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研究論文

本会記事

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経　済　統　計　学　会

創刊のことば

社会科学の研究と社会的実践における統計の役割が大きくなるにしたがって，統計にかんする問題は一段と複雑になってきた。ところが統計学の現状は，その解決にかならずしも十分であるとはいえない。われわれは統計理論を社会科学の基礎のうえにおくことによって，この課題にこたえることができると考える。このためには，われわれの研究に社会諸科学の成果をとりいれ，さらに統計の実際と密接に結びつけることが必要であろう。

このような考えから，われわれは，一昨年来経済統計研究会をつくり，共同研究を進めてきた。そしてこれを一層発展させるために本誌を発刊する。

本誌は，会員の研究成果とともに，研究に必要な内外統計関係の資料を収めるが同時に会員の討論と研究の場である。われわれは，統計関係者および広く社会科学研究者の理解と協力をえて，本誌をさらによりよいものとすることを望むものである。

1955年4月

経 済 統 計 研 究 会

経 済 統 計 学 会 会 則

第1条　本会は経済統計学会（JSES：Japan Society of Economic Statistics）という。

第2条　本会の目的は次のとおりである。

1．社会科学に基礎をおいた統計理論の研究　　2．統計の批判的研究

3．すべての国々の統計学界との交流　　4．共同研究体制の確立

第3条　本会は第2条に掲げる目的を達成するために次の事業を行う。

1．研究会の開催　　2．機関誌『統計学』の発刊

3．講習会の開催，講師の派遣，パンフレットの発行等，統計知識の普及に関する事業

4．学会賞の授与　　5．その他本会の目的を達成するために必要な事業

第4条　本会は第2条に掲げる目的に賛成した以下の会員をもって構成する。

(1) 正会員　(2) 院生会員　(3) 団体会員

2　入会に際しては正会員2名の紹介を必要とし，理事会の承認を得なければならない。

3　会員は別に定める会費を納入しなければならない。

第5条　本会の会員は機関誌『統計学』等の配布を受け，本会が開催する研究大会等の学術会合に参加することができる。

2　前項にかかわらず，別に定める会員資格停止者については，それを適応しない。

第6条　本会に，理事若干名をおく。

2　理事から組織される理事会は，本会の運営にかかわる事項を審議・決定する。

3　全国会計を担当する全国会計担当理事1名をおく。

4　渉外を担当する渉外担当理事1名をおく。

第7条　本会に，本会を代表する会長1名をおく。

2　本会に，常任理事若干名をおく。

3　本会に，常任理事を代表する常任理事長を1名おく。

4　本会に，全国会計監査1名をおく。

第8条　本会に次の委員会をおく。各委員会に関する規程は別に定める。

1．編集委員会　　2．全国プログラム委員会　　3．学会賞選考委員会

4．ホームページ管理運営委員会　　5．選挙管理委員会

第9条　本会は毎年研究大会および会員総会を開く。

第10条　本会の運営にかかわる重要事項の決定は，会員総会の承認を得なければならない。

第11条　本会の会計年度の起算日は，毎年4月1日とする。

2　機関誌の発行等に関する全国会計については，理事会が，全国会計監査の監査を受けて会員総会に報告し，その承認を受ける。

第12条　本会会則の改正，変更および財産の処分は，理事会の審議を経て会員総会の承認を受けなければならない。

付　則　1．本会は，北海道，東北・関東，関西，九州に支部をおく。

2．本会に研究部会を設置することができる。

3．本会の事務所を東京都文京区音羽1-6-9　㈱音羽リスマチックにおく。

1953年10月9日（2016年9月12日一部改正［最新］）

【研究論文】（『統計学』第127号 2024年9月）

Annual leave usage behavior in the post-COVID-19 era : A focus on teleworking

Go IGUSA*

Summary

This paper focuses on teleworking and uses quantitative and qualitative data to analyze how annual leave usage behavior changed in the post-COVID period. Text analysis confirmed annual leave usage behavior changed greatly from "during the COVID-19 pandemic" to the "with-COVID period" as peoples' fear of the pandemic was relieved. Those engaged in teleworking were found to be more likely to use annual leave for "travel" and "events". Multivariate analysis showed those engaged in teleworking use more annual leave days, and are more likely to use it for the purpose of "travel", as opposed to short-term errands such as "housework and childcare". One reason for this is thought to be the interchangeability between annual leave and teleworking. Furthermore, path analysis revealed that teleworking not only has a direct impact, but also has an indirect impact on annual leave by reducing work hours and thereby creating room for taking annual leave. From the analysis of annual leave, one was able to show the possibility that teleworking could improve work-life balance.

Key Words

Annual leave, Post-COVID-19 era, Teleworking

1. Introduction

Leave is a system to exempt the worker from labor obligations on workdays. Among the many different types of leave, annual leave is given the most attention to, as it is given to almost all workers. Continuing to work long hours without time-off leads to the accumulation of stress and fatigue, resulting in lower productivity[1)]. In severe cases, this can even cause harm to the health of the mind and body. The low usage of annual leave in Japan has been an important labor issue for a long time and is said to be a large hurdle for the achievement of work-life balance.

According to a study by Katharine and Lea (2023), Americans are not working as long compared to prior to the COVID-19 pandemic. The average number of hours worked has fallen by more than 0.5 hours per week during the last 3 years. Like European workers, Americans are now spending more time in leisure. This is especially the case with the workaholic group that worked more than 55 hours per week in 2019, which now "only" works 52 hours per week. Workers engaged in remote work and hybrid work also are seeing a decreasing trend in the number of hours worked. While the exact cause

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is unknown, the authors speculated that one reason for these results could be many Americans rethinking work-life balance[2)]. A similar decrease in the number of work hours can be seen in Japan during the COVID-19 pandemic. According to the Monthly Labor Survey by the Ministry of Health, Labor, and Welfare, total actual working hours, which indicate the number of hours worked per worker, have remained at significantly lower levels since 2020 compared to pre-COVID-19 levels before 2019. According to Usui et al. (2022), men with children who used remote work during the COVID-19 pandemic saw an increase in time spent engaged in housework and childcare, compared to those who did not use remote work. This suggests a trend of greater weight being given to family and personal life. Furthermore, Inoue et al. (2023) showed that working from home leads to an improvement in work-life balance, with men placing a greater importance on personal life by spending more time with family and housework.

As reported in the 2023 "General Survey on Working Conditions" of the Ministry of Health, Labor, and Welfare, workers at private companies with more than 30 employees used on average 10.9 days of annual leave in 2022, which was 0.8 days greater than that of 2020. Despite the fact that annual leave usage improved greatly since the enforcement of the amended Labor Standards Law in 2019, which made annual leave usage mandatory, this marked a historical high for 2 consecutive years since the oldest comparable data of the 1980s. The resulting usage rate was 62.1%, a large 5.5 pt. increase compared to 2020. The possible achievement of the 2025 government target rate of 70% has come into view and it can be said that some kind of change has occurred.

The way of working has greatly changed due to the COVID-19 pandemic. Similarly, one can say that the "usage of annual leave", which is inseparable from the labor phenomenon of taking a break from work, has greatly changed as well. This is extremely natural given that annual leave exists as an extension to family and everyday life (equivalent to the L in WLB). Conversely, one can also make the claim that the field of labor economics, which has studied labor phenomena, should deepen its understanding of the relation between labor and human life (family life, leisure activities, etc.).

2. Previous studies

The first COVID-19 patient in Japan was reported on January 15, 2020. This unknown disease frightened the world and greatly restricted our daily lives. Two years later in 2022, the government put forth a policy of balancing disease prevention and socioeconomic activity. While the disease still persists, almost all movement restrictions have been lifted and society has entered the "with-COVID" period. This study focuses on the 2022 "with-COVID" period and how annual leave usage changed in the transition to the "with-COVID" period. It is therefore necessary to first examine "how things were before" and answer the academic question of "how this study differs from previous studies". This section will accordingly review previous studies that focused on the early COVID-19 pandemic period.

2.1. Previous studies targeting the early COVID-19 pandemic period

One previous study targeting the early COVID-19 pandemic period is Igusa (2023). To investigate "the realities of annual paid vacation usage amidst the COVID-19 pandemic", Igusa

conducted a survey study in 2020. This study mainly used text mining to analyze freeform responses (about reasons behind increase / decrease in annual paid vacation usage). For people who saw a decrease in the number of annual leave days taken, characteristic words to describe the reason for the change included "COVID-19", "returning home", "opportunity", "work at home", "travel", and "can go (negative)". Actual responses using these words include "worked at home because I refrained from traveling and returning home due to the influence of COVID-19"; "I did not feel the need to use paid holidays because of the increase in work from home"; "most of my work was done at home and I can run errands without using annual paid vacation". The study also highlighted that there was a difference in trend depending on whether or not work from home is used. The group that worked from home used the code "busy"[3] more frequently than the group that did not work from home.

Previously, the motive for adopting teleworking was the achievement of work-life balance (Shimozaki & Kato 2007). However, the teleworking that was implemented together with the spread of COVID-19 was not for the achievement of workers' work-life balance. Instead, by enabling employees to continue working regardless of place or time, teleworking ensured business continuity while preventing the spread of COVID-19. As such, it is possible that such teleworking would not improve work-life balance and as seen in the actual responses given above, even potentially negatively impact the usage of annual leave.

2.2. Previous studies prior to COVID

Initial quantitative studies on annual leave in Japan used theoretical hypotheses such as work and non-work economics (Japan Institute of Labor 2002, Ogura 2003, Ohtake 2001, Kobayashi 1995, Mitani 1995). Kobayashi (1995) and Mitani (1995) analyzed the relation between unused annual leave and performance appraisal, and noted a higher probability of promotion with unused annual leave. Ohtake (2001) demonstrated that a higher cost of job loss led to fewer absences or vacations and that a good labor market led to an increase in annual leave days used. Similarly, the Japan Institute of Labor (2002) and Ogura (2003) revealed that the unemployment rate influenced the use of annual leave. The Japanese labor market showed extreme resilience, with stable unemployment and employment rates during the COVID-19 pandemic. The unemployment rate improved from a peak of 3.1% in 2020 to 2.6% in 2022 and may have contributed to the increase in annual leave days used. Ogura (2003, 2012) showed there is a negative correlation between the number of hours worked and annual leave days used. It is therefore possible that the decrease in working hours contributed to higher annual leave usage rates[4].

Many of these previous studies have contributed to policies on annual leave and improved the ease of use for annual leave. These studies have also already analyzed certain topics that have received attention with new ways of working. The perspectives of these studies are therefore useful in understanding annual leave usage behavior in the post-COVID period.

3. Overview of the study and results

To investigate how things changed from the early stages of the COVID-19 pandemic, it is necessary to make this study comparable to the study by Igusa (2023) that looked at 2020. To reach a conclusion, however, relying only on

text mining would be insufficient in terms of statistical significance[5]. This study therefore increased the number of question items and sample size to be able to withstand multivariate analysis.

In this study, the survey design was done by the author and carried out online using Rakuten Insight. Survey collection started online on July 19, 2023 and ended once the number of respondents reached 1,800 people (July 26, 2023). The survey sample was based on sex and age distribution from the "labor force survey" and targeted both male and female fulltime employees that were 20-69 years old. This aligns with the survey sample of Igusa (2023). Screening survey was set at within 10,000 samples, and the main survey was set at 1,800 samples. Using free-form responses, the survey asked respondents to answer questions about how annual leave usage changed "compared to the previous fiscal year" and "compared to before the COVID-19 pandemic".

Question items were as follows[6]: (1) Demography items (marital status / number of children / educational background / industry, number of employees, and work location of employer / commuting time / job occupation / job title / length of employment / annual income / work hours per week and number of days worked), (2) items relating to annual leave (annual leave days used and granted[7], annual leave usage compared to previous fiscal year (used in text analysis) and compared to before the COVID-19 pandemic, usage method, purpose of usage), (3) availability of sick leave, (4) days per week using working at home and teleworking, (5) others (availability of labor unions, health condition)[8].

The survey is answered by survey testers, which do not necessarily reflect the target sample population. Given the issue of falling response rates of surveys in recent years, however, one can say that by carefully selecting the survey sample through screening, and by using Rakuten Insight, whose survey testers fairly well represent the composition of the national survey that asked about attitudes on leisure, the survey sample is meaningful[9].

To ensure an accurate discussion based on data it is extremely important to secure a representative sample in the online survey. Similar to other Internet survey companies, Rakuten Insight uses random sampling to extract the sample from its survey tester population, which includes users of Rakuten's various services. While it is unrealistic to expect the testers to have the same representativeness as the national census, there are over 100 million Rakuten users. As Rakuten's services include banking and telecommunications, its users go through strict ID verification. The same ID is used across group services and duplicate registrations are terminated when found. The probability of duplicate registrations is therefore extremely low compared to other companies. One can therefore say that this study, which uses a sample drawn from a Rakuten user base close to the total population of Japan, secures a close to representative sample.

For those interested in the full details of the survey questionnaire and survey results, please refer to the website (https://go1935.wixsite.com/my-site). Key results that relate to this paper's analysis are as follows. The average number of annual leave days used was 11.57 days in 2022 with a standard deviation of 7.35. This was approximately 1.3 days greater than the Igusa study of 2020. Similar to the results of the General Survey on Working Conditions, the number of annual leave days used has greatly increased. The percentage of people working at home

(i.e. teleworking) was 27.6%.

4. Word extraction and analysis from freeform response data

4.1. Analysis method

To make the analysis results comparable with Igusa (2023), this chapter uses the same text mining methodology for analysis. The subject materials for the analysis are the freeform responses regarding the usage of annual leave "compared to the previous fiscal year" (Q16-1). In the freeform responses that compared annual leave usage in FY2022 with "pre COVID-19" (Q16-3), there were many answers that were unfit for analysis. This paper therefore did not conduct analysis for that particular item.

By finding patterns among the data and visualizing the connection between words, one can explore topics relating to annual leave usage and understand how things changed from the early COVID-19 pandemic period. KH Coder (Ver.3.beta.05b) was used for the analysis[10].

4.2. Frequency of word appearance

Morphological analysis is performed for the 1,800 samples of freeform response data. A total of 19,769 words are extracted, which is an average of 11.0 words per sample[11]. This is the total number of appearances and includes words that appear multiple times in the same sample.

In freeform response data, words with the same meaning may be written or expressed in different ways. However, such variations in expressions are not adjusted to ensure reproducibility and prevent arbitrary interference. The most frequently appearing 150 words are listed in Appendix 1[12]. Compared to the study performed in 2020, characteristic nouns such as "COVID-19", "infection", "disease" have fallen in frequency of appearance, suggesting peoples' anxiety over the pandemic have relieved.

4.3. Co-occurrence relationship between extracted words

As the next step, the relationship between words is shown in Figure 1 using co-occurrence network, which visually connects words with a strong connection. The strength of the co-occurrence relationship is measured using the Jaccard index and a co-occurrence network is created showing words with index values greater than 0.11. Number of occurrences is set at a minimum of 8 and a maximum of 90[13]. Extracted words used by most respondents appear frequently and are typically difficult to analyze. In particular, words with a maximum occurrence frequency of over 90 were often the same as the words used in the question. The locations of the words in the figure have no significance.

From this diagram, one can interpret freeform responses about changes in annual leave usage from the previous year. There are 3 community groups with 3 or more close-knit words. The bottom group with the most number of circles can be understood to represent words relating to "can travel with COVID-19 having settled down" as the reason for changes in annual leave. As one can see from the correlation coefficient (the color of the circle), the negative reason of "cannot travel due to COVID-19", seen in the analysis results of 2020, has turned to a positive reason. Using the co-occurrence relation and KWIC concordance functions, examples of actual responses include "with COVID-19 settling down, the opportunity to travel on weekdays has increased" and "can now travel". This is a representative topic that indicates the impact of the COVID-19 pandemic on annual leave usage behavior has lessened. In particular, similar to the results of the 2020 survey, the

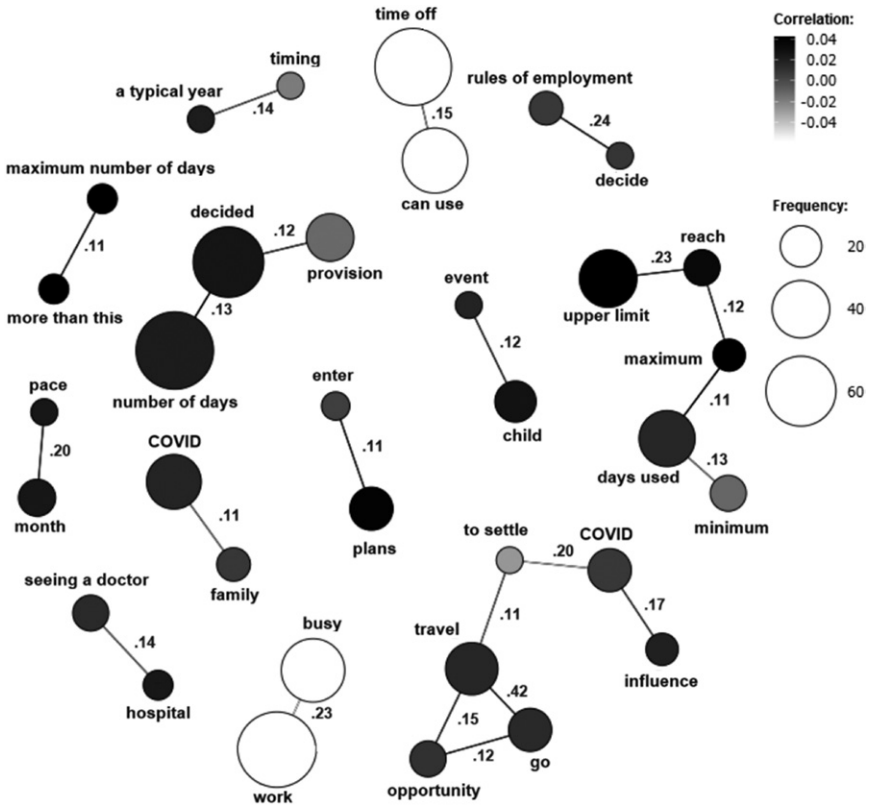

Figure 1: Co-occurrence networks for freeform responses (on change in annual leave usage compared to previous fiscal year)

Notes: (1) Co-occurrence is the appearance of a set of words within the same text. The size of the circle indicates the word's frequency of appearance and the line drawn between words indicates the co-occurrence is high. Each circle is grouped using subgraph detection and the shade of the color indicates the correlation with annual leave usage.

(2) The "Correlation" legend uses color to indicate the approximate range of the value. The range does not necessarily represent the maximum and minimum values. For example, a white node indicates a correlation below −0.04. The color becomes darker as the Pearson correlation coefficient approaches +1 and lighter when it approaches −1. The "Frequency" legend indicates the approximate size.

word "travel" had a strong co-occurrence relation with the COVID-19 pandemic and was not infrequent in appearance.

The next large group of circles located center right can be understood to represent words relating to the maximum number of annual leave days. This group includes answers such as "the maximum number of paid annual leave days is 20". The group on the upper left (3 circles) also relates to the annual leave system and focuses on the number of paid annual leave days granted. While the expression and wording are different, both are about topics relating to the number of annual leave days granted.

The other small groups with 2 words are about individual issues. Specifically, from the upper right, the groups are about "rules of employment", "cannot rest", "timing", "child related events", "whether or not one has plans", "COVID-19 and family", "routine", "effect of COVID-19", "busy with work", and "seeing a doctor". This concludes the grouping of topics men-

tioned in the freeform responses.

In Igusa (2023) there were groups (2 or more related words) relating to "work style reform". With the law enforcement in April 2019, however, such topics were not very visible from this analysis and suggest it is becoming a topic of the past.

As a first step of the analysis, this section presented the data while eliminating subjectivity to the best extent possible. As the next step, the next section of this paper will continue with the analysis using mainly multivariate analysis, based on the awareness of issues.

4.4. Correspondence analysis

Correspondence analysis, which is used for multivariate categorical data, is used to find whether or not one could empirically confirm the differences in reasons behind "changes in annual leave days"[14), 15)]. In carrying out the correspondence analysis, groups are sorted according to not only "whether or not teleworking was used" but also by sex[16)]. This is because the impact of whether or not teleworking was used, as well as annual leave taking behavior, may differ based on one's sex.

The results are shown in Figure 2[17)]. Total in-

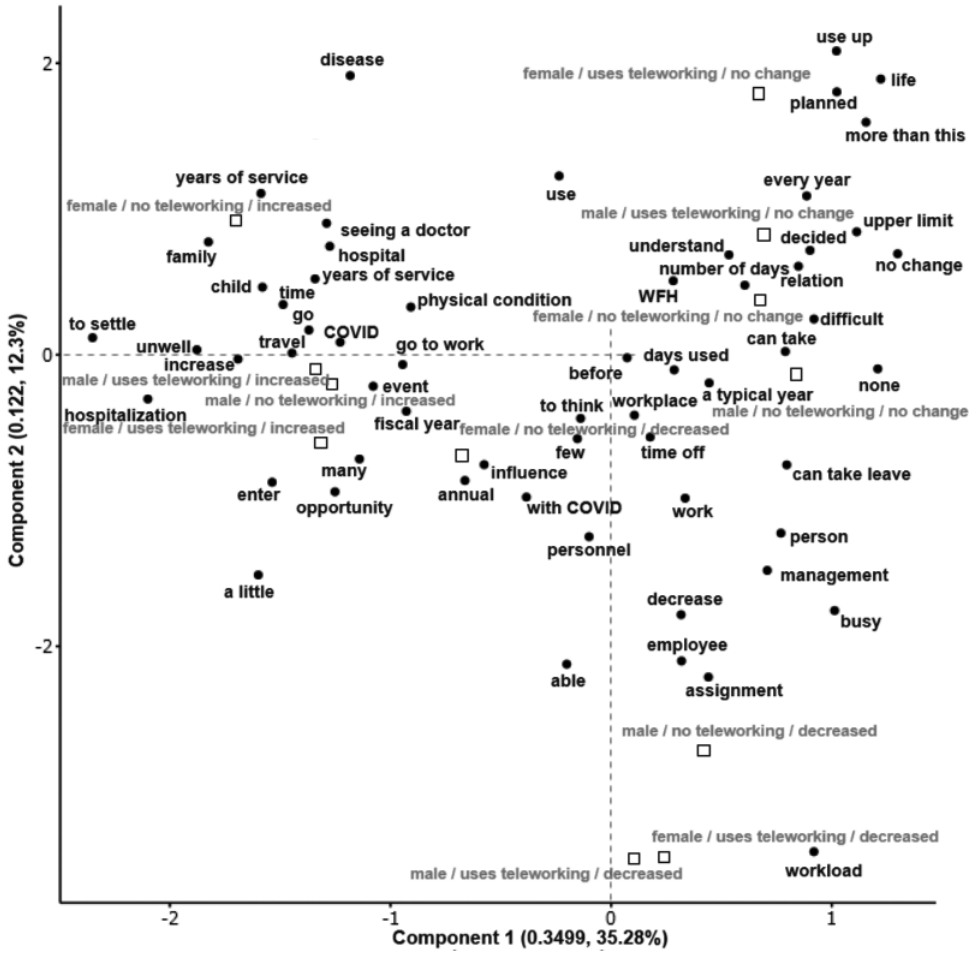

Figure 2: Correspondence analyses of changes in annual leave usage and commonly used words

ertia is 0.472, with the inertia for component 1 being 0.350 (35.3%) and component 2 being 0.122 (12.3%). The sum of the 2 dimensions results in a total inertia of approximately 50% and therefore one can validly interpret the 2 dimensional plot[18].

Starting from the origin (0,0) of the figure, characteristic words are distributed with the left side representing those who saw an increase in used annual leave days, the upper right representing those who saw no change, and the bottom right representing those who saw a decrease in usage[19]. As an interpretation of the components, component 1 seems to show "the work and life in work-life balance"[20]. For component 1 (x-axis), words relating to work are mostly found in the positive direction and words relating to personal life are mostly found in the negative direction, thereby making a distinction between "work" and "life"[21]. Furthermore, the location of composite variable value of sex and the use of teleworking, and the location of the value for annual leave usage behavior are close in all classes. From this, one can deduce that the variation due to sex and use of teleworking is relatively small, with similar characteristic words and annual leave usage behavior. The impact of teleworking among females who saw an increase in annual leave days used, however, is extremely interesting. While the difference is slight, the group "female & does not use teleworking & saw an increase in annual leave days" is characterized by words such as "hospital" and "going to see the doctor", which are errands that can be finished in a short amount of time. On the other hand, the group "female & uses teleworking & saw an increase in annual leave days" is characterized by words such as "events", "hospitalization", "travel", which are activities that take up a long or significant amount of time. This reflects the interchangeability between annual leave and teleworking. Those who do not use teleworking have a tendency to use annual leave to attend to short-term errands. One can therefore hypothesize that those engaged in teleworking are attending to such short-term errands while teleworking[22].

One can observe next that the difference between "increase", "no change", and "decrease" in annual leave days used is large. Characteristic words for those with an increase in annual leave days used include "travel", "family", "child", "hospital", "seeing a doctor", "COVID-19 pandemic", and "time". Actual responses using these words include "went on vacation with family" (50s male, manufacturing), "took leave to take care of child" (20s male, manufacturing), "was hospitalized" (30s male, utilities), "annual days used increased more than expected due to catching COVID-19" (40s female, finance), and "felt tired and wanted some alone time away from work" (60s male, wholesale / retail).

On the other hand, characteristic words for those with a decrease in annual leave days used include "workload", "assignment", "employee", "personnel", "busy", "management", "work", etc. Actual responses using these words include "increased workload, insufficient personnel, insufficient management" (50s male, education), "there was a switch in staff and taking leave would disrupt the business" (50s female, wholesale / retail), "became busy with work so was not able to take leave" (40s manufacturing), "after becoming a manager, the target number of annual leave days used decreased to 10 days. Target for labor union workers is 18 days" (40s male, manufacturing).

For those who did not see a change in the number of annual leave days used, characteris-

tic words include “maximum”, “use up”, “more than this”, “every year”, “life”, etc. Actual responses using these words include “in principle I try to use up all annual leave days every year” (50s male, telecommunications), “this is the maximum so cannot increase” (60s female, academia / specialist / technical services), “way of life has not changed” (40s female, other).

One can say from these words that the reason differs depending on how annual leave usage changed. Those who saw decrease in annual leave days used referred mainly to “matters concerning work”. On the other hand, those who saw an increase in annual leave days used referred mainly to “matters concerning personal life”[23]. In particular, when compared to Igusa (2023), the plotted location of “travel” has moved from “people who saw a decrease in annual leave days used” to “people who saw an increase in annual leave days used”. This result represents the restarting of travel. Furthermore, the plotted location of WFH was previously in the direction of “people who say a decrease in annual leave days used” but this time is near the origin and has become a notable word that “is close to the average of all words”. These are the conclusions that can be drawn from the analysis of the freeform responses but it is likely necessary to take a closer look using regression analysis.

5. The impact of teleworking on annual leave usage

The text analysis confirmed that annual leave usage behavior changed greatly from the COVID-19 pandemic to the “with-COVID” period. Changes in the relation between WFH and annual leave usage were also seen. As seen in the General Survey on Working Conditions and the results of this survey, annual leave days used have also greatly increased. Reasons for this could include teleworking and a decrease in work hours. As it is hard to judge based solely on the analysis of freeform responses, this question is considered using regression analysis. The analysis uses the censored regression model, with annual leave days used as the dependent variable. There were 115 cases in which annual leave days used was “0” (equivalent to 8.2% of the 1,410 valid samples). The censored regression model was therefore selected, as it is suited for cases when the dependent variable is cutoff when plotted. A binomial logistic regression analysis is also performed to investigate the impact of teleworking, with whether or not the purpose of the annual leave (Q22, multiple answers allowed) was for “housework / childcare”, “travel, leisure, etc.” as the dependent variable. The explanatory variables are age / sex / marital status / number of children / educational background / industry, number of employees, and availability of unions, availability of sick leave of employer / annual income / job occupation / job title / work hours per week and number of days worked / use of work at home and teleworking / commuting time / annual leave days granted / health condition[24].

The results are shown in Table 1. Looking at the analysis results (1), the “teleworking dummy” index is positive and statistically significant. In other words, those that used teleworking saw an increase in annual leave days used. As the result controls for the impact of work hours and commuting time, it is thought that annual leave usage behavior is impacted in some way by “changes in the place of work”. It should also be noted that the ratio of people using teleworking increased in accordance with the size of the company. It is meaningful that

Table 1: The impact of teleworking on annual leave usage (censored regression model analysis, binomial logistic regression analysis)

Analytical Model	(1) Censored Data Models (N = 1585)		(2) Binomial logistic regression analysis (N = 412)		(3) Binomial logistic regression analysis (N = 1410)	
Target for Analysis	All respondents		Respondents with children (middle school or younger)		All respondents	
Dependent variable	Annual leave days used		Purpose of annual leave is household chores or childcare		Purpose is going out to travel, leisure etc.	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Intercept	4.511	3.476	−3.716	1.985	−5.179**	1.285
Age	0.039**	0.016	−0.045**	0.016	0.001	0.006
Sex (male = 1, female = 0)	−0.822	0.468	−1.166**	0.336	−0.084	0.158
Marital status (has spouse = 1, does not have spouse = 0)	0.310	0.452	2.231*	1.112	0.415**	0.158
Number of chidren (has child = 1, does not have child = 0)	0.346	0.420			−0.295*	0.147
Educational background（ref: graduate of high school, : graduate of						
—Graduate of middle school	−1.745	2.905			1.257	1.256
—Graduate of vocation school/professional school/junior college	0.094	0.590	0.943	0.487	0.474*	0.204
—Graduate of university	−0.159	0.489	0.527	0.382	0.162	0.166
—Graduate of graduate school	−0.247	0.789	0.396	0.499	0.504	0.278
Industry (ref: manufacturing)						
—Construction	−0.771	0.758			0.360	0.264
—Electriity, Gas, Water and Heat supply	1.636	1.309			0.277	0.448
— Information and communications	0.826	0.721			−0.030	0.251
—Transport and postal activities	−0.382	0.971			0.206	0.328
—Wholesale and Retail trade	−1.426*	0.647			0.172	0.217
—Finance and Insurance	0.177	0.742			0.107	0.252
—Real estate and goods rental and leasing	−1.183	1.121			0.461	0.402
—Scientific research, professional and technical services	0.507	0.983			−0.077	0.333
—Accomodations, eating and drinking services	−4.197**	1.526			0.229	0.529
—Living-related and personal services and amusement services	−0.793	1.440			0.419	0.523
—Education, learning support	−1.304	1.083			−0.665	0.366
—Medical, health care and welfare	−0.234	0.943			−0.035	0.313
—Compound services and Services (N.E.C)	−0.263	0.740			0.288	0.257
—Other (incl. Mining and quarrying of stone and gravel)	−0.355	1.239			−0.024	0.416
Size of enterprise (ref: 29 employees or less)						
—30 ～ 99 employees	2.143**	0.675	0.324	0.592	−0.020	0.232
—100 ～ 299 employees	2.833**	0.692	1.142	0.593	0.000	0.236
—300 ～ 999 employees	3.276**	0.701	0.515	0.575	0.298	0.240
—1,000 ～ 2,999 employees	3.319**	0.762	0.335	0.603	0.117	0.258
—3,000 or more employees	3.570**	0.714	0.591	0.564	0.314	0.245
Occupation (ref: general clerical worker, receptionist, secretary: for (2) only due to sample size- clerical jobs such as general clerical worker, receptionist, secretary, research specialist, patent clerk)						
—Management	−0.970	0.850	0.911	0.519	−0.284	0.289
—General affairs, human resources, education training	−1.448	0.785	0.742	0.572	−0.102	0.263
—Planning, public relations, editing	−0.624	1.008	0.693**	0.681	−0.192	0.342
—Accounting, finance	0.094	0.899	1.816	0.698	−0.411	0.308
—Clerical specialists such as research and analysis, patent clerk	1.024	1.935			0.556	0.708
—Sales and marketing	−1.635*	0.649	0.900	0.481	−0.273	0.221
—Hospitality services	−1.731	1.140	0.162	0.956	−0.550	0.391
—Technical specialists such as research & development, design, programming	−1.002	0.756	0.970	0.528	−0.360	0.261
—Medical, education specialist	−0.919	1.282	1.454	0.752	0.194	0.431
—On-site management, supervision	1.413	1.330	0.901	0.835	−0.035	0.455
—On-site worker in manufacturing, production	−1.305	0.940	0.830	0.663	−0.134	0.318
—Construction, civil engineering work	−3.365	1.854	0.868	1.008	0.714	0.847
—Transport, driving, security, cleaning	1.224	1.462	0.587	0.836	0.590	0.543
—Other	0.240	1.038	1.505*	0.700	−0.371	0.349
Availability of labor unions（ref: is not available）						
—Is available	0.730	0.447			0.210	0.150
—Unknown	−0.069	0.772			0.120	0.261
Availablility of sick leave (ref: no)						
—Yes	0.095	0.393			0.063	0.133
—Unknown	−1.505*	0.610			−0.191	0.212
Annual income	0.491	0.488			0.798**	0.176
Job title (ref. regular employee)						
—Chief, foreman or equivalent	−1.691**	0.472			−0.432**	0.161
—Section manager or equivalent	−1.847**	0.680			−0.234	0.230
—Director or equivalent	−2.969**	0.866			−0.566	0.302
—Other:	−1.870	1.564			−0.757	0.602
Hours worked per week	−0.031**	0.009	0.004	0.006	−0.001	0.003
Days worked per week	−0.747	0.397	0.307	0.283	−0.139	0.151
Use of work at home, teleworking	0.988*	0.438	0.173	0.274	0.301*	0.153
Commuting time	0.001	0.007	−0.005	0.005	−0.001	0.002
Annual leave days granted	0.337**	0.022	0.012	0.015	0.011	0.008
Health condition（ref: not good）						
—Good	0.754	0.553			1.128**	0.187
—Normal	−0.435	0.552			0.813**	0.186
Log likelihood	−4978.150					
−2log likelihood			482.052		1731.334	
Nagelkerke			0.164		0.148	

Notes: (1) the available/not available of work at home is determined by whether or not the respondent had used work at home at the time of the survey.
(2) *indicates P<.05 and **indicates P<.01.

the index value was positive even after controlling for company size. Other items that had a statistically significant impact include age (+), wholesale / retail industry (−), accommodations, eating and drinking services industry (−), size of company (+), sales and marketing (−), do not know if sick leave is available (−), is management (−), work hours per week (−), annual leave days granted (+). The results of these control variables mostly match the findings of previous studies and therefore the validity of this study can be deemed as high.

In analysis result (2), where the dependent variable is limited to "housework / childcare" as the reason for using annual leave, the impact of teleworking is limited and does not result in a statistically significant value. In analysis result (3), where the dependent variable is limited to "travel" as the reason for using annual leave, the impact of teleworking results in a statistically significant positive value. This means travel opportunities increased for those engaged in teleworking. This was seen among females only, but similar to the results of the correspondence analysis, teleworking results in a more proactive reason for using annual leave.

6. The relation between teleworking, work hours, and annual leave usage

In contrast to the results of Igusa (2023), the results showed those that used teleworking saw an increase in annual leave days used. Work hours also had a negative impact of annual leave days used. This conclusion regarding work hours reflects the results of many previous studies such as that by Ogura, which point out "in Japan actual work hours are too long and people cannot afford to take annual leave". As introduced earlier, some of the latest research demonstrates that teleworking has led to a decrease in hours worked[25]. To sort and understand how the difficult relation between teleworking, work hours, and annual leave usage, which influence each other, it is necessary to concisely visualize the series of events. Therefore, to clarify the causal relationship between such variables, path analysis is considered[26].

Firstly, Figure 3 shows the compatibility of the overall model. The χ^2 value is not significant (it tests the null hypothesis of "the model is

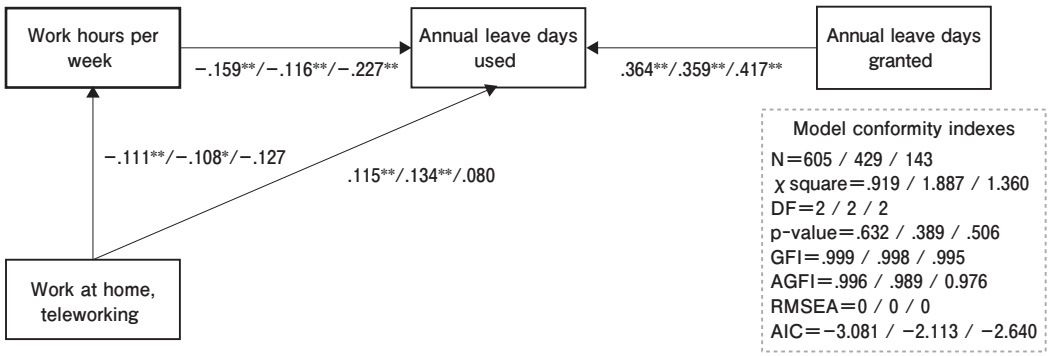

Figure 3: Path analysis about annual leave usage, work hours, and teleworking

Notes: (1) This analysis does not use latent variables. All rectangular boxes indicate observed variables.
(2) All coefficients are standardized coefficients. *indicates P<.05 and **indicates P<.01.
(3) In the analysis, all endogenous variables have error variables but this was abbreviated in the figure.
(4) The left value is the estimation result for male & female, the middle value is for male only, and the right value is for female only. The same is true for the model confirmity values.

correct") and other indices also look favorable[27]. For the analysis results of both males & females, and males only, the relations between variables were all significant. The indirect effect of teleworking on annual leave usage is positive (for females the direct impact of teleworking on work hours and annual leave usage is not significant). This result differs from Igusa (2023) and indicates the nature of teleworking has changed. In addition to the direct impact, the chain of events is shown, with teleworking resulting in fewer work hours, which in turn creates room to be able to take annual leave, which contributes to an increase in annual leave usage[28]. Many previous studies showed that by using teleworking, especially men were able to improve work-life balance. The same results may be reflected in this path diagram.

7. Conclusion

This paper focused on teleworking and considered how annual leave usage behavior changed in the post-COVID period. By using both qualitative and quantitative data analysis, and making the best use of and augmenting the weaknesses of each research method, this paper was able to obtain a comprehensive understanding of the research theme. Freeform responses tend to pick up recent topics. What one is aware of can also be put into words but what one is unaware of cannot be put into words. Therefore, to confirm the impact of potential variable factors, the analysis like that performed in Section 5 was needed. The results were consistent with the results of the qualitative analysis and both results pointed in the same direction.

The summary of the results is as follows. Text analysis confirmed annual leave usage behavior changed greatly from "during the COVID-19 pandemic" to the "with-COVID period" as peoples' fear of the pandemic was relieved. Those engaged in teleworking were more likely to use annual leave for "travel" and "events". Next, the multivariate analysis delved deeper into the impact of teleworking, and revealed those engaged in teleworking use more annual leave days, and are more likely to use it for the purpose of "travel", as opposed to short-term errands such as "housework / childcare". One reason for this can be thought to be the interchangeability between annual leave and teleworking. Under normal circumstances, one would use hourly paid leave to attend to tasks but instead, such tasks are taken care of while teleworking, allowing annual leave to be used instead for more proactive purposes. Furthermore, path analysis revealed that teleworking not only has a direct impact, but also has an indirect impact on annual leave by reducing work hours and thereby creating room for taking annual leave. From the analysis of annual leave, one was able to show the possibility that teleworking could improve work-life balance.

On the other hand, factors that cause a decrease in annual leave usage remain unchanged for 20 years and results were consistent with the research results of the Japan Institute of Labour (2002), Ogura (2003), and the Japan Institute for Labour Policy and Training (2011, 2022), which used large-scale surveys. As shown in the analysis results, issues with workload, work hours, and personnel remain at the center of the group of workers who saw a decrease in annual leave usage. As seen from the results of the correspondence analysis, for this group to move from "work" to "life", corporate efforts will likely be needed. It is hoped that an environment be created where the pursuit of work-life balance becomes the norm.

Finally, this paper would like to address fu-

ture challenges. Details can be found in Appendix 2 but the issue of "weak Satisfice", a typical issue seen in internet surveys where respondents answer without trying to understand the question asked, was also seen in response to this survey's questions about work hours. Internet surveys tend to induce inappropriate response behavior and create concerns about the reliability of the results. It is therefore necessary to address this issue by incorporating mechanisms to detect satisficers such as a Directed Questions Scale and Instructional Manipulation Check in the future to the extent possible.

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Notes

1）Kawashima (2004) examined the relation between usage of annual leave and labor productivity at companies and Ogura (2005) examined the correlation of long-term vacation and its impact on corporate management by using covariance structure analysis. Yamamoto and Matsuura (2014) examined the impact of work-life balance measures on productivity, including the correction of working long hours. Yamamoto (2019) analyzed the impact fulltime employee work hours have on profitability.

2）The analysis is based on data collected from the Household Survey, and is not based on monthly Current Employment Statistics.

3）The words "extremely busy", "busy", and "cannot keep up with" from the freeform responses were classified under the code "busy".

4）Ogura (2012) showed via factor analysis that the "busy factor" relating to long working hours has a negative effect on annual leave usage rates.

5）Some ambiguity remains regarding the interpretation methodology for viewing the results (analysis diagram) of co-occurrence network and correspondence analysis.

6）Rakuten Insight is aware of the sex, age, and home location of the survey respondent and therefore such questions were not included in the list of questions.

7）The number of days used is the actual number of leave days used during fiscal year 2022 (or during the proceeding year after annual leave days are newly granted). The Japanese fiscal year begins in April. For details, refer to the questionnaire.

8）To prevent bias in the freeform responses, questions other than those pertaining to demography were placed after the freeform responses. For details, refer to the questionnaire.

9）For details of Rakuten Insight survey testers, refer to Rakuten Insight, Inc. (2018).

10）KH Coder is designed to enable one to recursively conduct quantitative and qualitative analysis while looking at the source text. Over 5,000 studies have used KH Coder (recent labor studies in Japan include Ogasawara et al. 2023, Morishita 2023, Akama et al. 2023).

11）For word extraction, the "tea whisk" function included in KH Coder is used to forcibly extract compound words.

12）The survey is in the format of freeform responses in Japanese. Appendix 1 includes both Japanese and

English lists but the “English list” is a translation prepared by the author. This is the same for Figure 1 and Figure 2.

13）The Jaccard index shows the strength of co-occurrence between words. While it varies depending on the data used, a value of 0.1 indicates a relation and a value above 0.2 indicates a strong relation. The benchmark value varies depending on the data characteristics and word distribution.

14）As there was a difference in response ratios, the answers for the question “annual leave days used in FY2022 when compared to the previous year (Q16 of the survey)” were combined. The answers increased by “1-2 days”, “3-4 days”, and “5 or more days” were merged into “increased” and the answers decreased by “1-2 days”, “3-4 days”, and “5 or more days” were merged into “decreased”.

15）Minimum occurrence frequency is 8 and maximum occurrence frequency is 100.

16）In freeform response data, words with the same meaning may be written or expressed in different ways. In this analysis important words (such as COVID-19 pandemic, WFH, child, etc.) were adjusted to account for variations in expression. For example, in Japan “teleworking” and “work at home” are used almost interchangeably but in Western countries, “work at home” is used to represent the common meaning of “working from home (WFH)” (Tanimura 2022). In this step, the analysis is furthered by subjectively and explicitly extracting concepts from the data (step 2). The difference in wording in this paper is made to match previous studies or the wording in the survey answers, to the best extent possible.

17）The wording in KH Coder is “component” but in the translation book “Correspondence Analysis in Practice”, the word is described as “main axis” instead of “component”. The figure plots Component 1 on the x-axis and Component 2 on the y-axis. This represents the component (principal axis) that is extracted using dimensionality reduction of correspondence analysis. When taking the sum of the x-axis and y-axis, a value of 40-50% is considered valid and a value above 70% is considered highly accurate.

18）With more categories, an issue arises of the inertia (dispersal), expressed by the generated coordinate axes, becoming too small. This is an unavoidable phenomenon that occurs with the increase in the number of categories (Fujimoto 2020).

19）Words located near the point of origin represent commonly used words across all variables.

20）The interpretation of Component 2 is not done due to its small value.

21）Compared to Igusa (2023), the x-axis more strongly represents work and life.

22）When looking at the original freeform responses, the interchangeability of annual leave and teleworking can be seen in some cases but not to the extent seen in Igusa (2023).

23）In Igusa (2023), those who saw an increase in annual leave days used mostly referred to work-style reform, which is about making 5 days of annual leave per year mandatory, and “the promotion and popularization of taking leave”.

24）To enable comparison, The 3 analyses use the same explanatory variables as the previous studies introduced in section 2 where possible (Takami (2021), who analyzed the impact working at home has on time spent doing housework and childcare, is referred to for estimation formula (2)). However, some changes are made due to the impact of sample size. Refer to the descriptive statistics in Appendix 2 for details. As the survey was unable to reach the necessary sample size to allow for the analysis of only females, only the combined results of males and females are published in this paper. There is no large difference between the analysis results of only males vs. males and females combined.

25）According to the analysis by Usui et al. (2023), male workers with children shortened their work hours when using teleworking but the analysis by Inoue et al. (2023) showed work hours did not decrease.

26）Analysis was performed after controlling for number of leave days granted.

27）Refer to Hu & Bentler (1999) for the criteria for what constitutes a favorable fit.

28）To check for the indirect impact of teleworking on annual leave usage by way of effected work hours per week, the Sobel test (Sobel, 1982) was performed. The results of the test showed the indirect impact was statistically significant (male & female: $z=2.317$, $p<.05$, male only: $z=1.705$, $p<.05$)

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Appendix 1: Frequent words in freeform responses (top 150 words)

Extracted word (in Japanese)	Extracted word	Number of appearances	Extracted word (in Japanese)	Extracted word	Number of appearances	Extracted word (in Japanese)	Extracted word	Number of appearances
特に	especially	273	子供	child	20	考える	to think	10
取得	acquire	236	用事	things to do	20	最大日数	maximum number of days	10
増える	increase	192	自分	oneself	19	在宅勤務	work at home	10
理由	reason	175	体調不良	unwell	19	子ども	child	10
変化	change	173	職場	workplace	18	少し	a little	10
変わる	to change	171	年度	fiscal year	18	病院	hospital	10
取る	to acquire	152	方針	policy	18	付与日数	days granted	10
年休	annual leave	119	計画的	planned	17	雰囲気	atmosphere	10
会社	company	113	有給取得	acquire paid leave	17	管理	manage	9
休む	take leave	102	月	month	16	管理職	management	9
有給	paid vacation	92	例年通り	as usual	16	関係	relation	9
毎年	every year	86	機会	opportunity	15	仕事内容	content of work	9
仕事	work	77	最低	minimum	15	仕事量	amount of work	9
日数	number of days	74	前年	previous year	15	人員	personnel	9
休み	time off	72	増加	increase	15	前	before	9
決まる	decided	61	達す	reach	15	増減	increase/decrease	9
使う	use	55	通院	seeing a doctor	15	代わり	instead of	9
無い	none	53	勤務年数	years of employment	14	通常	usually	9
取れる	can take	52	決める	decide	14	入る	enter	9
思う	think	50	使い切る	use up	14	変動	fluctuate	9
消化	use up	50	特別	special	14	タイミング	timing	8
忙しい	busy	49	意識	conscious	13	ペース	pace	8
勤続年数	years of service	48	家族	family	13	以前	previously	8
有休	paid leave	48	自由	freedom	13	応じる	to respond	8
上限	upper limit	40	就業規則	rules of employment	13	基本的	basically	8
必要	necessary	40	難しい	difficult	13	行事	event	8
休暇	vacation	39	入院	hospitalization	13	今	now	8
取得日数	days used	38	余裕	leeway	13	社員	employee	8
コロナ	COVID*	36	影響	influence	12	上司	superior	8
有給休暇	paid vacation	36	最大	maximum	12	足りる	enough	8
旅行	travel	33	最低限	bare minimum	12	定める	decide	8
付与	grant	32	使用	to use	12	内容	content	8
業務	assignment	31	出勤	go to work	12	年次	annual	8
多い	many	31	少ない	few	12	病気	disease	8
休める	can take leave	29	状況	situation	12	有給日数	number of paid leave days	8
環境	environment	27	人	person	12	落ち着く	to settle	8
規定	provision	27	積極的	proactive	12	例年	a typical year	8
制度	system	26	体調	physical condition	12	それ以上	more than that	7
分かる	understand	26	都合	circumstances	12	ルール	rule	7
変化なし	no change	26	規則	regulation	11	何日	how many days	7
年間	annual	25	時間	time	11	暇	time off	7
年	year	24	出来る	able	11	感染	infection	7
減る	decrease	23	調整	adjust	11	既に	already	7
コロナ	COVID*	22	働く	to work	11	休職	leave of absence	7
行く	go	22	利用	utilize	11	結果	result	7
生活	life	22	これ以上	more than this	10	行う	conduct	7
変更	modify	22	コロナ禍	with COVID	10	産休	maternity leave	7
予定	plans	22	気	mood	10	使える	can use	7
勤務	service	21	業務内容	job description	10	出る	go out	7
言う	say	21	業務量	workload	10	上がる	rise	7

Note: the duplication is a result of KH Coder extracted the words Corona (the disease) and Corona (the organization). However, all respondents were referring to COVID when using the word.

Appendix 2: Descriptive Statistics

Analytical Model		(1) Censored Data Models (N = 1585)		(2) Binomial logistic regression analysis (N = 415)		(3) Binomial logistic regression analysis (N = 1410)	
Target for Analysis		All respondents		Respondents with children (middle school or younger)		All respondents	
Dependent variable	Explanation of variable	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Annual leave days used	Annual leave days used by respondent in 2022, actual value	11.592	7.354				
Purpose of annual leave is housework/ childcare	Dummy variable for purpose of using annual leave. reason is housework/childcare = 1, reason is not housework/childcare = 0			0.121	0.326		
Purpose is going out to travel, leisure etc.	Dummy variable for purpose of using annual leave. reason is going out to travel/leisure etc. = 1, reason is not goig out to travel/leisure etc. = 0					0.603	0.489
Explanatory variable							
Age	Age of respondent, actual value	45.550	12.244	40.388	7.804	45.388	12.163
Sex	Dummy variable for sex of respondent. male = 1, female = 0	0.669	0.471	0.777	0.416	0.672	0.469
Marital status	Dummy variable for marital status of respondent. has spouse = 1, does not have spouse = 0	0.607	0.488	0.971	0.168	0.615	0.487
Number of children	Dummy variable for number of children of respondent. has child = 1, does not have child = 0	0.426	0.495			0.432	0.495
Educational background	Dummy variable for educational background of respondent. If educational background matches the left = 1, other = 0 (for formula (2), the answers for middle and high school are combined as the sample size for for middle school was insufficient)						
—Graduate of middle school		0.004	0.066	0.167	0.373	0.003	0.053
—Graduate of high school		0.204	0.403			0.200	0.400
—Graduate of vocation school/ professional school/junior		0.160	0.367	0.121	0.327	0.154	0.361
—Graduate of university		0.545	0.498	0.585	0.493	0.554	0.497
—Graduate of graduate school		0.086	0.281	0.126	0.332	0.089	0.285
Industry	Dummy variable for employer industry. If industry matches the left = 1, other = 0						
—Construction		0.081	0.272			0.077	0.266
—Manufacturing		0.276	0.447			0.282	0.450
—Electriity, Gas, Water and Heat supply		0.018	0.134			0.020	0.140
—Information and communications		0.085	0.279			0.084	0.277
—Transport and postal activities		0.047	0.212			0.050	0.217
—Wholesale and Retail trade		0.126	0.331			0.126	0.331
—Finance and Insurance		0.079	0.270			0.084	0.277
—Real estate and goods rental and leasing		0.028	0.164			0.025	0.156
—Scientific research, professional and technical		0.038	0.191			0.037	0.188
—Accomodations, eating and drinking services		0.015	0.122			0.013	0.112
—Living-related and personal services and amusement		0.016	0.127			0.014	0.118
—Education, learning support		0.045	0.208			0.046	0.210
—Medical, health care and welfare		0.048	0.214			0.048	0.214
—Compound services and Services (N.E.C)		0.077	0.267			0.074	0.261
—Other (incl. Mining and quarrying of stone and gravel)		0.021	0.143			0.022	0.147
Size of enterprise	Dummy variable for size of enterprise. If size of enterprise matches the left = 1, other = 0						
—29 employees or less		0.146	0.353	0.063	0.243	0.112	0.315
—30 ～ 99 employees		0.143	0.350	0.136	0.343	0.145	0.352
—100 ～ 299 employees		0.140	0.347	0.150	0.358	0.144	0.351
—300 ～ 999 employees		0.160	0.367	0.189	0.392	0.165	0.371
—1,000 ～ 2,999 employees		0.121	0.326	0.133	0.340	0.126	0.332
—3,000 or more employees		0.290	0.454	0.328	0.469	0.308	0.462
Job occupation	Dummy variable for job occupation of respondent. If job occupation matches the left = 1, other = 0 (for formula (2), the answers for “clerical specialists such as research and analysis, patent clerk” and “general clerical worker, receptionist, secretary” are combined as the sample size for “clerical specialists such as research and analysis, patent clerk” was insufficient)						
—Management		0.140	0.347	0.177	0.382	0.143	0.350
—General affairs, human resources, education training		0.074	0.261	0.061	0.239	0.078	0.268
—Planning, public relations, editing		0.038	0.192	0.041	0.199	0.042	0.200
—Accounting, finance		0.050	0.219	0.036	0.187	0.048	0.213
—General clerical worker, receptionist, secretary		0.160	0.367	0.109	0.312	0.159	0.366
—Clerical specialists such as research and analysis		0.008	0.090			0.009	0.096
—Sales and marketing		0.182	0.386	0.209	0.406	0.179	0.384
—Hospitality services		0.030	0.170	0.017	0.129	0.027	0.162
—Technical specialists such as research & development		0.132	0.338	0.146	0.353	0.133	0.340
—Medical, education specialist		0.032	0.175	0.029	0.168	0.032	0.176
—On-site management, supervision		0.022	0.147	0.027	0.161	0.022	0.147
—On-site worker in manufacturing, production		0.064	0.245	0.068	0.252	0.064	0.244
—Construction, civil engineering work		0.011	0.103	0.017	0.129	0.008	0.088
—Transport, driving, security, cleaning		0.020	0.138	0.027	0.161	0.019	0.137
—Other		0.037	0.189	0.036	0.187	0.037	0.188

Availability of labor unions							
—Is available	Dummy variable for availability of labor unions at employer of respondent. If answer matches the left = 1, other = 0	0.497	0.500			0.519	0.500
—Is not available		0.439	0.496			0.418	0.493
—Unknown		0.064	0.245			0.062	0.242
Availablility of sick leave							
—Yes	Dummy variable for availability of sick leave at employer of respondent. If answer matches the left = 1, other = 0	0.534	0.499			0.556	0.497
—No		0.350	0.477			0.342	0.474
—Unknown		0.115	0.320			0.102	0.303
Annual income	The median value for the 14 categories of annual income for the respondent (logarithmic value). Samples that answered "do not want to answer" are excluded from analysis (1) and (3)	6.215	0.496			6.244	0.481
Job title							
—Regular employee	Dummy variable for job title of respondent. If answer matches the left = 1, other = 0	0.542	0.498			0.532	0.499
—Chief, foreman or equivalent		0.218	0.413			0.225	0.417
—Section manager or equivalent		0.138	0.345			0.148	0.355
—Director or equivalent		0.088	0.283			0.085	0.279
—Other:		0.014	0.117			0.010	0.099
Hours worked per week	Actual hours the respondent worked per week. Actual value. For formulas (2). (3). (4). the irregular samples of 0 hours and 168 hours were excluded from analysis (2) and (3). For (4), in which the hours worked per week is a major analysis factor, samples with an answer fewer than 10 hours were also removed from the analysis, which are thought to be mistaken responses. To ensure reproducibility and prevent arbitrary interference, such adjustments were not made in formula (1), where the purpose of the analysis is to gain an overall understanding of the results. It should also be noted that for analysis (1) to (3), the impact of samples thought to be mistaken answers did not have a meaningful impact on the analysis results. There was no change in the items that were found to be statistically significant.	34.175	20.692	34.817	19.771	35.802	19.501
Days worked per week	Actual days the respondent worked per week. Actual value. As the targets of the analysis are fulltime employees, samples that answered 0 days worked per week were excluded from formulas (2) and (3).	5.037	0.464	5.024	0.440	5.026	0.409
Use of work at home, teleworking	Dummy variable for use of work at home/teleworking for the respondent. Work at home/teleworking is used = 1, work at home/teleworking is not used = 0	0.281	0.450	0.325	0.468	0.289	0.453
Commuting time	The median value for the 7 categories of communting time for the respndent	44.602	26.019	45.822	25.755	45.117	25.893
Annual leave days granted	The number of annual leave days granted for the respondent in 2022. Actual value. For formulas (2) and (3), where the purpose of annual leave is the dependent variable, the target for analysis includes only those samples that answered they are able to use annual leave. Therefore, samples that answered 0 days for the number of annual leave days granted and the number of annual leave days used were excluded from formulas (2) and (3).	17.032	8.656	18.364	8.118	18.086	7.810
Health condition	Dummy variable for health condition of respondent. If answer matches the left = 1, other = 0 (as there was a gap in response rates, the answers "very good" and "pretty good" were merged into "good" and the answers "not good" and "not very good" were merged into "not good")						
—Good		0.433	0.496			0.440	0.496
—Normal		0.442	0.497			0.434	0.496
—Not good		0.125	0.331			0.126	0.332

Note: The question asks for hours worked per week but Rakuten Research commented that there was a high probability a certain number of respondents gave answers for average hours worked per day. This is a problem with internet surveys and the issue of "weak Satisfice" was seen with respondents answering the question without trying to understand the meaning of the question. For details of issues with internet surveys, refer to Inagaki (2021).

Appendix 3: Descriptive Statistics for path analysis

Target for Analysis	(4) Respondents (male & female) with children (N = 605)		(5) Respondents (male) with children (N = 429)		(6) Respondents (female) with children (N = 143)	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Annual leave days used	11.823	7.448	11.364	6.805	12.566	8.112
Hours worked per week	41.330	13.742	44.420	12.483	39.290	8.512
Use of work at home, teleworking	0.309	0.463	0.305	0.461	0.301	0.460
Annual leave days granted	17.471	8.956	17.674	8.891	16.699	9.238

Note: Refer to Appendix 2 for a detailed explanation of the variable.

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Economic Determinants of Fertility in Contemporary China : A Multilevel Analysis

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Summary

This study investigates the impact of economic variables on fertility patterns in China, leveraging data from the Chinese General Social Survey from 2010 to 2015. Employing a multilevel-ordered regression model, the analysis accounts for regional heterogeneity, offering an understanding of how income inequality, gross domestic product (GDP) per capita, family income, and employment status shape preferences for the desired number of children and contribute to the fertility gap. A notable finding is the presence of an inverted U-shaped relationship between GDP per capita and fertility preferences. The results underscore the importance of balancing economic development with social equity to effectively address the evolving demographic landscape in contemporary China.

Key Words

Fertility, Regional Heterogeneity, Income Inequality, GDP, Chinese General Social Survey

1 . Introduction

China is on the verge of a pivotal demographic shift, transitioning from a period of population growth to an anticipated decline. In the past, numerous scholars and institutions assumed a considerably high fertility rate for China. For instance, the United Nations relied on a total fertility rate of 1.7 to forecast China's population dynamics (Cai, 2022). However, findings from the seventh national population census in 2020 revealed a more modest actual total fertility rate of 1.3.

The China Population and Development Research Center, along with the United Nations Population Fund in China (2022), conducted a probabilistic forecast for the total fertility rate. By 2050, the 0-14 age group is predicted to constitute only 11.6% of the total population, whereas the proportion of individuals aged 65 and above is expected to reach 30.8% of the total population. The sustained decrease in fertility and longer lifespans are likely to lead to a significantly older population as well as a reduction in population size, producing a range of noteworthy social consequences, such as slowed economic growth and increased labor costs (Hondroyiannis and Papapetrou, 2001; Lu and Cai, 2014).

Family planning policies have significantly influenced China's demographic transition. The Chinese Communist Party initially promoted higher birth rates but later realized the need for family planning. In 1979, the "one-child" policy

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was introduced to control fertility. To address the declining birth rate and aging population, restrictions on childbirth were gradually relaxed. In 2013, families wherein one spouse was an only child were allowed to have two children. In 2015, the "Population and Family Planning Law" recommended two children per couple. In 2021, the government further relaxed childbirth constraints, allowing couples to have three children, with additional measures to enhance fertility policy (Fudan University, 2015). The long-term implementation of the "one-child" policy has led to drastic changes in the population structure, with the fertility rate remaining low for an extended period. Concurrently, reforms in China's economic system and improvement in people's living standards since the reform and opening-up era may have substantially influenced fertility behaviors. Despite recent policies aimed at promoting childbirth, fertility rates remain consistently low.

Wang (2010) suggests that China's population policy has influenced fertility preferences but is not the exclusive or most significant factor contributing to the low fertility rate. Factors affecting low fertility rates in other countries, including economic factors like income inequality and individual employment situations, could also impact China (Zheng et al., 2009; Cai, 2010). While fertility behavior has been extensively researched in developed countries, few studies have considered the impact of economic factors, such as income inequality, on fertility preferences and behavior in China. This study aims to address this gap by examining the factors influencing the desired number of children and the fertility gap in China, considering the country's population control policies and the current economic landscape. Utilizing microdata from the Chinese General Social Survey (CGSS) of 2010, 2012, 2013, and 2015 and employing a multilevel-ordered logistic model, the study assesses the impact of economic factors on desired number of children and the fertility gap. The study provides policy considerations based on the empirical findings, with the potential to mitigate the effects of declining birthrates and an aging population if individuals can attain their desired number of children.

The remainder of this study is organized as follows: Section 2 reviews the relevant literature, while Section 3 describes the data and empirical models. Section 4 summarizes the empirical findings. Finally, Section 5 concludes the study and explores potential avenues for addressing demographic challenges.

2. Literature review

2.1. Fertility aspirations

Comprehending the correlation between desired and actual fertility rates is crucial for understanding economic developments and forecasting future population dynamics. In predicting future population sizes, Pritchett (1994) emphasized the significance of the desired number of children, revealing that nearly all differences in actual fertility rates among countries stem entirely from variations in desired fertility rates. Moreover, in countries with higher fertility rates, women tend to desire more children than men. Sobotka (2009) utilized micro-census data from Austria to demonstrate that Austria's intended fertility rates began to decline to below replacement levels in the mid-1950s onwards, with subsequent cohorts maintaining similarly low fertility rates throughout their reproductive years.

Many scholars have extensively investigated the factors influencing the desire to have children. Using Dutch panel survey data, Liefbroer

(2009) examined intentions regarding family size, revealing that the intentions of some respondents remain constant as they age, whereas those of others tend to decrease, contributing to an overall downward trend. Additionally, individuals with higher education levels tend to desire families with more children (Heiland et al., 2005; Mills et al., 2008).

2.2. Fertility gap

Studies have suggested that individuals in different developed countries and regions typically desire two children, yet many struggle to achieve this aspiration, resulting in fertility rates persistently remaining below replacement levels (Philipov, 2009; Beaujouan and Berghammer, 2019). The term "fertility gap," introduced by Chesnais (1999), denotes the disparity between the desired and the actual number of children. This phenomenon is observed not only in developed countries but also in developing countries such as China and Iran (Wang and Wang, 2016; Hosseini et al., 2021). Drawing on data from the European demographic data sheet and other sources, Gauthier and Philipov (2008) examined the relationship between fertility policies and birth rates in various European countries, demonstrating that the implementation of fertility support policies can eliminate barriers to fertility and thus facilitate the achievement of the desired number of children.

A significant body of literature has discussed the fertility gap. Bongaarts (2001) introduced an analytical model to explore the factors influencing low fertility rates, using the desired number of children as a comparative benchmark. The model examines the shift from desired fertility to actions and identifies facilitating factors such as "unwanted fertility," "replacement of deceased children," and "sex preferences," as well as hindering factors including "rising age at childbearing," "involuntary infertility," and "competing preferences."

Based on Bongaarts's (2001) study, Morgan and Rackin (2010) utilized the 1979 National Longitudinal Survey of Youth and employed a multinomial logistic regression. Their findings suggest that social norms and various constraints significantly impact the timing of parenthood for men and women. Consequently, the accumulation of human capital and competitive demands of work contribute to disparities between fertility intentions and actual fertility.

2.3. Economic factors and fertility behavior

The current study specifically focuses on "competing preferences," which implies that achieving a balance between work and childcare is a considerable challenge when individuals prioritize career advancement or higher income. Many studies have indicated that as income increases, the desire for fertility decreases, as parents prioritize investing in the quality of their children (Bollen et al., 2007; Cordoba and Ripoll, 2016). However, a gap remains in the understanding of the relationship between income inequality and fertility behavior. Japaridze's (2019) model introduced a family consumption level comparison as a factor, considering the utility of childbearing. The results suggest that low-income families tend to mirror the consumption behaviors of higher-income households, connecting their consumption decisions with choices related to childbearing. Further, economic considerations play a greater role in childbearing decisions in regions with higher income inequality, where low-income families are exposed to higher consumption standards. Employing empirical regression analysis using data from the 2010 American

Community Survey, Japaridze (2019) found a negative correlation between income inequality and fertility rates, indicating that higher income inequality is associated with reduced fertility rates.

2.4. Main issues in the research field

Despite extensive research on fertility behavior, the existing literature lacks a comprehensive understanding of how regional heterogeneity and economic disparities specifically impact fertility decisions. In China, fertility levels across various provinces are inconsistent, mirroring differing developmental statuses and substantial income disparities among provinces. To fill this gap, this study uses a multilevel-ordered regression model. It also analyzes the regional disparities in fertility levels, addressing the heterogeneity among provinces to provide a more comprehensive understanding of fertility trends.

In addition, prior studies lack a deep understanding of the economic factors, such as income inequality, that may influence the gap between desired and actual fertility. Furthermore, there is limited empirical evidence addressing these issues within the Chinese context, where rapid economic development and significant regional heterogeneity present unique challenges and opportunities for understanding fertility behaviors. This study aims to address these deficiencies by exploring the relationship between income inequality and the desired number of children, providing a more detailed examination of how economic factors influence fertility behavior. Through this approach, the study aims to elucidate the underlying economic drivers of the fertility gap and suggest potential policy interventions to narrow this gap.

3. Data and model

3.1. Chinese general social survey

The data employed in this study are sourced from the CGSS of 2010, 2012, 2013, and 2015; this project is facilitated by the National Survey Research Center at Renmin University of China. Since 2003, the CGSS has encompassed cross-sectional surveys covering approximately 10,000 households across provinces, cities, and districts of mainland China. The study utilized data from 2010 onwards, considering the extraction design and the presence or absence of variables used.

3.2. Desired number of children and fertility gap

This section provides an overview of the sample population's desired number of children and the fertility gap. Regarding the desired number of children, the CGSS posed the question, "If no policy restrictions existed, how many children would you wish to have?" The actual number of children corresponded to respondents' current number of children. Cases in which either the desired or actual number of children exceeded six were excluded because of the very small sample sizes. The fertility gap is typically described as the difference between lifetime family size ideals or intentions and the period indicators of fertility in the recent past, such as the total fertility rate (Testa, 2012; Beaujouan and Berghammer, 2019). In this study, the fertility gap is defined as the difference between the desired number of children and the actual number of children, specifically calculated as the desired number of children minus the actual number of children[1)].

This study focuses on individuals aged between 18 and 45 years. Table 1, illustrating the distribution of the desired and actual number of

Table 1 Distribution of desired and actual number of children

Desired number	Frequency	Percent	Actual number	Frequency	Percent
0	248	1.57	0	3460	21.94
1	4048	25.67	1	7567	47.98
2	10497	66.56	2	4044	25.64
3	799	5.07	3	610	3.87
4	166	1.05	4	79	0.50
5	13	0.08	5	11	0.07
Total	15771	100.00	Total	15771	100.00

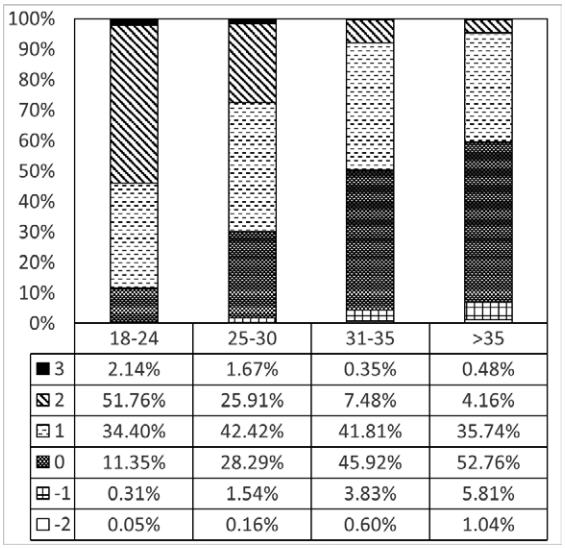

Figure 1 Fertility gap distribution at different age ranges

NOTE: Values ranging from −2 to 3 represent the deviation between the actual and desired number of children. Specifically, 0 indicates parity between actual and desired number, while negative and positive values denote an excess and shortfall in the desired number of children, respectively.

children, indicates that approximately 67% and 26% of individuals aspired to have two children and one child, respectively. Those with no desire for children or desiring four or more children represent less than 3% of the total number of cases. These findings are corroborated by the existing literature; for example, Wang and Wang (2016) suggest that the ideal number of children for Chinese individuals hovers around two (1.86, to be precise), while Song and Hu (2022) report that over 57% of Chinese couples aspire to have two children and 30% one child.

Regarding the actual number of children, Table 1 illustrates that approximately 48% of individuals had only one child, 26% had two children, and 22% had no children. Those with three or more children constituted less than 5% of the total sample. Therefore, despite the traditional belief in China that more children bestow more blessings, restrictions such as the "one-child" policy have resulted in Chinese individuals typically having fewer than three children. Consequently, they often tend to have fewer children than they desire.

Figure 1 illustrates the shift in the gap between the desired and actual number of children

across different age groups. Only 11% of individuals aged 18-24 years attained their desired number of children. Approximately 0.5% had more children than desired, whereas the majority (88%) had not achieved their desired family size. As age increases, the proportion of individuals who achieve the desired number of children gradually rises. Among those with fewer actual children than desired, the proportion of individuals with a fertility gap of two decreased as their age increased, whereas the proportion of those with a gap of one increased. Notably, even among individuals over 35 years of age, approximately 40% had not achieved their desired number of children.

3.3. Covariates

This study investigates the factors influencing the desired number of children and the fertility gap, focusing primarily on four economic indicators as the main explanatory variables:

1. The Gini coefficient, denoting income inequality for each province;

2. Gross domestic product (GDP) per capita (log transformation) for each province;

3. Family income (log transformation); and

4. Employment status (employed=1, unemployed=0).

Individual income data from the CGSS were used to calculate the Gini coefficients for each province, as the National Bureau of Statistics of China (2010-2016) does not publicly release Gini coefficients at the provincial level.

Adjustments for GDP per capita involved utilizing the Consumer Price Index to align incomes with the 2009 consumption levels. Data on the Consumer Price Index, GDP, and population were sourced from the China Statistical Yearbook for the respective years under consideration.

Table 2 Descriptive statistics for total sample

Variable	Obs	Mean	St.dev	Min	Max
Desired number of children	15771	1.7861	0.6116	0.0000	5.0000
Actual number of children	15771	1.1322	0.8181	0.0000	5.0000
Fertility gap	15771	0.6539	0.8357	−2.0000	3.0000
Gini coefficient	15771	0.5089	0.0898	0.2299	0.8594
log (GDP percapita)	15771	10.6357	0.4658	9.4901	11.5797
log (Family income)	15771	10.5113	1.1677	0.0000	16.0593
Employed	15771	0.8174	0.3864	0.0000	1.0000
Age	15771	34.3686	7.4195	18.0000	45.0000
Marriage					
Unmarried	3163	0.2006	0.4004	0.0000	1.0000
Marrired	12608	0.7994	0.4004	0.0000	1.0000
Sex					
Male	7731	0.4902	0.4999	0.0000	1.0000
Female	8040	0.5098	0.4999	0.0000	1.0000
Education					
Illiterate	527	0.0334	0.1797	0.0000	1.0000
Compulsory education	7891	0.5003	0.5000	0.0000	1.0000
High school	3232	0.2049	0.4037	0.0000	1.0000
Junior college	1890	0.1198	0.3248	0.0000	1.0000
University and above	2231	0.1415	0.3485	0.0000	1.0000

Information on family income and individual employment status was obtained from the CGSS. Similar adjustments were made to standardize family income to the same reference point. In addition, the explanatory variables included individual characteristics such as age, education level (illiterate=0, compulsory education=1, high school=2, junior college=3, university and above=4), and marital status (married and currently cohabiting=1, otherwise=0). Respondents with covariates with missing values were excluded from analysis[2]. Descriptive statistics are presented in Table 2.

3.4. Model

This study utilized two regression models to analyze the desired number of children and the fertility gap, both categorized into six levels. The first model examined factors influencing the desired number of children, while the second focused on factors affecting the fertility gap. Separate regression analyses were conducted for male and female subgroups within the sample. Recognizing the ordered nature of the desired number of children and the fertility gap, they were treated as ordinal data in the analysis, acknowledging their non-normal distributions.

While previous studies, such as Morgan and Rackin (2010), have discussed the gap between desired and actual children, they have often overlooked regional variations. China's vast size means diverse economic conditions across its provinces, which can influence attitudes toward childbirth and actual fertility levels. Surveyed individuals were dispersed across provinces, creating a multilevel structure. To address heterogeneity across provinces and considering the structure of the survey data, a multilevel-ordered logistic model was employed[3]. Level 1 included surveyed individuals and variables related to income inequality, economic conditions, and individual characteristics. Level 2 included the provinces[4].

The model is specified as follows. In this random intercept model, where i represents individuals and j represents groups, which in this study are the provinces. y_{ij} is the number of desired children or the fertility gap, while k indicates the category of each dependent variable. $\boldsymbol{\kappa}$ represents the cut points that indicate the thresholds (the points at which the probability of observing a particular category change to the probability of observing the next higher category). $\boldsymbol{\eta}_{ij}$ represents the linear predictor, ϵ_{ij} represents the error term, $\mathbf{x}_{ij}$ is the vector of fixed-effect covariates, $\boldsymbol{\beta}$ is the associated vector of coefficients, and $\mathbf{u}_j$ is a set of cluster-level random effects. More comprehensive information can be found in StataCorp (2021, pp. 346-347).

$$
\begin{aligned}
p_{ij} &= \Pr(y_{ij}=k \mid \boldsymbol{\kappa}, \mathbf{u}_j) \\
&= \Pr(\kappa_{k-1} < \boldsymbol{\eta}_{ij} + \epsilon_{ij} \leq \kappa_k) \\
&= \frac{1}{1+\exp(-\kappa_k + \boldsymbol{\eta}_{ij})} - \frac{1}{1+\exp(-\kappa_{k-1} + \boldsymbol{\eta}_{ij})} \\
&\text{where } \boldsymbol{\eta}_{ij} = \mathbf{x}_{ij}\boldsymbol{\beta} + \mathbf{u}_j
\end{aligned}
$$

4. Regression results

4.1. Desired number of children analysis

Table 3 presents the regression outcomes for the desired number of children and fertility gap[5]. The ensuing discussion adheres to a significance level of 5%. Columns 1 and 2 of Table 3 present the results of the desired number of children for men and women, respectively. While both groups demonstrate some similar trends regarding educational attainment and marital status, there are also key differences. For example, individuals with higher levels of education, such as high school or university graduates, tend to desire fewer children com-

Table 3 Regression results for desired number of children and fertility gap

	(a) Desired number of children		(b) Fertility gap	
	Male	Female	Male	Female
Gini	1.2303***	1.0698**	−0.2192	−0.2775
	(0.4392)	(0.4593)	(0.2915)	(0.3010)
log (GDP per capita)	−1.6427	7.2880***	9.1450***	−1.5270
	(4.1704)	(2.5770)	(2.9111)	(2.4871)
log (GDP per capita)_squared	0.1023	−0.3215***	−0.4189***	0.0796
	(0.2004)	(0.1234)	(0.1374)	(0.1181)
log (Family income)	0.0320	0.0198	0.0605*	0.0632**
	(0.0235)	(0.0208)	(0.0350)	(0.0267)
Employed	0.1706**	0.0003	0.1171	0.2130***
	(0.0800)	(0.0734)	(0.0955)	(0.0762)
Age	−0.0741***	0.0321	−0.3253***	−0.6589***
	(0.0284)	(0.0290)	(0.0485)	(0.0458)
Age_squared	0.0012***	−0.0002	0.0031***	0.0080***
	(0.0004)	(0.0004)	(0.0007)	(0.0007)
Education				
Compulsory education	−0.3444	−0.6854***	0.2304	1.0236***
	(0.2657)	(0.1593)	(0.3113)	(0.1679)
High school	−0.7811***	−1.1584***	0.8978***	2.0860***
	(0.2789)	(0.2087)	(0.3150)	(0.1818)
Junior college	−0.7036**	−1.0956***	1.4785***	2.5133***
	(0.2785)	(0.1758)	(0.2992)	(0.1674)
University and above	−0.6377**	−0.7787***	1.8834***	2.8761***
	(0.2821)	(0.2023)	(0.3045)	(0.1708)
Marriage	0.6030***	0.2541***	−2.9105***	−1.9681***
	(0.0870)	(0.0865)	(0.0985)	(0.0905)
Desired number of children				
1			3.9859***	3.6964***
			(0.1981)	(0.2220)
2			7.2040***	6.9430***
			(0.2859)	(0.3419)
3			9.8992***	8.9589***
			(0.4599)	(0.5569)
4			11.9165***	12.1767***
			(0.7998)	(1.0237)
5			11.6619	14.3269***
			(8.2955)	(4.9484)
/cut1	−10.3752	37.6305	40.1844	−20.1908
/cut2	−7.0865	40.8942	42.6966	−17.9143
/cut3	−3.0505	45.0013	47.2892	−13.3146
/cut4	−1.0810	46.6736	50.8576	−9.6229
/cut5	1.4928	49.3871	55.8281	−4.5961
Province				
var (_cons)	0.5922	0.5084	0.2574	0.3856
Number of obs	7731	8040	7731	8040
Number of groups	28	28	28	28
Obs per group:				
Min	46	73	46	73
Avg	276.1	287.1	276.1	287.1
Max	515	474	515	474
Wald chi2 test	Wald chi2(12) = 261.48	Wald chi2(12) = 205.80	Wald chi2(17) = 3655.07	Wald chi2(17) = 11483.99

NOTE: For the symbols, *p<.1, **p<.05, ***p<.01. The reference category for the number of desired children is set to 0. The cut point(/cut) represents the κ in the model's section (3.4). var (_cons) refers to the variation in the regional estimates. The Wald chi-squared test is used to test the null hypothesis that all coefficient values are zero.

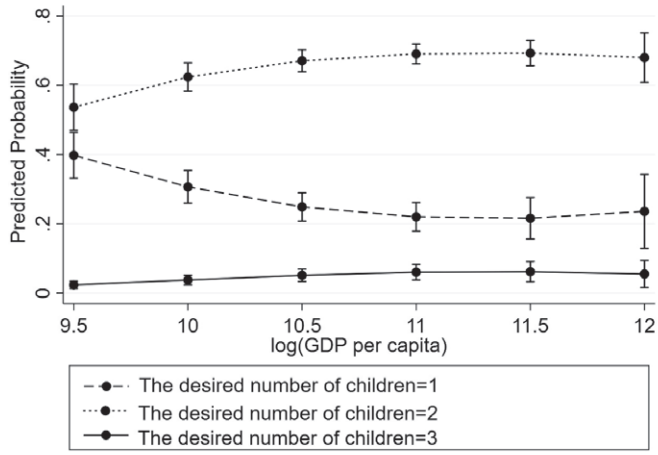

Figure 2 Predicted probabilities of the desired number of children at different levels of GDP per capita for women with 95% CIs

pared to those with the illiterate. This trend is consistent across both men and women, although the magnitude of the effect varies slightly. Additionally, married individuals express a significantly higher desire for children than do unmarried individuals, with the effect being stronger among men.

With an increase in the Gini coefficient, individuals from both sexes exhibited a greater desire for offspring. For men, employed individuals tended to express a greater desire for a higher number of children than unemployed individuals. Furthermore, considering that the parameter for GDP per capita is positive and the quadratic term (log (GDP per capita)_squared) is negative, there appears to be an inverted U-shaped relationship between GDP per capita and the desired number of children for women. Further exploration of GDP per capita was conducted utilizing predicted probabilities. Specifically, cases with a high predicted probability for the desired number of children (restricted to 1-3) were analyzed, whereas those involving a low predicted probability for the desired number of children (0, 4, or 5) were excluded. Figure 2 further shows that, holding other factors constant, for women, an increase in GDP per capita results in a decreased likelihood of desiring one child and an increased likelihood of desiring two or three children. However, at higher levels of GDP per capita, exceeding the turning point of approximately CNY 98715.77 (when log (GDP per capita) ≈ 11.5, equivalent to approximately US$13628.19), the likelihood of desiring two or three children modestly decreases, whereas the trend toward preferring only a single child shows a slight increase.

4.2. Fertility gap analysis

Columns 3 and 4 of Table 3 present the regression results of the fertility gap for men and women. Although the coefficient of compulsory education is not significant in the male population, the results from both men and women demonstrate that higher levels of education are associated with increased difficulty in attaining their desired number of children. For example, individuals with higher education, such as high school or university graduates, tend to have fewer children than they desire compared to the

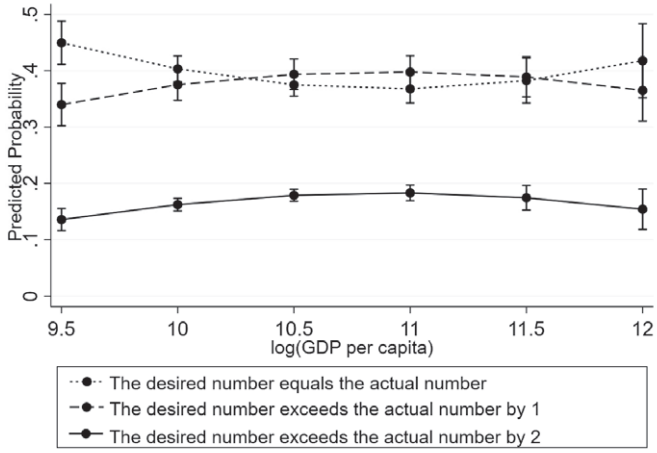

Figure 3 Predicted probabilities of the fertility gap at different levels of GDP per capita for men with 95% CIs

illiterate. Additionally, being in a marital relationship increases the likelihood of both men and women having their desired number of children compared to unmarried individuals.

Moreover, for women, higher family income or employment poses challenges in achieving their desired number of children, as indicated by the significantly positive parameters of the terms of family income and employment. Considering that the parameter for GDP per capita is positive and the quadratic term (log (GDP per capita)_squared) is negative, an inverted U-shaped relationship can be seen between GDP per capita and the fertility gap for men is apparent. As most individuals have either reached their desired number of children or have a shortfall of a few children compared to their desired number, this study conducts an empirical analysis to explore the precise influence of GDP per capita within these contexts by utilizing predictive probabilities. Figure 3 illustrates the variations in the predicted probabilities for men at different GDP per capita levels, holding the other conditions constant. With an increasing GDP per capita, the likelihood of achieving the desired number of children decreases, whereas the probability of falling one child short of the desired number increases. However, at higher GDP per capita levels, surpassing the turning point of approximately CNY 59874.14 (log (GDP per capita) = 11, equivalent to approximately US$8431.09), there is a reduction in the likelihood of falling short of the desired number by one or two children, while the trend of achieving the desired number increases.

5. Discussion and conclusions

In this study, the impact of various economic factors on fertility behavior was analyzed using data from the CGSS 2010, 2012, 2013, and 2015, considering regional differences. Although the analysis was conducted under the "one-child" policy, it utilized the desired number of children assuming the absence of such restrictions. The analysis utilized a multilevel-ordered-regression model. Subsequently in this section, the findings on the desired number of children and the fertility gap are examined and discussed based on previous studies and in the context of the current situation in China.

The findings indicate that, regardless of gender, regions with higher Gini coefficients tend to have a higher desired number of children, but the Gini coefficient was not significant in relation to the fertility gap. According to Li (2023), as the Gini coefficient increases, China's intergenerational income elasticity, which refers to the degree to which children's income levels are influenced by their parents' income levels, in central and western areas decreases, indicating higher income mobility. This means that the younger generation from low-income families has a higher potential to achieve better income compared to their parents. In other words, the economic environment becomes more conducive to upward mobility, and children have greater opportunities for financial success. In such a social context, parents may be more inclined to desire more children, anticipating that their offspring will have better income prospects. Therefore, the relationship between income inequality and intergenerational income elasticity observed in the underdeveloped regions of central and western areas suggests an indirect influence on the desired number of children. However, as economic development continues in these regions, this relationship of income inequality and intergenerational income elasticity may shift. When income inequality increases, intergenerational income elasticity also rises, as observed in more developed regions. In this situation, the younger generation from low-income families may struggle to surpass their parents' income, making it harder for them to achieve better financial outcomes. In such a context, they might limit their desired number of children accordingly.

In terms of the influence of GDP per capita, an inverted U-shaped relationship exists between GDP per capita and the desired number of children for women, implying that with an increase in GDP per capita, women have a greater desire for children; however, when GDP per capita reaches a high level, continued economic growth results in a slight decrease in the desired number of children. The relationship between GDP per capita and desired number of children was not observed in men. Instead, an inverted U-shaped relationship exists between GDP per capita and the fertility gap while controlling for the desired number of children. This suggests that with an increase in GDP per capita, men may find achieving their desired number of children more challenging. However, when the GDP per capita reaches a high level, continued growth increases the likelihood of men achieving their desired number of children.

Regarding the relationship between GDP per capita and the desired number of children, an increase in GDP per capita implies that residential areas may have improved access to education, culture, and healthcare resources, leading to higher living standards and a more conducive environment for personal development. Individuals may have a greater willingness to have children in such an environment. Nevertheless, as the economy progresses further, so do educational costs and the financial burden associated with childcare, and individuals may decide on a specific desired number of children.

As for the relationship between GDP per capita and the fertility gap. Prior research has pointed out that an increase in per capita GDP or human development indices is associated with an initial decline in fertility rates, followed by a potential resurgence (Myrskylä et al., 2009; Luci-Greulich and Thévenon, 2014). Jones et al. (2008) highlighted the increase in educational technology and expenses as pivotal factors explaining the decline in fertility accom-

panying economic development. First, as economies advance, parents may consider the benefits of education and invest their limited resources to improve the quality of their children. This may result in a decrease in the rates of achieving the desired number of children. Additionally, as the economy reaches a certain stage, individuals may gain more access to childcare due to the abundant existence of childcare facilities, hospitals, cram schools, and so on. This could offer more opportunities for parents to achieve their desired number of children. In China, ongoing economic development has led to a decreasing trend in childbirth rates in some regions, while the proportion of households not achieving their fertility goals may be rising.

Further, the regression results showed that, for the influence of employment status, employed men are associated with an increase in the desired number of children. For women, a high family income or employment status may bring greater challenges in achieving their desired number of children.

Employed men are likely to exhibit a stronger desire to have more children, as employment naturally provides them with greater economic resources to support their offspring. Based on this observation, maintaining economic stability and simultaneously establishing sufficient unemployment assistance systems positively impact the desire to have more children.

For women, a higher family income or being employed may pose challenges in achieving their desired number of children. Previous studies have shown a negative relationship between family income and childbirth (Bollen et al. 2007; Cordoba and Ripoll, 2016). Presently, China has a shortage of childcare services. Affluent households and employed women often prioritize their careers, leading to limited time investment in childcare, rendering attaining the desired number of children difficult.

China is currently undergoing significant economic and social transformations, accompanied by notable demographic changes. This study reveals the influence of various economic factors on reproductive behavior, indicating that in the absence of the "one-child" policy, economic conditions could play a significant role in shaping fertility trends. Specifically, economic development may hinder families' goals of reaching their desired number of children, particularly if there is inadequate societal support for childcare and related services. Therefore, balancing economic growth with social policies that support sustainable fertility levels is crucial. In addition, improving access to childcare and supporting women in balancing career and family responsibilities will contribute to creating a more inclusive and pro-natal environment, which is essential for addressing China's demographic challenges.

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Footnotes

1） Unlike the approach used by Morgan and Rackin (2010), which categorizes fertility outcomes into underachieved, achieved, and overachieved based on the comparison between actual fertility and desired fertility, this study directly calculates the fertility gap as the difference between the desired number of children and the actual number of children. This straightforward calculation method allows for a clear quantification of the gap between fertility intentions and outcomes.

2） Among the analyzed participants, approximately 6% had missing values. It is assumed that this level of missing data did not significantly affect the estimation. Therefore, the analysis proceeded with the complete dataset.

3） Models that do not account for provincial-level differences yield results that do not accurately reflect the actual situation in China. It is essential to apply a model that considers the regional heterogeneity within China.

4） The analysis was conducted using Stata Standard Edition 17.0, with robust standard errors employed for regression coefficients to ensure estimation robustness.

5） While the application of models such as the Seemingly Unrelated Regression (SUR) model could be considered for analyzing the desired number of children and the fertility gap, it is a natural assumption in fertility behavior analysis to first determine the desired number of children and then decide on actual childbearing. Therefore, in this analysis of the fertility gap, it is appropriate to use the desired number of children as a control variable.

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