The Relationship between Consumption, Labor Supply and Fertility - Theory and Evidence from Japan

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Abstract

We present an alternative explanation of the positive relationship between total fertility rate (TFR) and female labor participation rate (FLPR) observed in recent cross section of OECD countries. We first show quality adjusted consumption is related to fertility and female labor supply in a general equilibrium model with vertical quality differentiation and heterogeneous labor. Then we verify this relationship with Japanese cross sectional data from 8 different points in time (every five years from 1970 – 2005) in which a positive correlation between TFR and FLPR among prefectures (regions) have been observed since 1980. We show that consumption variables are statistically significant when they are added to the cross section regression of TFR on FLPR. However, the FLPR coefficient is no longer significant at the 5% level when quality of consumption variables are included in the regression. Furthermore, FLPR has a statistically significant negative effect on TFR in addition to the statistically significant consumption variables, once we take both time-variant regional heterogeneity of consumption and time-invariant heterogeneity into account using the fixed effect model.

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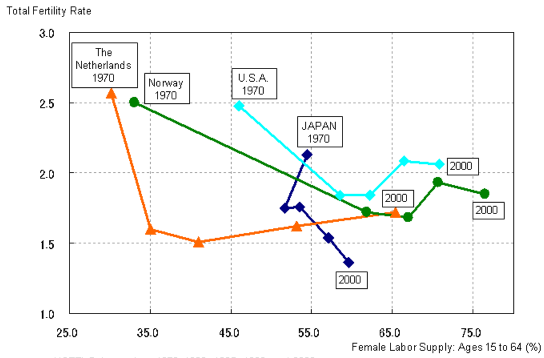
1 Introduction

In this paper we present an explanation to the positive relationship between fertility rate and female labor participation rate observed in cross section of OECD countries. We first show theoretically that there is a relationship between quality of consumption and number of children (Aoki (2008)). This reflects not only preference of workers between consumption and children but also the labor market and wages for skilled labor necessary for high quality goods and unskilled labor necessary for the standard goods. In particular the relationship between labor supply and number of children differ by skill level, meaning the relationship may be positive or negative. The theoretical implications are upheld by Japanese cross sectional data from 1970 to 2005. This constitutes the second half of the paper.

Time series among many OECD countries show negative relationship between female labor participation and TFR (Figure 1), while cross country in 2005 (average of years 1985-1996 as well as year 2000, Sleebos (2003), d'Addio and d'Ercole (2005), Da Rocha and Fuster (2006)) show a positive relationship. In Japan, although time series relationship has been negative for 1980 - 2000 (Figure 1) , cross section among prefectures show positive relationship in 1987 and 2002 (Figure 2). Obviously conditions that differ across regions in Japan are different from difference between two points in time. We also note that countries with high per capita GDP have low birthrates (Figure 3), suggesting low fertility may be correlated with high consumption.

The theoretical model is in the spirit to papers in growth and trade that take into account the reaction of the economy in the long run (Acemoglu (1998), Flam and Helpman (1987), Thoenig and Verdier (2003)). Acemoglu (1998) showed that while in the short run, labor input is reduced in response to scarcity of skilled labor and high wages, skilled labor supply increase in response triggers technological change that makes skilled labor even more productive, raising skilled labor wage in the long run. Our analysis suggests that a similar long term adjustment of the economy will prevent a natural feedback mechanism from working. That is, smaller population will increase marginal product of labor more productive in the short run but consumption pattern will change in the long run reducing such an advantage.

In Section 2 we present a theoretical framework that derives a relationship between quality of consumption and number of children. In Section 3, we verify the results using Japanese data from 1970 to 2000.

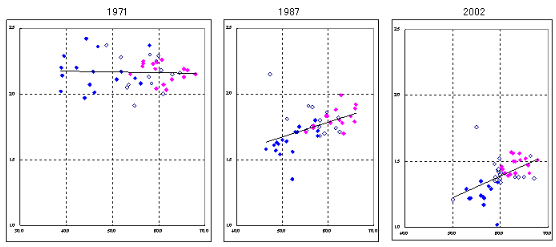


NOTE) 5 time points: 1970, 1980, 1985, 1990, and 2000.

FTR and female labor supply 1970,80,85,90,2000

(Council for Gender Equality, Special Committee on the Declining Birthrate and Gender-Equal Participation, 2006a)

Figure 1: Time Series TFR and Female Labor Supply, OECD Countries



NOTE) Pink points are TYPE1(low declining rate in TFR and high level of TFR and female labor supply). Blue points are TYPE7(high declining rate in TFR and low level in TFR and female labor supply).

Sources) Ministry of Internal Affairs and Communications "Employment Status Survey," National Institute of Population and Social Security Research "Indicators of Fertility by Prefecture in 1970-1985," and Health, Labor and Welfare Ministry "Population Survey Report."

FTR and female labor participation ratio by prefecture in 1971, 1987, 2002

(Council for Gender Equality, Special Committee on the Decling Birthrate and Gender-Equal Participation, 2006b)

Figure 2: Japanese TFR and FLPR by Region

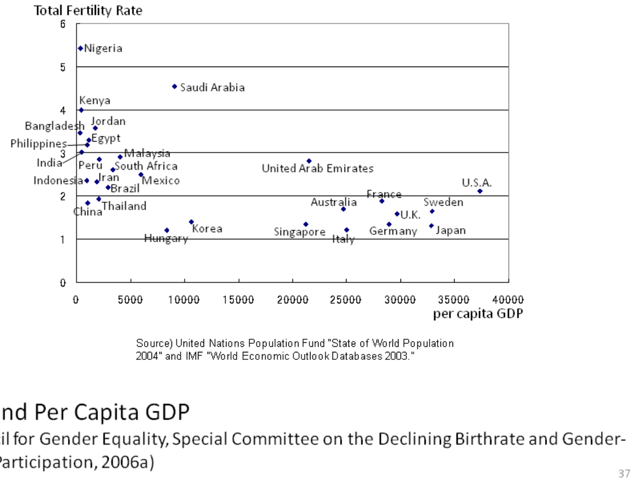


Figure 3: Cross Section TFR and Per Capita GDP

2 Theoretical Analysis

In this section we analyze a general equilibrium model in which consumers differ by two attributes, their preference and skill level of labor. Consumers choose either to consumer high quality product or standard (low quality) product. Child bearing choice differ according to which product they choose, as well as if they are skilled or not since wages differ according to skill level. Skilled workers produce the high quality product and the labor supply level determine the level of quality.

2.1 General Equilibrium with High Quality Product and Heterogenous Labor

Consumers

We simplify the consumer's problem so that she chooses between consumption (x) and childbearing (n). Her preference is represented by the following utility function which also depends on the quality of the good consumed, Q,

$$U_\rho(n, x) = (Qx^\rho + n^\rho)^{\frac{1}{\rho}}, \quad 0 < \rho < 1. \tag{1}$$

Consumers preference, ρ, is distributed uniformly over [0,1]. Consumption good is either the standard (low quality) $Q = 1$ or high quality $Q > 1$. Consumer's labor endowment is $\bar{\ell}$ and wage is w which is also the opportunity cost of children. Denoting price of the good by p, consumer chooses consumption and number of children to maximize (1) with respect to the budget constraint,

$$px + wn = w\bar{\ell}.$$

Each consumer's consumption and number of children given quality Q is determined by the utility maximization given the budget constraint,

$$x_\sigma^*(p, w; Q) = \frac{Q^\sigma \bar{\ell}}{(\frac{p}{w})^\sigma \left(Q^\sigma (\frac{p}{w})^{1-\sigma} + 1\right)}, \quad n_\sigma^*(p, w; Q) = \frac{\bar{\ell}}{Q^\sigma (\frac{p}{w})^{1-\sigma} + 1}, \tag{2}$$
$$\text{where } \sigma \equiv \frac{1}{1-\rho} > 1.$$

Consumption is increasing and number of children is decreasing in quality, as in the previous section. The indirect utility is,

$$v_\sigma(p, w; Q) = \bar{\ell} \left(Q^\sigma (\frac{w}{p})^{\sigma-1} + 1 \right)^{\frac{1}{\sigma-1}}.$$

The consumer must choose which quality to consume. If her marginal utility from more consumption is relatively large, she devotes less resources to children and has fewer children. If the quality is low and not as beneficial, she derives utility by having many children. She compares the utility levels from consuming each quality and buys whichever yields higher utility. We denote the prices of the goods with different qualities by p_H and p_L. Consumer will buy the high quality good when

$$v_\sigma(p_H, w; Q) > v_\sigma(p_L, w; 1).$$

This condition is equivalent to,

$$\sigma < \hat{\sigma} \equiv \frac{\ln \frac{p_H}{p_L}}{\ln \frac{p_H}{p_L} - \ln Q}. \tag{3}$$

Since $\sigma > 1$, there will be no demand for the low quality good if $\ln \frac{p_H}{p_L} < \ln Q$. This occurs if low quality product is more expensive ($p_L \geq p_H$) since $Q > 1$ and $p_H > p_L$ but the price premium for the high quality is small relative to difference in quality. It does not depend on the level of income.

Consumer's labor supply is the hours not devoted to raising children,

$$\ell_\sigma(p, w; Q) = \bar{\ell} - n_\sigma^*(p, w; Q) = \frac{Q^\sigma}{Q^\sigma + (\frac{p}{w})^{\sigma-1}}. \tag{4}$$

Markets

The labor each consumer supplies is either skilled (s) or unskilled (u). There are total of N consumers, and $\theta \in (0,1)$ of the consumers are skilled. Labor endowment, $\bar{\ell}$, is the same for both types. We denote wages for skilled and unskilled by w_s and w_u. Production technology is constant returns to scale in labor: one unit of skilled labor produces one unit of high quality product and one unit of unskilled labor produces one unit of the standard product. Furthermore we assume both products are supplied competitively, meaning $p_H = w_s$ and $p_L = w_u$.

One skilled worker's demand for high quality product is , denoting relative wage by $\xi = \frac{w_s}{w_u} > 1$ and using (2),

$$x_s^H(\xi) = x_\sigma^*(w_s, w_s; Q) = \frac{Q^\sigma \bar{\ell}}{Q^\sigma + 1}, \quad \sigma < \hat{\sigma} = \frac{\ln \xi}{\ln \xi - \ln Q},$$

and her demand for low quality product is,

$$x_s^L(\xi) = x_\sigma^*(w_u, w_s; Q) = \frac{\bar{\ell}}{\xi^{-\sigma}(\xi^{\sigma-1} + 1)}, \quad \sigma > \hat{\sigma}.$$

There will be positive demand for the low quality product only if $\xi > 1$ since $\xi = \frac{p_H}{p_L}$. We make the following observation

Claim 1. *High skilled consumers consume more of both quality,* $x_s^H(\xi) > x_u^H(\xi)$ *and* $x_s^L(\xi) > x_u^L(\xi)$.

Total demand from all the skilled workers for high quality product and low quality product are ,

$$\theta N \int_1^{\hat{\sigma}} x_s^H(\xi) d\sigma \text{ and } \theta N \int_{\hat{\sigma}}^{\infty} x_s^L d\sigma.$$

Similarly for unskilled workers, we have the individual demands for high quality good,

$$x_u^H(\xi) = x_\sigma^*(w_s, w_u; Q) = \frac{Q^\sigma \bar{\ell}}{\xi^\sigma \left(Q^\sigma \xi^{1-\sigma} + 1\right)}, \quad \sigma < \hat{\sigma} = \frac{\ln \xi}{\ln \xi - \ln Q},$$

and demand for low quality good,

$$x_u^L(\xi) = x_\sigma^*(w_u, w_u; Q) = \frac{\bar{\ell}}{2}, \quad \sigma > \hat{\sigma}.$$

Total demands for each quality from all unskilled workers are,

$$(1-\theta)N\int_1^{\hat{\sigma}} x_u^H(\xi)d\sigma \text{ and } (1-\theta)N\int_{\hat{\sigma}} x_u^L(\xi)d\sigma.$$

Since production of one unit of good requires one unit of labor, demand for skilled and unskilled labor, L_s^D and L_u^D are,

$$L_s^D(\xi) = \theta N\int_1^{\hat{\sigma}} x_s^H(\xi)d\sigma + \theta N\int_{\hat{\sigma}}^{\infty} x_s^L d\sigma, \tag{5}$$

$$L_u^D(\xi) = \theta N\int_1^{\hat{\sigma}} x_s^L(\xi)d\sigma + (1-\theta)N\int_{\hat{\sigma}} x_u^L(\xi)d\sigma. \tag{6}$$

Labor supply is constructed in a similar manner from individual supplies. Individual labor supply as function of relative wage is , using (4) ,

$$\ell_s^H(\xi) = \ell_\sigma^*(w_s, w_s; Q) = \frac{Q^\sigma \bar{\ell}}{Q^\sigma + 1}, \quad \sigma < \hat{\sigma},$$

$$\ell_s^L(\xi) = \ell_\sigma^*(w_u, w_s; 1) = \frac{\bar{\ell}}{\xi^{1-\sigma} + 1}, \quad \sigma > \hat{\sigma}$$

$$\ell_u^H(\xi) = \ell_\sigma^*(w_s, w_u; Q) = \frac{Q^\sigma \bar{\ell}}{Q^\sigma + \xi^{\sigma-1}}, \quad \sigma < \hat{\sigma},$$

$$\ell_u^L(\xi) = \ell_\sigma^*(w_u, w_u; 1) = \frac{\bar{\ell}}{2}, \quad \sigma > \hat{\sigma}.$$

Aggregation yields the total labor supply of each type,

$$L_s^S = N\bar{\ell}\int_1^{\hat{\sigma}} \left\{\ell_s^H(\xi) + \ell_s^L(\xi)\right\} d\sigma, \tag{7}$$

$$L_u^S = (1-\theta)N\bar{\ell}\int_{\hat{\sigma}}^{\infty} \left\{\ell_u^H(\xi) + \ell_u^L(\xi)\right\} d\sigma. \tag{8}$$

It is easy to show, from (3), that $\hat{\sigma}$ is decreasing in ξ that L_s^D and L_u^S is decreasing in $\xi = \frac{w_s}{w_u}$ and L_s^S and L_u^D are increasing in ξ. Equilibrium relative wage for a given quality level, $\xi^*(Q)$, is determined by the skilled labor market clearing condition,

$$L_s^D(\xi) = L_s^S(\xi).$$

The unskilled labor market has cleared by Walrus Law.

2.2 Comparative statics

We first see how the equilibrium labor supply and relative wage change with quality.

Claim 2. *(i)* L_s^S*,* L_u^S *and* L_s^D *are increasing and* L_u^D *are decreasing in* Q*.*

(ii) Equilibrium relative wages and level of skilled labor are increasing in quality. That is, $\partial\xi^*(Q)/\partial Q > 0$ *and* $\partial L_s^*(Q)/\partial Q > 0$*.*

(See Figures 4 and 5. Proof is in the Appendix.) Higher quality makes consumption attractive for skilled workers and also increases proportion of all workers that consume the high quality product. Thus both demand and supply of skilled labor is increasing in quality. The same effect increases the supply of unskilled workers and reduces demand for low quality good. The latter effect implies demand for unskilled workers decreases when quality improves.

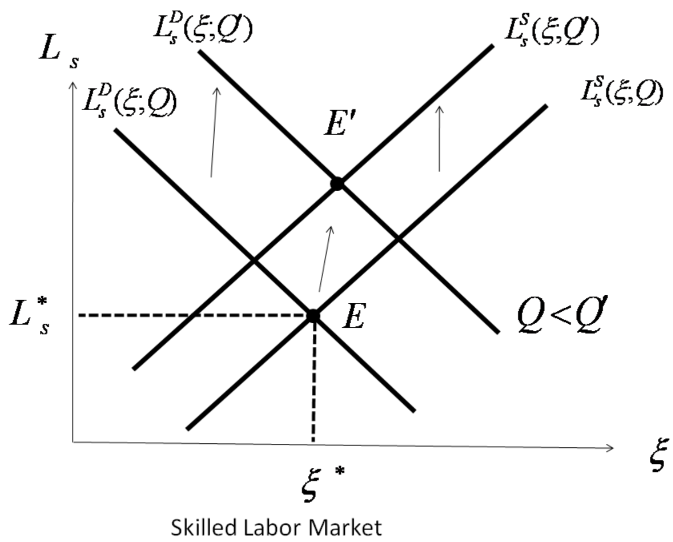


Figure 4: Equilibrium in Skilled Labor Market

Skilled labor supply is increasing in population, $\partial L_s^S/\partial N > 0$, from (7) and demand is also increasing in population, $\partial L_s^D/\partial N > 0$, from (5). (See proof of Claim 2 in the Appendix.) This implies

Claim 3. *Both equilibrium skilled and unskilled labor will increase when population increases,* $\partial L_s^*/\partial N > 0$ *and* $\partial L_u^*/\partial N > 0$*.*

Again, using the proof of Claim 2 in the Appendix, both demand and supply of skilled labor are also increasing in proportion of skilled consumers, $\partial L_s^S/\partial\theta > 0$, from (7) and $\partial L_s^D/\partial\theta > 0$, from (5).

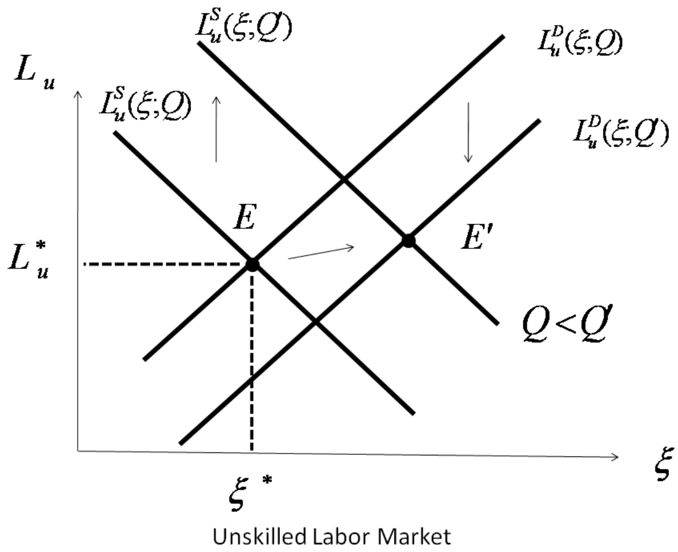


Figure 5: Equilibrium in Skilled Labor Market

Claim 4. *Equilibrium skilled labor and equilibrium relative wage are increasing in the proportion of skilled consumers,*$\partial L_s^*/\partial\theta > 0$ *and* $\partial\xi^*/\partial\theta > 0$.

Birthrate

Individual number of children are,

$$n_s^H(\xi) = n_\sigma^*(w_s, w_s; Q) = \frac{\bar{\ell}}{Q^\sigma + 1}, \quad \sigma < \hat{\sigma},$$
$$n_s^L(\xi) = n_\sigma^*(w_u, w_s; 1) = \frac{\bar{\ell}}{\xi^{\sigma-1} + 1}, \quad \sigma > \hat{\sigma}$$
$$n_u^H(\xi) = n_\sigma^*(w_s, w_u; Q) = \frac{\bar{\ell}}{Q^\sigma \xi^{1-\sigma} + 1}, \quad \sigma < \hat{\sigma},$$
$$n_u^L(\xi) = n_\sigma^*(w_u, w_u; 1) = \frac{\bar{\ell}}{2}, \quad \sigma > \hat{\sigma}.$$

It is clear that for given wage level, those that consume high quality good devoted even more resources for consumption and thus reduce number of children when quality improves. Since the equilibrium relative wage is increasing in quality, we can say the following,

Claim 5. *(i) Skilled consumers have less children . That is ,* $n_s^H < n_u^H$ *for* $\sigma < \hat{\sigma}$ *and* $n_s^L < n_u^L$ *for* $\sigma > \hat{\sigma}$.

(ii) Skilled consumers have less children when quality of product improves.

That is, $dn_s^H/dQ < 0$ for $\sigma < \hat{\sigma}$ and $dn_s^L/dQ < 0$ for $\sigma > \hat{\sigma}$.

(iii) *Unskilled consumers that consume low quality product have the same number of children when quality improves. That is, $dn_u^L/dQ = 0$ for $\sigma > \hat{\sigma}$.*

The substitution effect dominates for skilled workers that consume low quality and they reduce number of children. For unskilled consumers that bought high quality good, improvement makes consumption more attractive (reduce children) but their relative wage becomes lower and the income effect works in the opposite direction. The total effect is not clear.

Endogenous quality

We have so far assumed that quality Q is exogenously determined. In this section we pride a brief explanation of how quality can be determined endogenously. Assume that level of quality is increasing in the size of the skilled labor. That is, $Q = Q_T(L_s)$ is an increasing function of Q. Subscript T refers to "technology" which is what this relationship reflects. We will denote the inverse relationship between the market equilibrium supply of skilled labor and quality of $L_s^*(Q)$ by $Q = Q_M(L_s)$, which is an increasing function from Claim 2. The equilibrium level of labor L_s^* and equilibrium level of quality, $Q^* = Q_M(L_s^*) = Q_T(L_s^*)$, is the intersection of the two curves.

When marginal increase in quality from labor is very large, then the equilibrium is unstable. Graphically, this would mean slope of Q_T is steeper than Q_M $(Q_T' > Q_M')$. This is the case around equilibrium E_1 in Figure 6. A perturbation away from E_1 results in either spiral increase in quality and skilled labor supply or decrease of quality and skilled labor supply. When technology is mature so that marginal quality improvement is very small, then equilibrium is stable $(Q_T' < Q_M')$. This is equilibrium E_2 in Figure 6. There may be multiple equilibria, some stable and others unstable. A slight perturbation from low quality with small skilled labor force will start a spiral of labor and quality improvement until E_2 is reached.

3 Empirical Application

In this section we examine the empirical evidence to support the theoretical implications of the previous sections. In Section 3.1, we present the data with descriptive statistics and confirm the positive relationship between total fertility rate (TFR) and female labor participation rate (FLPR) among regions (prefectures) in Japan, as seen in other OECD countries. We present the estimation results in Section 3.2. We estimate the equations that assume that regional TFR

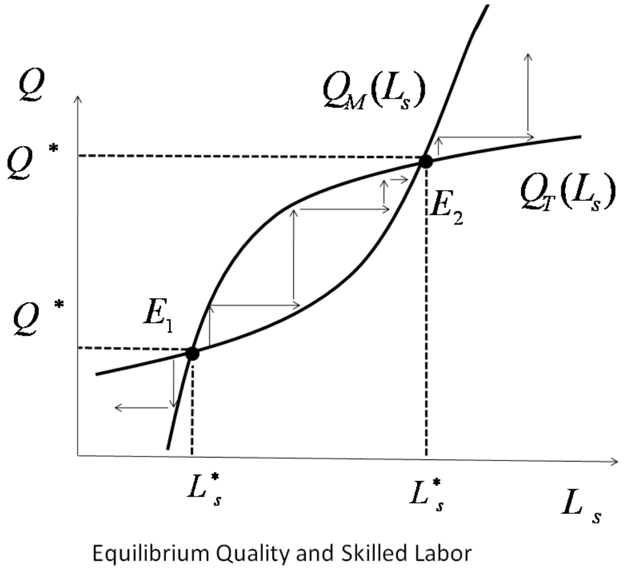


Figure 6: Equilibrium Relationship Between Quality and Skilled Labor

is affected by regional variables that reflect quality or variety of consumption goods. Specifically we consider household leisure and entertainment expenditures, automobile ownership, and number of department stores as explanatory variables, in addition to the traditional marriage and other family variables. We employ the fixed effects model to take into account the unobserved heterogeneity among regions.

3.1 Data and Descriptive Statistics

We use data from 47 prefectures for years 1970, 75, 80, 85, 90, 2000, and 2005 (Okinawa prefecture is not included in 1970). Figure 7 plots correlation coefficients between regional TFR and FLRP by the 8 years from 1970 – 2005. The coefficient is negative for 1975 but is positive thereafter. For the last few years, the correlation is not only positive but close to 0.5 , a very clear positive relationship between TFR and FLRP. This is similar to the phenomenon observed in other OECD countries in recent years. We will be controlling for consumption variables implied by the proceeding theoretical model to understand the relationship.

The labels and source of the variables for the regression in the next section are summarized in Table 1. We introduce some new variables as determinants of TFR in addition to the traditional marriage variables. In order to capture quality of consumption, we use proportion of leisure and entertainment expenditure

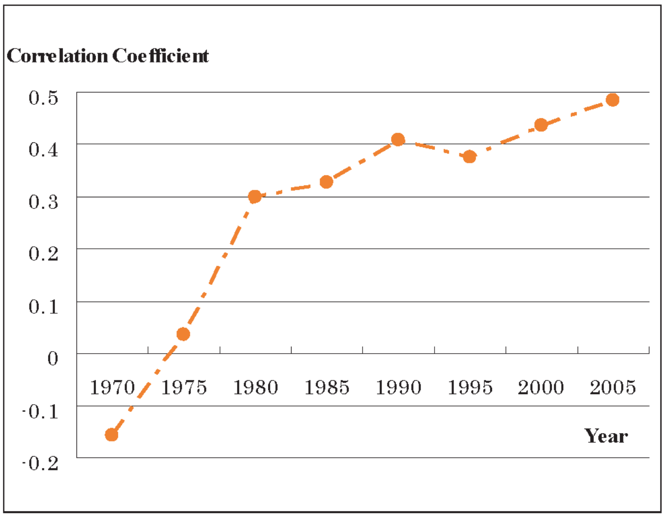


Figure 7: Correlation Coefficient by Year

in household expenditure , automobile ownership per working population, and number of department stores, which usually specialize in high end products.

Table 2 summarizes the change through time by depicting mean, standard deviation, minimum and maximum values for each variable for each year. The steady decline of TFR is striking and TFR in 2005 has been decreased to almost one-half of that in 1975. The number of married couples has been declining as well. FLPR declines slightly in the period, but the standard deviation has changed from 6.313 (in 1975) to 2.467 (in 2005), implying that prefectures have become more homogeneous for FLPR. There is a similar phenomenon in marriage standard deviation. On the other hand, we also observe that some variables have had rising means (proportion of one-person households, proportion of leisure and entertainment expenditure, automobile ownership rate and number of department stores), especially means of automobile ownership and the number of department store have risen substantially. And their standard deviations have increased, suggesting they could be better explanatory variables for heterogeneity of prefectures. In Section 3.2 we regress TFR on FLPR and other variables, and apply the fixed effect model to our panel data to incorporate unobservable heterogeneity among prefectures.

Table 2: Descriptive Statistics

Table 1: Description of Variables

Var. Name	Description	Data
TFR	Total Fertility Rate	the Vital Statistics
FLPR	Famale Labor Force Participation Rate	the Labour Force Survey
Marriages	# of married couple at the year /1000	the Vital Statistics
One-person Household	# of one-person households/ # of Private households	the Population Census
Leisure & Entertainment	Reading and recreation expenditure / Living expenditure	the Family Income and Expenditure Survey
Automobile Ownership	# of automobiles / the working population	Automobile Inspection & Registration
Department Store	# of department stores	the Unincorporated Enteprise Survey

Variable	Year	Mean	S.D.	Min	Max	Obs.
TFR	1970	2.092	0.116	1.88	2.35	46
	1975	2.001	0.165	1.63	2.88	47
	1980	1.829	0.135	1.44	2.38	47
	1985	1.825	0.125	1.44	2.31	47
	1990	1.616	0.125	1.23	1.95	47
	1995	1.525	0.134	1.11	1.87	47
	2000	1.473	0.133	1.07	1.82	47
	2005	1.307	0.122	0.98	1.71	47
FLPR	1970	54.48	6.313	40.2	65.5	46
	1975	48.55	5.730	35.7	58.8	47
	1980	49.06	5.260	36.3	59.4	47
	1985	49.26	4.398	37.6	57.5	47
	1990	49.39	3.743	38.7	56.3	47
	1995	49.87	3.178	40.7	56.1	47
	2000	48.91	2.850	40.8	54.0	47
	2005	48.57	2.467	41.9	53.1	47
Marriages	1970	8.980	1.458	6.4	12.5	46
	1975	7.987	0.695	6.5	9.6	47
	1980	6.383	0.496	5.3	7.7	47
	1985	5.853	0.429	5.1	7.3	47
	1990	5.453	0.570	4.5	7.0	47
	1995	5.885	0.658	4.8	7.6	47
	2000	5.936	0.589	4.8	7.4	47
	2005	5.272	0.554	4.3	6.9	47
One-person Household	1970	N.A.	N.A.	N.A.	N.A.	N.A.
	1975	0.113	0.033	0.068	0.256	47
	1980	0.130	0.033	0.083	0.267	47
	1985	0.180	0.039	0.121	0.339	47
	1990	0.201	0.039	0.143	0.359	47
One-person Household	1995	0.229	0.039	0.176	0.381	47
	2000	0.250	0.040	0.191	0.409	47
	2005	0.267	0.040	0.209	0.425	47
Leisure & Entertainment	1970	N.A.	N.A.	N.A.	N.A.	N.A.
	1975	0.0827	0.008	0.063	0.106	47
	1980	0.0849	0.009	0.068	0.111	47
	1985	0.0884	0.008	0.070	0.115	47

Variable	Year	Mean	S.D.	Min	Max	Obs.
	1990	0.0952	0.008	0.080	0.113	47
	1995	0.0960	0.010	0.076	0.121	47
	2000	0.1001	0.009	0.080	0.120	47
	2005	0.1021	0.010	0.076	0.127	47
Automobile Ownership	1970	0.120	0.027	0.068	0.184	46
	1975	0.238	0.038	0.164	0.333	47
	1980	0.319	0.048	0.212	0.443	47
	1985	0.354	0.051	0.246	0.478	47
	1990	0.428	0.056	0.304	0.560	47
	1995	0.561	0.078	0.341	0.718	47
	2000	0.681	0.105	0.358	0.852	47
	2005	0.773	0.127	0.365	0.956	47
Department Store	1970	17.196	20.72	3	123	46
	1975	29.213	37.56	4	203	47
	1980	35.532	41.94	2	231	47
	1985	51.617	59.26	7	300	47
	1990	57.106	59.05	5	242	47
	1995	44.596	45.37	3	235	47
	2000	65.085	63.89	11	322	47
	2005	63.447	60.69	12	295	47

3.2 Estimation Results

Table 3 is from cross section regression of TFR on all variables in Table 2. The regression equation is,

$$TFR_i = c + \beta_1 FLPR_i + \beta_2 Marriage_i + \beta_3 Oneperson_i \quad (9)$$
$$+\beta_4 Leisure_i + \beta_5 Automobile_i + \beta_6 Dpt.Store_i + \epsilon_i, \quad (1)$$

where $i = 1, \ldots, 47$, c is the constant term, $\beta_j, j = 1, \ldots, 6$ are unknown parameters and ϵ is the error term.

Table 3 only shows the estimated coefficient($\hat{\beta_1}$) of FLRP and $**$ indicates the null hypothesis $\beta_1 = 0$ can be rejected at 5% significance level. Although we could observe positive correlation between FRP and FLRP by the Pearson's Correlation Coefficient (See Figure 7), after adding to the consumption variables, the FLPR coefficient is no longer significant at the 5% level. However, the coefficient is significantly positive when cross sections are pooled for 1975 – 2005 with $\beta_{FLRP} = 0.066$.

Table 3: Estimation Coefficient of FLPR

1975	1980	1985	1990
-0.002	0.0072	0.0029	0.0072
1995	2000	2005	1970-2005
0.0056	0.0064	0.070	0.0066$**$

We believe that the variables we employ do not completely explain the heterogeneity of TFR. We suspect that there must be correlate with the error term, which causes a bias in the OLS estimators, as is often the case. To address this problem, we assume the heterogeneity among the prefectures is time invariant and apply the fixed effect model to our panel data which will guarantee a consistent estimation even with unobservable heterogeneity. We show the estimation results in Table 4, Column 1 of Table 4 is the pooled OLS regression result of equation 10, where $t = 1975, \ldots, 2005$ and α is the constant term.

$$TFR_{i,t} = \alpha + \beta_1 FLPR_{i,t} + \beta_2 Marriage_{i,t} + \beta_3 Oneperson_{i,t} \quad (10)$$
$$+\beta_4 Leisure_{i,t} + \beta_5 Automobile_{i,t} + \beta_6 Dpt.Store_{i,t} + \epsilon_{i,t} \quad (2)$$

Column 2 is regression result of equation 3. This is a fixed effects model that takes into account of heterogeneity(α) and FLRP is the only dependent variable.

$$TFR_{i,t} = \alpha_i + \beta_1 FLPR_{i,t} + \epsilon_{i,t} \tag{3}$$

FLPR coefficients become significantly positive the two regressions, (10) and (refreg3).

Column 3 shows a regression results of equation 4, where we obtain the negative coefficient of FLPR and it is significant.

$$\begin{aligned} TFR_{i,t} = \alpha_i + \beta_1 FLPR_{i,t} + \beta_2 Marriage_{i,t} + \beta_3 Oneperson_{i,t} \\ + \beta_4 Leisure_{i,t} + \beta_5 Automobile_{i,t} + \beta_6 Dpt.Store_{i,t} + \epsilon_{i,t}. \end{aligned} \tag{4}$$

We summarize the estimation results of other variables briefly. The coefficient marriages, which we expected has positive correlation with TFR, is significantly positive, the region which has large number of married couples rather than other region achieve at higher TFR. High proportion of one-person households, proportion of leisure and entertainment expenditure and automobile ownership rate all give negative impact on TFR. In column 1, although we could see the negative correlation of department store numbers with TFR, it is not significant.

We conclude that our empirical investigation confirms the explanations of TFR and FLPR relationships of the theoretical model. Variables that capture consumption quality, such as household leisure and entertainment expenditures, automobile ownership, and number of department stores, have significant coefficients when they are added to the cross section regression model of TFR regressed on FLPR. And the FLPR coefficient is no longer significant at the 5% level (See Table 3). Furthermore, we found that FLPR has a statistically significant negative effect on TFR while consumption variables are statistically significant, once we take both time-variant regional heterogeneity of consumption and time-invariant heterogeneity into account using the fixed effect model.We also note that our results suggest that much of the distinction between the urban and rural areas in fertility patterns (Council for Gender Equality, Special Committee on the Declining Birthrate and Gender-Equal Participation, 2006b), can be explained by the differences in consumption patterns.

4 Concluding Remarks

In this paper we have presented an alternative explanation of the positive relationship between total fertility rate (TFR) and female labor participation rate (FLPR) observed in a cross section of OECD countries in recent years.

Table 4: Estimation Results

	Pooled OLS	Fixed Effect Model 1	Fixed Effect Model 2
Variables	Coefficients (t-value)	Coefficients (t-value)	Coefficients (t-value)
FLPR	0.0066(2.21)**	0.029 (5.32)**	-0.025 (-9.14)**
Marriages	0.053 (6.02)**		0.044 (7.05)**
One-person - households	-1.174 (-6.25)**		-0.626 (-2.52)**
Leisure & Entertainment	-4.162 (-5.66)**		-1.597 (-3.11)**
Automobile - ownership	-0.415 (-7.47)**		-0.819 (-13.60**)
Department - store	-0.001 (-6.54)**		0.0003 (1.12)
constant	1.889 (13.82)**	0.216 (0.77)	3.237 (23.76)**
R^2	0.806	0.079	0.937
Hausman Test	N.A.	7.88**	51.51**
Obs.	329	375	329

In the first half, we showed how low fertility is associated with consumption of higher quality products using a general equilibrium model with vertical quality differentiation and heterogeneous labor. Higher quality product has two effects: it makes consumption more attractive but also increases wage for skilled workers. The second effect make working more attractive and the resulting income effect implies having more children or consuming more higher quality product or both. If the income effect dominates, higher labor participation and higher birthrate will be observed when income effect dominates. If the substitution effect dominates, the relationship will be negative. In both cases, there will be a negative relationship between birthrate and consumption.

In the second half, we employed Japanese cross section from 8 different points in time (every five years from 1970 – 2005), that have also shown a positive correlation between TFR and FLPR in recent years to test the theory. We have shown significant coefficients for consumption variables when they are added to the cross section regression of TFR on FLPR. However, the FLPR coefficient is no longer significant at the 5% level once the consumption variables are included. Furthermore, FLPR has a statistically significant negative effect on TFR, and also consumption variables are statistically significant in a fixed effects model. The results are consistent with our new model as well as traditional economic models of the relation between TFR and FLPR.

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Appendix

Proof of Claim 2

The demand and supply functions, (5),(6), (7), and (8), can be rewritten as,

$$L_s^S = \theta N\bar{\ell}\int_1^\infty \frac{Q^\sigma}{Q^\sigma + \xi^{1-\sigma}}d\sigma + \theta N\bar{\ell}\int_{\hat{\sigma}}^\infty \left\{\frac{Q^\sigma}{Q^\sigma + \xi^{1-\sigma}} - \frac{Q^\sigma}{Q^\sigma + 1}\right\} d\sigma$$

$$L_s^D = \theta N\bar{\ell}\int_1^{\hat{\sigma}} \frac{Q^\sigma}{Q^\sigma + 1}d\sigma + (1-\theta)N\bar{\ell}\int_1^{\hat{\sigma}} \frac{Q^\sigma}{Q^\sigma\xi + \xi^\sigma}d\sigma$$

$$L_u^S = (1-\theta)N\bar{\ell}\int_1^\infty \left\{\frac{Q^\sigma\xi^{1-\sigma}}{Q^\sigma\xi^{1-\sigma} + 1} - \frac{1}{2}\right\} d\sigma + (1-\theta)N\bar{\ell}\int_1^\infty \frac{1}{2}d\sigma,$$

$$L_u^D = (1-\theta)N\bar{\ell}\int_{\hat{\sigma}}^\infty \frac{1}{2}d\sigma + \theta N\bar{\ell}\int_{\hat{\sigma}}^\infty 1\xi^{-1} + \xi^{-\sigma}d\sigma.$$

The claim follows from noting that $\hat{\sigma}$ is decreasing in ξ and increasing in Q, and that $Q^\sigma\xi^{1-\sigma} > 1$ for $\sigma < \hat{\sigma}$.