 4, pp. 1009 - 1050.

Fu, R. and Noguchi, H. (2017) “Moral Hazard under Zero Price Policy: Evidence from Japanese Long-term Care Claims Data”, *European Journal of Health Economics*, Vol. 20, pp. 785 - 799.

Fu, R., Noguchi, H., Kawamura, A., Takahashi, H. and Tamiya, N. (2017) “Spillover Effect of Japanese Long-term Care Insurance as an Employment Promotion Policy for Family Caregivers”, *Journal of Health Economics*, Vol. 56, pp. 103 - 112.

Fu, R., Iizuka, T. and Noguchi, H. (2023) “Long-term Care in Japan”, *National Breau of Economics Research Working Paper 31829*.

Fu, R., Le, D. D. and Ibuka, Y. (2024) “The Impact of Reducing Formal Care Benefits on Caregivers’ Well-being: Evidence from Japan”, *Review of Economics of the Household*, https://doi.org/10.1007/s11150-024-09699-5.

Gaynor, M. and Town, R. J. (2011) “Competition in Health Care Market”, *Handbook of Health Economics 2*, pp. 499 - 637.

Ghandour, Z. (2021) “Public-Private Competition in Regulated Markets”, *Journal of Institutional and Theoretical Economics*, Vol. 177, No. 3, pp. 299 - 336.

Glaeser, E. L. (2002) “The Governance of Not-for-Profit-Firms”, *National Breau of Economics Research Working Paper 8921*.

Grabowski, D. C., Grube, J. and McGarry, B. (2023) “Immigration, the Long-term Care Workforce, and Elder Outcomes in the U.S.”, *National Breau of Economic Research Working Paper No. 30960*.

Hanaoka, C. (2009) “Relative Wages and Direct Care Worker Turnover in Japan's Public Long-term Care Insurance System”, *Journal of Social Security Research*, Vol. 45, No. 3, pp. 269 - 285.

Hanaoka, C. (2011) “Care Staff Turnover in Long-term Care Services for Older People: How Does the Effect of Relative Wages on Turnover Vary by Tenure?”, *Japanese Journal of Health Economics and Policy*, Vol. 23, No. 1, pp. 39 - 57.

Hanaoka, C. (2015) “Direct Care Worker Shortages Using Japanese Data: A Review of Previous Studies”, *Japanese Journal of Labour Studies*, Vol. 57, No. 5, pp. 16 - 25.

Heckman, J. J. (1979) “Sample Selection Bias as a Specification Error”, *Econometrica*, Vol. 47, No. 1, pp. 153 - 161.

Imrohoroglu, S., Kitao, S. and Yamada, T. (2017) “Can Guest Workers Solve Japan’s Fiscal Problems?”, *Economic Inquiry*, Vol. 55, No. 3, pp. 1287 - 1307.

Kessler, D. P. and McClellan, M. B. (1999) “Is Hospital Competition Socially Wasteful?”, *Quarterly Journal of Economics*, Vol. 115, No. 2, pp. 577 - 615.

Kessler, D. P. and McClellan, M. B. (2001) “The Effects of Hospital Ownership on Medical Productivity”, *National Bureau Economic Research Working Paper 8537*.

Kessler, D. P. and Geppert, J. J. (2005) “The Effects of Competition on Variation in the Quality and Cost of Medical Care”, *Journal of Economics and Management Strategy*, Vol. 14, No. 3, pp. 575 - 589.

Kishida, K. (2022) “The Effects of Wages and Training on Intent to Switch or Leave among Direct Care Workers”, *Innovation in Aging*, Vol. 6, No. 4, pp. 1 - 12.

Kondo, A. and Shigeoka, H. (2013) “Effects of Universal Health Insurance on Health Care Utilization, and Supply-Side Responses: Evidence from Japan”, *Journal of Public Economics*, Vol. 99, pp. 1 - 23

Kondo, A. (2019) “Impact of Increased Long-term Care Insurance Payments on Employment and Wages in Formal Long-term Care”, *Journal of the Japanese and International Economies*, Vol. 53, 101034.

Nawata, K. and Nagase, N. (1996) “Estimation of Sample Selection Bias Models”, *Econometric*

Reviews, Vol. 15, No. 4, pp. 387 - 400.

Lukasik, S., Tobis, B., Kropinska, S. and Suwalska, A. (2020) "Role of Assistive Robots in the Care of Older People: Survey Study Among Medical and Nursing Students", *Journal of Medical Internet Research,* Vol. 22, No. 8, e18003.

Ministry of Health, Labour and Welfare, https://www.mhlw.go.jp/stf/newpage_28131.html. 2025/07/01

Mroz, T. (1987) "The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions", *Econometrica*, Vol. 55, No. 4, pp. 765 - 799.

Nam, S. J. and Park, E. Y. (2024) "Effectiveness of Robot Care Intervention and Maintenance for People with Dementia: A Systematic Review and Meta-Analysis", *Innovation in Aging*, gae110, https://doi.org/10.1093/geroni/igae110.

Noguchi, H. and Shimizutani, S. (2006) "Do Non-profit Operators Provide Higher Quality of Care? Evidence from Micro-level Data for Japan's Long-term Care Industry", *Hitotsubashi Journal of Economics*, Vol. 47, pp. 125 - 135.

Noguchi, H. and Shimizutani, S. (2007) "Nonprofit/For-profit Status and Earning Differentials in the Japanese At-home Elderly Care Industry: Evidence from Micro-level Data on Home Helpers and Staff Nurses", *Journal of the Japanese and International Economies*, Vol. 21, No. 1, pp. 106 - 120.

Noguchi, H. and Shimizutani, S. (2009) "Supplier Density and At-home Care Use in Japan: Evidence from a Micro-level Survey on Long-term Care Receivers", *Japan and the World Economy*, Vol. 21, No. 4, pp. 365 - 372.

Maibaum, A., Bischof, A., Hergesell, J. and Lipp, B. (2022) "A Critique of Robotics in Health Care", *AI & Society*, pp. 1 - 11.

McKee, M., Rosenbacke, R. and Stuckler, D. (2024) "The Power of Artificial Intelligence for Managing Pandemics: A Primer for Public Health Professionals", *International Journal of Health Planning and Management*.

Mommaerts, C. (2025) "Long-Term Care Insurance and the Family", *Journal off Political Economy*, Vol. 133, No. 1.

Mori, T., Jin, X., Sato, M., Watanabe, T., Noguchi, H. and Tamiya, N. (2020) "Individual and Regional Determinants of Long-term Care Expenditure in Japan: Evidence from National Long-term Care Claims", *European Journal of Public Health*, Vol. 30, No. 5, pp. 873 - 878.

Okubo, S. (2016) "Prisoner of Love in Care Work: Evidence from Japan", *Kansai Sociological Review*, Vol. 15, pp. 46-59.

Okubo, S. (2017) "Solving Early Turnover in Care Work: Evidence from Japan", *Journal of Welfare Sociology*, No. 14, pp. 147-167.

Okubo, S. (2018) "How Do We Solve Early Turnover in Care Work?: Evidence from Japan", *Osaka*

Human Science, Vol. 4, pp. 157 - 174.

Shimizutani, S. and Suzuki, W. (2007) "Quality and Efficiency of Home Help Elderly Care in Japan: Evidence from Micro-level Data", *Journal of Japanese and International Economics*, Vol. 21, pp. 287 - 301.

Sparrow, R. (2016) "Robots in Aged Care: A Dystopian Future?", *AI & Society*, Vol. 31, pp. 445 - 454.

Statistics Bureau of Japan (2025) https://www.stat.go.jp/data/topics/pdf/topi142_01.pdf.

Suzuki, W. (2020) "Labor Productivity in Japanese Home Help Industry: Evidence from Establishment-Level Data", *Japanese Journal of Health Economics and Policy*, Vol. 32, No. 1, pp. 21 - 43.

Suzuki, W. and Zhou, Y. (2006) "Market Concentration, Efficiency, and Quality in the Japanese Home Help Industry", *Health Care Issues in the United States and Japan,* pp. 147 - 164, University of Chicago Press.

Ueno, A. and Hamaaki, J. (2017) "The Impact of the 2009 Long-Term Care Compensation Reform on Caregiver Wages, Working Hours, and Job Separation Rate", *Japanese Journal of Health Economics & Policy*, Vol. 29, No. 1, pp. 33 - 57.

Yamada, A. and Ishii, K. (2021) "Aging and Wages of Long-term Care Workers: A Case Study of Japan, 2002 - 2017", *Economic Analysis*, Vol. 202, pp. 71 - 100.

Zhou, Y. (2009) "Shortage of Long-Term Care Workers in Japan", *Academic Studies Journal of Health Care and Society*, Vol. 19, No. 2, pp. 151 - 168.

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Statements and Declarations;

1. Compliance with ethical standards; This analysis does not identify individuals. Moreover, this analysis does not assess any community or social. Therefore, the author has no problem on compliance and ethical standards.
2. Conflict of interest statement; The author has no competing interests associated with this manuscript.
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Table 1. Current state of employing foreign workers

Items	Answer rate
There are foreign workers.	7.74
The impression for working with foreign workers	
1. *We can recheck on working.*	10.84
2. *We can work aggressively.*	18.23
3. *Users are pleasant.*	7.84
4. *The stress and pain can be mitigated.*	18.38
5. *We can get stable labor force.*	58.55
6. *We can't enough communications.*	48.08
7. *We worry on communications with users.*	63.04
8. *There are limits of doing the foreign workers can.*	46.77
9. *We worry if foreign workers can understand on work and habits.*	36.30
10. *We confuse on cultural difference between the foreign workers.*	51.93
11. *Others*	5.00
Note: Observations are 9080.	
The management workers could multiple answer.	

Table 2. Current state of employing foreign workers

Items	Answer rate
Introduced robots: None	75.58
The reason do not introduce robots	
1. *We don't have enough budget*.	55.25
2. *We don't know what type robots are*.	20.83
3. *We don't like using robots at long-term care*.	16.00
4. *We worry if we can use robots*.	25.94
5. *We afraid error of robots at working*.	24.98
6. *There is no place to set robots*.	25.12
7. *We can't enough maintenance and management robots*.	25.97
8. *Using robots is not useful and effectively*.	25.40
9. *There are no useful robots for long-term care*.	4.62
10. *Others*.	10.25
Note: Observations are 9080.	
The management workers could multiple answer.	

Table 3 Description of variables and its basic statistics

	Descriptions	Mean	S. D.	Observation
Employing foreign workers	Takes 1 value if offices employ foreign workers	0.0674	0.2508	8900
Introducing robots	Takes 1 value if offices introduce long-term care robots.	0.2442	0.4296	9080
Log of turnover rate	Log of each offices' turnover rate at 2018	0.6991	0.8154	9080
Growth rate of profits	Ratio of profit of 2019 compared to its of 2018	0.0283	0.0334	7846
Scale (20 to 49)	Takes 1 value if total number of corporations' employee is between 20 to 49	0.2101	0.4074	9126
Scale (50 to99)	Takes 1 value if total number of corporations' employee is between 50 to 99	0.1542	0.3611	9126
Scale (100 to 299)	Takes 1 value if total number of corporations' employee is between 100 to 299	0.1792	0.3835	9126
Scale (300 to 499)	Takes 1 value if total number of corporations' employee is between 300 to 499	0.0512	0.2204	9126
Scale (500)	Takes 1 value if total number of corporations' employee is over 500	0.0962	0.2949	9126
Operation years	Years offices start their business.	12.9471	10.3459	8542
Supply long-term care years	Years offices supply long-term care services for old people.	12.0497	8.0693	8357
City	Takes 1 value if offices places at city.	0.2163	0.4117	9126
Others	Takes 1 value if corporation has other offices	0.6819	0.3443	9041

Table 4. Results of estimation on employing foreign workers

Dependent variable	*There are foreign workers.*		
	(1) All	*(2) For-profit*	*(3) Nonprofit*
Log of turnover rate	0.0208 ***	0.0116 ***	0.0312 ***
	[0.00]	[0.00]	[0.01]
Growth rate of profits	0.0022	-0.0137	0.0315 **
	[0.01]	[0.01]	[0.01]
Scale (20 to 49)	0.0254 **	0.0195 **	0.0712
	[0.01]	[0.01]	[0.04]
Scale (50 to 99)	0.0461 ***	0.053 ***	0.0663
	[0.01]	[0.01]	[0.04]
Scale (100 to 299)	0.0588 ***	0.069 ***	0.0868 **
	[0.01]	[0.01]	[0.04]
Scale (300 to 499)	0.0504 ***	0.0135	0.1042 **
	[0.01]	[0.03]	[0.04]
Scale (Over 500)	0.0607 ***	0.0546 ***	0.1106 **
	[0.01]	[0.01]	[0.04]
Constant term	-2.1176 ***	-2.0999 ***	-2.6746 ***
	[0.20]	[0.24]	[0.48]
Operation years and square term	✓	✓	✓
Supply care years and square term	✓	✓	✓
Type of organizations type	✓	-	-
Mainly service	✓	✓	✓
City	✓	✓	✓
Other	✓	✓	✓
N	7038	4027	2748
R square	0.1422	0.0985	0.1476

Note: **, *** indicate statistically significance at the 5%, 1% respectively. Robust standard deviations are parenthesis. The numbers without parenthesis are marginal effect. *For-profit* are companies which are *Commercial companies,* at survey. *Nonprofit* is organizations, which are *Social welfare council, Social welfare associations, Medical foundations, NPO organizations, Foundations, and Cooperatives,* at survey.

Table 5. Results of estimation on introducing robots

Dependent variable	*Introduced Robots: Yes.*		
	(1) All	*(2) For-profit*	*(3) Nonprofit*
Log of turnover rate	0.0316 ***	0.0039	0.0599 ***
	[0.01]	[0.01]	[0.01]
Growth rate of profits	-0.0328 **	-0.0280	-0.0430
	[0.02]	[0.02]	[0.03]
Scale (20 to 49)	0.0265 *	0.0396 **	0.0014
	[0.02]	[0.02]	[0.04]
Scale (50 to 99)	0.0311	0.017	0.0724 *
	[0.02]	[0.02]	[0.04]
Scale (100 to 299)	0.0266	0.0008	0.0650 *
	[0.02]	[0.03]	[0.04]
Scale (300 to 499)	0.0280	0.0048	0.0607
	[0.02]	[0.05]	[0.04]
Scale (Over 500)	0.0647 **	0.0854 ***	0.0730 *
	[0.02]	[0.03]	[0.04]
Constant term	-0.8625 ***	-0.8781 ***	-1.1130 ***
	[0.11]	[0.13]	[0.32]
Operation years and square term	✓	✓	✓
Supply care years and square term	✓	✓	✓
Type of organizations type	✓	-	-
Mainly service	✓	✓	✓
City	✓	✓	✓
Other	✓	✓	✓
N	7147	4110	2916
R square	0.0543	0.0985	0.0921

Note: *, **, *** indicate statistically significance at the 10%, 5%, 1% respectively. Robust standard deviations are parenthesis. The numbers without parenthesis are marginal effect. *For-profit* are companies which are *Commercial companies*, at survey. *Nonprofit* is organizations, which are *Social welfare council, Social welfare associations, Medical foundations, NPO organizations, Foundations, and Cooperatives,* at survey.