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Abstract

How gender equality and equity relate to fertility becomes a central concern for population scholars as well as policy makers in developed countries. Both the theories and empirical studies from western countries suggest that achieving higher levels of gender equality within the household can also lead to higher fertility in the societies where gender gaps in education and employment are small. Using "Longitudinal Survey of Newborns in the 21st Century", this study provides firm evidence on the associations of couples' participations in market labor and domestic work with transition to the second birth in the first quinquennium of the 21st century Japan.

1. Introduction

How gender equality and equity relate to fertility becomes a central concern for population scholars as well as policy makers in developed countries. As women's education levels and market labor positions become much resemble to those of men in many industrial countries, achieving high degree of gender equality both in the labor market and the family life becomes an important policy goal to mitigate work-family conflicts and to increase both individuals' well-being and fertility. McDonald (2000) is one of the fastest demographers who suggested taking gender equity into account of the theory of fertility decline. He proposed that decline to very low fertility levels is associated with the gap between high levels of gender equality in individual-oriented institutions such as education and market employment and low levels of gender equality in the family (McDonald 2000). Therefore,

women who value their involvement in such individual-oriented institutions would limit family-oriented demands by deterring marriage and childbearing (McDonald 2000).

McDonald's proposition is gaining empirical supports from recent studies of large cross-national comparisons as well as fertility analysis of individual-level data from Europe and the United States. Myrskylä, Kohler and Billari (2009) examined cross-national data of 24 developed countries during a 30-year period up until the early 2000s and discovered a reversal in total fertility rate in the countries where socioeconomic development measured by Human Development Index (HDI) produced by United Nations Development Programme (UNDP) is the most advanced. Moreover, in the subsequent study, they further revealed that the fertility reversals in advanced HDI countries are, in fact, driven by fertility at older reproductive ages and by the countries with high gender equality in the society (Myrskylä, Kohler and Billari 2013).

By seeing a much faster pace of women's advancements in economic roles than men's participation in domestic roles as a cause of low fertility, social demographers also explore how men's gender attitude relates to their fertility desire and fertility outcomes in eight European countries such as Austria, Estonia, East- and West Germany, Italy, Lithuania, the Netherlands and Poland (Puur et al. 2008). Although the results advocate some controversy in the measurement of gender attitude (Westoff and Higgins 2009, Goldscheider, Oláh and Puur 2010), the study reports a positive relationship between men's gender egalitarian attitude and both higher fertility desire and outcomes in above countries except for West Germany and Estonia. Using more comprehensive measurement of men's gender attitudes, Miettinen, Basten and Rotkirch (2011) found that both traditional and the most egalitarian attitudes relate to men's higher fertility expectation in Finland. Do these studies suggest a possibility of fertility upturn within a country once gender equalities at work and at home are more balanced? Or are these findings just attributing to country-specific contexts?

Japan is characterized as one of the highest socioeconomic development with least gender equality among high income nations. For example, in 2011, Japan's HDI is ranked top 12 out of 187

countries (UNDP 2011), while Japan is ranked 98 out of 135 countries in the Global Gender Gap (GGG) measure (Housmann, Tyson and Zahidi 2011). In Japan, however, much less is known about the relationship between fertility and gender equality in the family due mainly to data limitation. Most of previous studies in Japan use cross-sectional surveys to link men's participation in domestic work and fertility intention (Fujino 2006, Nishioka and Hoshi 2009, Koba, Yasuoka and Urakawa 2009, Mizuochi 2010). There are few existing research examines the link between men's participation in domestic work and probability of childbirth using longitudinal surveys (Abe and Oi 2004, Toda and Higuchi 2011). However, the former group of studies lacks a direct linkage to actual fertility behaviors, whereas results of the latter longitudinal studies are largely hindered by the use of inappropriate data to analyze the relationship.

Using "Longitudinal Survey of Newborns in the 21st Century", this study overcomes shortcomings of existing research and provides firm evidence of the relationships between the degrees of wife's and husband's participations in domestic work and childbearing, according to wives' employment statuses. In this study, I focus on the correlates of second births to reveal underlying mechanisms of marital fertility and spousal role sharing in market labor and domestic work. Second births represent crucial transitions in couples' reproductive behaviors for replacement, albeit the transitions are becoming increasingly selective in younger cohorts (IPSS 2012a). Furthermore, a research on the correlates of second birth also allows us to assess the impact of current family settings on fertility. Previous study found that childrearing experience after having a first child affect a couple's decision to have additional child (Yamaguchi 2005). A couple's gender relations measured by a wife's employment and a husband's participation in housework and childcare play important roles in determining the couple's well-being after the childbearing (Yamaguchi 2009) and expected to affect their intentions to have an additional child. This study aims to investigate the direct linkage between couples' gender relations after the arrival of the first child and additional fertility by studying the correlates of the second births.

Examination of the current relationships between second births and spouses' participations in market labor and domestic work sheds a light on the couples' strategies of childbearing in the beginning of the 21st century Japan. The study assumes that the couples which fit better to the current socioeconomic environment should have higher fertility if their fertility desire is equivalent. Therefore, the results of this study informs policy makers how the current policy efforts which aim to increase women's social enhancement as well as to achieve more equal role sharing between spouses affect fertility of married couples who already have one child. The findings of this study will, then, be useful to consider future levels of fertility in relation to establishing more balanced gender equality in Japan.

2. Background

2.1. Demographic causes of fertility decline in Japan

Fertility started to decline to below replacement levels since the early 1970s in Japan, mainly due to the expansion of never-married population. The increase in never-married population is initially enforced by delayed marriage. By 2010, however, 10% of women and 20% of men stay as never-married at age 50 (IPSS 2014), and these figures are estimated to rapidly increase up to 17-18% for women in 2030 (IPSS 2012a). Given very low levels of extra-marital birth (2.23% in 2012), most of these life-time singles are assumed to end up with childlessness.

Scholars claim that one of the main reasons for the spread of delayed marriage is educational upgrading of young adults. At first place, educational upgrading, in particular, enrollments to universities, delays young adults' entry into a marriage market (Kaneko 2004, Raymo 2003). Moreover, the search process of highly educated women tends to be longer than their lower educated counterpart due partially to scarce availability of potential men who are similarly highly educated and economically qualified men, given high prevalence of female hypergamy (Raymo and Iwasawa 2005). Some of the highly educated women are arguably highly motivated for their career too and desire continuous employment during the childbearing period. Although not many, some of these women are

assumed to retreat from the norm of a gender traditional marriage and choose to be life time celibacy[1] (Tsuya and Mason 1995). On top of that, other scholar also argues that deteriorations of men's economic standings which manifested as high youth unemployment rates, the increasing share of non-standard jobs and flattered wage increase (Brinton 2011, Genda 2005) drives marriage delay among young men, thus affected marriage timing of women accordingly (Kato 2011). As a result, a substantial proportion of men and women who could not find a marriage partner in their most marriageable ages are expected to stay as a single and childlessness for a life time unless current behavioral patterns continue.

Table 1 Parity Distribution of Married Women:

for first-marriage couples who have been married for 15-19 years

			Parity					
Survey Year	Total	(Number of cases)	None	1 child	2 children	3 children	4 children or more	Completed N of Children (±S.E.)
1977	100.0%	(1,427)	3.0%	11.0	57.0	23.8	5.1	2.19 (±0.023)
1982	100.0	(1,429)	3.1	9.1	55.4	37.4	5.0	2.23 (±0.022)
1987	100.0	(1,755)	2.7	9.6	57.8	25.9	3.9	2.19 (±0.019)
1992	100.0	(1,849)	3.1	9.3	56.4	26.5	4.8	2.21 (±0.019)
1997	100.0	(1,334)	3.7	9.8	53.6	27.9	5.0	2.21 (±0.023)
2002	100.0	(1,257)	3.4	8.9	53.2	30.2	4.2	2.23 (±0.023)
2005	100.0	(1,078)	5.6	11.7	56.0	22.4	4.3	2.09 (±0.027)
2010	**100.0**	**(1,385)**	**6.4**	**15.9**	**56.2**	**19.4**	**2.2**	**1.96 (±0.023)**

Source: IPSS (2012) "Report on the Fourteenth Japanese National Fertility Survey in 2010".

In addition to the trends toward later and less marriage, it is noteworthy that fertility of married couples is increasingly more responsible for the fertility decline in the recent period than before. A demographic analysis employing a decomposition method shows that up to one third (33.3%) of the decline in total fertility rate (TFR) in 1990-2005 is explained by the decline in fertility of first marriage couples, while it explains only one in eighth (12.5%)of the TFR decline in 1975-1990[2] (Iwasawa

[1] Women who do not intend to get married for a life time is less than 10% among women aged 18-49 in 2010 (IPSS 2012c).

[2] The rest of TFR decline in each period is due to the decline in first marriage rates among women in reproductive ages.

2008). In accord with the trend, the Japanese National Fertility Surveys reveals that the completed number of children for married women in 15-19 years of their first marriage started to decline since 2002 after staying around 2.2 for three decades (Table 1). In 2010, it reached to below 2 (1.96) for the first time since beginning of the survey (Table 1). The parity distribution of the same group of women shows that much fewer percentages of women get parity three and more while percentages of women who completed one child or stayed childlessness are increasing. The table figure suggests that as percentage of women who ever have two children become lower than before in recent years. In other words, the transition to the second birth becomes more and more selective among Japanese couples.

2.2. Gender equality in Japan

Japanese families have been dominated by a notion of traditional gender role division which assumes men work outside home and women stay at home for household tasks and childrearing throughout the post-WWII period.

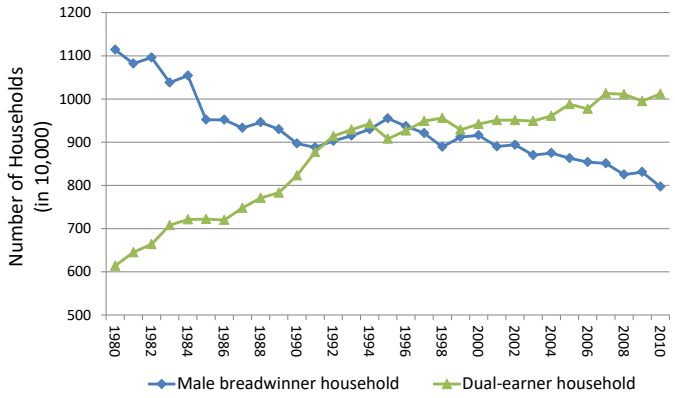
However, the recently emerging trend of the increase in dual-earner couples urges a sign of the change. The number of dual-income households increased and lagged behind that of male single-earner households since the 2000s (See Figure 1). The trend of dual-earner household shows even steeper rise among households with women in their childbearing ages of 25-34 (Cabinet Office 2005).

The increase in wives' labor force participation is, on the one hand, pushed by the decline in men's wage due to the prolonged deflation economy which continued over ten years since the late 1990s till very recent period (Cabinet Office 2005). To sustain household consumption, increasing share of house wives started working part-time to supplement husbands' income (Cabinet Office 2005).

On the other hand, proportion of working wives who continue their employment over childbearing are also increasing in the past ten years in Japan. Figure 2 shows the percentages of wives' employment status before and after the first birth in 2001 and 2010. It is clear from this figure that the birth of the first child is a major factor that makes Japanese women resign from employment. However,

the percentage of employed mothers after six months from first birth is showing a substantial increase from 25% in 2001 to 37% in 2010. It is noteworthy that the majority of the increase is achieved by mothers of full-time regular employees.

Figure 1 Number of male-breadwinner household and dual-earner household



Source: Statistics Bureau (each year), "Labour Force Survey"

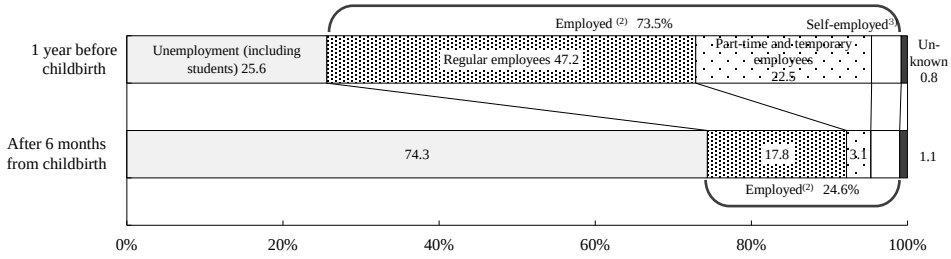
Note: Male-breadwinning household is a household which only a husband is an employee of non-agricultural industries and a wife is either unemployed or in non-labor force. Dual-earner household is a household which both a husband and a wife are employees of non-agricultural industries.

Japanese government have been enacted a series of new policies that aim to effectively utilize women's labor force participation during the childbearing period by gradually extending applicability of childcare leave to a wider range of employees, e.g. employees of small or medium sized companies or non-regular employees (such as part-time employees, temporary employees, dispatched employees, contract employees, and fixed-term employees) who satisfy certain requirements[3]. Therefore, gradual prevalence of childcare leave is also, in part, contributing to the increasing share of dual-earner couples among childbearing ages.

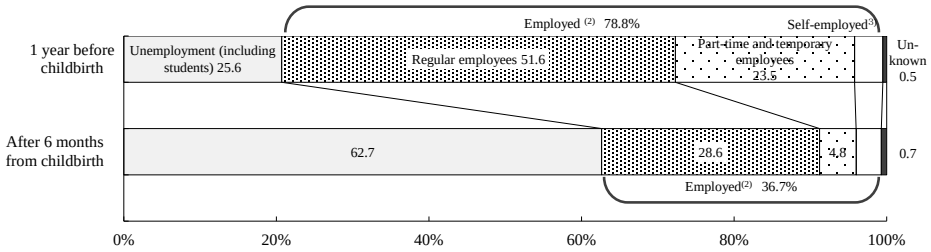
[3] Non-regular employees are entitled to take childcare and family care leave under the 2005 Revised Act. These non-regular employees have to satisfy all of the following requirements:
(1)Employees who have been employed on a continuous basis by the same employer for 1 year or longer; and
(2) Employees who are expected to be continuously employed beyond the date on which the child reaches 1 year of age.

Figure 2 Women's employment status changes over first birth in 2001 and 2010

a. Mothers of the 2001 newborn cohort



b. Mothers of the 2010 newborns cohort



Note:1) Among the valid sample of the 1st wave surveys of the 2001 cohort (47,010 in total) and the 2010 cohort (38,554 in total), the cases which a subject child is the only child and lives with a mother are used for the tabulations (22,914 cases for the 2001 cohort and 18,100 cases for the 2010 cohort).

2) "Employed" includes leaves of absence such as childcare leaves.

3) "Self-employed, etc." includes "Self-employed and family business workers", "Home workers" and "Others".

Source: The 1st Longitudinal Survey of Newborns in the 21st Century (2001 cohort and 2010 cohort) .

In addition, Japanese government tries to facilitate gender equality within households by encouraging men's greater involvement with household tasks, especially, childrearing. However, men's participation in domestic sphere is at much slower pace than women's participation in labor force. For example, a comparison of time-use surveys reveals that, in average, only a little less than one hour per day is spent for household chores and child rearing by Japanese husbands who have at least one pre-school child, despite of that more than three hours are spent by husbands in similar situations in western countries such as USA, Sweden and Germany (Cabinet Office 2006). In contrast, women spend nearly eight hours per day in average, for these domestic tasks in Japan despite that women in those western countries do so about 6 hours (Cabinet Office 2006). The latest time use survey reveals

the same picture for men while women's hours spent for housework and childcare are reduced one hour in 2011 (Statistics Bureau 2012). In addition, a percentage of male eligible workers who take up childcare leave is only 1.89% in 2012 Japan[4]. This indicates another evidence of lower degree of men's commitment to childcare. Therefore, the progress of men's participation in unpaid work is much disproportional to women's participation in paid work in Japan.

Both the theory (McDonald 2000) and empirical evidence from cross-national study (Myrskylä, Kohler and Billari 2013) suggest, the existing gap between relatively high degree of gender equality in market employment and low degree of gender equality in the family life can be seen as the major cause of very low fertility. It is, then, important to know whether fertility is likely to recover once gender role division within the family life becomes more symmetric. In addition, achieving equal opportunities across genders is a global political agenda. Japanese government has also been taking a series of actions to improve gender equalities at home and work place, partially, in response to demographic pressure of sharp decline in current and future labor force. Therefore, it is particularly important for the government and policy makers to understand how gender equality in both market labor and family life relates to fertility behaviors in current Japan and what will be the consequences of the change into a more gender egalitarian society in future fertility.

3. Previous studies on gender equality and second births

Several country-specific studies are conducted in Europe and the US to investigate the relationship between spousal role sharing in domestic work such as housework and childcare, and the transition to the second birth. Using data from Hungary and Sweden where prevalence of the dual-earner family is high for both countries while gender relations in the home is rather more traditional in Hungary than in Sweden, Oláh (2003) found that a positive link between men's participation in domestic tasks and

[4] Ministry of Health, Labour and Welfare (2013) "Basic Survey of Gender Equality in Employment Management"

the likelihood of the second births in both countries.

However, evidence from Italy and Spain where traditional male-breadwinner families are still highly prevalence suggests that opportunity cost of women's employment is still very high so that men's hours in childcare do not alter the trade-off (Cooke 2003). But in Italy, Cooke (2003) found that men's greater participation in childcare relates to higher likelihood of second births in the youngest marriage cohort, and interpreted this as a sign of the change in the relationship.

In addition, using cross-national time use surveys, Sullivan, Billari and Altintas (2014) found significant evidence of the recent increases in the time spent for child care and core domestic work of the younger and more educated fathers in very low fertility countries such as Germany, Italy, Spain and Slovenia. They interpret these findings as suggestive evidence for a process of cross-national social diffusion of more egalitarian domestic gender relations which is likely to facilitate recent upturns in fertility of these countries (Sullivan, Billari and Altintas 2014).

In the US, the relationship between wife's housework share and the second birth intensity among dual-earner couples is found to be U-shaped by indicating that both traditional and egalitarian division of housework appears to be positively related to a higher chance of having a second child (Torr and Short 2004) as similar to a Finnish study of gender attitudes and fertility intention (Miettinen, Basten and Rotkirch 2011). These results imply the existence of the two heterogeneous couples regarding divisions of gender roles, namely gender-traditional and gender-non-traditional couples. Then, men's greater participation in housework relates positively to the likelihood of the second births among those gender-non-traditional couples, possibly by reducing wives' burden of the "second shift".

In Japan, several studies examined the relationship between fertility and men's participation in domestic work. But many of them are examining fertility intention rather than fertility behavior. These studies found that husbands' greater participations in childcare (Fujino 2006, Koba, Yasuoka and Urakawa 2009) and housework (Fujino 2006) relate to wives' higher fertility intention. Using two-wave panel data, Nishioka and Hoshi (2009) also found that husband's greater participation in

housework increases wife's fertility intention. In analyzing panel data, Yamaguchi (2009) also found a positive relationship between husband's greater share in childcare and marital satisfaction though husband's share in housework did not affect marital satisfaction. As marital satisfaction positively relates to fertility intention, Yamaguchi (2009) indirectly infers that improving work-family balance is likely to increase marital fertility through increasing wife's marital satisfaction. There are a few exceptions too as Mizuochi (2010) and Fujino (2002) did not find significant effects of husband's participations in childcare and housework, respectively, on wife's fertility intention. In general, most of the studies find a positive link between men's greater participation in domestic work and fertility intention of married women. However, it is not clear how much of these positive links are actualizing as behavior.

Longitudinal data is necessary to examine the causal linkage between spousal role sharing and fertility behavior. Few studies examine fertility behaviors in relation to men's participation in domestic roles using longitudinal data in Japan. Using the Japanese Panel Survey of Consumers (JPSC), Abe and Oi (2004) conducted multivariate probit model and fixed effect model to examine married women's probability of childbirth and number of children, respectively. Their study found a positive effect of husband's hours spent on domestic tasks including both housework and childcare, on birth probability. They also found that the positive effect is stronger in younger cohort. However, it is not clear in their model whether the time order of husband's time spent for domestic work and fertility outcomes is appropriately set or not. In their model, it is likely that both husband's time spent on domestic work and fertility outcomes are measured at the same survey wave so that husband's time for domestic work is increased as a result of the childbirth. Even if they use husband's domestic work hours at t-1 wave, the problem still remains as it is likely that husbands spend more time for domestic work than before if his wife is already pregnant at t - 1 wave. Therefore, even using panel data, setting an appropriate time order to analyze the effect of spousal role sharing on birth behavior urges great caution.

Toda and Higuchi (2011) use larger sample of the Longitudinal Survey on Adults in the 21st Century, conducted by Japanese Ministry of Health, Labour and Welfare to examine the relationship between husband's participation in domestic work and fertility. By taking advantage of the large samples size, they divide their analytical sample into six groups according to wife's employment (employed or not) and parity (parity 0,1 and 2). This makes sample size of each group ranging from 100 to 500. Using data from the second and third wave survey, they use husband's hours spent on housework including childcare for both working day and non-working day measured at t-1 to link the childbirth probability between time t-1 to t. Also they avoid contamination in time ordering of the causality by excluding women who are supposed to be pregnant at the survey in t-1. However, as mentioned, the result is based on only one-year of observation between November 2003 and November 2004. Moreover, their measure of the hours spent on domestic work does not allow one to separate childcare and other housework, neither. In the analysis of Toda and Higuchi (2011), they found the only limited relationship between husbands' participations in domestic work and second birth probabilities. Only husband's domestic work hours in non-working days have a positive link to the second birth probability of women without employment. Husband's domestic work hours in working days did not correlate with wife's second birth probability. Fertility of employed women was neither affected by husbands' domestic work at any sense. This result contradicts to our expectation of that husband's participation in domestic work should have a stronger positive effect on fertility of employed women rather than that of housewives.

In conclusion, the results of previous studies on the relationship between husband's domestic work participation and fertility are ambiguous in Japan due to the data limitation and methodological difficulties. This study overcomes these problems by using newly available large panel data of the new born babies and their parents[5]. By taking advantage of the panel data, the study also employs an

[5] Similar analyses with simplified models are conducted by the author himself and published as one of the chapters in "Special Report on the Longitudinal Survey of Newborns in the 21st Century and the Longitudinal Survey of

innovative method to construct the measure of domestic work participations of each spouse. The details for the data and method are described in the following section.

4. Data and analytical strategy

4.1. Data

The data used for the analysis is the 1st through 6th wave data from the "Longitudinal Survey of Newborns in 21st Century (LSN21, thereafter)" conducted by Japanese Ministry of Health, Labour and Welfare[6]. The LSN21 is the largest and one of the latest longitudinal surveys in Japan. The survey is annual panel survey which subjects to all babies born in Japan in 10-17th January or in 10-17th July in 2001. The households of 53,575 babies are the sample of this survey. The mail survey method is used to distribute and collect questionnaires. The first questionnaire is mailed to the households of sample babies at six months after their births. Among all, 47,015 questionnaires are filled out and returned. Thus, the valid response rate was 88% in the first wave survey. Thereafter, the response rates have been above 90% in the subsequent waves.

In addition to its relatively large sample size with high response rates, the LSN21 covers a wide range of topics such as babies' physical and emotional developments, sickness and care situations as well as household compositions and both parents' socio-economic status, values on family and childrearing, and involvement with household tasks and childrearing activities. Birth year and month of new born babies are also recorded in the subsequent surveys. Therefore, it is possible to relate a broad set of covariates to transition rates of the second birth. For these advantages, the LSN21 is the best panel data that I can use for the correlates of the second birth in Japan.

It should be worth mentioning that the LSN21 has no left-truncated observations for the analysis

Adults in the 21st Century: Ten-Year Follow-up, 2001–2011" which is an official report released by Japanese ministry of Health, Labour and Welfare (2013). This paper refined the analysis, added extensive literature review and completely revised the frame for the academic purpose.

6 I used data from only first 6 waves, while LSN21 is ongoing and have completed 15th wave in 2016. This is because birth dates of additional newborns are not obtained at 7th and later waves. Also over 90% of second births recorded until 10th wave survey are, in fact, observed by the time of 6th wave survey.

of the second birth. As being a cohort panel of newborn babies, observation of the study starts at six months after the birth of the first child for all respondents in our analytical data, and the survey takes place annually. Therefore, all covariates including husband's and wife's participations in housework and childcare are measured at the same timing since the birth of the first child for all respondents. This is a potentially important advantage in analyzing the effect of spousal role sharing in fertility as the amount of domestic work as well as the patterns of spousal role sharing can be quite different according to age of the first child as well as pregnancy and arrival of the second child. In previous studies (Abe and Oi 2004, Toda and Higuchi 2011), husband's domestic work hours are measured at various time points in the duration since the first birth. Therefore, the results may be much affected by both the duration since the first birth and associated couples' living conditions in the beginning of the observations. As much of these initial differences are unobserved, estimated effects of husband's participation in domestic work suffer from omitted variable bias in the models of previous studies (Abe and Oi 2004, Toda and Higuchi 2011). Our use of the LSN21 can avoid this bias at a great degree as the comparison is made across respondents in the same birth duration since the first birth.

4.2. Measurement of domestic work participation

Both husband's and wife's participations in housework is measured in the first through third wave surveys by six items with each four-point scale which ask respondents how often each spouse participates in those activities. The six given items are 1) cooking, 2) doing dishes, 3) cleaning rooms, 4) washing clothes, 5) taking out garbage and 6) shopping daily goods. To each item, each spouse's participation is rated as "Not at all" (0 point), "Rarely" (1 point), "Sometimes" (2 points) and "Always" (3 points). Similarly, the frequencies of childcare provisions are also measured by six items with the same four-point scale for each spouse. For example, these six items in the first wave are 1) feeding, 2) changing a diaper, 3) bathing, 4) bedding, 5) nursing and playing, and 6) taking outside for a walk. However, only first three items are maintained in the second and third waves, while three other items

are replaced to different items adjusting to the growth of the subject newborns[7]. Therefore, in the analysis, only first three items are used for constructing the scales for childcare.

About 90% of the questionnaires were filled by wives, mothers of the subject newborns, in the survey. Therefore, in construction of the measurements, only questionnaires assigned by wives are used. Thus, in this study, measurement of domestic work participation is based on wife's evaluation on husband's and her own commitments to household tasks and childrearing activities. Also as husband's domestic work participations are measured only when the husband shares the same household with his wife and the subject newborn. Therefore, I used households which both a wife and a husband live together at all three waves of the survey.

It is tempting to use the household work situation measured at wave 1 in the model because it can be used without worrying about pregnancy for all respondents. However, as shown in Table 2, there are considerable degree of the within-individual changes in the frequencies of housework and childcare provided by husbands. Table 2 shows the distributions of husbands and wives who changed their frequencies on each childcare and housework item between survey waves. Husband's "perceived" participations in each housework and childcare activity are surprisingly inconsistent. Percentages of husbands who stay in the same levels of participation in a variety of activities are ranging from 44% in feeding to 69% in washing clothes. The rest of 30 to 55% of husbands are perceived to change their levels of commitment to each household activity. Furthermore, the changes in husbands' participation in each activity can be observed not only between wave 1 and wave 2 but also wave 2 and wave3 at the same degrees.

In contrast to husband's domestic work participations, wives are almost always main provider of childcare and household chores. Over 90% of wives declare that they are "always" providing above mentioned household tasks and childcare activities in all three waves, except for taking out garbage

[7] The item on changing diaper is replaced to "cleaning up excrement" in the third wave survey as using a diaper cannot be conditioned at child's age of 2 and a half years old.

and bathing as only a half of them always do such activities. Therefore, both housework and childcare are heavily reliance to wives' provisions and wives' frequencies on these domestic tasks do not show much changes within three years of observation as shown in Table 2.

Table 2 Distribution of the changes in frequencies on childcare and housework (%)

a. Childcare

	Changes in frequency (%)	Feeding	Bathing	Changing diaper
a. Husband				
	Increase	43.1	15.7	19.6
Wave 1 -> Wave 2	Same	44.0	62.5	61.0
	Decrease	12.9	21.8	19.4
	n	15,056	15,359	15,196
	Increase	31.1	15.4	17.1
Wave 2 -> Wave 3	Same	54.3	65.7	62.4
	Decrease	14.6	19.0	20.5
	n	15,127	15,395	15,270
b. Wife				
	Increase	0.7	24.7	0.7
Wave 1 -> Wave 2	Same	97.2	61.4	97.9
	Decrease	2.0	13.9	1.3
	n	15,474	15,271	15,459
	Increase	1.3	17.9	1.0
Wave 2 -> Wave 3	Same	89.6	69.4	96.8
	Decrease	9.0	12.7	2.2
	n	15,496	15,368	15,472

b. Housework

	Changes in frequency (%)	Cooking	Doing a dish	Clearning home	Washing clothes	Taking out garbage	Shopping
a. Husband							
	Increase	15.3	21.6	21.7	18.0	19.1	19.1
Wave 1 -> Wave 2	Same	65.1	55.7	58.9	65.9	61.8	54.5
	Decrease	19.6	22.7	19.3	16.1	19.1	26.5
	n	15,204	15,249	15,236	15,195	15,359	15,291
	Increase	16.8	20.1	19.8	15.6	16.3	21.7
Wave 2 -> Wave 3	Same	67.9	58.5	61.2	69.1	65.1	57.0
	Decrease	15.3	21.4	19.0	15.4	18.6	21.3
	n	15,252	15,292	15,278	15,237	15,394	15,323
b. Wife							
	Increase	4.7	4.4	7.9	2.7	20.5	9.7
Wave 1 -> Wave 2	Same	92.3	92.0	87.5	94.2	59.9	85.7
	Decrease	2.9	3.6	4.6	3.1	19.6	4.7
	n	15,414	15,401	15,397	15,394	15,083	15,396
	Increase	3.1	3.5	5.3	2.8	19.2	5.8
Wave 2 -> Wave 3	Same	94.4	93.3	90.7	94.8	63.4	89.9
	Decrease	2.6	3.2	4.0	2.5	17.4	4.3
	n	15,468	15,450	15,450	15,432	15,124	15,449

Men's participation in the domestic sphere is much responsive to family situations as well as the child development. For example, previous studies found that both husband's hours spent on housework and

childcare (Suruga 2010) and husband's degree of participations in childcare activities (Nishioka 1998, Matsuda 2002) are affected by such factors as wife's employment status, number of pre-school children and age of the youngest child. Also our measurements of husband's domestic work participations are based on the wives evaluations. Therefore, the responses in each item could be quite naive to wife's mood, views or satisfaction regarding to the domestic role sharing at each survey wave. In any case, given the fluctuations in the degrees of domestic work participations experienced by relatively large proportions of husbands, it is risky to choose the measurements of domestic role sharing at one or even each time point. Rather, it is desirable to make full use of the information from all three waves to estimate some sort of the individual-specific means of each spouse's participations in domestic work.

To construct the best practiced measurements on domestic work participation of husband and wife in our data, I take two steps. First, I used the pooling individual data from the first through third wave and applied principal component analysis (PCA) to the six housework items and three childcare items separately for both husband and wife. Each PCA gives only one factor which gives the eigenvalue larger than 1. Therefore, the scores of these four factors are considered to represent the degrees of housework or childcare participation provided by either wives or husbands at different survey waves. In the second step, fixed effect regression models are applied to each of the four factor scores. After running a series of the fixed effect models, individual fixed effects of these factor scores are saved and used as covariates which represent husband's and wife's participations in the housework and childcare in the hazard models of the second birth. In this way, I could estimate individual-specific averages of domestic work participation controlling for both observed changes in the family situations such as wife's employment, pregnancy and child birth, and unobserved time-constant factors, i.e. wives' tendencies in the evaluation of her husband's domestic work participation. The estimation results of the PCA and fixed effect models are shown in Table A-1 and Table A-2 in Appendix.

4.3. Selection of analytical sample

The analytical sample in my study is Japanese married couples 1) who have their first baby as a subject to the survey, 2) whose first birth was a single birth, 3) who were in Japan at each survey wave, 4) both parents were living together with their first baby through first to third wave surveys and retained as a valid respondent until 4th wave survey, and 5) a mother of the subject child filled in the questionnaires through first to third wave survey. Therefore, illegitimate births, births from mixed or foreigner couples or babies residing in abroad were also excluded as heterogeneous cases to birth behaviors of other Japanese couples. I only selected couples who live together at the first through third wave survey because wife's and husband's participation in housework and childcare are collected only when both parents present in the same household. This might induce a potentially strong selection in our analytical sample. However, due to our objective to measure the effects of gender equality at home on the second birth transition, it is necessary to choose couples who stay together at a sufficient length. As a result of this selection, the sample size reduced from 47,015 to 10,808[8].

Table 3. Occurrences and Exposures of Second Births in the LSN21 Analytical Sample

	2nd birth			
Survey waves	No	Yes	Attrition	Total
1->2	9,734	694	0	10,428
	93.3	6.7	0	100
2->3	7,170	2,944	0	10,114
	70.9	29.1	0	100
3->4	4,861	2,309	0	7,170
	67.8	32.2	0	100
4->5	3,477	1,105	247	4,829
	72.0	22.9	5.1	100
5->6	2,644	528	160	3,332
	79.4	15.9	4.8	100
Total	27,886	7,580	407	35,873
	77.7	21.1	1.1	100

[8] A majority of excluded sample is those who had a baby from second or higher ordered birth as a subject to the survey (23,512 cases). Also 584 cases were either multiple birth of the first and higher ordered child or born outside Japan. In addition to them, 826 cases have interval censoring due to the temporal drop-out from the survey before the second birth and they are deleted. Among the rest of 20,810 respondents, 15605 cases are retained after deleting 5,205 cases who did not return the valid questionnaires filled by a mother up to three consecutive waves or who both parents did not live together. The rest of 4,797 cases are deleted due to the listwise selection of the non-missing covariates.

Occurrences and exposures of second births in the analytical data are shown in Table 3. Second births are most concentrated on the period between second and third waves and third and fourth waves, which correspond to the birth intervals of 1.5-2.5 year and 2.5-3.5 year after the first birth. Thereafter, the occurrence-exposure rates of the second births gradually decline in later birth intervals. Note also that the annual attrition rates are negligibly small at around 5% after 4trh wave among our sample.

5. Statistical modeling and covariates

A discrete-time hazard model is used to analyze correlates of the second birth hazard observed in the LSN21. I have created a person-period data which covers the time period since the first birth till the time when the second birth or censoring occurs. The observation is censored when one of the followings occurs before the second birth; (1) the analytical subject withdraws from the survey after the 4th wave survey, 2) marriage is dissolved after the 4th wave survey, and (3) the time of the 6th wave survey arrives. Complementary log-log model is applied to the person-period data, in order to analyze the factors associating with the second birth hazards of women who gave the first birth in 2001. The model equation is expressed as follows:

$$\ln[-\ln(1-P_t)]=a_t+b_1X_1(t)+b_2X_2(t)+\ldots+b_kX_k(t) \quad \cdots \quad (1)$$

P_t: hazard probability, a_t: baseline hazard function, b_k: coefficient of X_k

In the model, the birth interval from the birth of the first child is used as the time variable, which acts as the baseline of hazard probability. Time until second birth or censoring is measured in a unit of month. Therefore, the model is eventually an approximation of a continuous-time model as explained in Allison (1982). The exponential of the coefficient, $\exp(b_k)$ can be directly interpreted as a hazard ratio which represents a ratio of hazards in a given category relative to a reference category.

In the model, the following variables are used as covariates: wife's and husband's employment statuses, couple's participations in housework and childcare activities, wife's anxiety and feelings of burden over child rearing, first child characteristics such as sex and birth month of the first child, whether the first child was born as premature baby or not and whether first birth was a consequence of premarital pregnancy or not, and other household and demographic characteristics such as wife's education levels, coresidence with grandparents, wife's age at first birth, region of residence and size of municipality. The definitions of the covariates used for the analysis are also shown in Table A-3 in Appendix.

It is expected that the relationship between couple's domestic work participations and the hazard of the second birth can vary depending on wife's employment status. Therefore, in the multivariate analysis, I will examine the interaction effects of the couple's domestic work participations and the wife's employment status. It is also possible that the gender relations of couples whose wives continue her full-time employment after first birth are qualitatively different from the majority of other housewife couples. Therefore, I will also provide estimation results by dividing the analytical sample according to whether a wife is full-time employee or staying at home without employment at the 1st wave survey (6 months after the first birth).

6. Results

6.1. Interaction effects of couple's domestic work participations and wife's employment status

The first set of estimation results are shown in Table 5. In Table 5, only both main and interaction effects of couple's domestic work participations and wife's employment status are shown in the form of hazard ratio, the exponential b. The estimation results of the full models including control variables are shown in Table A-4 in Appendix.

First, Model 1 serves as a base model and the estimated results are interpreted as follows. The model indicates that husband's greater participation in childcare as well as wife's greater

commitment to housework contributes to the higher hazard of the transition to the second child. Whereas wife's employment leads to lower hazard of the second birth, husband's stable employment which is indicated as a full-time employment or self-employment positively relates to the second birth hazard. Therefore, gender equality in the market labor measured by wife's employment relates negatively to the second birth hazard in Japan. However, gender relations in domestic sphere have mixed effects on the second birth hazard.

Table 5. Hazard ratios of the transition to second birth: Interaction effects

	Model 1	Model 2	Model 3	Model 4	Model 5
Covariates	exp(b)	exp(b)	exp(b)	exp(b)	exp(b)
Couple's participation in housework and child-rearing					
Husband's childcare frequency (Ind. fixed effect)	1.08 ***	1.08 ***	1.08 ***	1.08 ***	1.08 ***
Husband's housework frequency (Ind. fixed effect)	0.99	0.99	0.98	0.99	0.99
Wife's childcare frequency (Ind. fixed effect)	1.01	1.01	1.01	1.01	1.01
Wife's housework frequency (Ind. fixed effect)	1.06 ***	1.06 ***	1.06 ***	1.05 ***	1.11 ***
Wife's employment status					
(Reference: Not employed or students)					
Not employed or students	1	1	1	1	1
Self-employed or family businesses	0.86 **	0.86 **	0.87 **	0.86 **	0.86 **
Full-time employees	0.86 ***	0.87 ***	0.87 ***	0.86 ***	0.86 ***
Part-time employees	0.67 ***	0.67 ***	0.67 ***	0.67 ***	0.67 ***
Husband's employment status					
(Reference: Not employed or students)					
Not employed or students	1	1	1	1	1
Self-employed or family businesses	1.50 ***	1.50 ***	1.51 ***	1.50 ***	1.49 ***
Full-time employees	1.45 ***	1.46 ***	1.46 ***	1.46 ***	1.45 ***
Part-time employees	1.18	1.18	1.18	1.18	1.17
Interaction effects:					
Wife's employment status		Husband's	Husband's		
* Husband's child-rearing / housework frequencies (Fixed Effect)		child-rearing	housework		
Not employed or students		1	1		
Self-employed or family businesses		1.08	1.25 ***		
Full-time employees		0.98	0.99		
Part-time employees		0.98	1.03		
Wife's employment status				Wife's	Wife's
* Wife's child-rearing / housework frequencies (Fixed Effect)				child-rearing	housework
Not employed or students				1	1
Self-employed and family businesses				1.04	1.09
Full-time employees				1.01	0.89 ***
Part-time employees				0.92	0.95
Constant	0.015 ***	0.015 ***	0.015 ***	0.015 ***	0.015 ***
Number of person-period	68503	68503	68503	68503	68503
Number of samples	10808	10808	10808	10808	10808
Number of events	7580	7580	7580	7580	7580
Chi-square values	3371.174	3371.498	3379.055	3375.922	3378.800
Degree of freedom	39	42	42	42	42

*: p<.10, **: p<.05, ***: p<.01

Model 2 through Model 5 shows the interaction effects between wife's employment status and each measure of couple's domestic work participations. Only one set of the interaction effects are estimated

in each model to avoid complexity in the interpretation. The results indicate that both husband's and wife's housework participations have the interaction effects with wife's employment status. In Model 3, husband's greater participation in housework can compensate negative effects of the wife's self-employment on the transition to the second birth.

Self-employed wives are highly likely to be involved with family businesses of her husband. In our analytical sample, 53% of their husbands are also self-employed. It is also likely that these self-employed couples spend a time together both at home and workplace. The result indicates that only in such a situation, husband's greater participation in housework has a positive effect on the second birth hazard in Japan. In Model 5, a full-time employed wife further declines her chance of having the second child when she has a greater commitment to housework. This effect is considered as a negative consequence of the "second shift" among full-time employed wives on fertility outcomes.

In sum, this first set of the analysis suggests that second birth hazard is in general high among the families with traditional gender role division where a husband works outside and a wife stays at home for home making and childrearing. However, husbands' greater participations in childcare can further increase the probability of the second birth irrespective of wife's employment statuses. In terms of couple's participation in housework, I find statistically significant interaction effects with wife's employment status. First, husband's greater participation in housework boosts the second birth hazard of self-employed wives. Second, wife's greater commitment to housework reduces a chance of the second birth among full-time employed wives. For the former relationship, it is not clear from our analysis what aspects of self-employed couples lead to the higher chance of the second birth. However, such factors as the proximity of home and workplace, flexible work hour arrangement and higher gender equality at workplace can be possible conditions to make husband's greater housework commitment increase fertility of working wives. The latter relationship confirms the negative fertility response to the "second shift" among full-time employed wives.

6.2. A comparison of full-time wives and housewives on the correlates of the second births

In the second set of the analysis, I compare the effects of couples' employment status, domestic work participations as well as other covariates on the second birth hazard between full-time employed wives and housewives. The analytical sample is divided by wives' employment status at wave 1 survey. The estimation results are shown in Table 6.

Correlates of the second birth hazard are substantially different across two sub-samples. In fact, the estimation result of the housewife sample is much the same as the all sample results in Table 5 (or Table A-4). This is because housewives are the majority after giving the first birth in Japan as shown in Figure 2. Therefore, I mainly interpret correlates of the second birth hazard for the sample of full-time employed wives and contrast them to those of the housewife sample.

First, wife's deeper commitment to housework leads to higher second birth hazard only among housewives. Contradicting our expectation, the effect of wife's housework commitment was not negative in the full-time worker sample as shown in Table 5. I suspect that this was because some of the wives resigned their full-time employment after the wave 1 survey. For example, there are 13% of wives who resigned her full-time employment and 7% of wives turned their employment to part-time jobs in the full-time worker sample. In addition, these wives who resigned a full-time employment have higher hazard of second birth than the other wives. The family situations of these resigned wives are supposed to become much resemble to the housewife sample where effect of wife's housework participation is positive. Thus, the effects of wife's housework participation on the second birth hazard are likely to be canceled out due to wives' employment changes. Therefore, we could conclude that the positive effect of wife's housework commitment on the second birth was largely observed phenomenon among gender traditional couples.

Second, I expect that a husband's participation in housework would reduce wife's burden of the "second shift" and, thus, contributes to sustaining fertility of full-time working wives. However, this effect was not found. Instead, living with either a wife's or husband's parent(s) are positively relating

Table 6. Hazard ratios of the transitions to second birth: Full-time wives and housewives

	Wife's employment status at wave 1	
	Full-time employee	Not employed
Covariates	exp(b)	exp(b)
Couple's participation in housework and child-rearing		
Husband's childcare frequency (Ind. fixed effect)	1.09 **	1.07 ***
Husband's housework frequency (Ind. fixed effect)	0.98	0.98
Wife's childcare frequency (Ind. fixed effect)	1.04	1.01
Wife's housework frequency (Ind. fixed effect)	1.00	1.08 ***
Wife's employment status		
(Reference: Not employed or students)		
Not employed or students	1.48 ***	1
Self-employed or family businesses	1.54	0.81 **
Full-time employees	1	0.68 ***
Part-time employees	1.01	0.64 ***
Husband's employment status		
(Reference: Not employed or students)		
Not employed or students	1	1
Self-employed or family businesses	1.22	1.51 ***
Full-time employees	1.36	1.45 ***
Part-time employees	0.72	1.28
Wife's education level (Reference: High school)		
Junior high school	0.64	0.98
High school	1	1
Vocational school /Junior college/Technical college	1.24 ***	1.11 ***
University/Graduate school	1.17 *	1.15 ***
Coresidence with parents (Reference: Not living together)		
Living together	1.18 **	1.04
Wife's take-up of childcare leave		
Did not take childcare leave	1	-
Took childcare leave from a company of 1-99 regular employees	1.01	-
Took childcare leave from a company of 100-499 regular employees	1.10	-
Took childcare leave from a company of over 500 regular employees	1.01	-
Took childcare leave from public office (inc. public schools)	1.30 ***	-
Wife's anxiety and feelings of burden over child-rearing		
Anxiety or distress over child-rearing		
Feel a lot	0.89	0.76 ***
Feel a bit	1	1
Feel almost none	1.13 *	1.12 ***
Score on feelings of burden over child-rearing (Reference: 0 point)		
0 point	1	1
1-2 points	1.07	1.00
3-4 points	1.14	0.97
5-8 points	0.87	0.81 **
First child characteristics		
Sex of the first child (Reference: Male)		
Female	0.90 **	1.00
Premature, underweight baby (Reference: No)		
Yes	0.72	0.62 ***
Premarital pregnancy (Reference: No)		
Yes	1.14 *	1.16 ***
Month of birth (Reference: Born in January)		
Born in July	0.96	1.06 **

*: p<.10, **: p<.05, ***: p<.01

Table 6. continued

	Wife's employment status at wave 1	
	Full-time employee	Not employed
Covariates	exp(b)	exp(b)
Demographic Characteristics		
Birth interval spline (Base point: 0 year)		
0-3 year	2.27 ***	2.18 ***
3-4 year	0.68 ***	0.63 ***
4-6 year	0.70 ***	0.63 ***
Wife's age at first birth		
(Reference: Age 25-29)		
Age -24	1.04	1.19 ***
Age 25-29	1	1
Age 30-34	0.78 ***	0.71 ***
Age 35-	0.38 ***	0.30 ***
Area of residence (Reference: Kanto)		
Hokkaido	0.89	0.99
Tohoku	1.02	1.12 **
Kanto	1	1
Hokuriku	1.06	1.03
Chubu	0.96	1.16 ***
Kinki	1.06	1.15 ***
Chugoku	0.97	1.17 ***
Shikoku	1.18	1.15 *
Kyusyu and Okinawa	1.25 **	1.27 ***
Size of the municipality where the respondent resides		
(Reference: Other cities)		
14 Largest cities	0.87 *	0.93 **
Other cities	1	1
Rural districts	1.24 ***	1.12 ***
Constant	0.011 ***	0.015 ***
Number of person-period	12305	52492
Number of samples	1896	8327
Number of events	1349	5844
Chi-square values	665.057	2657.645
Degree of freedom	43	39

*: p<.10, **: p<.05, ***: p<.01

to the second birth hazard of working wives. In fact, this positive effect is not found in housewife sample. Therefore, it is possible that wife's double burden of work and household chores is, in a large part, mitigated by the help from the couple's parents rather than by the hands of husbands.

It is noteworthy that husband's employment status does not affect the likelihood of the second births in the full-time worker sample, while it does strongly affect likelihood of the second birth in the housewife sample. Wife's economic independence may reduce the importance of husband's breadwinning role in deciding whether to have a second child. Oppenheimer (1997) pointed out that

dual-earner couples are more durable to the risk of a spouse's job loss than single-earner couples. The result confirms her statement on dual-earner household in relation to its effects on the second birth.

Effects of other covariates on the second birth hazards also exhibit interesting difference between full-time working wives and housewives. For example, psychological factors are more important for the birth decisions of housewives than those of working wives. Previous study found that negative childrearing experiences of the first child reduce the likelihood of additional childbirths (Yamaguchi 2005). Our result additionally confirms that fertility outcomes of housewives are also more sensitive to her psychological assessment of childcare burdens than working wives.

Another interesting contrast is the effects of the sex of the first child. The sex of the first child matters for the full-time working wives while it does not for housewives. It is reported that daughter preference is more common than son preference among Japanese couples since the mid-1980s (National Institute of Population and Social Security Research 2011). Although it has to be confirmed in further study, it is possible that among couples who are under the strong constraint of having two children, they tend to stop bearing a second child when the first baby meets their preference on daughter.

Finally, our result shows that regional differences in the second birth hazards are observed only in housewife couples. Among full-time working wives, regional differences are remarkably negligible except for the high second birth hazard in Kyushu and Okinawa region. It is assumed that in Kyushu and Okinawa region, there are some unobserved factors which facilitate second births of working wives. To identify such factors through either qualitative or quantitative studies focusing on this topic is potentially important to understand how constraints of working wives can be reduced and to examine if those identified factors would be extendable to other regions by some forms of policy measure.

7. Conclusion

How gender equality and equity relate to fertility in the highly developed countries and what are the

causal linkages between the two become a growing concern for not only population scholars but also policy makers. In this paper, I examined the relationship between couples' domestic work participations and the transitions to the second birth in the beginning of the 21st century Japan by using a newly available nationally representative panel data of LSN21. The data I have used is the highest quality panel data in Japan as LSN21 data is collected by the government agency and known for its large sample size with the minimum rates of attrition. Our analysis was benefitted from the survey design of LSN21 and provided a new insight of the relationship between couples' gender relations and fertility in Japan.

Our analysis revealed that the transition rates from first to second birth are higher in Japan among gender traditional families which are single earner households with husbands' stable employments and wives' great commitments to housework, than gender equal families of dual-earner households. However, husband's greater participation in childcare can contribute to higher chance of the second birth, irrespective to the wife's employment status. Men's greater concern to childrearing is positively relating to fertility outcomes in Japan. In terms of the social role expectation, men's participation in childrearing may be highly demanded by wives and meeting with such expectation affects transitions to the second birth.

I also find a strong negative effect of wife's higher commitment to housework on the second birth hazard when the wife works full-time. I interpret this as a negative fertility response to the "second shift". However, our analyses consistently reveal that husbands' supports in housework do not remedy the negative consequence on fertility. Instead, our analysis suggests that a large part of the physical and psychological burdens of the full-time employed wives is, in fact, mitigated by coresident parents. The only exception for this relationship seems to be a situation where a wife is self-employed. Husband's greater participation in housework has a positive effect on the transitions to the second birth only when the wife is self-employed. As more than a half of the self-employed wives' husbands are also self-employed, this relationship is considered to be a specific to self-employed couples.

However, it is not clear from our analysis on which aspects of the self-employment make husband's housework participation a driving force of the second births. Thus, further study is necessary to search for key factors to extend the observed relationship to a majority of couples whose husbands are employed by a company. In this paper, I only speculate that work conditions of self-employment, e.g. flexible work arrangement, proximity of home and workplace or small gender gap in the workplace may explain the positive link.

Finally, the policy implications of our study will be the followings; First, our analyses consistently reveal that wives' employments relate negatively to the second birth intensities. Therefore, strong policy measures for reducing women's worker-mother conflicts are necessary to establish the positive linkage between gender equality in labor market and fertility as observed in some western countries. However, one remark is that our analysis is based on the first five years of the 21st century Japan where formal introductions of the childcare support policies such as childcare leave system, sick/injured child care leave and reduced work hours for childcare were only its onset. Therefore, using data which covers more recent period may already see some improvement in the negative relationship as indicated in Figure 2. Therefore, the continuous monitoring of the relationship between women's employment and fertility outcomes will be particularly important to evaluate the policy effects as well as future levels of fertility.

Second, our analysis indicates that gender equality at home has some mixed effects on fertility outcomes. Men's participation in childcare seems to be a universally required social role in contemporary Japanese couples and the degree to meeting with such expectation, in fact, affects fertility outcomes. In this respect, the gender equality in childcare can lead to higher fertility in Japan as similar to some of other European countries (Puur et al. 2008 Miettinen, Basten and Rotkirch 2011). On the other hand, men's work hours are, in general, very long and inflexible in Japan. Previous studies suggest this inflexibility, in a large part, explains very low levels of husband's participation in housework in Japan (Nishioka 1998, Matsuda 2002, Suruga 2010). Our results, however, shows that

husband's greater participation relates positively to the second birth hazard in the self-employed couples who are likely to share both home and work place. Therefore, it is possible that more flexible work arrangement as well as proximity of home and workplace contribute to establish a positive link between the gender equality within the family life and fertility in Japan.

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APPENDIX :

Table A-1. Principal-Component Analysis of Participations in Housework and Childcare

1. Housework

a. Husbands

・Principal-Component Factor

Factor	Eigenvalue	Proportion	Cumulative
Factor1	2.738	0.456	0.456
Factor2	0.852	0.142	0.598
Factor3	0.812	0.135	0.734
Factor4	0.622	0.104	0.837
Factor5	0.525	0.088	0.925
Factor6	0.450	0.075	1

・Factor Loadings

Variable	Factor1
Cooking	0.634
Doing a dish	0.772
Cleaning	0.717
Washing	0.722
Garbage	0.554
Shopping	0.630

b. Wives

・Principal-Component Factor

Factor	Eigenvalue	Proportion	Cumulative
Factor1	2.410	0.402	0.402
Factor2	0.928	0.155	0.556
Factor3	0.786	0.131	0.687
Factor4	0.719	0.120	0.807
Factor5	0.678	0.113	0.920
Factor6	0.480	0.080	1

・Factor Loadings

Variable	Factor1
Cooking	0.743
Doing a dish	0.676
Cleaning	0.627
Washing	0.658
Garbage	0.366
Shopping	0.665

2. Childcare

a. Husbands

・Principal-Component Factor

Factor	Eigenvalue	Proportion	Cumulative
Factor1	1.750	0.583	0.583
Factor2	0.751	0.250	0.834
Factor3	0.499	0.166	1

・Factor Loadings

Variable	Factor1
Feeding	0.808
Bathing	0.660
Changing a diaper	0.813

b. Wives

・Principal-Component Factor

Factor	Eigenvalue	Proportion	Cumulative
Factor1	1.505	0.502	0.502
Factor2	0.951	0.317	0.819
Factor3	0.544	0.181	1

・Factor Loadings

Variable	Factor1
Feeding	0.827
Bathing	0.366
Changing a diaper	0.829

Table A-2. Fixed Effect Models on Participations in Housework and Childcare

a. Husbands

Fixed effect regression on husband's frequencies in housework and childcare

	All couples		By wife's employment status at wave 1			
			Full-time employee		Staying at home	
	Housework	Childcare	Housework	Childcare	Housework	Childcare
	b	b	b	b	b	b
Couple's participation in housework and childcare						
Husband's childcare frequency (Factor score)	0.207 ***	-	0.258 ***	-	0.191 ***	-
Husband's housework frequency (Factor score)	-	0.298 ***	-	0.384 ***	-	0.265 ***
Wife's childcare frequency (Factor score)	-0.015 ***	0.030 ***	-0.004	0.035 ***	-0.014 ***	0.025 ***
Wife's housework frequency (Factor score)	-0.027 ***	0.015 **	-0.032 **	0.024	-0.014 **	0.019 ***
Couple's income						
Husband's income	0.000	-0.030 *	-0.036	-0.006	-0.019	-0.031
Wife's income	-0.017 ***	-0.008	0.000	-0.014	-0.006	-0.005
(Wife's income / Couple's income)*10	0.052 ***	0.016	0.027 *	0.025	0.021	0.013
Wife's employment status						
(Reference: Not employed or students)						
Self-employed or family businesses	-0.025	-0.066	0.000	0.063	-0.028	-0.110 *
Full-time employees	0.126 ***	0.007	0.199 ***	-0.041	0.380 ***	0.087
Part-time employees	0.061 **	0.000	0.007	-0.124	0.192 ***	0.014
Husband's employment status						
(Reference: Full-time employee/Self-employed or family businesses)						
Not employed/students/Part-time employees	0.148 ***	0.144 ***	0.037	0.114	0.190 ***	0.164 ***
Pregnancy	0.197 ***	0.076 ***	0.146 ***	0.040	0.227 ***	0.091 ***
Childbirth	-0.071 ***	0.059 ***	-0.167 ***	0.043	-0.057 ***	0.064 ***
Coresidence with parents (Reference: Not living together)	-0.380 ***	0.013	-0.477 ***	0.092	-0.360 ***	0.001
Use of Childcare	0.226 ***	0.126 ***	0.165 ***	0.193 ***	0.096 ***	0.075 ***
Survey wave (Reference: 1st wave)						
2nd wave	-0.127 ***	0.210 ***	0.025	0.230 ***	-0.171 ***	0.199 ***
3rd wave	-0.185 ***	0.265 ***	-0.024	0.233 ***	-0.212 ***	0.266 ***
Constant	0.073	-0.018	0.005	-0.211	0.248 **	0.005
Number of person-period	33597	33597	5871	5871	25845	25845
Number of samples	11199	11199	1957	1957	8615	8615
Within R2	0.112	0.136	0.204	0.233	0.096	0.117
Between R2	0.293	0.288	0.356	0.34	0.227	0.254
Overall R2	0.247	0.233	0.316	0.302	0.187	0.201
Degree of freedom	11214	11214	1972	1972	8630	8630

*: p<.10, **: p<.05, ***: p<.01

Table A-2. Continued

b. Wives

	All couples		By wife's employment status at wave 1			
			Full-time employee		Staying at home	
	Housework	Childcare	Housework	Childcare	Housework	Childcare
	b	b	b	b	b	b
Couple's participation in housework and childcare						
Husband's childcare frequency (Factor score)	0.015 **	0.057 ***	0.024	0.062 ***	0.021 ***	0.054 ***
Husband's housework frequency (Factor score)	-0.040 ***	-0.042 ***	-0.046 **	-0.009	-0.022 **	-0.042 ***
Wife's childcare frequency (Factor score)	0.110 ***	-	0.146 ***	-	0.081 ***	-
Wife's housework frequency (Factor score)	-	0.206 ***	-	0.263 ***	-	0.156 ***
Couple's income						
Husband's income	-0.033 **	-0.077 ***	0.019	-0.130 ***	-0.013	-0.077 ***
Wife's income	0.030 ***	0.015	0.019	0.024	0.019 **	0.021
(Wife's income / Couple's income)*10	-0.087 ***	-0.068 ***	-0.062 ***	-0.056 **	-0.060 ***	-0.084 ***
Wife's employment status						
(Reference: Not employed or students)						
Self-employed or family businesses	-0.032	0.005	-0.249	0.495 **	-0.093	-0.094
Full-time employees	-0.156 ***	-0.102 **	-0.157 ***	-0.098	-0.603 ***	-0.461 ***
Part-time employees	-0.034	-0.051	-0.042	-0.027	-0.072 *	-0.027
Husband's employment status						
(Reference: Full-time employee/Self-employed and family businesses)						
Not employed/students/Part-time employees	-0.093 **	-0.086 *	0.117	-0.189	-0.146 ***	-0.098
Pregnancy	-0.113 ***	-0.001	-0.131 ***	-0.061	-0.118 ***	0.015
Childbirth	0.071 ***	-0.035	0.191 ***	0.058	0.032	-0.068 **
Coresidence with parents (Reference: Not living together)	-0.761 ***	0.052	-0.736 ***	-0.130	-0.882 ***	0.122 ***
Use of Childcare	-0.172 ***	-0.120 ***	-0.121 ***	0.033	-0.082 ***	-0.219 ***
Survey wave (Reference: 1st wave)						
2nd wave	0.126 ***	-0.050 ***	-0.004	-0.154 ***	0.191 ***	-0.018
3rd wave	0.215 ***	-0.298 ***	0.088 ***	-0.319 ***	0.267 ***	-0.310 ***
Constant	0.331 ***	0.651 ***	0.324	1.110 ***	0.123	0.596 ***
Number of person-period	33597	33597	5871	5871	25845	25845
Number of samples	11199	11199	1957	1957	8615	8615
Within R2	0.084	0.065	0.117	0.086	0.085	0.06
Between R2	0.264	0.13	0.349	0.196	0.17	0.04
Overall R2	0.21	0.095	0.283	0.144	0.142	0.052
Degree of freedom	11214	11214	1972	1972	8630	8630

*: p<.10, **: p<.05, ***: p<.01

Table A-3. Definition of Covariates

Names of variables		Definitions
Participation by each spouse in housework and child rearing		
	Individual fixed effect on participation in housework (both for husband and wife)	An estimated fixed effect of factor scores based on either husband's or wife's participation in housework measured at wave 1 through wave 3. The factor score is calculated from the following 6 items: (1) Cooking, (2) Doing dishes, (3) Cleaning a house, (4) Washing laundry, (5) Taking out garbage, and (6) Doing daily shopping using a pooled data of wave 1 through wave 3. 0 points are given if the husband "never" does such activity, 1 point if the husband "rarely" does such activity, 2 points if the husband "sometimes" does such activity, and 3 points if the husband "always" does such activity.
	Individual fixed effect on participation in child rearing (both for husband and wife)	An estimated fixed effect of factor score based on both husband's and wife's participations in childcare measured at wave 1 through wave 3. The factor score is calculated from the following 3 items: (1) Feeding, (2) Changing diapers, and (3) Bathing using a pooled data of wave 1 through wave 3. 0 points are given if the husband "never" does such activity, 1 point if the husband "rarely" does such activity, 2 points if the husband "sometimes" does such activity, and 3 points if the husband "always" does such activity.
Couple's employment status		
	Wife's employment status	Based on the question about the wife's employment status, as asked in each survey, the following 4 categories are created: "1: Not employed or students," "2: Self-employed or family business workers," "3: Regular employment," and "4: Employment other than 2 and 3." *"Self-employed or family business workers" includes the cases where the employment status belongs to "Others." *By using the employment status at t-1, the influence over the birth of a second child occurred during the period from t-1 to t is estimated.
	Husband's employment status	Based on the question about the wife's employment status, as asked in each survey, the following 4 categories are created: "1: Not employed or students," "2: Self-employed or family business workers," "3: Regular employment," and "4: Employment other than 2 and 3." *"Self-employed or family business workers" includes the cases where the employment status belongs to "Others." *By using the employment status at t-1, the influence over the birth of a second child occurred during the period from t-1 to t is estimated.
Social variables		
	Wife's education level	Based on the question about the wife's education level with respect to the "school that the wife last graduated (or is attending)," as asked in the 2nd wave survey, the following 4 categories are created: "1: Junior high school, special training school, or vocational school (after graduation from junior high school)," "2: High school," "3: Special training school, vocational school (after graduation from high school), junior college, or technical college," or "4: University or graduate school." *The analysis excludes the case where the wife's education level belongs to "Others."
	Coresidence with parents	Based on the question about the household member of the first child, the dummy variables are created on whether or not the parents of either the wife or the husband are living together.
Wife's anxiety and feelings of burden over child rearing		
	Anxiety and distress over child rearing	For the question "Do you feel anxiety or distress over child rearing? Please check one number that applies," the following response alternatives are provided: "1: Feel a lot," "2: Feel a bit," and "3: Feel very little." These responses are used as category variables. The values at the 1st wave survey are used.
	Score on feeling of burden over child rearing	For the question "What makes you feel burdened after you had a child?", the following choices are provided (multiple choices allowed): (1) Physical burden is heavy, (2) Expenses for child rearing is high, (3) Unable to have own free time, (4) Unable to have time for enjoyment for a couple, (5) Unable to have enough time for work, (6) People around do not understand how difficult it is to raise a child, (7) My child is sickly, and (8) Others. We have used the number of selected choices. The values at the 1st wave survey are used.
First child characteristics		
	Sex of the first child	0: Male, 1: Female
	Premature and underweight baby	Whether first baby was a premature and underweight baby or not. 0: Not premature baby 1: Premature baby (a baby whose weight at the time of birth was less than 2500 g AND who was born in less than 37 weeks of pregnancy).
	Premarital pregnancy	Whether first birth is consequence of a premarital pregnancy or not. 0: Not premarital pregnancy 1: Premarital pregnancy (The first birth took place less than 9 months after the father and mother started to live together).
	Month of birth	Whether the first child was born in either January or July. 0: January 1: July
Demographic characteristics		
	Birth interval	The duration measured in months since the birth of the first child is used as the spline function.
	Wife's age at first birth	The dummy variables for the wife's age at the time of giving birth to the first child.
	Area of residence	Based on the domicile information obtained in each survey, the following 9 local block categories are created: "1: Hokkaido" "2: Tohoku (Aomori, Iwate, Miyagi, Akita, Yamagata, and Fukushima)" "3: Kanto (Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, and Kanagawa)" "4: Hokuriku (Niigata, Toyama, Ishikawa, and Fukui)" "5: Chubu (Yamanashi, Nagano, Gifu, Shizuoka, Aichi, and Mie)" "6: Kinki (Shiga, Kyoto, Osaka, Hyogo, Nara, and Wakayama)" "7: Chugoku (Tottori, Shimane, Okayama, Hiroshima, and Yamaguchi)" "8: Shikoku (Tokushima, Kanagawa, Ehime, and Kochi)" "9: Kyusyu and Okinawa (Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, and Okinawa)"
	Size of municipality where the respondent resides	Based on the domicile information obtained in each survey, the following 3 categories are created with respect to the size of the municipality: "1: Large cities," "2: Other cities," and "3: Rural districts" *"Large cities" means the Tokyo Metropolitan Area and the government-ordinance-designated cities as of the time of each survey.

Table A-4. Hazard ratios of the transition to second birth: All covariates

Covariates	Model 1 exp(b)	Model 2 exp(b)	Model 3 exp(b)	Model 4 exp(b)	Model 5 exp(b)
Couple's participation in housework and child-rearing					
Husband's childcare frequency (Ind. fixed effect)	1.08 ***	1.08 ***	1.08 ***	1.08 ***	1.08 ***
Husband's housework frequency (Ind. fixed effect)	0.99	0.99	0.98	0.99	0.99
Wife's childcare frequency (Ind. fixed effect)	1.01	1.01	1.01	1.01	1.01
Wife's housework frequency (Ind. fixed effect)	1.06 ***	1.06 ***	1.06 ***	1.05 ***	1.11 ***
Wife's employment status					
(Reference: Not employed or students)					
Not employed or students	1	1	1	1	1
Self-employed or family businesses	0.86 **	0.86 **	0.87 **	0.86 **	0.86 **
Full-time employees	0.86 ***	0.87 ***	0.87 ***	0.86 ***	0.86 ***
Part-time employees	0.67 ***	0.67 ***	0.67 ***	0.67 ***	0.67 ***
Husband's employment status					
(Reference: Not employed or students)					
Not employed or students	1	1	1	1	1
Self-employed or family businesses	1.50 ***	1.50 ***	1.51 ***	1.50 ***	1.49 ***
Full-time employees	1.45 ***	1.46 ***	1.46 ***	1.46 ***	1.45 ***
Part-time employees	1.18	1.18	1.18	1.18	1.17
Interaction effects:					
Wife's employment status		Husband's	Husband's		
* Husband's child-rearing / housework frequencies (Fixed Effect)		child-rearing	housework		
Not employed or students		1	1		
Self-employed or family businesses		1.08	1.25 ***		
Full-time employees		0.98	0.99		
Part-time employees		0.98	1.03		
Wife's employment status				Wife's	Wife's
* Wife's child-rearing / housework frequencies (Fixed Effect)				child-rearing	housework
Not employed or students				1	1
Self-employed and family businesses				1.04	1.09
Full-time employees				1.01	0.89 ***
Part-time employees				0.92	0.95
Wife's education level (Reference: High school)					
Junior high school	1.00	1.00	0.99	0.99	1.00
High school	1	1	1	1	1
Vocational school /Junior college/Technical college	1.13 ***	1.13 ***	1.13 ***	1.13 ***	1.13 ***
University/Graduate school	1.17 ***	1.17 ***	1.17 ***	1.17 ***	1.17 ***
Coresidence with parents (Reference: Not living together)					
Living together	1.09 ***	1.09 ***	1.09 ***	1.09 ***	1.07 **
Wife's anxiety and feelings of burden over child-rearing					
Anxiety or distress over child-rearing					
Feel a lot	0.79 ***	0.79 ***	0.79 ***	0.79 ***	0.79 ***
Feel a bit	1	1	1	1	1
Feel almost none	1.11 ***	1.11 ***	1.11 ***	1.11 ***	1.11 ***
Score on feelings of burden over child-rearing (Reference: 0 point)					
0 point	1	1	1	1	1
1-2 points	1.01	1.01	1.01	1.01	1.01
3-4 points	0.99	1.00	0.99	0.99	1.00
5-8 points	0.80 ***	0.80 ***	0.80 ***	0.80 ***	0.80 ***
First child characteristics					
Sex of the first child (Reference: Male)					
Female	0.98	0.98	0.98	0.98	0.98
Premature, underweight baby (Reference: No)					
Yes	0.66 ***	0.65 ***	0.66 ***	0.65 ***	0.66 ***
Premarital pregnancy (Reference: No)					
Yes	1.14 ***	1.14 ***	1.14 ***	1.14 ***	1.14 ***
Month of birth (Reference: Born in January)					
Born in July	1.04 *	1.04 *	1.04 *	1.04 *	1.04 *
Demographic Characteristics					
Birth interval spline (Base point: 0 year)					
0-3 year	2.17 ***	2.17 ***	2.17 ***	2.17 ***	2.17 ***
3-4 year	0.62 ***	0.62 ***	0.62 ***	0.62 ***	0.62 ***
4-6 year	0.65 ***	0.65 ***	0.65 ***	0.65 ***	0.65 ***
Wife's age at first birth					
(Reference: Age 25-29)					
Age -24	1.17 ***	1.17 ***	1.17 ***	1.17 ***	1.17 ***
Age 25-29	1	1	1	1	1
Age 30-34	0.72 ***	0.72 ***	0.72 ***	0.72 ***	0.72 ***
Age 35-	0.32 ***	0.32 ***	0.31 ***	0.32 ***	0.31 ***
Area of residence (Reference: Kanto)					
Hokkaido	0.99	0.99	0.98	0.99	0.99
Tohoku	1.09 *	1.09 *	1.09 *	1.09 *	1.08
Kanto	1	1	1	1	1
Hokuriku	1.08	1.08	1.08	1.08	1.08
Chubu	1.14 ***	1.14 ***	1.14 ***	1.14 ***	1.14 ***
Kinki	1.13 ***	1.13 ***	1.13 ***	1.13 ***	1.13 ***
Chugoku	1.14 ***	1.14 ***	1.14 ***	1.14 ***	1.14 ***
Shikoku	1.16 **	1.16 **	1.16 **	1.16 **	1.16 **
Kyusyu and Okinawa	1.27 ***	1.27 ***	1.27 ***	1.27 ***	1.27 ***
Size of the municipality where the respondent resides					
(Reference: Other cities)					
14 Largest cities	0.91 ***	0.91 ***	0.91 ***	0.91 ***	0.91 ***
Other cities	1	1	1	1	1
Rural districts	1.14 ***	1.14 ***	1.14 ***	1.14 ***	1.14 ***
Constant	0.015 ***	0.015 ***	0.015 ***	0.015 ***	0.015 ***
Number of person-period	68503	68503	68503	68503	68503
Number of samples	10808	10808	10808	10808	10808
Number of events	7580	7580	7580	7580	7580
Chi-square values	3371.174	3371.498	3379.055	3375.922	3378.800
Degree of freedom	39	42	42	42	42

*: p<.10, **: p<.05, ***: p<.01

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