	σ								
CRO	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
$c_B = 2$									
No	0	0	6.04	10.33	14.26	17.83	21.04	15.22	18.00
E	0	0	12.11	13.13	13.42	13.24	12.99	12.83	12.78
U (0.45)	0	7.30	16.20	18.75	19.91	20.35	20.47	20.50	20.50
U (0.75)	0	0	13.64	18.40	21.81	24.10	25.49	26.20	26.46
S	0	7.30	16.20	19.58	19.91	20.35	20.47	20.50	20.50
$c_B = 4$									
No	0	0	0	0	4.89	7.67	10.44	13.22	16.00
E	0	0	0	0	12.69	15.00	16.36	16.78	16.25
U (0.45)	0	0	0	11.00	15.13	18.10	19.49	20.20	20.46
U (0.75)	0	0	0	0	9.75	18.50	21.13	21.00	24.75
S	0	0	0	11.00	15.13	18.50	19.49	20.20	20.46
$c_B = 6$									
No	0	0	0	0	0	5.67	8.44	11.22	14.00
E	0	0	0	0	7.75	11.50	15.25	19.00	22.75
U (0.45)	0	0	0	0	7.75	11.50	15.25	19.00	20.13
U (0.75)	0	0	0	0	7.75	11.50	15.25	19.00	22.75
S	0	0	0	0	7.75	11.50	15.25	19.00	20.13

Table 7: Simulated equilibrium welfare levels in model 2 given $c_A = 5$. 'No': No CRO, 'E': Equal CRO, 'U (z)': Unequal CRO, 'S': Strict CRO.

CIS Discussion Paper No.420

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 use a simple model of consumer behavior where consumption good is indexed by quality, both consumption and child rearing require time and a physical good as inputs. The model predicts that while the relationship between number of children and consumption will always be negative, relationship with hours worked is ambiguous when there is positive relationship between wages and quality of goods. We verify implications of the model 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. However, we found that FLPR has a significantly negative effect on TFR after dealing with unobservable heterogeneity, simultaneity or endogeneity problem and the measurement error problem by Fixed effect IV estimation. The results are consistent with the theoretical prediction as well as traditional economic models of the relation between TFR and FLPR. Furthermore, consumption variables are statistically significant and high-quality consumptions have negative impact on TFR.

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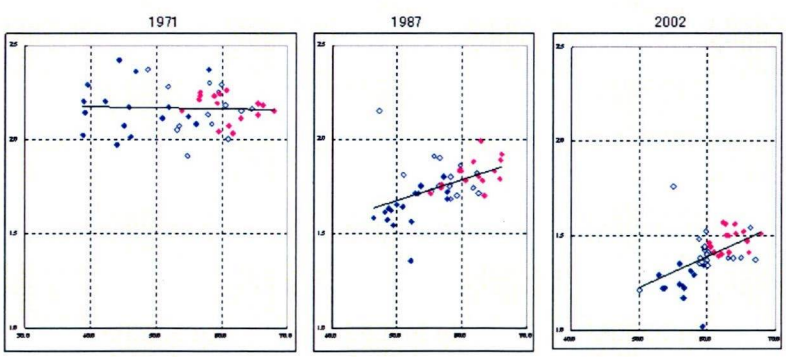
1 Introduction

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 how number of children, consumption and hours worked relate to quality of consumption good and wages (Aoki (2008)) when both consumption and children require time and physical good as inputs. Allocation of time between number of children, consumption, and hours worked is determined by the relative wage and quality of consumption. Increase in wages can increase both hours worked and number of children because substitution away from labor intensive child-rearing is possible. Increase in quality increases consumption and decreases number of children because marginal utility from consumption becomes greater. If there are positive relationships between quality of goods and wages, the relationship between number of children and hours worked is ambiguous. The theoretical implications are upheld by Japanese cross sectional data from 1970 to 2005. This constitutes the second half of the paper.



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."

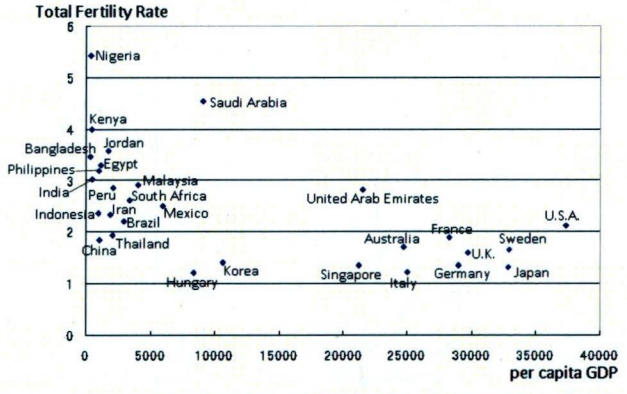
FTR and female labor participation ratio by prefecture in 1971, 1987, 2002

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

Figure 1: Japanese TFR and FLPR by Region

The cross-sectional positive relationship between female labor participation rate (FLPR) and total fertility rate (TFR) among OECD countries in recent years has attracted considerable attention. The positive relationship is robust, observed using averages of years 1985-1996 as well as years point values for 2000 and 2005 (Sleebos (2003), d'Addio and d'Ercole (2005), Da Rocha and Fuster (2006)). In Japan also, cross section among prefectures show positive relationship in last two decades (Figure 1).

The positive relationship is contrary to the traditional explanation (Becker (1965)) where cost of children is the forgone income from not working. This implies a negative relationship between labor participation and birth rate. To explain the new positive relationship, De Rocha and Fuster (2006) focus on the negative cross-country relationship between unemployment rates and birth rate and argue that labor market friction effects labor participation and birth rate. They incorporate labor market friction into a quantitative life cycle model and show a positive relationship between fertility and labor participation. Higher labor market friction increases the cost of interrupting work to have children because it is more difficult for mothers to go back to work. Higher friction leads to low female labor participation and low birthrate. De Rocha and Fuster show among other things that the differences in FLRP and TFR between Spain and U.S.A. can be attributed to such friction.



Source) United Nations Population Fund "State of World Population 2004" and IMF "World Economic Outlook Databases 2003."

TFR and Per Capita GDP

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

Figure 2: Cross Section TFR and Per Capita GDP

We focus on the cross-country relationship between per capita GDP and

TFP (Figure). Mincer(1962) and Becker(1965) would argue that higher wages associated with higher per capita GDP raises opportunity cost of children and thus there should be a negative relationship between per capita GDP and TFP, contrary to what is observed. We suspect that higher per capita GDP is associated with greater consumption opportunities, in particular, that higher quality and variety of goods become available with higher per capita GDP.

We first use a simple consumer optimization model that incorporates quality of the consumption good, and the fact that consumption requires time. The cost of having children is the opportunity cost of consumption in addition to forgone income from working less. We show that the optimal labor supply and number of children are both increasing in quality, while consumption and number of children will always have a negative relationship.

We confirm the theoretical implications with cross-sectional data of 47 prefectures for every five years over the period 1970-2005. We have shown 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 estimate the equations that assume that regional TFR is affected by regional variables that reflect quality or variety of consumption goods. Specifically we consider household leisure and entertainment expenditures and automobile ownership as consumers' behaviors variables, and the number of restaurants, convenience stores, supermarket stores and department stores as proxy variables for quality or variety of consumption goods, in addition to the traditional marriage and other family variables. Obviously, the decisions of child bearing and female labor market participation are simultaneously determined, and there would be endogenous relationship between TFR and consumption behaviors in our theoretical model.

Furthermore, because the quality and variety of consumption goods are latent variables, we employ some proxy variables in our estimation models. We have simultaneity or endogeneity problem and measurement error problem by using proxy variables, OLS estimator cannot be a consistent estimator. Therefore, we apply the fixed effects instrumental variables (FE-IV) method to our pànel data in order to deal with these econometric problems and also take into account the unobserved heterogeneity among regions. As a result, we find that FLPR has a significantly negative effect on TFR after dealing with unobservable heterogeneity, simultaneity or endogeneity problem and the measurement error problem by Fixed effect IV estimation. The results are consistent with our new model as well as traditional economic models of the relation between TFR and FLPR. Furthermore, consumption variables are statistically significant and high-quality consumptions have negative impact on TFR in Fixed effects IV model. We could show the empirical evidence to support the our new model.

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 2005.

2 Theoretical framework

We assume that a utility of a household depends on number of children, n, consumption of a good x. Both child rearing and consumption of a good requires time. Number of children is determined by amount of good x_c, and time devoted, ℓ_c,

$$n = f(x_c, \ell_c), \quad f_x > 0, f_\ell > 0.$$

Subscripts on functions denote partial derivatives. The utility of consumer is actually determined by amount of z, which is consumption experience that depends on amount of the good, x, and time devoted, ℓ,

$$z = g(x, \ell), \quad g_x > 0, g_\ell > 0.$$

Utility function is,

$$u(n, z), u_n > 0, u_z > 0.$$

Budget constraint depends on price of good and wage, and labor endowment, $\bar{\ell}$,

$$px + px_c + w\ell + w\ell_c = w\bar{\ell}.$$

Figure 3 demonstrates the optimization problem. The opportunity set is defined as,

$$\left\{(z, n) | u(f(x_c, \ell_c), g(x, \ell)), \quad p(x + x_c) + w(\ell + \ell_c) = w\bar{\ell}\right\}.$$

The frontier is downward sloping (see Appendix). It reflects the budget constraint as well as the technologies, g and f. When wage increases, the opportunity set expands. (Dotted line in Figure 3) We can show that

Claim 1. *Under regularity conditions, hours worked increases and number of children increase or consumption increases or both when wage increases. That is, denoting equilibrium quantities as ℓ_c^*, x_c^*, ℓ^*, and x^*, if $u(n, z)$, $f(x, l)$ and $g(x, c)$ are concave, then*

$$\frac{\partial \ell_c^*}{\partial w} < 0, \frac{\partial \ell^*}{\partial w} < 0, \text{ and } \frac{df(x_c^*, \ell_c^*)}{dw} > 0 \text{ or } \frac{dg(x^*, \ell^*)}{dw} > 0 \text{ or both.}$$

Proof is in the Appendix. The result is intuitive. When wage increases,

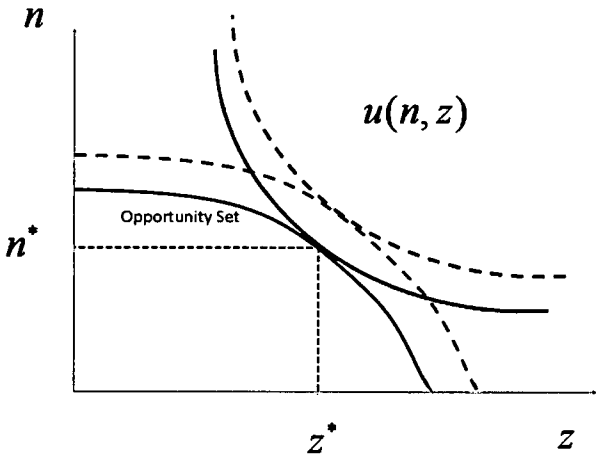


Figure 3: The Opportunity Set

there is substitution away from labor to goods, which increases hours worked. Higher wage expands the budget set and will increase x_c. This may off set the decline in ℓ_c which increases number of children despite lower ℓ_c, i.e., more hours worked. A positive relationship between labor participation and child birth is observed.

We further index consumption (more precisely, the consumption experience) by quality, Q. Utility function is

$$u(Qz, n)$$

where z measures quantity of consumption. First-order conditions for utility maximization are,

$$\frac{f_x}{f_\ell} = \frac{g_x}{g_\ell} = \frac{p}{w}, \tag{1}$$

$$\frac{u_n}{u_z} = Q\frac{g_x}{f_x}. \tag{2}$$

Equation (1) implies less labor intensive consumption and child rearing method will be used when wage increase, as observed before. The time series of female wage has been rising in Japan would lead to less labor intensive methods which means greater labor participation. From equation (2), we have

Claim 2. *Higher quality of the consumption good implies more consumption*

and less number of children. That is,

$$\frac{\partial n^*}{\partial Q} < 0, \quad \frac{\partial z^*}{\partial Q} > 0.$$

When quality of consumption goods and wages are compared through time and across regions there is a positive relationship between quality and wages. Claim 3 implies higher wage increases number of children but higher quality decreases number of children. Turning to relationship between number of children and number of hours worked, higher wage but not significantly higher quality means a positive relationship. However with the same higher relative wage and higher quality consumption means negative relationship between labor participation and fertility. Availability of consumption goods, such as entertainment and restaurants, is much greater in larger cities. This means higher Q, meaning less children and more consumption in cities.

3 Empirical Application

In this section we examine the empirical evidence to support the theoretical findings 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 cross-section of OECD countries. The estimation results are presented in Section 3.2.

We estimate the equations assuming that regional TFR is affected by regional variables that reflect quality or variety of consumption goods. Specifically we include household leisure and entertainment expenditures and automobile ownership as consumption behavior variables, and number of restaurants, convenience stores, supermarket stores and department stores as proxy variables for quality or variety of consumption goods, in addition to the traditional marriage and other family variables. Child bearing and female labor market participation are determined simultaneously which implies there is a simultaneous or endogeneous relationship between TFR and consumption behavior variables.

Furthermore, because the quality and variety of consumption goods are latent variables, we employ some proxy variables in our estimation models. With the aforementioned simultaneity or endogeneity problem and measurement error problem from the proxy variables, OLS estimator cannot be a consistent estimator. To address these econometric issues, we apply the fixed effects instrumental variables (FE-IV) method to our panel data. The approach also allows us 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, 95, 2000, and 2005 (Okinawa prefecture is not included in 1970). Figure 4 plots correlation coefficients between regional TFR and FLRP by the 8 years from 1970 – 2005. The coefficient is negative for 1970 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.

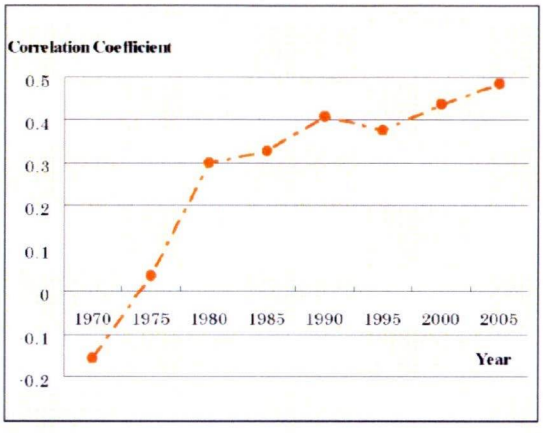


Figure 4: Correlation Coefficient by Year

3.1.1 Data description

The labels and source of the regression variables are summarized in Table 1. We introduce some new variables as determinants of TFR in addition to the traditional female labor participation rate, marriages and household variables. Specifically we consider household leisure and entertainment expenditures and automobile ownership as the consumer behavior variables that capture optimal consumption choice. In order to reflect quality or variety of consumption goods, we use the number of restaurants, convenience stores, supermarket stores and department stores, which differ by quality and variety of products.

In the previous section we showed how number of children is always decreasing in quality of consumption but can be increasing or decreasing in wages.

Hours worked will always increase with wages. Consumption is increasing in quality. Given higher quality associated with higher wages, there is always a negative relationship between consumption and number of children, the relationship greater for higher quality consumption. On the other hand, the relationship between low fertility and labor supply can be positive or negative.

Now we briefly describe our independent variables. FLPR, Marriages and One Person Household are all variables traditionally known to have an impact on TFR. FLPR is the simultaneous variable, Marriages is the exogenous variable and One Person Household might be a proxy variable for capturing the share of the young aged group's population. Based on our theoretical analysis, we expect the the coefficient of FLPR can be positive/negative and coefficients on Marriages and One Person Household to be positive.

Leisure and Entertainment Expenditure and Automobile Ownership are the consumer behavior variables and are endogenous, chosen simultaneously with child bearing decision. We expect both Leisure and Automobile to be high quality goods and have negative impacts on TFR.

We use Restaurant, Convenience store, Supermarket and Department stores as proxy variables for quality or variety of consumption goods. The supermarkets sell mainly basic foods and everyday household items, i.e., a small variety of standard quality goods. Convenience stores sell goods similar to that of supermarkets, but prices are higher and items are more selected than Supermarket stores, focusing on urban households. They sell a small variety of high quality goods. Department stores have both higher quality and greater variety than the pervious two. The Restaurant variable is the number of all types of drinking and eating establishments, including both high or low quality well as various variety of cuisines. Therefore we are unable to *a priori* make any claims how it will impact TFR. We expect the sign of Department's coefficient to be negative.

3.1.2 Descriptive Statistics

Table 2 summarizes TFR's 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 by 2005 it had decreased to almost one-half of that in 1970 while standard deviation has been increasing slightly. The number of Marries has been declining as well. FLPR declined 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 with respect to FLPR. There is a similar phenomenon in Marriages standard deviation. On the other hand, we also observe that the means of other variables have been rising (proportion of one-person households, proportion of leisure and enter-

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 marriged couple at the year per 1000 Pop.	the Vital Statistics
One-person Household	# of one-person households/ # of Private households	the Population Census
Automobile Ownership	# of automobiles / the working population	Automobile Inspection & Registration
Leisure & Entertainment	Reading and recreation / Living expenditure	the Family Income and Expenditure Survey
Restaurant	# of eating and drinking places	the Unincorporated Enteprise Survey
Supermarket Store	# of self-service store	Census of Commerce
Convenience Store	# of convenience store	Census of Commerce
Department Store	# of department store	the Unincorporated Enterprize Survey

tainment expenditure, automobile ownership rate, the numbers of restaurants, convenience stores, supermarket stores and department stores), especially the means of automobile ownership and the number of department stores 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

Variables	**Year**	**Mean**	**S.D.**	**Min.**	**Max.**
TFR	1970	2.092	0.115	1.88	2.35
	1975	2.006	0.165	1.63	2.88
	1980	1.829	0.135	1.44	2.38
	1985	1.825	0.125	1.44	2.31
	1990	1.616	0.125	1.23	1.95
	1995	1.525	0.134	1.11	1.87
	2000	1.473	0.133	1.07	1.82
	2005	1.307	0.122	0.98	1.71
FLPR	1970	54.483	6.313	40.2	65.5
	1975	48.545	5.73	35.7	58.8
	1980	49.057	5.26	36.3	59.4
	1985	49.264	4.398	37.6	57.5
	1990	49.385	3.744	38.7	56.3
	1995	49.868	3.178	40.7	56.1
	2000	48.909	2.849	40.8	54.0
	2005	48.572	2.467	41.9	53.1
Marriages	1970	8.980	1.458	6.4	12.5
	1975	7.987	0.695	6.5	9.6
	1980	6.383	0.497	5.3	7.7
	1985	5.853	0.430	5.1	7.3
	1990	5.453	0.570	4.5	7.0
	1995	5.885	0.658	4.8	7.6
	2000	5.936	0.590	4.8	7.4
	2005	5.272	0.554	4.3	6.9
One-person Household	1970	N/A	N/A	N/A	N/A
	1975	0.113	0.033	0.068	0.256
	1980	0.13	0.033	0.083	0.267
	1985	0.18	0.039	0.121	0.339

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Variables	Year	Mean	S.D.	Min.	Max.
	1990	0.201	0.039	0.143	0.359
	1995	0.229	0.039	0.176	0.381
	2000	0.249	0.04	0.191	0.409
	2005	0.267	0.04	0.209	0.425
Automobile Ownership	1970	0.12	0.027	0.068	0.184
	1975	0.238	0.038	0.164	0.333
	1980	0.319	0.048	0.212	0.443
	1985	0.354	0.051	0.246	0.478
	1990	0.428	0.057	0.304	0.560
	1995	0.561	0.078	0.342	0.718
	2000	0.681	0.105	0.358	0.852
	2005	0.773	0.127	0.365	0.957
Leisure & Entertainment	1970	N/A	N/A	N/A	N/A
	1975	0.083	0.008	0.063	0.106
	1980	0.085	0.009	0.068	0.111
	1985	0.088	0.009	0.07	0.115
	1990	0.095	0.008	0.08	0.113
	1995	0.096	0.01	0.076	0.121
	2000	0.101	0.009	0.08	0.12
	2005	0.102	0.01	0.076	0.127
Restaurant	1970	N/A	N/A	N/A	N/A
	1975	12163.638	15011.113	2638	86704
	1978	14603.234	17740.033	3273	100721
	1981	16908.66	20005.405	3789	111758
	1986	17931.021	20618.633	3998	112749
	1991	18006.34	20511.633	3991	110432
	1996	17794.83	20240.277	3738	109528
	2001	16909.532	18863.461	3643	102534
Supermarket Store	1970	N/A	N/A	N/A	N/A
	1975	N/A	N/A	N/A	N/A
	1982	1893.915	1427.827	503	7203
	1985	2050.766	1629.074	453	7280
	1988	2056	1657.621	493	6812
	1994	2980.319	2646.905	816	13258
	1999	3472.255	3040.502	843	16721
	2004	3190.191	2875.23	792	15597
Convenience Store	1970	N/A	N/A	N/A	N/A

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Variables	Year	Mean	S.D.	Min.	Max.
	1975	N/A	N/A	N/A	N/A
	1982	494.362	388.129	110	2118
	1985	622.043	546.115	115	2812
	1988	735.106	680.476	159	3380
	1994	1029.894	982.972	223	5050
	1999	843.149	929.309	134	5074
	2004	909.319	995.575	142	5453
Department Store	1969	17.196	20.722	3	123
	1975	29.213	37.56	4	203
	1978	35.532	41.937	2	231
	1981	51.617	59.258	7	300
	1986	57.106	59.045	5	242
	1991	44.596	45.377	3	235
	1996	65.085	63.898	11	322
	2001	63.447	60.699	12	295

3.2 Estimation Results

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

$$\begin{aligned} TFR_i &= c + \beta_1 FLPR_i + \beta_2 Marriages_i + \beta_3 Oneperson_i \\ &+ \beta_4 Automobile_i + \beta_5 Leisure_i + \beta_6 Restaurant_i + \beta_7 Supermarket_i \\ &+ \beta_8 ConvenienceStore_i + \beta_9 Dpt.Store_i + \epsilon_i, \end{aligned} \tag{3}$$

where $i = 1, \ldots, 47$, c is the constant term, $\beta_j, j = 1, \ldots, 9$ are unknown parameters and ϵ is the error term.

Table 3 only shows the estimated coefficient($\hat{\beta}_1$) of FLRP and $**, ***$ indicate that the null hypothesis $\beta_1 = 0$ can be rejected at 10% and 5% significance levels, respectively. Although we could observe positive correlation between FRP and FLRP by the Pearson's Correlation Coefficient (See Figure 4), addition of other variables in Table 2 to the regression makes the FLPR coefficients are significantly positive in 1990 with $\beta_{FLRP} = 0.011$. Pooling cross sections for 1980 – 2005 results in $\beta_{FLRP} = 0.012$. In the other periods, the coefficients are no longer significant at the 5% level.

We believe that the variables we employ do not completely explain the heterogeneity of TFR among prefectures. We suspect that there must be correlated with the error term, which causes a bias in the OLS estimator. To address this

Table 3: Estimation Coefficients of FLPR

year	1980	1985	1990	1995	2000	2005	1980-2005
Cefficient	0.009*	0.005	0.011**	0.005	0.011*	0.010	0.012**
Std. Err.	(0.005)	(0.004)	(0.005)	(0.006)	(0.006)	(0.005)	(0.001)

Significant Level: * : 10% ** : 5%

problem, we assume the heterogeneity among prefectures is time invariant and apply fixed effect model to our panel date.

We show the estimation results in Table 4, Column 1 of Table 4 is the pooled OLS regression result of equation 3, where $t = 1980, \ldots, 2005$ and c is the constant term. We showed the same result in Table 3, the FLPR coefficient is significantly positive with 0.012. Column 2 is result of equation 4 where α is the constant term and $t = 1970, \ldots, 2005$. This is a fixed effects model that takes into account of heterogeneity(α) and FLRP and Marriages are only the dependent variables, as in the previous studies. The FLPR coefficient is not significant at the 5% level, even the sign is negative.

$$TFR_{i,t} = \alpha_i + \beta_1 FLPR_{i,t} + \beta_2 Marriages_{i,t} + \epsilon_{i,t} \tag{4}$$

Comparison of Column 2-4 allows us to understand the effects of consumption variables more clearly. Column 3 shows a fixed regression result of equation 5, where $t = 1980, \ldots, 2005$ and we obtain the negative coefficient of FLPR and it is significant.

$$\begin{aligned} TFR_{i,t} &= \alpha_i + \beta_1 FLPR_{i,t} + \beta_2 Marriages_{i,t} + \beta_3 Oneperson_{i,t} \\ &+ \beta_4 Automobile_{i,t} + \beta_5 Leisure_{i,t} + \beta_6 Restaurant_{i,t} + \beta_7 Supermarket_{i,t} \\ &+ \beta_8 ConvenienceStore_{i,t} + \beta_9 Dpt.Store_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{5}$$

As we pointed out previously, we must address the simultaneity and endogeneity between TFR, FLPR, and consumer behavior variables as well as the latency of proxy variables for the quality or variety of consumption goods. To this end, we employ the fixed effects instrumental variables model (FE-IV model), which will guarantee a consistent estimator even unobservable heterogeneity, simultaneous problem or measurement error problem. We employ the lagged variables of FLPR, Marriages, and the other consumption expenditures (e.g. expenses for food, lighting and heating, furniture, transportation expenses and so on) as instrumental variables, and Marriages is the exogenous variable. Column 4

shows a Fixed effect IV estimation results of equation 5. We conclude that this result is our final result in the analysis.

We focus the analyze on the impact of FLPR on TFR, the coefficient of FLPR is significantly negative after controlling the effect of consumption and dealing with the econometric problems. The coefficient of Marriages is significantly positive, the region which has large number of married couples rather than other region achieve at higher TFR. There is a same phenomenon in the proportion of one-person households. We observe the significantly negative effects of Automobile Ownership and Leisure and Entertainment on TFR. Restaurant is not significant which may not be surprising since given the fact that the variables is a mixture of all types of drinking and eating establishments and it might not capture variety nor quality of consumption goods.

Table 4: Estimation Results

	Pooled OLS Model1	Fixed Effect Model 2	Fixed Effect Model 3	Fixed Effect IV Model 4
Variables	Coef. (S.E.)	Coef. (S.E.)	Coef. (S.E.)	Coef. (S.E.)
FLPR	0.012***	-0.005	-0.017***	-0.013**
	(0.002)	(0.004)	(0.003)	(0.007)
Marriages	0.092***	0.171***	0.072***	0.056**
	(0.014)	(0.007)	(0.012)	(0.023)
One-person-	-0.892***		0.160	2.344***
households	(0.187)		(0.300)	(0.817)
Automobile	-0.460***		-0.934***	-1.454***
ownership	(0.055)		(0.065)	(0.201)
Leisure	-3.526***		-1.318**	-2.470*
& Entertainment	(0.731)		(0.511)	(1.466)
Restaurant	-0.003**		0.002	0.007
	(0.001)		(0.003)	(0.006)
Supermarket-	-0.017		0.000	0.098**
store	(0.011)		(0.008)	(0.042)
Convenience-	-0.032		-0.097***	-0.441***
store	(0.028)		(0.026)	(0.130)
Department-	0.264		0.254	-1.856**
store	(0.373)		(0.290)	(0.870)
Const.	1.327***	0.861***	2.608***	2.478***
	(0.166)	(0.170)	(0.174)	(0.326)
adj. R2	0.803	0.673	0.930	0.864
Hausman Test	N/A	35.60 ***	50.68***	19.03**
Obs.	282	375	282	282

Significant Level: * : 10% ** : 5% *** : 1%

On the other hand, the coefficient of Supermarket stores is significantly positive, supermarkets sell only food and everyday household (standard) goods, they have a fewer variety and less quality goods. Both coefficients of Convenience stores and Department store are negative and significant. They could describe the differences between rural and urban areas , due to the specialized focus of convenience stores mentioned previously. Obviously, department stores have more variety and high quality goods, and they give the negative impact on TFR as predicted by our theoretical model. Finally, we see that the coefficients of Supermarket and Department are significant in the FE-IV model result.

We conclude that our empirical investigation confirms the explanations of TFR and FLPR relationships implied by the theoretical model. We found that FLPR has a statistically significant negative effect on TFR while consumption variables are statistically significant. 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. We note that the use of fixed effects instrumental variables model (FE-IV model) guarantees a consistent estimator.

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.

In the first half, we used a very simple but none the less realistic model of consumer optimization that interprets consumption as a kind of "consumption experience", where the consumption is indexed buy quality and time input is required to consume it. Thus the opportunity set is defined by sum of time required to consume and raise children. The important implications of this framework is that there is always a trade-off between consumption and children because both require the scare resource time. Higher wage will increase both labor participation and number of children because it is possible to substitute away from labor intensive child rearing. On the other hand, higher quality of consumption good will reduce number of children because marginal utility of consumption becomes higher relative to that of children. When there is a positive relationship between quality of products and wages, the relationship between number of children and hours worked is ambiguous. But consumption and number of children will always have a negative relationship.

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. However, we found that FLPR has a significantly negative effect on TFR after dealing with unobservable heterogeneity, simultaneity or endogeneity problem and the measurement error problem by Fixed effect IV estimation. The results are consistent with our new model as well as traditional economic models of the relation between TFR and FLPR. Furthermore, consumption variables are statistically significant and high-quality consumptions have negative impact on TFR in Fixed effects IV model. We could show the empirical evidence to support the our new model.

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Appendix

Optimization of $u(Qx, n)$

Denoting the Lagrange multiplier by λ, fist-order conditions are,

$$u_n f_x = \lambda p, \quad u_n f_\ell = \lambda w, \quad u_n g_x = \lambda p, \quad u_n g_\ell = \lambda w,$$

and the budget constraint. This implies

$$\frac{f_x}{f_\ell} = \frac{g_x}{g_\ell} = \frac{p}{w}.$$

When w increases, ℓ_c and ℓ decrease while x and x_c increase.