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社会保障と経済の相互関係に関する研究

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厚生労働科学研究費補助金（政策科学総合研究研究事業）
総括研究報告書

社会保障と経済の相互関係に関する研究

研究代表者　青木　玲子　一橋大学　経済研究所　教授

研究要旨
我が国が直面する少子化と人口減少下での少子化・社会保障政策の効果を、過去の政策の再検討を通じて経済的に分析する。特に、
1）品質差別と労働の熟練・非熟練労働のあるモデルにおいて、従来の就業と出産と異なり、消費と出産のトレードオフを定式化した。都道府県別・時系列データを使って、消費と出生率との負の関係を検証した。さらに、消費を回帰に含めると就業率の出生率への有意な負の影響がなくなることを示した。
2）相対的に低スキルながら状況に応じた対人対応が求められる非定型手仕事業務が増加した背景を、高齢化、世帯規模の縮小等の人口動態等傾向的な要因、一時的な経済環境（所得）の影響、需要者としての高スキル就業者の増加等、需要面から分析した。世帯の個票及び都道府県別の職業別就業者のデータを用いた分析によると、人口動態上の変化や高スキル就業者の増加が非定型手仕事型の個人向けサービスの需要を高めたことが示唆された。
3）多数の消費者がある程の効用をみいだす「標準品」と極少数の消費者が非常に高い効用をみいだす「特注品」といった区別を反映することができる「スポーク型」品質差別のモデルを新たに構築した。均衡の分析により、保育や医療サービスの市場でそれぞれの子供や患者にあった医療を提供するためにはある程度のサービス提供者が市場に存在しなければ不可能なことがわかった。

青木玲子　一橋経済研究所　教授

A．研究目的

少子化の影響と政策の効果を理論分析と過去のデータを使って分析する。特に地域差のデータを使うことによって過去の政策をふくむ地域差がその後の出生率や労働市場にどのように影響しているかを都道府県データの利用により解明する。また、少子化と高齢化によるサービスと財のニーズの多様化に対応できるサービスの模索のために理論モデルの発展モデルを構築した。

B．研究方法

1．消費財の質と労働者のスキル（熟練度）の差で説明する理論モデルを構築し、国内の出産、就業行動の地域差を説明可能にした。都道府県データを用いて実証研究を行った。（青木・小西、小西）

2．人口減少、超高齢化と就業構造との関係を検討した。相対的に低スキルながら状況に応じた対応が求められる非定型手仕事業務の増加に対して、家計や地域の属性の変化で説明力を持つことを実証的に分析した。（池永）

3．スポーク型ホテリング・モデルにより、「標準型」と「特注型」財またはサービスを捕らえ、市場構造と均衡で供給される財と価格の関係を分析する。（青木）

４．少子化研究会を今年度も行った。発表は一橋大学経済研究所・世代間問題研究機構が中心となっているが、一橋内外の報告者・参加者がいた。強いてテーマのみ統一し、経済学者、法学者、官庁出身者など、方法論は異なるメンバーになっている。

C．研究結果

１．理論モデルが示す、クオリティやバラエティの違いを考慮することで、従来までのモデルでは説明できなかった出生率と女性の労働力化率の関係を説明することが可能となった。

２．人口減少、超高齢化と就業構造との関係について実証分析した。世帯の個票データ、都道府県別の就業者データを用いた分析の結果、非定型手仕事業務増加の背景には高齢化の進展、世帯規模の縮小という人口動態上の変化や高スキル就業者の増加があることが示唆された。

３．独占企業は標準製品を供給する。寡占市場でも、消費者の多様性に比べて企業数が少ない場合は必ず先行企業は標準商品を供給する。企業の数が相対的に多くなると、すべての企業が特注品を供給するようになる。よって、標準製品の存在は市場が消費者の多様性のわりに企業の数が少ない市場であることを示唆している。

４．消費や労働形態は少子化の説明要因であることが他の報告でも示された。

D．考察

１．出生率関数に消費行動を含むことが有用であることをサポートする結果となった。わが国の1980 年代以降の出生率に関しては、女性の就業行動、家計の消費行動と大きく関わっており、特に女性の社会進出は出生率をわずかではあるが引き下げる効果を持っていることがわかった。単純な相関係数の計測結果とは全く異なるものであり、わが国の現状はマクロ経済で時系列データを用いて観察される出生率と女性の労働力化率と整合的である。

２．世帯の個人向けサービスの支出割合の二時点の差について、サンプル世帯の属性の差以外の要因（介護保険制度の導入や新たなサービスの登場等）も無視できない寄与を示している。

３．少子化・高齢化により医療サービスやケア・サービスのニーズは多様化する。その場合、すべての人がニーズにより対応したサービスを受けられることを保障するには、十分多くの企業の参入が望ましい。

４．データの検証により、逆に少子化と高齢化による人口構造の変化が消費や労働形態に変化を及ぼしていることが示された。
今後は少子化と人口構造の変化が消費と労働形態に及ぼす影響を考慮した理論分析と実証分析を行う必要がある。

E．結論

１．近年、OECD 諸国でも議論されている、地域分析における出生率と女性の労働力化率の正の相関が観察されるメカニズムを明らかにした。さらに、上述のクオリティコントロールをすることで、地域分析においても出生率と女性の労働力化率に経済理論と整合的な関係が見られることが示された。

２．非定型手仕事業務増加の背景には高齢化の進展、世帯規模の縮小という人口動態上の変化や高スキル就業者の増加があることが示唆された

３．少子化や高齢化によって変化していく社会に対応するにあったて、経済政策、とくに競争法も考慮する必要がある。

４．今後は少子化と人口構造の変化が消費と労働形態に及ぼす影響を考慮した理論分析と実証分析を行う必要がある。

F．健康危険情報
該当しない。

G．研究発表

1.　論文発表
池永肇恵「日本における労働市場の二極化と非定型・低スキル就業について」（未公表）

R. Aoki and Y. Konishi, "The Relationship betweeen Consumption, Labor Supply and Fertility - Theory and Evidence from Japan" CIS ディスカッションペーパー 420

2.　学会発表
池永肇恵　一橋大学産業・労働ワークショップで発表（2009 年 1 月 27 日）

小西葉子　関西計量経済学研究会（2009 年 1 月１０日）で、"The Relationship between Consumption, Labor Supply and Fertility: Theory and Evidence from Japan" を報告 。

青木玲子　Econometric Society North American Winter Meetings（2009 年 1 月 3 日）で、"The Relationship between Consumption, Labor Supply and Fertility: Theory and Evidence from Japan" を報告 。

H．知的財産権の出願・登録状況
（予定を含む。）
該当しない。

厚生労働科学研究費補助金（政策科学総合研究研究事業）
分担研究報告書

社会保障と経済の相互関係に関する研究
—理論と実証—

研究代表者　青木　玲子　一橋大学　健在研究所
研究分担者　小西　葉子　独立行政法人　経済産業研究所　研究員

研究要旨　財の品質差別化と労働の熟練・非熟練の区別のある一般均衡モデルを構築し、労働参加と出生率の関係の他に、消費と出生率のトレードオフを明らかにした。都道府県別、時系列（1975-２００５年、５年おき）の出生率、就業率、消費の指標（百貨店店舗数、教養・娯楽支出など）を使って、モデルの検証を行った。出生率に女子就業率を回帰すると係数が負であるが、消費変数も回帰しると、それらの係数が負であり、女子就業率の係数は有意でなくなる。

A．研究目的

OECD 諸国のクロスカントリー分析では、労働力参加率と出生率には正の相関がみられ、女性の社会進出率が高い国ほど出生率が高いという逆転の現象が起きている。一方、日本、韓国などでは時系列は負の関係を保っている。日本においては、時系列データでみると女性の労働市場への参加率の上昇と共に出生率の低下とが観察されているが、都道府県データを用いたクロスセクション分析では、1980 年代後半からは、女性の社会進出率が高い都道府県ほど出生率も高くなっている。これは出生率と女子就業率の関係は単なるトレードオフではないことを示している。これら現象と整合的な理論モデルを構築し、データで検証する。

B．研究方法

一般均衡モデルに以下の要素を導入し、均衡を求める。

1. 消費財には標準製品（低質）と高級品（高質）とがある。
2. 個人の子供（出産）と消費の代替性は個人によって異なる（ヘテロネジェネイティー）。
3. 熟練労働と非熟練労働の2タイプの労働
4. 各消費者は労働（非熟練、熟練）でもある。
5. 高質財は熟練労働によって、低質財は未熟練労働によって生産される。
6. 均衡では両労働市場（塾・非熟）と両財市場（高・低質）市場がクリアする。

「人口動態調査」、「全国消費実態調査」、「自動車保有台数統計データ」、「労働力調査」、「国勢調査」、「個人企業経済調査報告」を使って、「出生率」、「女子労働就業率」、「婚姻率」、「単身家族数」、「教養娯楽支出」、「自動車保有率」、「百貨店店舗数」などを 1975～2005 年間の５年おきの時系列を都道府県別にまとめた。

C．研究結果

出生率に女子就業率を回帰すると係数が負であるが、消費変数も回帰しると、それらの係数が負であり、女子就業率の係数は有意でなくなる。

D．考察

出生率低下の背景は単に女子の労働参加以外の複雑な社会・経済の変化がある。労働条件の改善だけでは出生率の変化は期待できない。

E．結論

出生率低下の背景は単に女子の労働参加以外の複雑な社会・経済の変化がある。労働条件の改善だけでは出生率の変化は期待できない。労働参加以外に教育・娯楽もふくむ消費活動が円滑にできる社会システムも考慮する必要がある。労働以外の社会復帰や余暇の創出を援助する社会体制を考えるべきである。

F．健康危険情報
該当しない。

G．研究発表
1. 論文発表
R. Aoki and Y. Konishi, "The Relationship betweeen Consumption, Labor Supply and Fertility - Theory and Evidence from Japan" CIS ディスカッションペーパー 420

2. 学会発表
青木玲子 Econometric Society North American Winter Meetings (2009年1月3日)で、"The Relationship between Consumption, Labor Supply and Fertility: Theory and Evidence from Japan"を報告。

H．知的財産権の出願・登録状況
該当しない。

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

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2 January, 2009

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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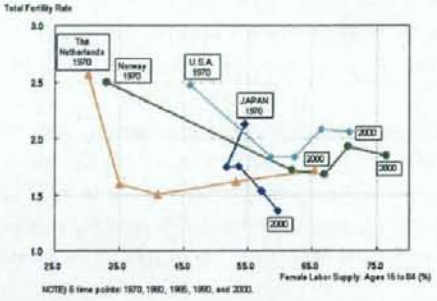
1 Introduction

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.

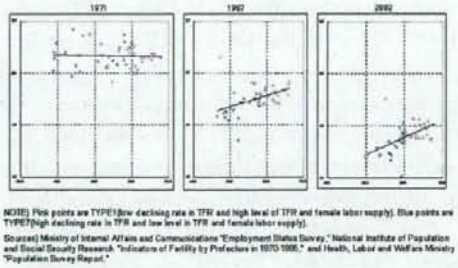
The theoretical model is in the spirit to papers in growth and trade that take into account the reaction of the economy in the long run (Acemoglu (1998), Flam and Helpman (1987), Thoenig and Verdier (2003)). Acemoglu (1998) showed that while in the short run, labor input is reduced in response to scarcity 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.



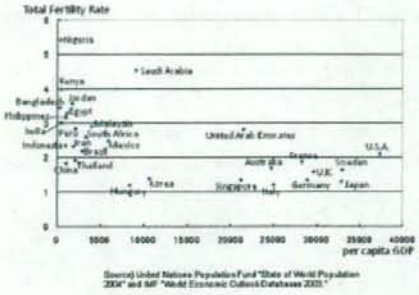
FTR and female labor supply 1970,80,85,90,2000
(Council for Gender Equality, Special Committee on the Declining Birthrate and Gender-Equal Participation, 2006a)

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



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



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

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 la-

bor 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,

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

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.

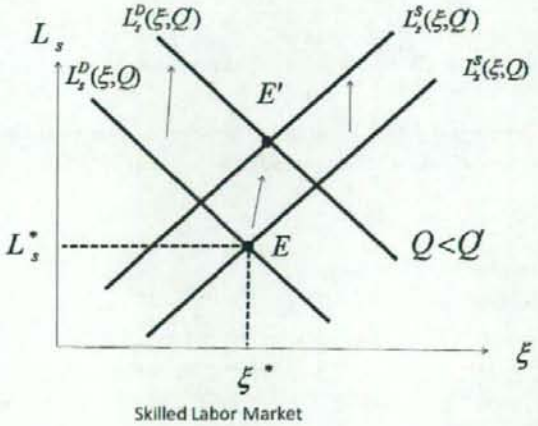


Figure 4: Equilibrium in Skilled Labor Market

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).

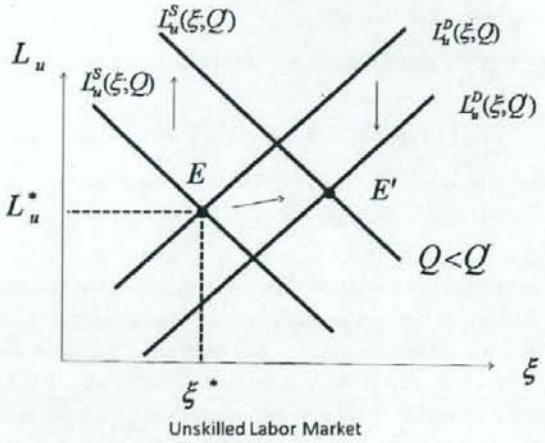


Figure 5: Equilibrium in Skilled Labor Market

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

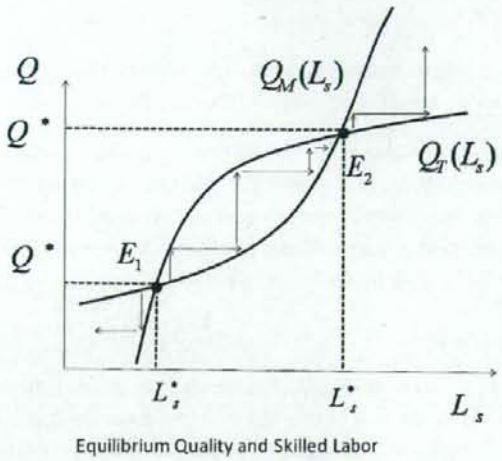


Figure 6: Equilibrium Relationship Between Quality and Skilled Labor

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

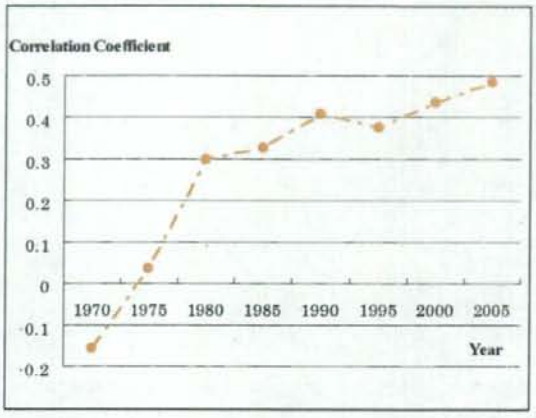


Figure 7: Correlation Coefficient by Year

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