Abstract
This paper seeks to address the problems of childcare scarcity, declining fertility rates and work-family conflict faced by the growing female labor force in Japan. Japan’s total fertility rate has been declining since the 1970s and it fell below the replacement level of 1.3 in 2003. Since the 1990s, the Japanese government has implemented pro-natal policies such as childcare market deregulation, childcare centre expansion in the Angel Plan and New Angel Plan, and provision of childbirth grants. However, these policies have failed to encourage childbirth. With rising labor force participation among Japanese women, the insufficiency of existing childcare centre capacity to accommodate children of working mothers has resulted in the problem of wait-listed children. In addition, the failure of childcare centers to mitigate the conflict between women’s work and child raising duties has discouraged women from childbearing. The purpose of this study is to examine the relationship and causality between childcare availability (CA), female labor force participation rate (LFPR) and fertility (TFR) in Japan for the period 1971-2009. A bounds test approach to cointegration establishes the existence of long-run equilibrium relations between CA, TFR and LFPR. Applying the Granger causality method, our results show the absence of Granger-causality running from childcare availability to fertility among females aged 30-39. In the long run, our results show that having more children at home does not discourage the female labour force participation. In addition, we find no evidence which suggests that working women tend to have fewer children. The findings indicate that fertility decision is strongly dependent on the availability of childcare. Overall, this study suggests the importance of the Japanese childcare system in supporting female employment and fertility.

Keywords: Childcare availability, fertility, female labor force participation, bounds testing approach, Granger causality

JEL codes: J1, J2
1. Introduction

Japan’s total fertility rate, defined as the total age-specific birth rates of women in the reproductive ages of 15-49 has been declining since 1970s and it fell below the replacement level of 1.3 in 2003 (Ministry of Internal Affairs and Communication, 2010). With sustained fertility decline and an ageing population, Japanese policy maker’s priority is to boost fertility to avoid low employment and output. To counteract against falling fertility rates and to bolster Japan’s economic productivity, the Japanese government implemented the Angel Plan (1994-1998) and the New Angel Plan (1999-2003). Through these initiatives, the Japanese government's attempts to strengthen family support include: expansion of capacity in childcare centres, provision of extended opening hours of childcare centres, temporary or drop-in care for sick infants and after-school day care programs (Palley and Usui, 2008).

However, regardless of the government’s initiatives since the 1990s, Japan’s fertility rate still declined.

In Japan, the culture of long work hours is forcing women to trade-off between securing a good job and having a family. As an employee, women who aspire to climb the corporate ladder are expected to work 10-15 hour days daily. Therefore, if they leave work to do familial duties such as fetching their children from childcare or preparing meals during office hours, they will be penalized (Boling, 2008). Japanese employment practice makes it difficult to foster continuous maternal employment. This is because under the seniority-based wage system, women hired in the career track will incur substantial monetary and opportunity cost if they change employers after childbirth (Date and Shimizutani, 2007). Women become relegated to part-time employment after child birth. According to a ministry survey of 42,000 firms in 2002, women constitute nearly 80 percent of part-time workers in Japan (Shimizu, 2003). In addition to underutilization of human capital, the concentration of maternal employment in part-time jobs that entails low-pay and low-social status widens the wage gap between males and females in Japan (Usui, 2005 as cited in Palley and Usui, 2005).

While rising female labor force participation among Japanese women was cited as a cause for reduced fertility rates, an examination of the literature reveals that a bi-directional causal relationship exists between fertility and female labor force participation. Another commonly cited cause of low fertility rates in Japan was the scarcity of childcare centers. However, there has been a lack of research that examines the effects of childcare availability on female labor force participation. While most research on childcare and female employment has examined the effects of childcare costs and subsidies, only a few studies have examined the effects of childcare availability on female labor force participation. The purpose of this study is to examine the relationship and causality between childcare availability, fertility and age-specific female labor force participation rates in Japan for the period 1971-2009. In terms of childcare availability, this study focuses on childcare centers for the working class instead of kindergartens and nurseries. This is because kindergartens in Japan operate under the assumption that childcare responsibility remains primarily with the stay-at-home mother. Unlike kindergartens, childcare centers operate longer hours throughout the year to cater for working parents’ needs (Palley and Usui, 2008).

This study differs from the extant literature in two important ways. First of all, this study expands on the scant literature that examines the non-monetary aspects on childcare and its effects on female labour force participation and fertility. In addition, age-specific female labor force participation rates in Japan have been examined. Secondly, the treatment of the data series is both comprehensive and unique. Given the long span of our sample, it is...
important to investigate the case structural breaks in order to account for important changes that took place in Japan. The reservation surrounding the robustness of standard unit root test concerns the possibility that structural breaks in the series may lead to erroneous inference. We apply the recent two-break unit root test developed by Narayan and Popp (NP, 2010). The appealing aspect of the NP test is that it accurately detects the break dates compared to other competing tests in the presence of two structural breaks. It has the advantage of not requiring the a priori specification of the possible timing of structural breaks. The break dates are endogenously determined within the model.\footnote{More discussions on this test can be found in Narayan and Popp (2010).}A further implication of this test is that we can use the break dates as dummy variables in our cointegration test. Education is also included as an additional control variable when testing our hypotheses.

This paper is organized in the following order: Section 2 discusses the problems in the Japanese childcare market and the problems faced by the Japanese women. Section 3 provides an overview of research conducted in the areas of childcare, fertility and female employment. Next, it is followed by a section on methodology and empirical findings. This paper concludes with policy recommendations and summary of key findings.

2. BACKGROUND

2.1 PROBLEMS IN THE JAPANESE CHILDCARE MARKET: WAIT-LISTED CHILDREN

As a result of shortage of childcare supply and rising childcare demand, children have been placed on waiting lists. The government increased childcare capacity for children aged 0-3 years old between 1995 and 2004 as part of the Angel Plan and New Angel Plan initiatives. These initiatives were aimed at meeting rising childcare service demand and to overcome falling fertility rates. Due to public budget constraints, the government reduced the minimum standards of child-childcare staff ratio in order to admit more children in licensed childcare centres. To cope with long waiting lists, some local governments have established their own childcare centres (Oishi, 2004). On the other hand, the deregulation of the childcare market in 1997 allowed for the expansion of private childcare centres. The government also encouraged public-private partnerships in family policy related initiatives and have increased the local government's authority in childcare policy. However, this raised the new issue of equal access and availability of high-quality childcare (Palley and Usui, 2008).

A possible explanation to this observation is that childcare supply in Japan is not responding to childcare demand, because some women have withdrawn from the labour force due to the high substitutability between labour market and domestic work (Bowen and Finegan, 1969). Given the labour market exit upon child birth, these women no longer demand for childcare because they commit their time completely to perform household and child-raising duties. Based on the 1st Longitudinal Survey of Babies in the 21st Century conducted by the MHLW, approximately 70 percent of women who worked one year before delivering the first child quit the job six months after childbirth (Ikeda, 2010). Moreover, women seldom acquire services of baby-sitters because this practice is not well accepted in Japan (Makino, 2009).

The problem of wait-listed children was contributed by the lack of public child care and the misallocation of funds (Kato, 2009). Compared to other wealthy countries, the Japanese government’s expenditure on childcare as a percentage of gross national product is the lowest (Harden, 2009). Yet, the understatement of number of wait-listed children could
have resulted in an underestimated budget allocation for the construction of childcare facilities (Zhou and Oishi, 2005; Kato, 2009).

2.2 PROBLEMS FACED BY JAPANESE WOMEN: LABOUR MARKET PARTICIPATION AND CHILDBEARING

According to the role incompatibility hypothesis proposed by Rindfuss and Brewster (1996), the social structural determinants of women’s work-family balance are: 1. Job characteristics; 2. Sequencing of mother-employee roles; and 3. Access to childcare alternatives. In addition, the ideational determinants of women’s perceptions towards maternal employment and parental surrogate care for children include: 1. Prevailing norms and mind-set towards working mothers; and 2. Visibility and acceptability of working mothers using childcare services (Rindfuss and Brewster, 1996).

The visibility of working mothers and their reliance on social support and childcare services as a parent surrogate signals the acceptability of maternal employment in society (Rindfuss and Brewster, 1996). The lack of role models for women contemplating maternal employment will decrease the likelihood that they arrange for a placement in childcare centres (Rindfuss and Brewster, 1996). However, even if women decide to return to work after childbirth, they face the obstacle of securing a slot in childcare centres (Fukue, 2010). Specifically, there is a shortage of conveniently-located childcare centres that operate extended-hours to accommodate women’s commuting time from the workplace to childcare centres after work (Palley and Usui, 2008). Furthermore, accessibility to public childcare facilities for women is inhibited by government regulations and private-sector policies (Harden, 2009). This is because unemployed mothers are ineligible to apply for placement in public childcare centres. Ironically, if they cannot secure a place for their children in the first place, they are unable to engage in paid work (Harden, 2009).

3. LITERATURE REVIEW

3.1 CHILDCARE AVAILABILITY AND FEMALE EMPLOYMENT

Defining childcare availability as a ratio of childcare workers to number of women eligible for workforce participation, Stolzenberg and Waite (1984) found that the effect of childcare availability on female labor force participation was positive and large. Interestingly, Stolzenberg and Waite (1984) found that childcare availability dominates childcare costs in terms of childcare constraints on female labor force participation. Estimating family members as childcare availability, Floge (1989) found that maternal employment was positively affected by the presence of family members who could act as childcare providers. Identifying hours spent in childcare as childcare availability, Bub and McCartney (2004) concluded that higher maternal employment hours were associated with higher children’s total number of hours in childcare. Defining geographic supply of childcare as childcare availability, Herbst and Barnow (2008) found that increased childcare slots is associated with increased female labor force participation in a geographical area. In a study outside the US, Kreyenfeld and Hank (2000) examined how maternal employment is affected by the number of day-care slots per 1000 children in a district in West Germany. Contrary to previous studies in the US, the authors found that West German mother’s labor force participation decisions were unaffected by regional childcare slots. In another European study, Van Ham and Mulder (2005) used the number of childcare within a mother’s potential activity space as a proxy for childcare availability in the Netherlands. In support of Herbst and Barnow (2008), Van Ham and
Mulder (2005) found that geographical access to childcare positively influenced mother’s labor force participation in the Netherlands. Due to the differences in cultural contexts and institutional constraints, it is clear from the literature that we do not expect consistency across countries.

Davis and Connelly (2005) warned that the patterns of child care use vary widely across states and exogenous differences in local child care markets could be caused by state regulations. In a related study using both a detailed survey from Minnesota on family child care use and county level market rate and availability data, the authors studied the influence of local price and availability on parents’ choice of child care. Their results suggest that the types of care chosen by mothers who are not in the paid labor force differ substantially from the choices of employed mothers, and their use of center care is influenced by the prices of both center and family providers. Attitudes towards relative care are also shown to influence type of care chosen.

To the best of our knowledge, there is only one study that examined the direction and causal effects between childcare availability and female labor force participation. Defining childcare availability as proportion of childcare workers in the labor force, Chevalier and Viitanen (2002) examined the causality between childcare availability and female labor force participation in the United Kingdom. It was found that Granger-causality runs from childcare supply to female labor force participation of women with young children, but Granger-causality does not run from female labor force participation to childcare supply.

3.2 FERTILITY AND FEMALE EMPLOYMENT

Since Becker’s (1960) pioneering analysis of fertility based on economic theory, many studies have examined the relationship between fertility and labor market participation decisions. Yet, the definition of fertility varies across studies. Smith-Lovin and Tickamyer (1978) defined fertility as the existing number of children, while Desai and Waite (1991) defined fertility as the number of births observed during a period. In addition, measurements of labor force participation differ among studies. Smith-Lovin and Tickamyer (1978) defined labor force participation as the number of accumulated years in employment while Cramer (1980) defined labor force participation as the number of hours worked. Nonetheless, due to differences in measurements of fertility and female labor force participation, this has resulted in inconsistent findings between studies (Felmlee, 1993).

Smith-Lovin and Tickamyer (1978) and Hout (1978) found that fertility negatively affects employment in the US, while Willis (1987) and Hotz et al. (1997) found a negative correlation between fertility and female labor force participation. Their findings are consistent with the ‘role incompatibility hypothesis’, which posits that fertility and female employment are negatively related due to the difficulties women face in balancing work and parenting duties (Stycos and Weller, 1967). Based on 1993 survey data, Bratti (2003) found that women with tertiary education participating in the labor force have higher fertility because they could afford to pay for childcare and to have more children. This finding confirms the ‘societal response hypothesis’, which suggests that a positive work-fertility relationship exists (Rindfuss and Brewster, 1996). Hence, contrary to US, a positive association between fertility and female labor force participation was observed in Italy. Using panel data between 1994 and 1998, Rica and Ferrero (2003) examined the effect of fertility on the likelihood of workforce participation and on actual female labor force participation in Spain. The authors found that regardless of whether fertility was considered exogenous or endogenous, female
labor force participation was strongly negatively affected by fertility. Employing panel data between 1992 and 1999, Vlasblom and Schippers (2004) found that the number and timing of children negatively affected female labor force participation in Spain, France and Italy, but contributed positively to female employment in UK, Netherlands and West Germany. Based on data from Argentina and Mexico, Cruces and Galiani (2007) found that a mother with more than two children and mixed sex sibling preference will reduce labor supply in response to her fertility decisions to have more children.

Most fertility and employment research investigates whether female employment affects fertility and vice versa. However, Cramer’s (1980) study was the first to find a reciprocal relationship between fertility and female employment. Employing modified Granger-causality tests, Cheng (1996b) found that African American women’s female labor force participation Granger-causes fertility without feedback. On the contrary, Cheng (1996a) and Cheng, Hsu and Chu (1997) found that fertility Granger-causes female labor force participation without feedback. Using UK data, McNown and Ridao-Cano (2005) found that in the long-run, female wages negatively affect fertility for females aged 20-24 and 25-34. However, for females aged 20-24, fertility does not Granger-cause female labor supply in the long-run. On the contrary, for females aged 25-34, fertility negatively Granger-causes female labor supply in the long-run. Mishra and Smyth (2010) pioneered in studying fertility and female labor force employment using panel unit root, panel cointegration and Granger causality testing on OECD countries. The authors found that between 1980 and 2005, female labor force participation Granger causes fertility with feedback. From 1995 to 2005, Granger-causality runs from female labor force participation to fertility without feedback. On the contrary, for females aged 15-34, Granger-causality runs from female labor force participation to fertility without feedback. Lastly, a negative relationship was found between fertility and female labor force participation.

3.3 Childcare Availability and Fertility

As Presser and Baldwin (1980) claimed, women constrained by childcare are likely to constrain their fertility. This was supported by Richter, Podhisita, Chamratrithirong and Soonthornmdhada’s (1994) study in Thailand that found that women facing childcare and employment constraints respond by reducing their fertility. Yet, studies on the effects of childcare availability on fertility have concluded with mixed results. Based on data from United States, Mason and Kuhlthau (1992) maintained that expansion of childcare centre would not increase fertility significantly. In support of Mason and Kuhlthau (1992), Wong and Levine (1992) also argued that increased childcare supply will increase female labour force participation among mothers of preschool-age children without increasing fertility. However, findings from recent studies dispute earlier results. Contrary to Wong and Levine (1992), Del Boca (2002) claimed that availability of childcare increases both fertility and the likelihood of labour market participation. In a study of twenty-one European countries, Hilgeman and Butts (2009) supports Del Boca’s claim by stating that in rising levels of female labour force participation, childcare services are effective in increasing fertility levels. Similarly, Baizan (2009) and Rindfusset al. (2010) reported that increased coverage of childcare has a positive effect on fertility.
3.4 Childcare, Fertility and Female Employment in Japan

Applying the three-stage least squares method, Lee and Gan (1989) found that the effect of increased female wage rate on fertility was negative. As female wage rate rises, the dominance of substitution effect over income effect causes women to substitute labour market work for child birth at a higher rate (Lee and Gan, 1989). However, Cheng et al. (1997) found that a causal relationship runs from fertility to labour force participation without feedback. Contrary to Lee and Gan’s (1989) findings, Cheng et al. (1997) concluded that Japanese women’s employment does not hinder child bearing, but the presence of children strongly discourages female employment.

In the examination of the relationship between childcare and female labour force participation, Nakamura and Ueda (1999) supported the view that increased supply of childcare centres will help married women achieve continuous employment across child birth. On the other hand, Oishi (2002) asserted that childcare fees have significantly negative effects on maternal labour force participation. Specifically, labour supply of mothers who earn low wages is more sensitive to changes in childcare fees than mothers who earn high wages (Oishi, 2002). In a recent study by Narayan and Peng (2007), it was found that advancement in contraception techniques, rising age at marriage and female education levels have jointly resulted in declining fertility rates in Japan.

4. Methodology and Empirical Findings

4.1 Data Description and Unit Root Test with Structural Breaks

To measure fertility rate in Japan, the total fertility rate is used. The female labor force participation rate is the percentage of employed and unemployed females in the potential labor force. Childcare availability is measured by the total capacity of licensed and non-licensed childcare centers in terms of number of children. The data are for the period 1971-2009. Historical data on total fertility rate, female labor force participation rate and childcare capacity are obtained from the Statistics Bureau of Japan. Table A1 in the Appendix provides the raw data (selected years) and the descriptive statistics for these variables. Data on education is obtained from Barro-Lee (2010) educational attainment dataset.

The results of the NP test are reported in Table 1. NP (2010) consider two different specifications for trending data. M1 allows for two breaks in the level of the series and M2 accounts for two breaks in the level and slope. TB1 and TB2 are the dates of structural breaks detected. The optimal lag length k is obtained by using the procedure suggested by Hall (1994). Results from M1 reveals that only the unit root null hypothesis for childcare availability (CA) can be rejected at the 5% level. Results from M2 reveal that we are able to reject the unit root null hypothesis for LFPR40-44 at the 5% level.

The structural breaks for TFR are 1988 and 1994, while structural breaks for CA appear to be 1978 and 2001. The 1994 and 2001 structural breaks coincide with the Japanese Government’s implementation of the Angel Plan (1994-1998) and the New Angel Plan (1993-2003) in an attempt to increase the national birth rate. The structural break in 1988 could be linked to the government policy in the 1980s which provided support for new urban development away from the large cities, particularly Tokyo, and assisted regional cities to attract young people to live and work there (a pattern known as U-turn) or migration to rural areas (J-turn) (Yoshimoto, 2002). The structural break in 1978, on the other hand, could be
due to Japanese government’s policy during the 1970s to promote kindergarten education which led to increased subsidies for private kindergartens (Boocock, 1989).

The structural breaks detected for \( LFPR_{20-44}(1982, 1998, 1986, 1997) \), \( LFPR_{20-29} \) (1984, 1992) and \( LFPR_{30-39} \) (1994, 1997, 1992 and 1996) could be linked to one or a combination of the following events: (1) the collapse of the bubble in 1992 that worsen the employment environment; (2) Japanese Government’s implementation of the Angel Plan from 1994 to 1998; (3) the New Angel Plan from 1993 to 2003; and (4) the U-turn and J-turn migration in the 1980s. The 1978 structural break detected for \( LFPR_{20-29} \) coincides with the period during which the government attempted to alleviate the employment pressure and to provide employment opportunities for the youth (i.e., Employment Security Law in 1974 and the Revised Vocational Training Law in 1978).

4.2 Cointegration

We investigate the existence of a long-run relationship between childcare availability, female labor force participation and total fertility rate using the bounds test procedure within an ARDL (autoregressive distributed lag) approach, developed by Pesaran et al. (2001). We include the break dates detected in the NP (2010) test as dummy variables in the cointegration test. In addition to the break dates dummies, we also include education as one of the control variables in the model. The bounds test method is chosen over such conventional methods as Engle-Granger (1987) and Johansen (1988) due to its better small sample size properties. A further advantage of this approach is that while other cointegration techniques require all of the series to be integrated of the same order, the ARDL can be applied regardless of their order of integration.

The unrestricted error correction model (UECM) will be applied within a bounds testing framework:

\[
\Delta CA_t = a_0CA + \sum_{i=1}^{n} b_{iCA} \Delta CA_{t-i} + \sum_{i=1}^{n} c_{iCA} \Delta LFPR_{(j)t-i} + \sum_{i=1}^{n} d_{iCA} \Delta TFR_{t-i} + \sigma_1CA CA_{t-1} + \sigma_2CA LFPR_{(j)t-1} + \ldots + \sigma_3TFR CA_{t-1} + \epsilon_1t
\]

(1)

\[
\Delta LFPR_{(j)t} = a_0LFPR_j + \sum_{i=1}^{n} b_{iLFPR} \Delta LFPR_{(j)t-i} + \sum_{i=1}^{n} c_{iLFPR} \Delta TFR_{t-i} + \sum_{i=1}^{n} d_{iLFPR} \Delta CA_{t-i} + \sigma_1LFPR LFPR_{(j)t-1} + \sigma_2LFPR TFR_{t-1} + \sigma_3LFPR CA_{t-1} + \epsilon_2t
\]

(2)

\[
\Delta TFR_t = a_0TFR + \sum_{i=1}^{n} b_{iTFR} \Delta TFR_{t-i} + \sum_{i=1}^{n} c_{iTFR} \Delta LFPR_{(j)t-i} + \sum_{i=1}^{n} d_{iTFR} \Delta CA_{t-i} + \sigma_1TFR LFPR_{(j)t-1} + \sigma_2TFR CA_{t-1} + \epsilon_3t
\]

(3)

where \( \Delta \) is the first difference operator and \( CA \) is the natural log of total childcare capacity, \( LFPR_{(j)} \) is the natural log of total female labour force participation rate for age group \( j \) (corresponding to: total, 20-29, 30-39 and 40-44) and \( TFR \) is the natural log of total fertility rate. To identify evidence of a long-run relationship in Equations 1-3, the \( F \)-test is applied to
determine whether coefficients of one-period lagged levels of the variables are jointly significant.

Table 2 presents results of the ARDL bounds test corresponding to Equations 1-3 in 3 different models. Following Narayan and Smyth (2006a), we report the bounds test results with and without a deterministic trend. First, the bounds test is applied with an unrestricted intercept, but without a trend, which is Case III in Pesaran et al. (2001). Subsequently, in accordance with Case IV in Pesaran et al. (2001), an unrestricted intercept and a restricted trend is also applied to these equations. The lag order of the bounds test is selected using the Schwarz Bayesian Criteria (SBC) because in comparison to Akaike Information Criteria (AIC), SBC yields a more parsimonious specification based on the smallest lag length (Pesaran and Shin, 1999, Sbeiti and Alshammari, 2010). Due to the annual observation of time series data employed in this study, a maximum of two lags is used, as recommended by Pesaran and Shin (1999). Cointegration is said to exist if the computed F-statistic exceeds the upper bound critical value. However, the critical values reported in Pesaran et al. (2001) are generated for large sample sizes of 500 and 1000 observations. Narayan and Narayan (2005) warned that these critical values based on large sample sizes cannot be used in small sample model. The small sample critical values for bounds test are therefore taken from Narayan (2005).

In the spirit of bounds test, there should be one long run relationship for each model in Table 1 to be valid. While Model 2 and 3 are found to have a time trend, Model 1 with a time trend is invalid due to the presence of two long run relationships. The bounds test results indicate the existence of cointegrating relationship when \( TFR \) is treated as dependent variable in Model 1. In Model 2 and 3, cointegrating relationships are found when \( LFPR_{30-39} \) and \( LFPR_{40-44} \) are treated as dependent variables respectively. This implies that long run Granger causality exists in at least one direction among the variables in the cointegrating relationship (i.e., \( TFR|CA, LFPR_{20-29} \)).

Further, we apply the Lagrange-Multiplier (LM) test to ensure that the three cointegrating relationships are free of autocorrelation. As evidenced in Table 2, the LM test for autocorrelation indicates that the null of no autocorrelation up to lag order 2 cannot be rejected at 1% significance level. Therefore, all of the cointegrating relationships fulfill the required condition of no autocorrelation.

While the presence of cointegrating relationships suggests that Granger-causation may exist between \( CA, LFPR_j \) and \( TFR \), the bounds test does not indicate the causal direction between the three variables. To determine the causal direction between \( CA, LFPR_j \) and \( TFR \), the Granger causality test is applied.

4.3 Granger Causality

If the bounds test indicates that cointegration does not exist when \( CA_t, LFPR_{ij,t} \) or \( TFR_t \) is treated as dependent variable, the short-run causal relationships between \( CA_t, LFPR_{ij,t} \) and \( TFR_t \) will be modelled using a vector autoregressive framework (VAR) as follows (Narayan and Smyth, 2006b):
ΔCA_t = υ + \sum_{i=1}^{m} \phi_i ΔCA_{t-i} + \sum_{i=1}^{n} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{p} \phi_i ΔTFR_t-i + \epsilon_{1t} \tag{4}

ΔLFPR(0)t = υ + \sum_{i=1}^{m} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{n} \phi_i ΔTFR_t-i + \sum_{i=1}^{p} \phi_i ΔCA_{t-i} + \epsilon_{2t} \tag{5}

ΔTFR_t = υ + \sum_{i=1}^{m} \phi_i ΔTFR_t-i + \sum_{i=1}^{n} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{p} \phi_i ΔCA_{t-i} + \epsilon_{3t} \tag{6}

where \epsilon_{1t}, \epsilon_{2t}, and \epsilon_{3t} are serially uncorrelated error terms.

In the stationary model, the error correction term is included to capture the short-run deviations of \( CA_t, LFPR_{0t} \) or \( TFR_t \) from their long-run equilibrium path. The following vector error correction model (VECM) will be applied to conduct Granger-causality tests:

\[
ΔCA_t = υ + \sum_{i=1}^{m} \phi_i ΔCA_{t-i} + \sum_{i=1}^{n} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{p} \phi_i ΔTFR_t-i + \pi_1ECT_{t-1} + \epsilon_{1t} \tag{7}
\]

\[
ΔLFPR(0)t = υ + \sum_{i=1}^{m} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{n} \phi_i ΔTFR_t-i + \sum_{i=1}^{p} \phi_i ΔCA_{t-i} + \pi_2ECT_{t-1} + \epsilon_{2t} \tag{8}
\]

\[
ΔTFR_t = υ + \sum_{i=1}^{m} \phi_i ΔTFR_t-i + \sum_{i=1}^{n} \theta_i ΔLFPR(0)t-i + \sum_{i=1}^{p} \phi_i ΔCA_{t-i} + \pi_3ECT_{t-1} + \epsilon_{3t} \tag{9}
\]

where \( ECT_{t-1} \) is the lagged error correction term, and other variables are as defined above.

Table 3 presents short-run and long-run Granger-causality results. These results are summarized in Figure 1-3. The optimal lag length used in the VAR and VECM are selected using SBC. In contrast to Chevalier and Viitanen’s (2002) study for the United Kingdom, our study finds that causality runs from labor force participation to childcare availability for females aged 20-29 in Japan (refer to Model 1 in Table 3). This could be due to differences in measurement of childcare availability in both studies, in addition to the institutional and societal differences between the two countries under study. Additionally, childcare availability is found to have an impact on labor force participation of females aged 20-29 in the short run; bidirectional relationship is found between childcare availability and labor force participation in the short run. The empirical results in Model 1 of Table 3 also indicate that the availability of childcare affects the child-bearing decision of females aged 20-29 in the long run (the sign of the effect is discussed in the next section). The statistically significant (at the 1% level) lagged error correction with the correct negative sign confirms the bounds test for cointegration. The coefficient of -0.194 indicates the speed of adjustment of fertility due to changes in childcare availability and labor force participation. If fertility deviates from its long-run equilibrium in the current period, 19.4% of the deviation will be corrected in the subsequent period.

In Japan, women are delaying marriage and postponing childbirth. The percentage of women who remain single into their 30s has more than doubled since 1980 (Harden, 2008). The empirical results show that the labor force participation of females aged 20-29 does not have a Granger-causal effect on their fertility decisions. The childbearing decision is Granger caused by the availability of childcare in the long run.
Unlike the 20-29 age group, the labour force participation of female aged 30-39 has a short run Granger causal effect on their childbearing decisions (refer to Model 2 in Table 3). The results also indicate that the availability of childcare has no effect on the child-bearing decisions of females aged 30-39. As the lagged error correction term in the labor force participation equation is statistically significant, in the long-run, childcare availability Granger-causes labor force participation through the error correction term. At -0.59, the coefficient of the lagged error correction term indicates that the speed of adjustment of labor force participation due to changes in childcare availability and fertility is high. If labor force participation deviates from its long-run equilibrium in the current period, 59% of the deviation will be corrected in the subsequent period.

With reference to Model 3 for females aged 40-44, in the short-run, unilateral Granger causality runs from childcare availability and labor force participation to fertility. The lagged error correction term in the labor force participation is statistically significant at the 1% level, suggesting that in the long-run, Granger-causality runs from childcare availability to labor force participation through the error correction term. With a coefficient of -0.569, the lagged error correction term suggests a moderate strength of convergence to equilibrium in Model 3. When labor force participation diverges from its long-run equilibrium in the current period, 56.9% of the divergence will be corrected in the next period.

On a separate note, the absence of causal effect running from fertility to labor force participation of females for all age group is different from Cheng’s (1996b) findings on US data. Notably, our study does not find evidence of Granger-causality running from labor force participation to childcare availability among for females aged 30-44. This suggests that childcare centre supply in Japan is not responsive to the demand for childcare by females aged 30-44 in the labor force.

While the Granger-causality test results specify the causal direction between childcare availability, fertility and female labor force participation, it does not indicate whether these variables have a positive or negative effect on each other. Therefore, the long-run elasticities of childcare availability, fertility and female labor force participation were computed using the ARDL approach.

4.4 AUTOREGRESSIVE DISTRIBUTED LAG (ARDL)

To investigate the long-run properties of childcare availability, fertility and female labor force participation, the following ARDL equations will be applied:

\[ \text{CA}^* = k_0 + \sum_{i=1}^{p} a_i \text{CA}_{t-i}^* + \sum_{j=0}^{q} b_j \text{LFPR}_{t-j}^* + \sum_{k=0}^{r} c_k \text{TFR}_t^* + \epsilon_{1t} \] (10)

\[ \text{LFPR}^* = k_0 + \sum_{i=1}^{p} a_i \text{LFPR}_{t-i}^* + \sum_{j=0}^{q} b_j \text{CA}_{t-j}^* + \sum_{k=0}^{r} c_k \text{TFR}_t^* + \epsilon_{2t} \] (11)

\[ \text{TFR}^* = k_0 + \sum_{i=1}^{p} a_i \text{TFR}_{t-i}^* + \sum_{j=0}^{q} b_j \text{CA}_{t-j}^* + \sum_{k=0}^{r} c_k \text{LFPR}_t^* + \epsilon_{3t} \] (12)

Table 4 shows the long-run elasticities of the three cointegrating relationships. Our results do not support the proposition that working women tend to have fewer children. In addition, we find no evidence which suggests that having more children at home discourages the participation of women in the labour force. This finding is in agreement with Cheng's
(1999) findings which found no causality from fertility to female LFPR in Taiwan. Increased availability of childcare is found to increase the labor force participation of females aged 30-44. With non-parental care as a replacement for parental care, females aged 30-44 are able to re-enter the labor market or remain in paid employment by substituting labor market work for domestic work.

Regrettably, our study does not find evidence to support either the societal response hypothesis or role incompatibility hypothesis. Fertility decision is strongly dependent on the availability of childcare.

5. Policy Recommendation

In response to the problem of wait-listed children, our results suggest that the Japanese government should increase expenditures on childcare centre expansion in order to produce a positive effect on maternal employment and on child birth. Childcare centre expansion could be implemented through cost reduction, extended operation hours, privatization of public childcare centres, and through deregulation of the childcare market to promote market competitiveness (Zhou and Oishi, 2005; Boling, 2008). However, the absence of a Granger-causal effect running from childcare availability to fertility among women from the prime child-bearing age group (30-39) implies that the positive effect of increased childcare availability on fertility may be small.²

Relating to childcare centre expansion, childcare leave should be used concurrently with childcare arrangements (Date and Shimizutani, 2007). This is because without childcare arrangements after childcare leave is exhausted, women particularly aged 30-44 would still be unable to re-enter the labour market after child birth. Another corporate policy recommendation is that firms provide on-site childcare facilities at the workplace. This reduces the need for women to seek part-time jobs due to the inherent rigid work hours of full-time jobs that disallows women from picking and leaving their children at childcare centres.

Another policy recommendation is to reform the Japanese taxation system, which favours single-income families and penalizes working women whose annual income exceeds 1.03 million yen (Oishi, 2002; Palley and Usui, 2008). Without a tax wedge on women’s labour supply, Japanese women would not be resigned to part-time employment, which typically entails lower pay and promotion opportunities.

6. Conclusion

A unilateral Granger-causal effect is found to run from childcare availability to fertility for both age groups of 20-29 and 40-44. The absence of Granger-causality running from childcare availability to fertility rates of females aged 30-39 in the labour force suggests that childcare availability is not a factor in their childbearing decisions because they have forgone family formation in anticipation of childcare placement problems. This indicates that existing childcare centers are insufficient to encourage child bearing among working women, especially among females aged 30-39.

²The mean female age at first birth rose to 30.1 in 2011 (Ministry of Health, Labour and Welfare, Japan).
In addition, evidence of bilateral Granger-causal effect between childcare availability and female labour force participation is only found for females aged 20-29. Among the different age groups examined, only the labour force participation of females aged 20-29 that Granger-causes childcare availability. Hence, in the short-run, we deduce that the Japanese childcare supply is not responsive to childcare demand of females aged 30-44 in the labour force.

The childcare situation during the period under study has a positive Granger-causal effect on labour force participation of females aged 30-44. Our study also finds that childcare availability has a positive and significant (and also long run Granger-causal) effect on fertility of females aged 20-29 in the labour force. In the long-run, there is no evidence that labour force participation discourages childbearing among females aged 20-29. In addition, we do not find evidence that presence of children hinders re-employment and continuous employment among females aged 30-44. Overall, this study suggests the importance of the Japanese childcare system in supporting maternal employment and fertility.

Acknowledgements

The authors are indebted to valuable comments and suggestions from Professor Mahendhiran Nair and two anonymous reviewers.
### Table 1: NP (2010) two-break unit root test

<table>
<thead>
<tr>
<th>Series</th>
<th>Test Statistics</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
<th>Test Statistics</th>
<th>TB1</th>
<th>TB2</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>-4.945**</td>
<td>1978</td>
<td>2001</td>
<td>1</td>
<td>-3.711</td>
<td>1978</td>
<td>2001</td>
<td>1</td>
</tr>
<tr>
<td>LFPR&lt;sub&gt;40,44&lt;/sub&gt;</td>
<td>-3.506</td>
<td>1982</td>
<td>1998</td>
<td>0</td>
<td>-5.719**</td>
<td>1986</td>
<td>1997</td>
<td>1</td>
</tr>
<tr>
<td>LFPR&lt;sub&gt;20,29&lt;/sub&gt;</td>
<td>-0.360</td>
<td>1978</td>
<td>1992</td>
<td>2</td>
<td>-4.039</td>
<td>1984</td>
<td>1992</td>
<td>0</td>
</tr>
</tbody>
</table>

**Notes:** Critical values are obtained from NP (2010). The 5% critical values obtained from NP (2010) are -4.514 and -5.181 for model 1 and model 2, respectively. ** denotes the rejection of the null hypothesis of unit root at the 5% significance level.

### Table 2: Bounds test and Lagrange-Multiplier test

<table>
<thead>
<tr>
<th>Model 1: CA, LFPR&lt;sub&gt;20,29&lt;/sub&gt;, TFR</th>
<th>Without a time trend</th>
<th>With a time trend</th>
<th>LM(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>Outcome</td>
<td>F-statistics</td>
</tr>
<tr>
<td>CA[TFR, LFPR&lt;sub&gt;20,29&lt;/sub&gt;]</td>
<td>5.4081</td>
<td>Not cointegrated</td>
<td>7.3894**</td>
</tr>
<tr>
<td>(LFPR&lt;sub&gt;20,29&lt;/sub&gt;[CA, TFR]</td>
<td>4.2777</td>
<td>Not cointegrated</td>
<td>6.9882**</td>
</tr>
<tr>
<td>(TFR[CA, LFPR&lt;sub&gt;20,29&lt;/sub&gt;]</td>
<td>8.8446***</td>
<td>Cointegrated</td>
<td>3.3784</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2: CA, LFPR&lt;sub&gt;30,39&lt;/sub&gt;, TFR</th>
<th>Without a time trend</th>
<th>With a time trend</th>
<th>LM(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>Outcome</td>
<td>F-statistics</td>
</tr>
<tr>
<td>CA[TFR, LFPR&lt;sub&gt;30,39&lt;/sub&gt;]</td>
<td>5.7314**</td>
<td>Cointegrated</td>
<td>6.3043</td>
</tr>
<tr>
<td>(LFPR&lt;sub&gt;30,39&lt;/sub&gt;[CA, TFR]</td>
<td>5.3451***</td>
<td>Cointegrated</td>
<td>10.9328***</td>
</tr>
<tr>
<td>(TFR[CA, LFPR&lt;sub&gt;30,39&lt;/sub&gt;]</td>
<td>7.4074**</td>
<td>Cointegrated</td>
<td>4.8083</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 3: CA, LFPR&lt;sub&gt;40,44&lt;/sub&gt;, TFR</th>
<th>Without a time trend</th>
<th>With a time trend</th>
<th>LM(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F-statistics</td>
<td>Outcome</td>
<td>F-statistics</td>
</tr>
<tr>
<td>CA[TFR, LFPR&lt;sub&gt;40,44&lt;/sub&gt;]</td>
<td>3.9377</td>
<td>Not cointegrated</td>
<td>4.0894</td>
</tr>
<tr>
<td>(LFPR&lt;sub&gt;40,44&lt;/sub&gt;[CA, TFR]</td>
<td>8.1107***</td>
<td>Cointegrated</td>
<td>7.4866**</td>
</tr>
<tr>
<td>(TFR[CA, LFPR&lt;sub&gt;40,44&lt;/sub&gt;]</td>
<td>8.1549***</td>
<td>Cointegrated</td>
<td>3.6829</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>F-test critical values</th>
<th>1%</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No trend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trend</td>
<td>7.643</td>
<td>9.063</td>
</tr>
</tbody>
</table>

**Notes:** The critical values for bounds test are taken from Narayan (2005). If the estimated F-statistic is higher than the upper bound of the critical values then the null hypothesis of no cointegration is rejected. If the estimated F-statistic is less than the lower bound of the critical values then the null hypothesis of no cointegration cannot be rejected. *** (**) denotes statistical significance at the 1% (5%) level.
Table 3: Short-run and long-run Granger causality test results

Model 1: CA, LFPR\textsubscript{20-29}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta$CA</th>
<th>$\Delta$LFPR\textsubscript{20-29}</th>
<th>$\Delta$TFR</th>
<th>ECT\textsubscript{t-1}</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta$CA</td>
<td>-</td>
<td>5.7886[.016] **</td>
<td>2.6642[.103]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta$LFPR\textsubscript{20-29}</td>
<td>3.1164[.078] *</td>
<td>-</td>
<td>.65757[.417]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta$TFR</td>
<td>2.7958[.955]*</td>
<td>.79785[.372]</td>
<td>-</td>
<td>-.19406**</td>
<td>-2.4144[.023]</td>
</tr>
</tbody>
</table>

Model 2: CA, LFPR\textsubscript{30-39}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta$CA</th>
<th>$\Delta$LFPR\textsubscript{30-39}</th>
<th>$\Delta$TFR</th>
<th>ECT\textsubscript{t-1}</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta$CA</td>
<td>-</td>
<td>.0027632[.958]</td>
<td>2.3121[.128]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta$LFPR\textsubscript{30-39}</td>
<td>4.0321[.045]**</td>
<td>-</td>
<td>2.4356[.119]</td>
<td>-.58960***</td>
<td>-2.9032[.007]</td>
</tr>
<tr>
<td>$\Delta$TFR</td>
<td>.28299[.595]</td>
<td>3.0084[.083]</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model 3: CA, LFPR\textsubscript{40-44}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$\Delta$CA</th>
<th>$\Delta$LFPR\textsubscript{40-44}</th>
<th>$\Delta$TFR</th>
<th>ECT\textsubscript{t-1}</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta$CA</td>
<td>-</td>
<td>2.6305[.105]</td>
<td>2.1680[.141]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta$LFPR\textsubscript{40-44}</td>
<td>3.6084[.057]*</td>
<td>-</td>
<td>.82906**</td>
<td>2.5967[.015]</td>
<td>-.56857***</td>
</tr>
<tr>
<td>$\Delta$TFR</td>
<td>5.9274[.015]**</td>
<td>12.4702[.000]***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ***, **, * denotes statistical significance at the 1%, 5% and 10% levels respectively. Figures in parenthesis are the $p$-values.

Table 4: ARDL-based long-run elasticities

Model 1: CA, LFPR\textsubscript{20-29}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>CA</th>
<th>LFPR\textsubscript{20-29}</th>
<th>t-stats</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFR</td>
<td>-7.2538</td>
<td>-.14923[.146]</td>
<td>.82906**</td>
<td>2.5967[.015]</td>
<td>-.57324</td>
</tr>
</tbody>
</table>

Model 2: CA, LFPR\textsubscript{30-39}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>CA</th>
<th>TFR</th>
<th>t-stats</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFPR\textsubscript{30-39}</td>
<td>.99534</td>
<td>1.4002[.175]</td>
<td>.19543***</td>
<td>4.9040[.000]</td>
<td>.13072</td>
</tr>
</tbody>
</table>

Model 3: CA, LFPR\textsubscript{40-44}, TFR

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Constant</th>
<th>CA</th>
<th>TFR</th>
<th>t-stats</th>
<th>t-stats</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFPR\textsubscript{40-44}</td>
<td>2.1871*</td>
<td>1.9090[.067]</td>
<td>.13009*</td>
<td>1.8016[.083]</td>
<td>-.08612</td>
</tr>
</tbody>
</table>

Notes: ***, **, * denotes statistical significance at the 1%, 5% and 10% levels respectively.
Figure 1: Graphical summary of Granger causality test for Model 1

A ——— B indicates that Granger causality runs from A to B in the short-run
A → B indicates that Granger causality runs from A to B in the long-run

Figure 2: Graphical summary of Granger causality test for Model 2

A ——— B indicates that Granger causality runs from A to B in the short-run
A → B indicates that Granger causality runs from A to B in the long-run

Figure 3: Graphical summary of Granger causality test for Model 3

A ——— B indicates that Granger causality runs from A to B in the short-run
A → B indicates that Granger causality runs from A to B in the long-run
REFERENCES


Usui, C., 2005. Japan’s frozen future: Why are women withholding investment in work and family?


Appendix

Table A1: Raw data (selected years) and the descriptive statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>CA</th>
<th>TFR</th>
<th>LFPR_{20-29}</th>
<th>LFPR_{30-39}</th>
<th>LFPR_{40-44}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>1200574</td>
<td>2.16</td>
<td>56.3</td>
<td>51.0</td>
<td>62.2</td>
</tr>
<tr>
<td>1980</td>
<td>2077698</td>
<td>1.75</td>
<td>59.6</td>
<td>53.1</td>
<td>64.1</td>
</tr>
<tr>
<td>1990</td>
<td>1992281</td>
<td>1.54</td>
<td>68.3</td>
<td>57.2</td>
<td>69.6</td>
</tr>
<tr>
<td>2000</td>
<td>1918910</td>
<td>1.36</td>
<td>71.3</td>
<td>59.3</td>
<td>69.3</td>
</tr>
<tr>
<td>2003</td>
<td>1961752</td>
<td>1.29</td>
<td>71.4</td>
<td>61.7</td>
<td>70.3</td>
</tr>
<tr>
<td>2009</td>
<td>2132081</td>
<td>1.37</td>
<td>73.7</td>
<td>66.4</td>
<td>71.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1924495</td>
<td>1.61</td>
<td>65.64</td>
<td>56.79</td>
<td>67.59</td>
</tr>
<tr>
<td>Median</td>
<td>1968942</td>
<td>1.54</td>
<td>68.30</td>
<td>57.10</td>
<td>69.30</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>235340.4</td>
<td>0.26</td>
<td>6.45</td>
<td>4.51</td>
<td>3.68</td>
</tr>
</tbody>
</table>

Source: Statistics Bureau of Japan