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Stress, Child Care, and Fertility

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Stress, Child Care, and Fertility†

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Abstract

In economically developed countries, an aging society with fewer children is progressing. Especially, Japan's aging society is rapidly progressing. There, child care policies are actively provided to mitigate effects of the rapidly aging society. Child care services have increased. Female labor participation has also increased. As the empirical data show, female labor participation is positively correlated with fertility, as shown also by results from OECD countries. However, our analyses show that the fertility rate cannot always be raised by child care service improvement, although child care services can raise the female labor participation rate. Additionally, our analyses consider work balance and the fertility rate. A fixed working time for the father reduces female labor participation and increases child care time of the mother.

Keywords: Child care service, Endogenous fertility, Stress, Work life balance
JEL Classifications: J13, J22

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1. Introduction

This paper presents an examination of how the fertility rate and the female labor participation are determined in the endogenous fertility model. Empirical results presented by Ahn and Mira (2002) and Sleebos (2003) show that the fertility is positively correlated with female labor participation in developed countries. Apps and Rees (2004), Ferrero and Iza (2004), and Day (2012) set a theoretical model with child care service and explain positive correlation between the fertility rate and female labor participation. These studies demonstrate the importance of considering child care services to examine why fertility is positively correlated with the female labor participation rate. Luci-Greulich and Thévenon (2014) survey the manner in which fertility is correlated with income, based on theoretical and empirical papers. Then they derive correlation between fertility and the income level, depending on the income level.

We regard child care stress as another factor that reduces the number of children people choose to have. As reported by the Annual Health, Labour and Welfare Report 2015 in Japan, child care stress is a factor deterring parents from having children. By virtue of child care services, parents can reduce child care time and be released from child care stress. Therefore, child care services can have a positive effect on increased fertility in terms of child care stress.

The child allowance raises fertility rates, as shown by van Groezen, Leers and Meijdam (2003). However, Fanti and Gori (2009) report that the child allowance might reduce the fertility rate because of tax burdens and decreased capital stock per capita. Therefore, child care services are superior to a child allowance in terms of slowing the decrease in the number of children per family.

Without child care services, an increase in female labor participation reduces fertility. This negative correlation was confirmed in the 1990s. Galor and Weil (1996) set a model in which a female (mother) cares for children with her time and derives the result that an increase in the female labor wage rate raises female labor participation and that the fertility rate decreases because the opportunity cost of having more children increases because of an increase in the female wage rate. Zhang and Zhang (1997) and de la Croix and Doepke (2003) establish an endogenous fertility model that incorporates education investment. An increase in the wage rate reduces the fertility rate because of an increase in opportunity cost and the parents' increased education investment in children.

Konrad and Lommerud (2000) consider a model by which both the husband and the wife allocate home care time including that used for child care and house cleaning. However, they do not consider the fertility rate explicitly. Our paper presents an

examination of how child care services affect fertility in a father and mother child care model.

Our study sets models of two types: one for child care time and the other for child care services. In both models, the father and the mother mutually cooperate to provide child care. Both the mother and the father use time for child care. Our paper presents derivation of the following results. First, even if child care is provided using parental time, an increase in the female wage rate raises female labor participation. However, it does not always reduce fertility. If the parent can use child care services, then an increase in the female wage rate can raise the fertility rate.

Second, fertility with child care services is not always greater than fertility with child care time by the parents. Our paper sets the fertility function inputting father and mother child care time in the child care time model. Depending on the marginal productivity of fertility, the fertility in child care time is higher than the fertility in child care services. This result demonstrates that not child care services but parental child care time is better in terms of alleviating the practice of having fewer children. In economically developed countries, child care services are implemented to increase female labor participation, constituting an important factor that raises the fertility rate. However, our paper is critical of such policies. If the child care time is regarded as raising the fertility rate, then female labor participation is not positively correlated with fertility, depending on the wage rate.

As shown in Fig. 1, countries with a high female labor participation rate do not have a high fertility rate. Compared with Germany with France, the total fertility rate in Germany is lower than that in France. However, female labor participation in Germany is higher than that in France. This result shows that the marginal productivity of child care in France might be larger than that in Germany.

[Insert Fig. 1 around here.]

Third, work–life balance should be considered. As shown in Fig. 2, the annual working hours in Japan are long.

[Insert Fig. 2 around here.]

If the father cannot allocate time into labor and child care time to maximize utility, the time allocations are adjusted by changing the mother's labor time and child care time. Generally, it is regarded as difficult for a father to change labor time at a full-time job in

Japan. Furthermore, a father cannot increase child care time. Therefore, the mother provides more time for child care and less time for labor. This result demonstrates that the father's fixed labor time reduces the female labor participation rate.

The remainder of the paper includes the following. Section 2 sets a basic model with child care time. Section 3 sets the child care service model and presents examination of how fertility depends on the female wage rate in the child care time model and child care service model. Section 4 considers work–life balance in the child care time model. Section 5 concludes the paper.

2. The Basic Model

A household has one father and one mother. They supply labor to obtain labor income. They care for the number of children, at a certain stress level, and a certain level of consumption. The utility function is assumed as the following form.[1]

$$u_i = \alpha lnn + \beta ln(S_i - l_{iL} - \varepsilon_i l_{iC}) + (1-\alpha-\beta) ln\frac{c}{2}, (0<\alpha, 0<\beta, \alpha+\beta<1), i = F, M \quad (1)$$

With $i = F$, u_F represents the father's utility. With $i = M$, u_M stands for the mother's utility. n denotes the number of children, which is determined by the input of the father child care time l_{FC} and the mother child care time l_{MC}. $S_F - l_{FL} - \varepsilon_F l_{FC}$ shows the stress level of the father. l_{FL} and l_{ML} respectively denote the labor input level of the father and mother. S_F and S_M respectively show the levels of mental strength, which are given by the positive parameters. ε_F and ε_M respectively represent positive parameters showing the relative effects of stress.

If $l_{FL} + \varepsilon_F l_{FC}$ or $l_{ML} + \varepsilon_M l_{MC}$ increases, then $S_F - l_{FL} - \varepsilon_F l_{FC}$ or $S_M - l_{ML} - \varepsilon_M l_{MC}$ decreases. That is, the stress level is higher than a usual level. c denotes the aggregate household consumption. The father and the mother are given respectively as $\frac{c}{2}$. Based on the following fertility function, fertility n is determined.[2]

$$n = A l_{FC}^{\gamma} l_{MC}^{1-\gamma}, (0<A, 0<\gamma<1). \quad (2)$$

Regarding the fertility function, Apps and Rees (2004) consider that the fertility rate depends on the child care time provided by the parents and child care services. Apps and

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[1] This setting resembles that described by Konrad and Lommerud (2000), who set a model in which the father and mother have a mutual utility function. They decide the allocation for labor time and child care in a non-cooperative game model. Our paper considers a cooperative model. However, even if our paper derives the equilibrium of non-cooperative model, the main results of our paper are not changed.

[2] With $l_{FC} = 0$ or $l_{MC} = 0$, we obtain $n = 0$ in the fertility function (2). This result might be unrealistic. However, if our paper defines the fertility function as $n = A(l_{FC} + \tilde{l})^{\gamma}(l_{MC} + \tilde{l})^{1-\gamma}$, ($\tilde{l}(>0)$ is a constant parameter), then we obtain the non-zero fertility in $l_{FC} = 0$ or $l_{MC} = 0$.

Rees (2004) assume a constant returns to scale function. Hirazawa and Yakita (2009) assume a Cobb–Douglas function related to the fertility function. Ferrero and Iza (2004) assume a perfect substitution function. No report of the relevant literature describes a study examining child care provided by the father and the mother. Our paper assumes a Cobb–Douglas function to consider cooperative child care

Defining w_F and w_M as the respective wage rates of the father (male) and the mother (female), the household lifetime budget constraint is shown as

$$w_F l_{FL} + w_M l_{ML} = c, \tag{3}$$

We assume that $w_F > w_M$. In Japan and other OECD countries, the female wage rate is lower than the male wage rate.[3] This assumption is regarded as necessary because we examine the problem of fertility in developed countries.

Now, the household maximizes total utility $u_F + u_M$ subject to the fertility function (2) and the household budget constraint (3).[4] Then, the Lagrange equation is set as

$$\begin{aligned} L &= u_F + u_M + \lambda(w_F l_{FL} + w_M l_{ML} - c) \\ &= 2\alpha\gamma ln l_{FC} + 2\alpha(1-\gamma) ln l_{MC} + 2(1-\alpha-\beta) lnc + \beta ln(S_F - l_{FL} - \varepsilon_F l_{FC}) \\ &\quad + \beta ln(S_M - l_{ML} - \varepsilon_M l_{MC}) - 2(1-\alpha-\beta) ln2 + 2\alpha lnA \\ &\quad + \lambda(w_F l_{FL} + w_M l_{ML} - c) \end{aligned} \tag{4}$$

The child care time by the father and mother is as shown below.

$$l_{FC} = \frac{\alpha\gamma(w_F S_F + w_M S_M)}{\varepsilon_F w_F} \tag{5}$$

$$l_{MC} = \frac{\alpha(1-\gamma)(w_F S_F + w_M S_M)}{\varepsilon_M w_M} \tag{6}$$

The labor supply time is shown as follows.

$$l_{FL} = S_F - \frac{\beta + 2\alpha\gamma}{2\alpha\gamma}\varepsilon_F l_{FC} \tag{7}$$

$$l_{ML} = S_M - \frac{\beta + 2\alpha(1-\gamma)}{2\alpha(1-\gamma)}\varepsilon_M l_{MC} \tag{8}$$

The consumption level is given as shown below.

$$c = \frac{1-\alpha-\beta}{1-\alpha}\left(w_F(S_F - \varepsilon_F l_{FC}) + w_M(S_M - \varepsilon_M l_{MC})\right) \tag{9}$$

Then, substituting (5) and (6) into (2), the fertility is given as the following.

$$n = A\alpha(w_F S_F + w_M S_M)\left(\frac{\gamma}{\varepsilon_F w_F}\right)^{\gamma}\left(\frac{1-\gamma}{\varepsilon_M w_M}\right)^{1-\gamma} \tag{10}$$

Galor and Weil (1996) derive that an increase in the female wage rate reduces the child

[3] OECD Statics "Gender Wage Gap"
[4] This setting is considered by Apps and Rees (2009).

care time and raises the labor supply time because of an increase in opportunity cost for child care. Our paper produces the same result as that reported by Galor and Weil (1996). As shown by (10), an increase in the mother wage rate w_M decreases the child care time provided by the mother. However, because of the assumption of a fertility function (2), an increase in the mother wage rate w_M does not always decrease fertility. If the following inequality holds,

$$w_M > \frac{(1-\gamma)S_F}{\gamma S_M} w_F \tag{11}$$

then an increase in mother wage rate w_M raises the fertility. If the mother wage rate is low, then an increase in the mother wage rate brings about a high opportunity cost for child care. Consequently, the fertility rate decreases. However, if the mother wage rate is at a high level, then an increase in the mother wage rate raises the fertility because the effect of an increase in the household income level is greater than the effect of opportunity cost. The following proposition can be established.

Proposition 1

If the mother wage rate is higher than the certain level to hold (11), then an increase in the mother wage rate can always raise the fertility rate.

Now, we consider the stress level and fertility. If both the mental toughness S_F and S_M are at a high level, then the fertility rate can be high, too, because high mental toughness can increase the labor supply time and child care time. An increase in the child care time increases the fertility directly. In addition to this effect, an increase in labor supply time can bring about an increase in household income. Consequently, the household can afford to have more children.

Considering (5) and (6), the ratio of child care time is obtained as presented below.

$$\frac{l_{MC}}{l_{FC}} = \frac{(1-\gamma)\varepsilon_F w_F}{\gamma \varepsilon_M w_M} \tag{12}$$

The ratio of child care between the father and mother depends on the relative wage rate ratio $\frac{w_F}{w_M}$ and the effect on the relative stress ratio $\frac{\varepsilon_F}{\varepsilon_M}$. If, a large relative wage $\frac{w_F}{w_M}$ is obtained, a low mother's wage rate means that the mother provides a large amount of child care time. We infer that ε_M shows ease of providing child care given by the mother. With small ε_M, the child care time by the mother l_{MC} is greater than the time by the father l_{FC}. Then, child care is provided mainly by the mother.

Mental toughness S_F and S_M are regarded as the available total time allocated to labor time and child care time. An increase in S_F and S_M means an increase in the available

total time. By virtue of an increase in the total available time, the household can afford to have more children because of an increase in household income. The negative effect on stress ε_F and ε_M is regarded as the child care time to input a unit of child care. If a unit of child care time is small, then a father or mother can input more child care time. With small ε_M, child care is provided mainly by the mother, too.

3. Child Care Service Model

This section considers a case in which the household uses child care services to have children, not child care time. Defining the price of child care services per child as p, then the household lifetime budget constraint is given as presented below.

$$w_F l_{FL} + w_M l_{ML} = c + pn \tag{13}$$

We consider maximization of total utility $u_F + u_M$ subject to budget constraint (13). Then, the Lagrange equation is set as shown below.

$$\begin{aligned} L = {} & 2\alpha ln n + 2(1-\alpha-\beta) ln c + \beta ln(S_F - l_{FL}) + \beta ln(S_M - l_{ML}) \\ & - 2(1-\alpha-\beta) ln 2 + \lambda(w_F l_{FL} + w_M l_{ML} - c - pn) \end{aligned} \tag{14}$$

It is noteworthy that $l_{FC} = l_{MC} = 0$ because it is unnecessary to provide child care time. Then, the following allocation is obtainable.

$$n = \frac{\alpha}{p}(w_M S_M + w_F S_F) \tag{15}$$

$$l_{FL} = S_F - \frac{\beta(w_F S_F + w_M S_M)}{2w_F} \tag{16}$$

$$l_{ML} = S_M - \frac{\beta(w_F S_F + w_M S_M)}{2w_M} \tag{17}$$

$$c = (1-\alpha-\beta)(\mathrm{w_M S_M} + \mathrm{w_F S_F}) \tag{18}$$

Now, we consider the child care sector. Child care service is assumed to be produced by the production function as $Y^c = BL$, (0<B), as assumed by Yasuoka and Miyake (2010). $Y^c$and L respectively denote an aggregate child care service and aggregate labor input into child care service. The profit function π is shown as

$$\pi = pBL - w^c L. \tag{19}$$

Then, profit maximization reduces to $w^c = pB$. Assuming that free labor mobility of female labor reduces to $w^c = w_M$, then the price of child care service is given as $p = \frac{w_M}{B}$. Therefore, fertility (15) changes to

$$n = \alpha B\left(\frac{w_F}{w_M} S_F + S_M\right). \tag{20}$$

This result differs from the case of child care time shown by (10). In the case of child care services, an increase in the mother wage rate invariably decreases the fertility. Then,

the following proposition can be established.

Proposition 2

If the household uses child care services to have children, then an increase in the female wage rate always decreases fertility.

This result is the same as that reported by Galor and Weil (1996), who set a model by which the mother provides child care time after having children. For analyses in this section, child care service is set. In this model, there exists no opportunity cost to having children. However, the price of child care service depends on the wage rate: an increase in the female wage rate raises the price of child care service. Apps and Rees (2004) does not consider how the price of child care service is determined. Then, an increase in the female wage rate raises the fertility. However, if the price of child care service depends on the female wage rate, then an increase in the female wage rate decreases the fertility. This proposition is presented by Yasuoka and Miyake (2010) and by Day (2012).

Compared the fertility given by (10) with (20), the fertility given by (20) is greater than the fertility given by (10) if the following inequality holds.

$$\frac{w_M}{w_F} < \frac{\varepsilon_F}{\gamma}\left(\frac{\varepsilon_M}{1-\gamma}\right)^{\frac{1-\gamma}{\gamma}}\left(\frac{B}{A}\right)^{\frac{1}{\gamma}} \tag{21}$$

Then, the following proposition can be established.

Proposition 3

If the male–female wage inequality is too great to satisfy inequality (21), then fertility in the case of child care service is greater than the fertility in the case of child care time.

Proposition 3 shows that child care services can solve the problem of fewer children. If the female wage rate increases because of the policy such as a lack of male–female inequality, then the fertility brought about by the child care service might reduce the fertility if the inequality (21) is not held. Then, the child care should be provided by the child care time if the government aims to increase the fertility rate.

We examine the child care and mother stress conditions. The mother stress level is defined as $S_M - l_{ML} - \varepsilon_M l_{MC}$ in child care by the time and $S_M - l_{ML}^*$ in child care by the service. If $S_M - l_{ML}^* > S_M - l_{ML} - \varepsilon_M l_{MC}$, then the case of child care service has a better stress condition than the case of child care by time. However, considering (6), (8), (17), we can obtain $S_M - l_{ML}^* = S_M - l_{ML} - \varepsilon_M l_{MC}$. Therefore, child care services cannot improve

the stress condition because the mother increases working time instead of decreasing child care time by virtue of child care services.

We examine whether child care service can raise the household utility level, or not. Substituting (5)–(10) into (1), we obtain the utility level for the case of child care time. Substituting (16)–(18), (20) into (1), we obtain the utility level for the case of child care service. If the following inequality holds, the utility level for the case of child care service is larger than that of child care time.

$$w_M < \left(\frac{B}{A}\left(\frac{\varepsilon_F}{\gamma}\right)^{\gamma}\left(\frac{\varepsilon_M}{1-\gamma}\right)^{1-\gamma}\right)^{\frac{1}{\gamma}} w_F. \tag{22}$$

This result is intuitive. A high female wage rate w_M reflects that the price of child care service is high and that fertility is at a low level, which reduces the utility.

4. Work Life Balance

This section presents examination of the work–life balance and the fertility rate. Concretely, this section fixes the father's work time $l_{FL} = \bar{l}$. In fact, it is difficult to change the labor time as the father might desire because the household must obtain a certain level of income to live. Firms demand a certain level of work time. Because of the father's fixed work time, the father cannot provide sufficient child care time, which might cause a tendency to have fewer children. This section shows that the decrease in the father's work time promotes child care cooperation by the father and that fertility increases.

The household maximizes total utility $u_F + u_M$ subject to the fertility function (2) and budget constraint (3). The Lagrange equation is set as the following form.

$$\begin{aligned} L &= u_F + u_M + \lambda(w_F l_{FL} + w_M l_{ML} - c) \\ &= 2\alpha\gamma ln l_{FC} + 2\alpha(1-\gamma) ln l_{MC} + 2(1-\alpha-\beta) lnc + \beta ln\left(S_F - \bar{l} - \varepsilon_F l_{FC}\right) \\ &\quad + \beta ln(S_M - l_{ML} - \varepsilon_M l_{MC}) - 2(1-\alpha-\beta) ln2 + 2\alpha lnA \\ &\quad + \lambda(w_F l_{FL} + w_M l_{ML} - c) \end{aligned} \tag{23}$$

Then, the child care time provided by the father is derived as shown below.

$$l_{FC} = \frac{2\alpha\gamma}{\varepsilon_F(\beta + 2\alpha\gamma)}\left(S_F - \bar{l}\right). \tag{24}$$

A decrease in fixed labor time increases child care time by the father. This equation shows that fixed labor time reduces the child care time. Then, the mother's labor time and child care time are derived as follows.

$$l_{ML} = S_M - \frac{\beta + 2\alpha(1-\gamma)}{2\alpha(1-\gamma)}\varepsilon_M l_{MC}. \tag{25}$$

$$l_{MC} = \frac{2\alpha(1-\gamma)}{2(1-\alpha\gamma)-\beta}\frac{w_F\bar{l}+w_M S_M}{w_M\varepsilon_M}. \tag{26}$$

As shown by (25) and (26), a decrease in the fixed father's labor time increases the mother's labor time. If the fixed father labor time is at a high level, then the mother makes her labor time decrease and the mother's child care time is at a high level: the household time allocation is adjusted by the mother's time for cases in which the father cannot change his labor time. The burden of child care falls to the mother. Female labor participation does not increase.

Intuitively, if the father's working time is fixed at a level to hold (7), then the utility level is maximum. The problem of work–life balance considers overtime work, when the father works more than the level to (7). Then, a decrease in the father's fixed working time raises the household utility.

A decrease in the father's fixed working time can raise the fertility rate. If $\frac{dn}{d\bar{l}} < 0$, then the decrease in the fixed working time raises the fertility rate. Substituting (24) and (26) into (2), the fertility is derived as presented below.

$$n = A\left(\frac{2\alpha\gamma(S_F-\bar{l})}{\varepsilon_F(\beta+2\alpha\gamma)}\right)^{\gamma}\left(\frac{2\alpha(1-\gamma)}{2(1-\alpha\gamma)-\beta}\frac{w_F\bar{l}+w_M S_M}{w_M\varepsilon_M}\right)^{1-\gamma}. \tag{27}$$

The condition to hold $\frac{dn}{d\bar{l}} < 0$ is derived as shown below.

$$\bar{l} > \frac{(1-\gamma)S_F - \gamma S_M w_M}{w_F}. \tag{28}$$

With large $\bar{l}$ to hold the inequality shown by (28), a decrease in $\bar{l}$ raises the fertility rate. Even if a decrease in $\bar{l}$ has a negative effect on household income and raises female labor and decreases child care time by mothers, the child care time by fathers increases. This positive effect on the fertility rate is dominant in the economy to hold (28).

Moreover, a decrease in the fixed overtime work raises labor productivity. As shown by OECD data, long working times decrease labor productivity. If long working time decreases, then the wage rate rises as a result of increased labor productivity. Consequently, the household income rises. The household can afford to have more children.

The following table compares paid work and unpaid work of men in France, Japan, and Sweden.

[Inserted Table around here.]

In France and Sweden, the total fertility rate is higher than that in Japan. As shown by

the table, the paid work time in France and Sweden is shorter than that in Japan. However, time for unpaid work such as housekeeping in France and Sweden is longer than that in Japan. This fact reflects that men in Japan work long hours and spend less time for care at home. These facts can partially explain why the fertility rate in Japan is low. Our analyses derive that the fertility rate increases if men reduce working time and increase child care time, based on a model in which the child care of the father and the mother are mutually complementary.[5]

5. Conclusions

The analyses described in this paper derives that child care services can not always raise the fertility rate, even if the female labor participation rate increases. Yasuoka and Miyake (2010) and Day (2012) have described that demand for child care service raises the price of child care services and that demand might be reduced. An increase in the wage rate of female labor does not always decrease fertility, although child care by the mother decreases by virtue of an increase in child care by the father. These analyses show that child care by the parents' own time might be better than the case of child care services.

In addition, work–life balance should be considered. Because of fixed work times or overtime work by fathers, female labor participation might be low. Instead of child care by fathers, the mother provides child care. Results presented herein show that male labor flexibility should be regarded as raising female labor participation.

[5] If our paper assumes the fertility function as $n = A(\gamma l_{MC} + (1-\gamma) l_{FC})$, a reduction of $\bar{l}$ might raise the child care time provided by the father. Then, child care time by the mother decreases because of perfect substitution of child care time between the father and the mother. However, as long as the wage rate of the father is higher than that of the mother, a decrease in $\bar{l}$ reduces the total household income. Then the fertility might decrease.

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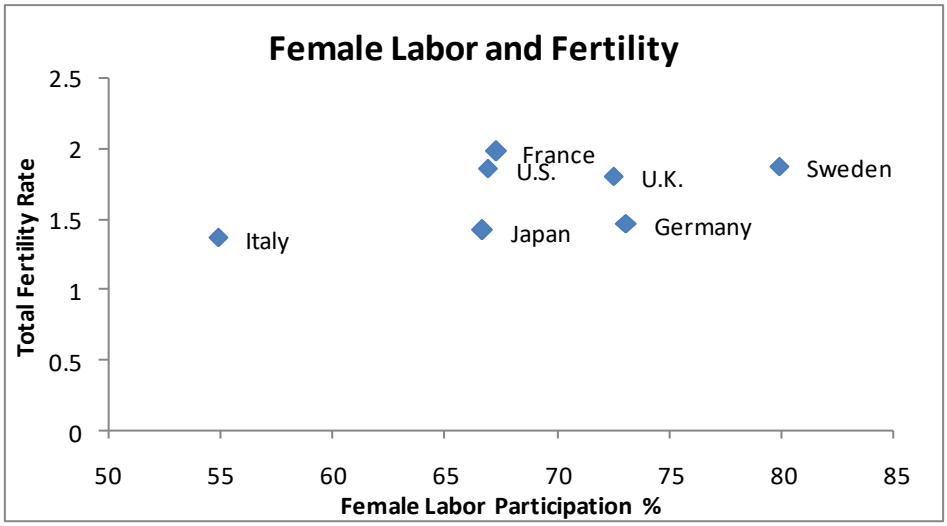

Fig. 1: Female Labor and Fertility.

(Data: OECD Statics, Female Labor Participation Rate at 2015 and Total Fertility Rate at 2014)

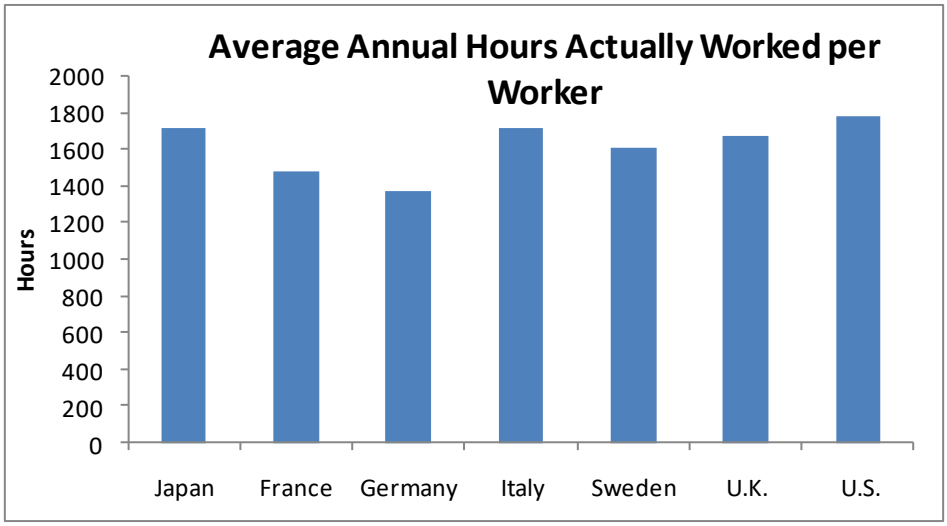

Fig. 2: Average Annual Hours Actually Worked per Worker.

(Data: OECD Statics, Data year is 2015.)

	Japan	France	Sweden
Paid Work	375	173	268
Unpaid Work	62	143	154

Table: Average Minutes Spent Per Day In Different Activities, Men Aged 15–64.
(Data: OECD (2014) Data "Balancing paid work, unpaid work and leisure")
Unpaid work includes routine housework, care for family members, child care, and so on.