

Female Labor Supply and Living with Seniors

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Penn State

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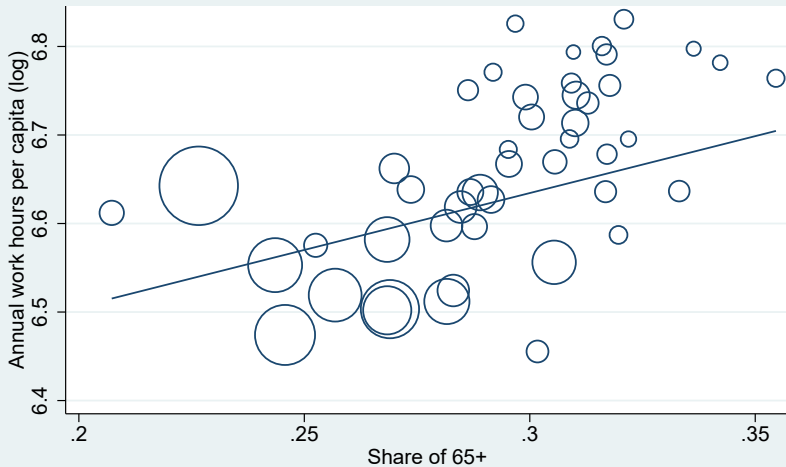
Disclaimer This project is approved to utilize the following Japanese Government Micro-Level Data; the Employment Status Survey and the Family Income and Expenditure Survey of the Ministry of Internal Affairs and Communications. The authors computed all aggregate moments presented in this paper. The moments do not always coincide with the numbers published by the government.

Outline

- We study regional distribution of female work hours in Japan.
- Women, especially married, work longer in prefectures where higher fractions of them live with 65+.
- We develop a quantitative general equilibrium model which features female work hours across prefectures.
- In the model, married women living with 65+ supply more labor than those who do not.

Aging and Female Work Hours

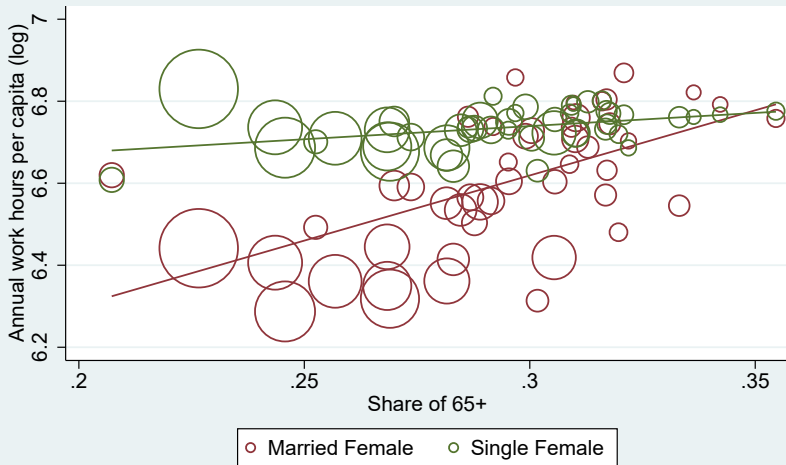
2017



Bubbles represent prefectures. Bubble size is proportional to female 15-64 pop.

Aging and Female Work Hours

2017

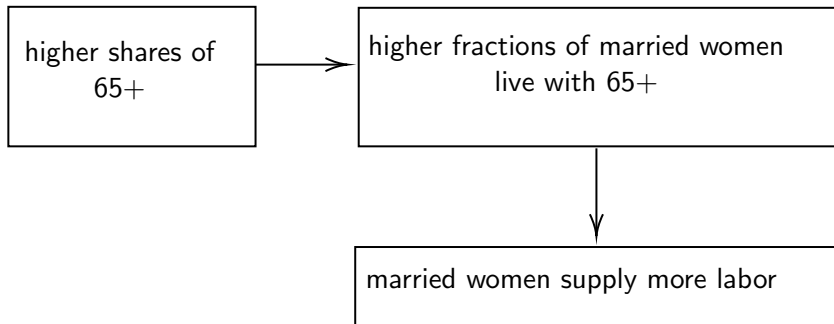


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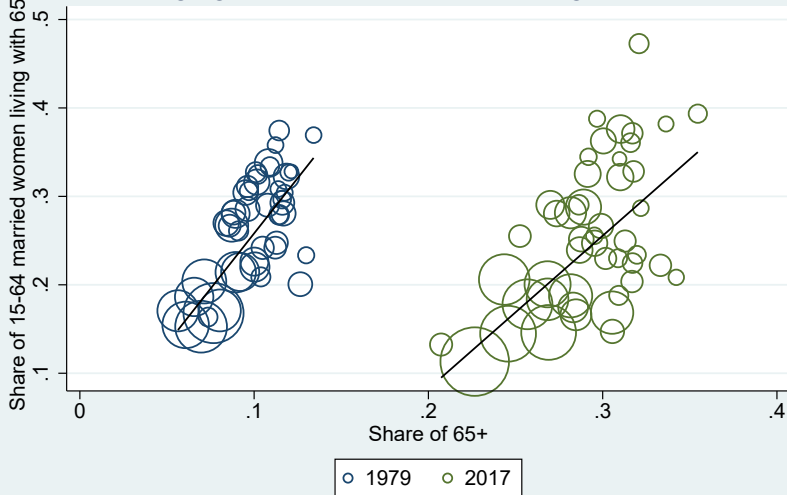
Aging and Female Work Hours

- Women's work hours are positively correlated with the shares of 65+ in population across prefectures.
- This is driven by married women, not single women.

Breakdown

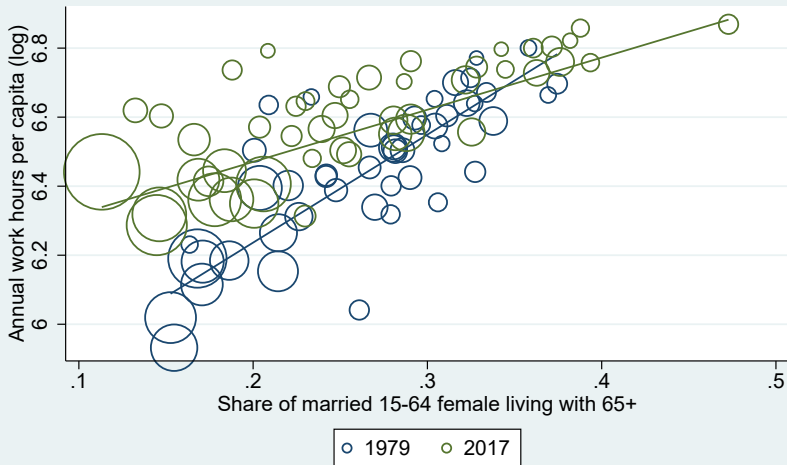


Aging and Married Women Living with 65+



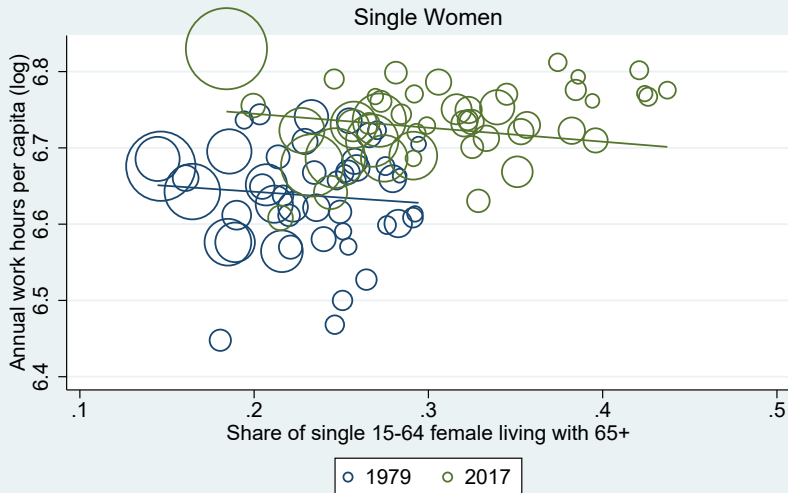
Bubbles represent prefectures. Bubble size is proportional to population.

Living with Elderly and Work Hours Married Women



Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

Living with Elderly and Work Hours Single Women

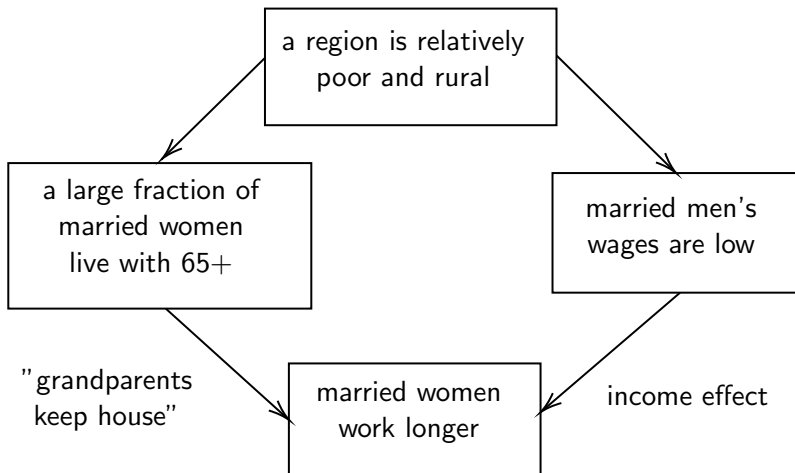


Bubbles represent prefectures. Bubble size is prop to single female 15-64 pop.

Aging, Living with 65+, and Married Women's Labor

- Higher fractions of married women live with 65+ in aged prefectures.
- Married women work longer in prefectures where higher fractions of them live with 65+.
 - This does not apply for single women.

Presence of Seniors or Husbands' Income?



Work Hours and Annual Wages



Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

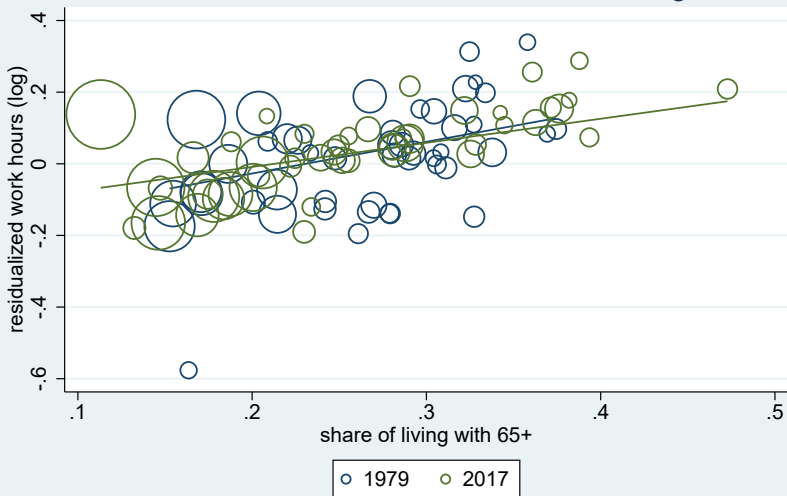
Presence of Seniors or Husbands' Income?

- Consider

$$\begin{aligned} & \text{married women's work hour}_i \\ & = \alpha + \beta \text{married men's annual wage}_i + u_i. \end{aligned} \tag{1}$$

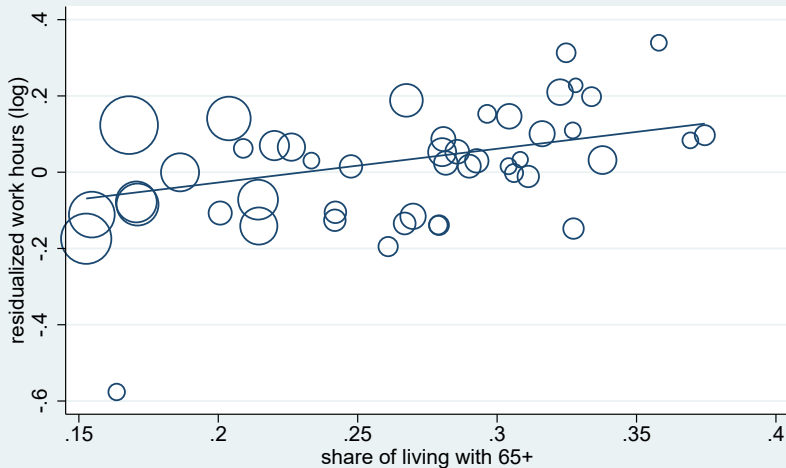
- Get residuals \hat{u}_i .
- Compare \hat{u}_i and the shares of married women living with 65+.

Residualized Work Hours and Annual Wages



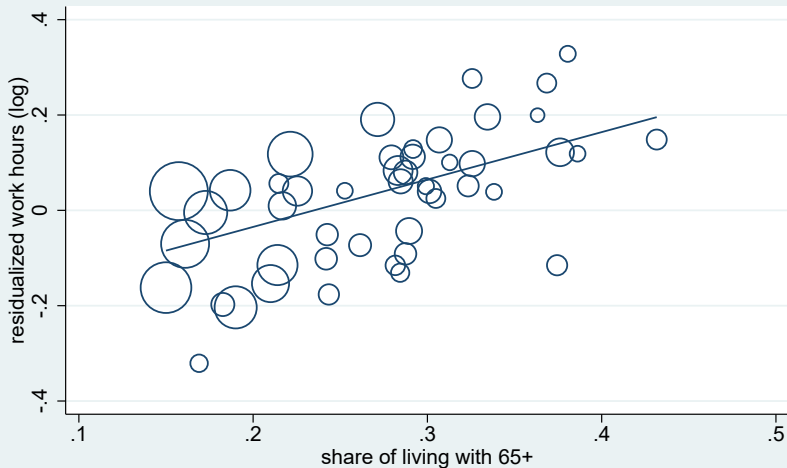
Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

Residualized Work Hours and Annual Wages 1979



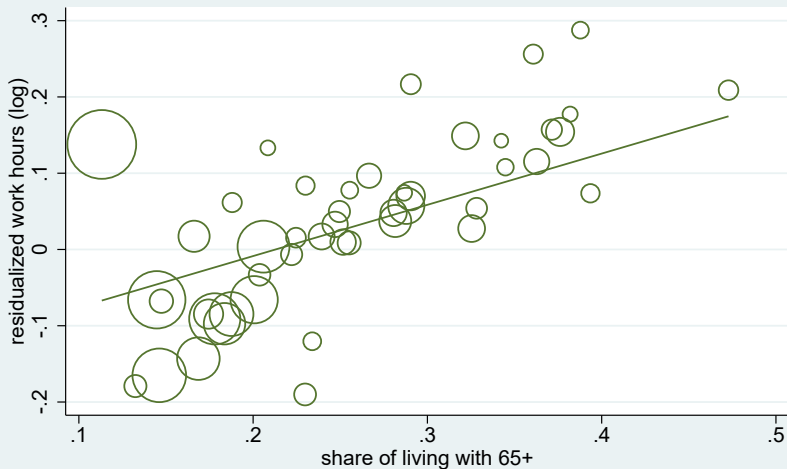
Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

Residualized Work Hours and Annual Wages 1987



Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

Residualized Work Hours and Annual Wages 2017



Bubbles represent prefectures. Bubble size is prop to married female 15-64 pop.

Residualized Work Hours and Living with 65+

- Residualized married women's work hours are higher in prefectures where higher fractions of them live with 65+.

A Possible Story

- If a married woman lives with a senior, the senior can do house-keeping tasks, so the married woman can work.

Literature

- ① Substitution of housework with electronic goods or maids.
 - electronics: Greenwood, Seshadri, and Yorukoglu (2005).
 - maids: Cortes and Pan (2013).
 - We propose association between female work hours and living with 65+.
- ② Service shares and female work hours.
 - Ngai and Petrongolo (2017).
 - We extend their model to a many-region setting, and distinguish households who live with 65+ with those who do not.

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The Purpose of Our Model Quantification

- We decompose variation in female work hours across prefectures into
 - ① productivity of sectors,
 - ② productivity of each type of workers,
 - ③ labor supply elasticity of each type of workers.

Model

- There are N locations, indexed by n .
- Two sectors: $k = g, s$,
 - goods or services.
- Household types: $h = s, m$,
 - single or married.
- Individual types: $i = sm, sw, mm, mw$,
 - single men, single women, married men, married women.
- Living with 65+ or not: $e = 0, 1$

Single Households (1)

- $h = s \Rightarrow i = sm, sw$.
- There are $L_{i,e,n}$ of the identical singles of (i, e, n) .
- The utility maximization is

$$\max U_{i,e,n} = C_{i,e,n} - \zeta_{i,e,n} \frac{H_{i,e,n}^{1+\nu_{i,e,n}}}{1 + \nu_{i,e,n}} \quad (2)$$

$$\text{s.t. } \sum_{k=g,s} p_n^k C_{i,e,n}^k \leq w_{i,n} H_{i,e,n} \quad (3)$$

$$\text{where } C_{i,e,n} = \left(\sum_{k=g,s} (a_{i,e,n}^k)^{\frac{1}{\sigma}} (C_{i,e,n}^k)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \quad (4)$$

Single Households (2)

- By the CES algebra,

$$C_{i,e,n} = \frac{w_{i,e} H_{i,e,n}}{P_{i,e,n}}, \quad (5)$$

where

$$P_{i,e,n} = \left(\sum_{k=g,s} a_{i,e,n}^k (p_n^k)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}. \quad (6)$$

- Then the labor supply problem is

$$\max_{H_{i,e,n}} \frac{w_{i,n} H_{i,e,n}}{P_{i,e,n}} - \zeta_{i,e,n} \frac{H_{i,e,n}^{1+\nu_{i,e,n}}}{1+\nu_{i,e,n}}. \quad (7)$$

- The FOC is

$$\frac{w_{i,n}}{P_{i,e,n}} = \zeta_{i,e,n} H_{i,e,n}^{\nu_{i,e,n}}. \quad (8)$$

Married Households (1)

- $h = m \Rightarrow i = mm, mw$.
- There are $L_{m,e,n}$ of the identical married couples of (m, e, n) .
- The utility maximization is

$$\max U_{m,e,n} = C_{m,e,n} - \zeta_{mm,e,n} \frac{H_{mm,e,n}^{1+\nu_{mm,e,n}}}{1+\nu_{mm,e,n}} - \zeta_{mw,e,n} \frac{H_{mw,e,n}^{1+\nu_{mw,e,n}}}{1+\nu_{mw,e,n}} \quad (9)$$

$$\text{s.t. } \sum_{k=g,s} p_n^k C_{m,e,n}^k \leq w_{mm,n} H_{mm,e,n} + w_{mw,n} H_{mw,e,n} \quad (10)$$

$$\text{where } C_{m,e,n} = \left(\sum_{k=g,s} (a_{m,e,n}^k)^{\frac{1}{\sigma}} (C_{m,e,n}^k)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}. \quad (11)$$

Married Households (2)

- By the CES algebra,

$$C_{m,e,n} = \frac{w_{mm,n}H_{mm,e,n} + w_{mw,n}H_{mw,e,n}}{P_{m,e,n}}. \quad (12)$$

- The labor supplies of a representative married man and woman of (e, n) are

$$\frac{w_{mm,n}}{P_{m,e,n}} = \zeta_{mm,e,n} H_{mm,e,n}^{\nu_{mm,e,n}} \quad (13)$$

$$\frac{w_{mw,n}}{P_{m,e,n}} = \zeta_{mw,e,n} H_{mw,e,n}^{\nu_{mw,e,n}}. \quad (14)$$

Demands for Goods and Services

- Single households' demands for goods and services are

$$C_{i,e,n}^k = a_{i,e,n}^k (p_n^k)^{-\sigma} (P_{i,e,n})^{\sigma-1} \cdot w_{i,n} H_{i,e,n} \quad (15)$$

for $k = g, s$.

- Married households' demands for goods and services are

$$C_{m,e,n}^k = a_{m,e,n}^k (p_n^k)^{-\sigma} (P_{m,e,n})^{\sigma-1} \cdot (w_{mm,n} H_{mm,e,n} + w_{mw,n} H_{mw,e,n}). \quad (16)$$

Production

- The production function of firms of sector k in n is

$$Y_n^k = A_n^k \ell_n^k \quad (17)$$

$$\text{where } \ell_n^k = \left(\sum_i (\kappa_{i,n}^k)^{\frac{1}{\eta^j}} (\ell_{i,n}^k)^{\frac{\eta^k - 1}{\eta^k}} \right)^{\frac{\eta^k}{\eta^k - 1}}, \quad (18)$$

and index i runs across sm, sw, mm, mw .

Conditional Labor Demands

- Goods and services markets are perfectly competitive.
- Firms as a price taker minimize costs

$$\min_{(\ell_{i,n}^k)_i} \sum_i w_{i,n} \ell_{i,n}^k \quad \text{s.t.} \quad A_n^k \ell_n^k \geq Y_n^k. \quad (19)$$

- The FOCs are

$$p_n^k A_n^k (\ell_n^k)^{\frac{1}{\eta^k}} (\kappa_{i,n}^k)^{\frac{1}{\eta^k}} (\ell_{i,n}^k)^{-\frac{1}{\eta^k}} = w_{i,n}. \quad (20)$$

- The unit cost is

$$c_n^k = \frac{1}{A_n^k} \left(\sum_i \kappa_{i,n}^k (w_{i,n})^{1-\eta^k} \right)^{\frac{1}{1-\eta^k}}. \quad (21)$$

- The conditional labor demand is

$$\ell_{i,n}^k = \frac{p_n^k Y_n^k}{w_{i,n}} \frac{\kappa_{i,n}^k w_{i,n}^{1-\eta^k}}{\sum_{i'} \kappa_{i',n}^k w_{i',n}^{1-\eta^k}}. \quad (22)$$

Assumptions on Tradability

- Goods are freely tradable across locations.
 - The price of goods is the numeraire: $p_n^g = 1$ for any n .
- Services are not tradable across locations.

Goods and Services Market Clearing

- Goods market clears nationally

$$\sum_n \sum_e \left(C_{m,e,n}^g + \sum_{i=sm,sw} C_{i,e,n}^g \right) = \sum_n Y_n^g. \quad (23)$$

- Services market clears locally

$$\sum_e \left(C_{m,e,n}^s + \sum_{i=sm,sw} C_{i,e,n}^s \right) = Y_n^s. \quad (24)$$

Labor Market Clearing

- For $i = sm, sw$,

$$\sum_e L_{i,e,n} H_{i,e,n} = \ell_{i,n}^g + \ell_{i,n}^s. \quad (25)$$

- For $i = mm, mw$,

$$\sum_e L_{m,e,n} H_{i,e,n} = \ell_{i,n}^g + \ell_{i,n}^s. \quad (26)$$

- Each type of workers are perfectly mobile across sectors.
 - So the labor market clears for each type of workers, not sectors.
 - Hourly wages in data: Single Married

Equilibrium

- An equilibrium is $(w_{i,n}, p_n^S)$ such that
 - households choose optimal hours worked and consumption,
 - firms choose optimal labor demands for different types of people,
 - goods and services markets clear,
 - labor markets clear.

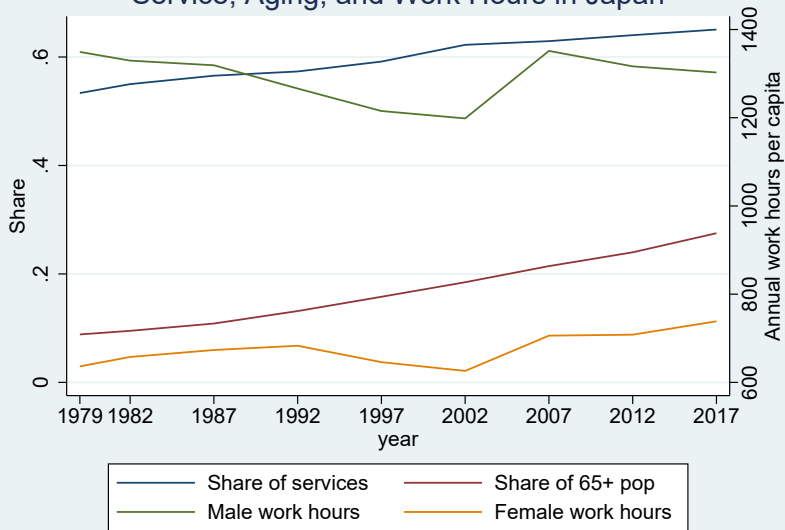
Data

- MIC employment status survey
 - Wages and work hours of members in a sample of households.
- MIC family income and expenditure survey (household survey)
 - Income and expenditure on various goods/services of singles and couples.

Conclusion

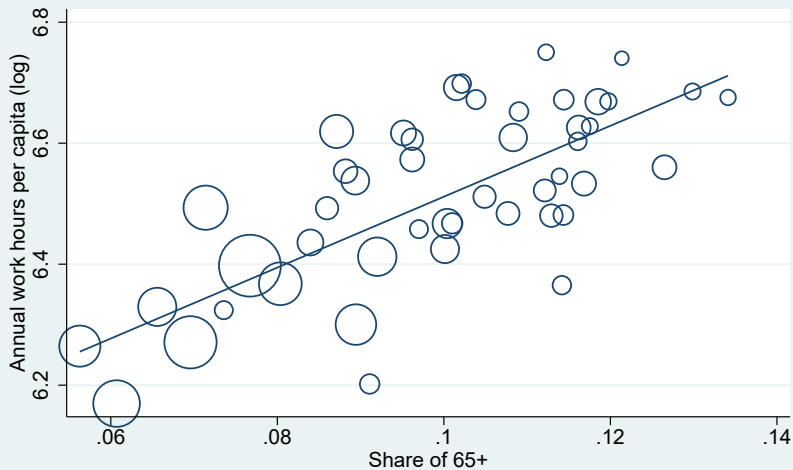
- We propose association between work hours of married women and their living with a senior.
- We develop a quantitative general equilibrium model which features female work hours in a many-region setting.
- Our remaining task is to quantify a model.
- We plan to use a model to decompose spatial variation in female work hours into productivity and labor supply parameters.

Service, Aging, and Work Hours in Japan



Aging and Female Work Hours

1979



Bubbles represent prefectures. Bubble size is proportional to female 15-64 pop.

Aging and Female Work Hours

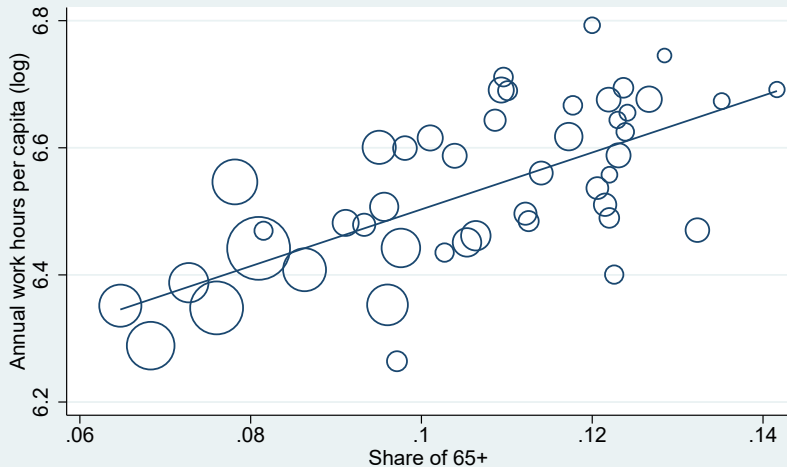
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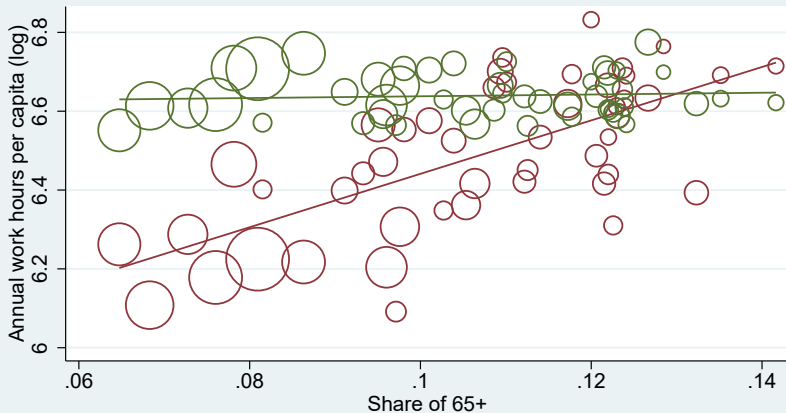
1982



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Aging and Female Work Hours

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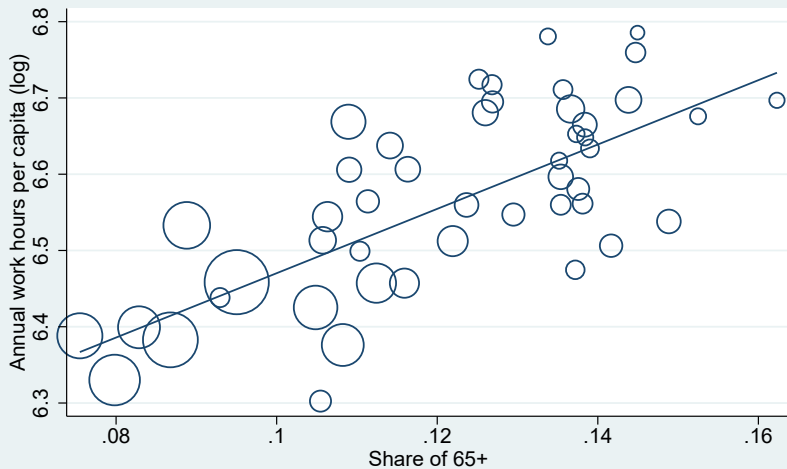


○ Married Female ○ Single Female

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Aging and Female Work Hours

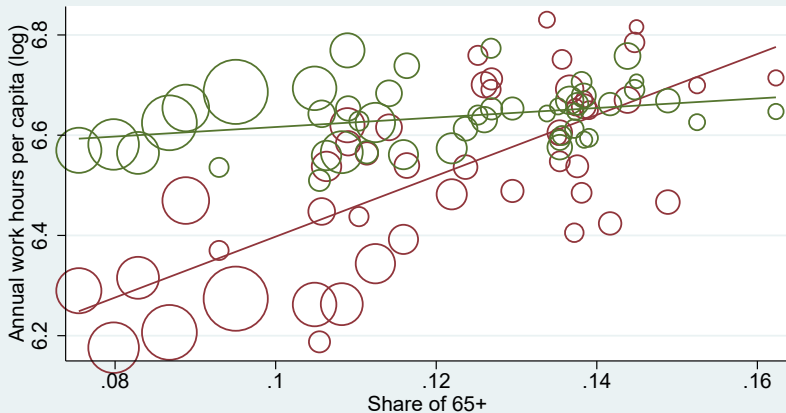
1987



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Aging and Female Work Hours

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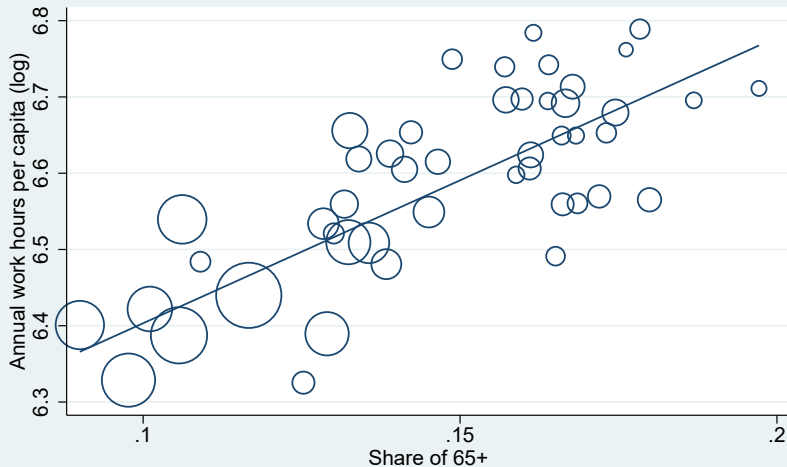


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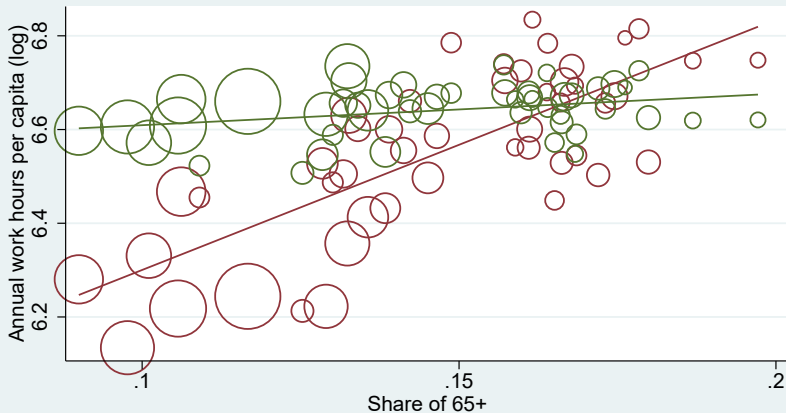
1992



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Aging and Female Work Hours

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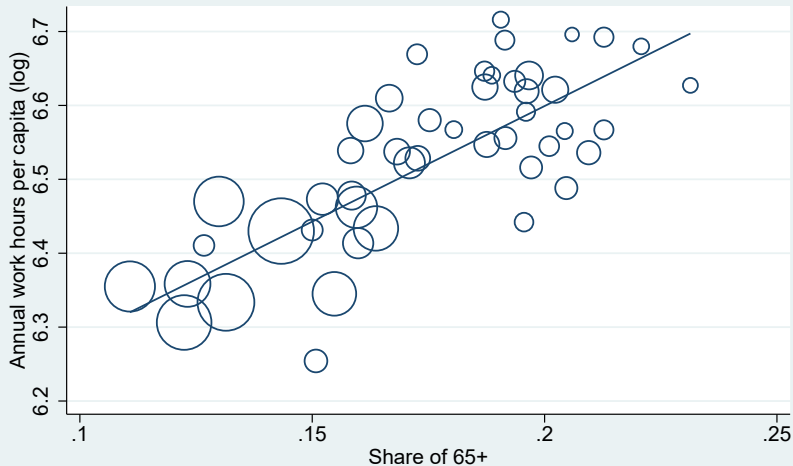


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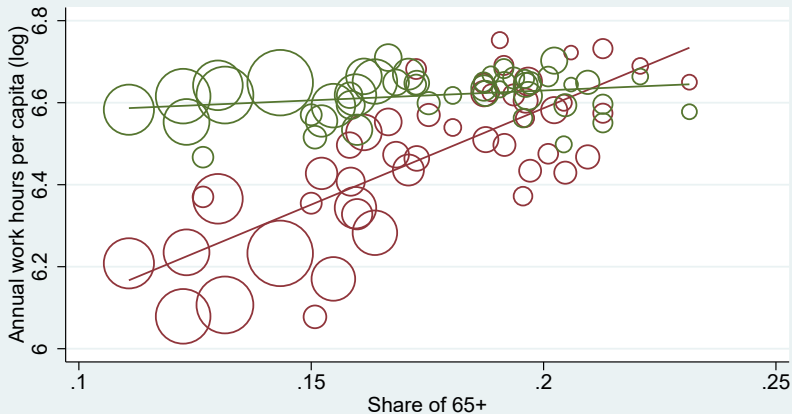
1997



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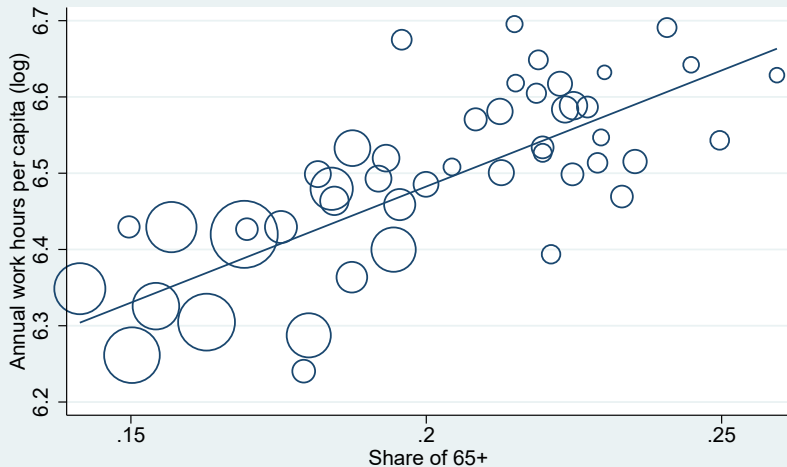
1997



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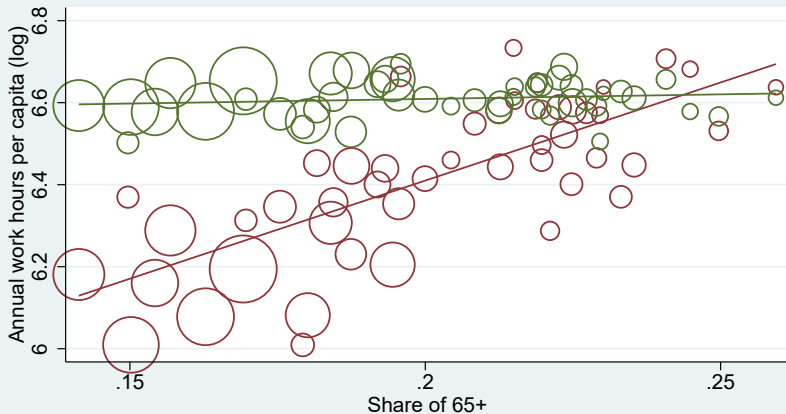
2002



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Aging and Female Work Hours

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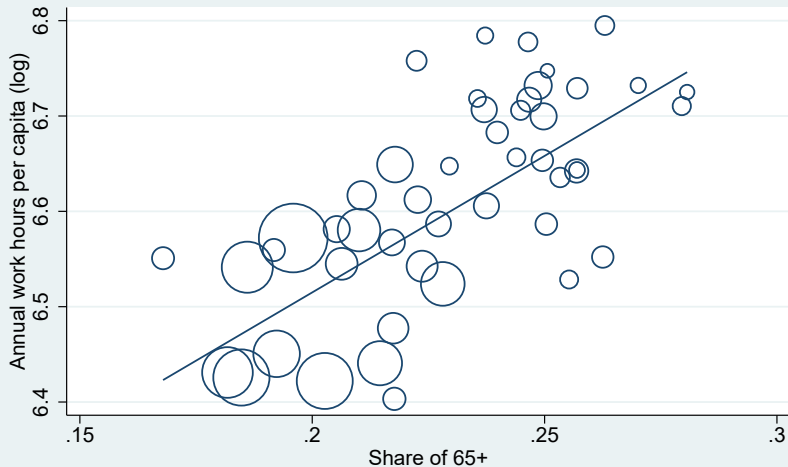


○ Married Female ○ Single Female

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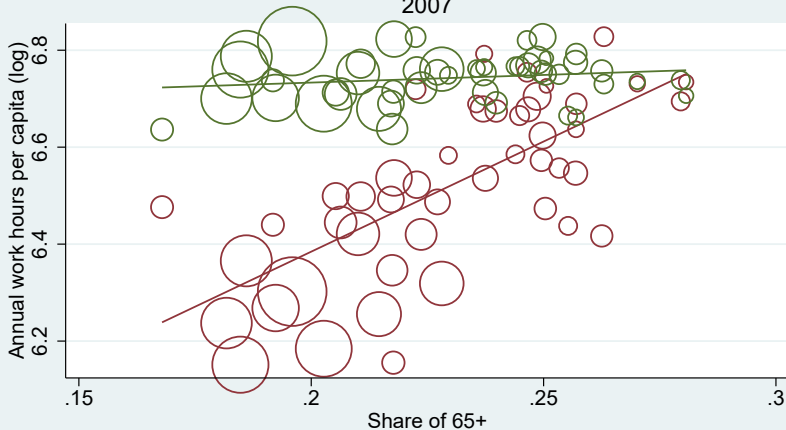
2007



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Aging and Female Work Hours

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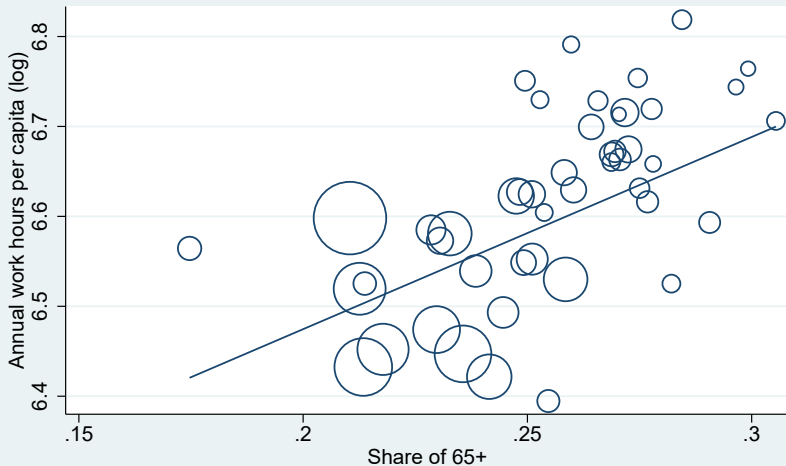


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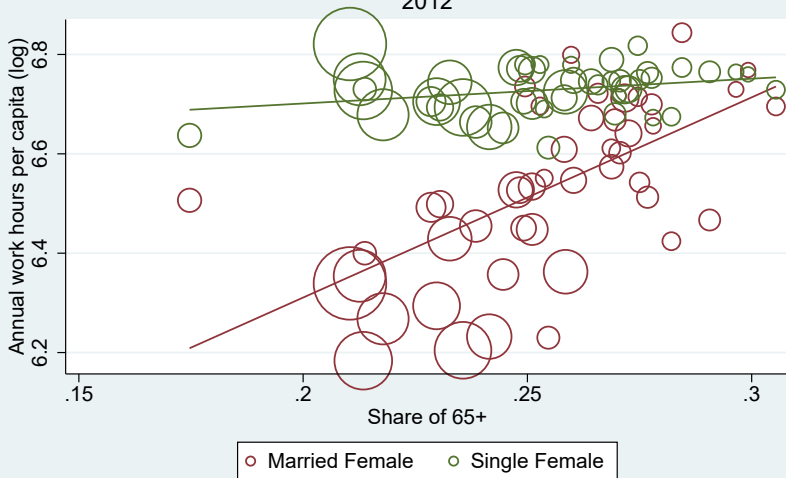
2012



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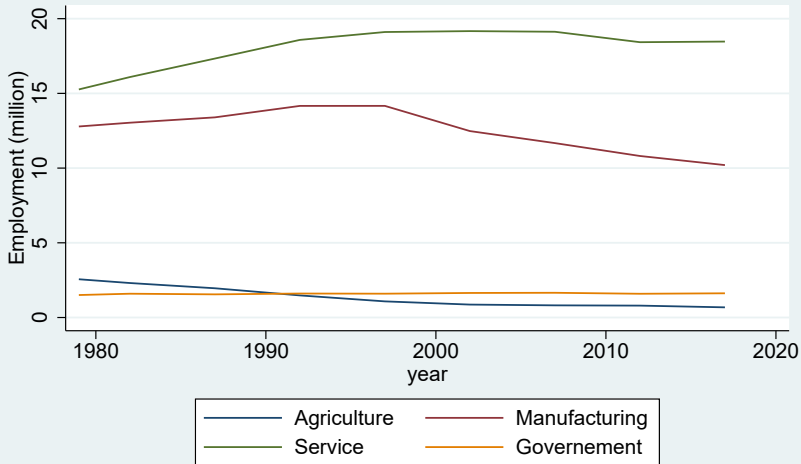
Aging and Female Work Hours

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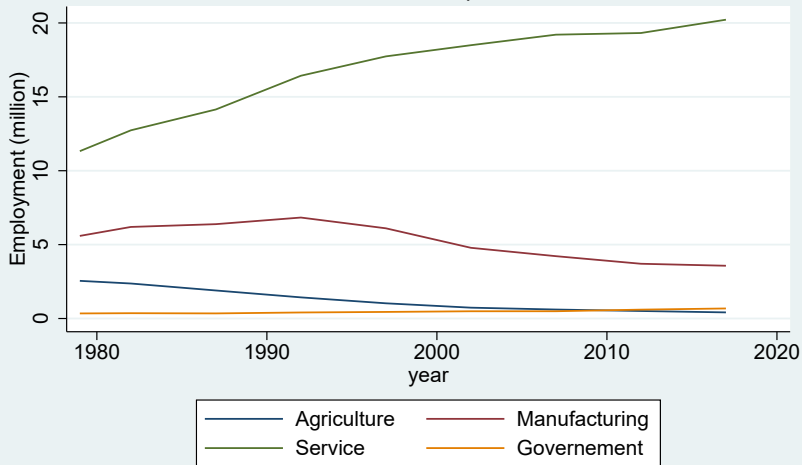
Bubbles represent prefectures. Bubble size is proportional to female 15-64 pop.

Employment by Sector Male, Japan



Source: MIC Basic Survey of Employment Structure 1979 - 2017

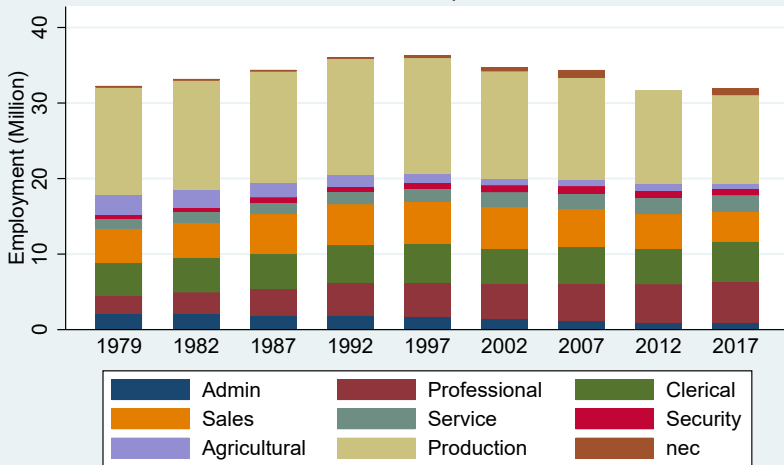
Employment by Sector Female, Japan



Source: MIC Basic Survey of Employment Structure 1979 - 2017

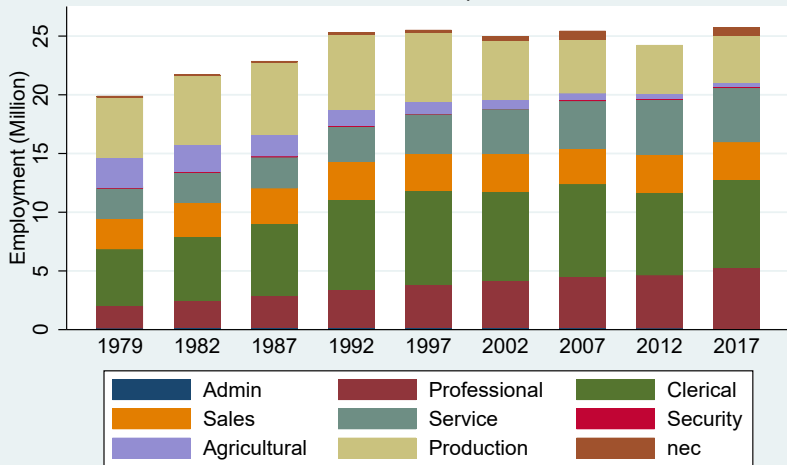
Employment by Occupation

Male, Japan



Source: MIC Basic Survey of Employment Structure 1979 - 2017

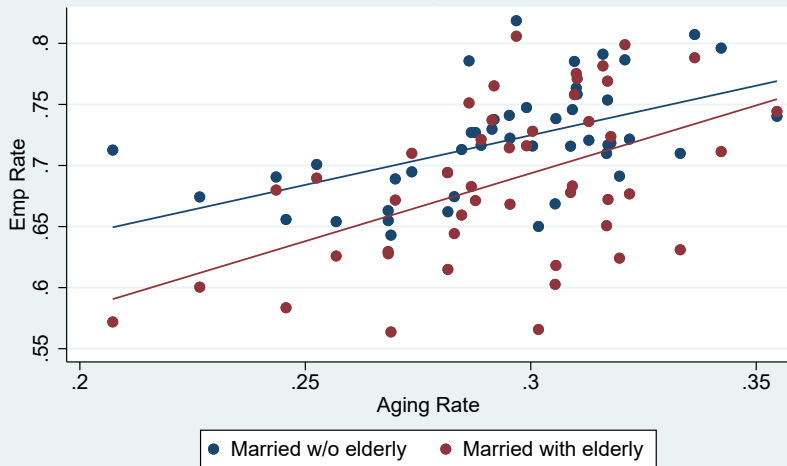
Employment by Occupation Female, Japan



Source: MIC Basic Survey of Employment Structure 1979 - 2017

Aging Rate and Female Emp Rate

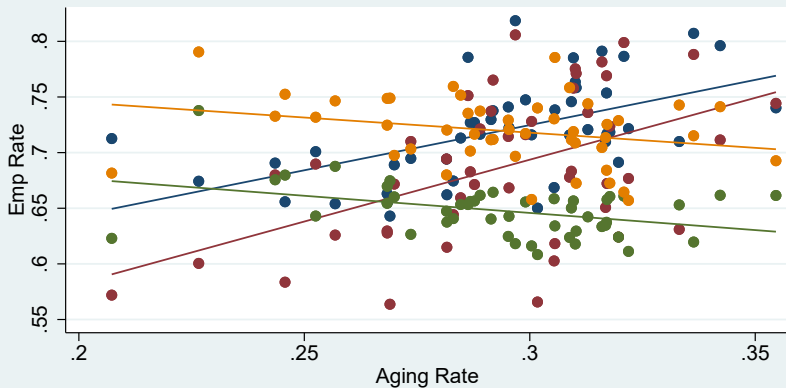
Married, 2017



Source: MIC Basic Survey of Employment Structure

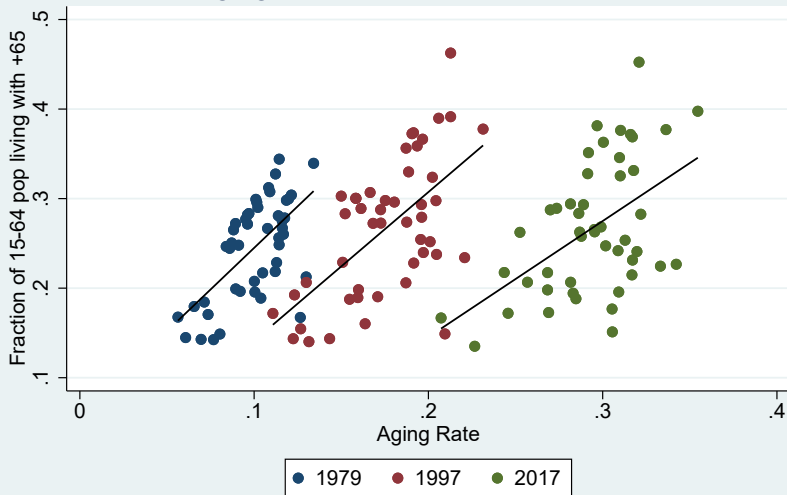
Aging Rate and Female Emp Rate

2017



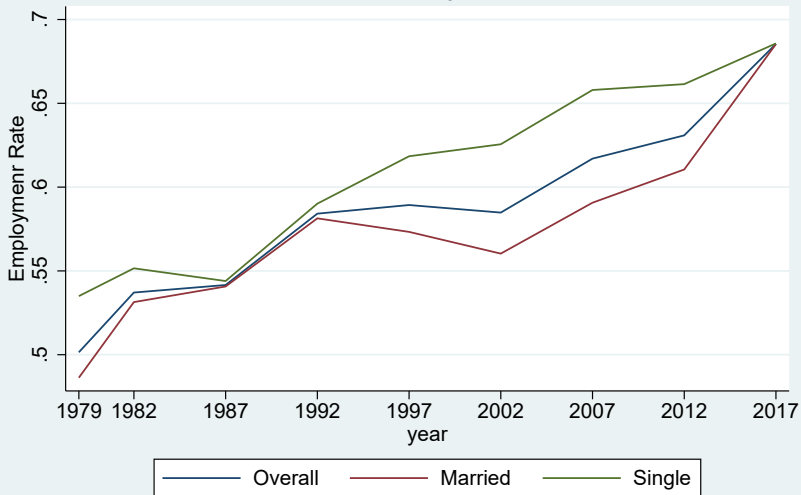
Source: MIC Basic Survey of Employment Structure

Aging Rate and Fraction 15-64 Pop



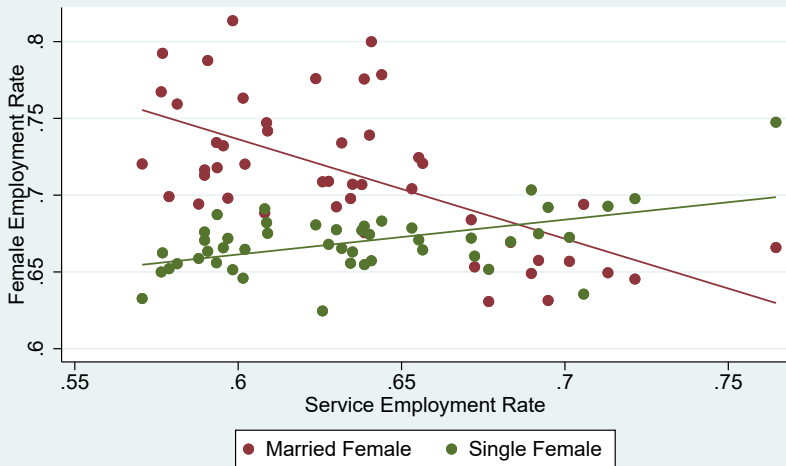
Source: MIC Basic Survey of Employment Structure

Female Employment Rate



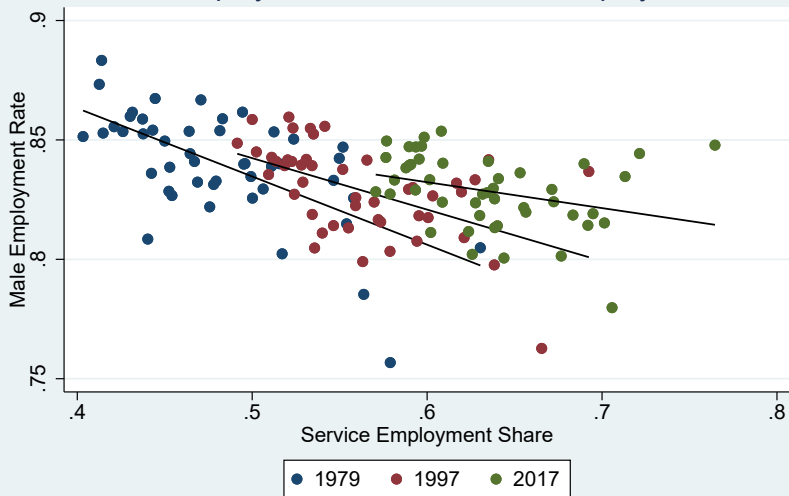
Source: MIC Basic Survey of Employment Structure

Service Employment Rate and Female Employment Rate 2017



Source: MIC Basic Survey of Employment Structure

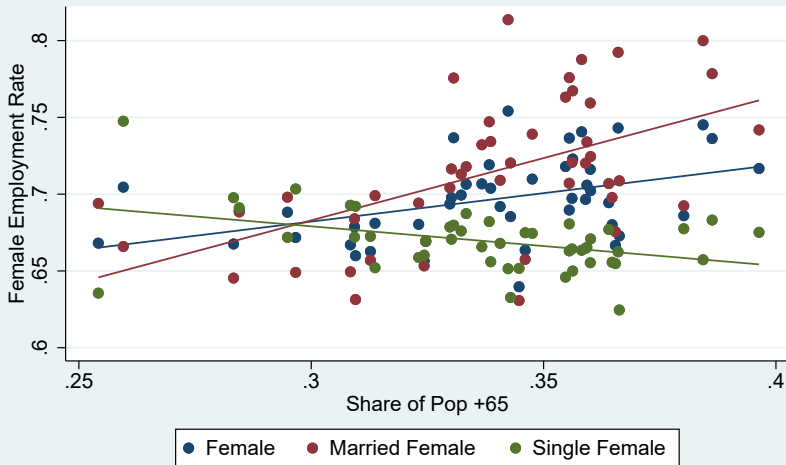
Service Employment Share and Male Employment Rate



Source: MIC Basic Survey of Employment Structure

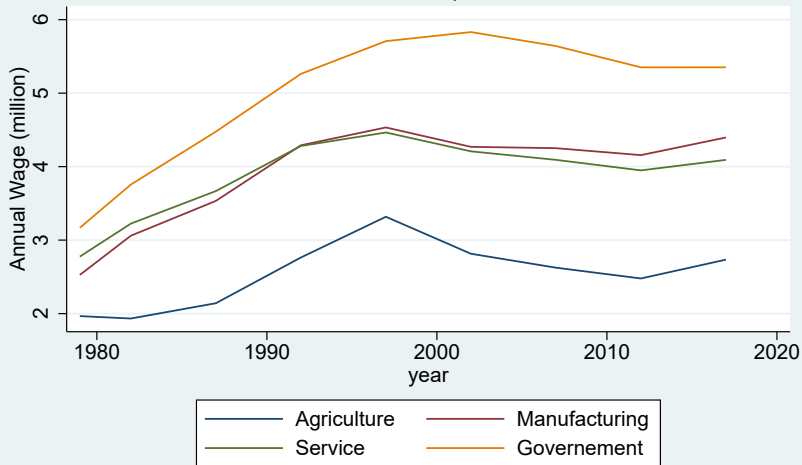
Aging Rate and Female Employment Rate

2017



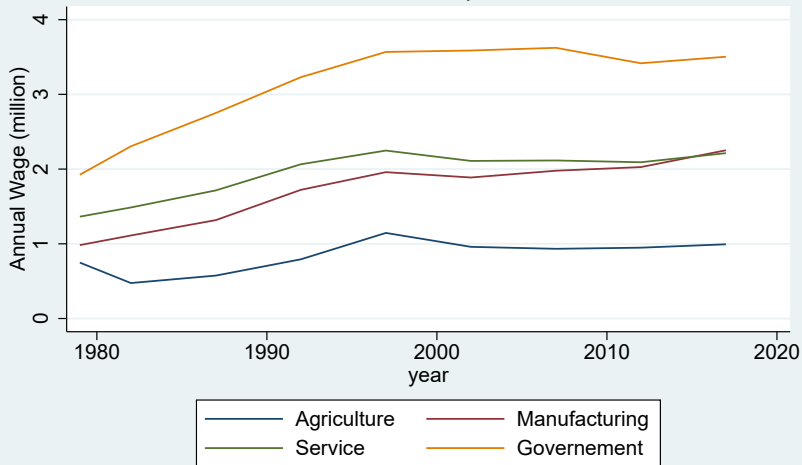
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Annual Wage by Sector Male, Japan

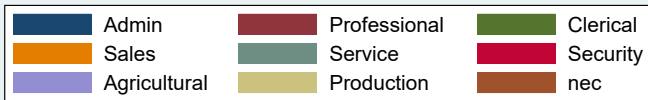
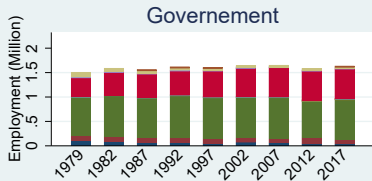
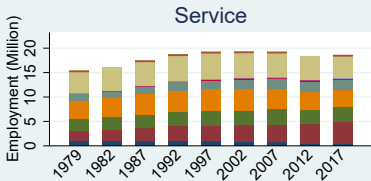
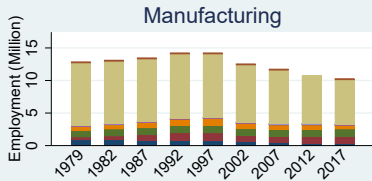
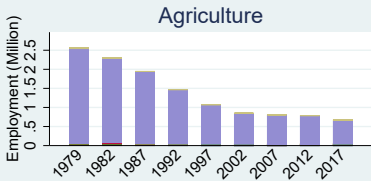


Source: MIC Basic Survey of Employment Structure 1979 - 2017

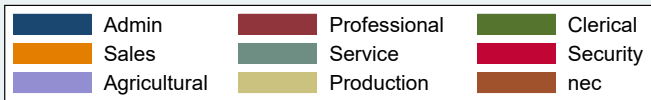
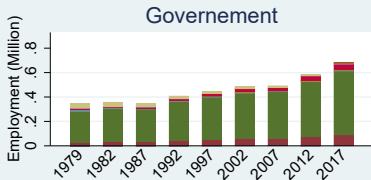
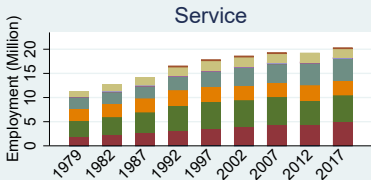
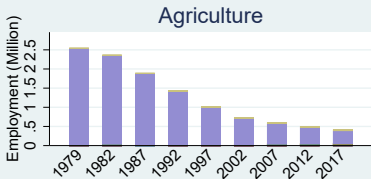
Annual Wage by Sector Female, Japan



Source: MIC Basic Survey of Employment Structure 1979 - 2017

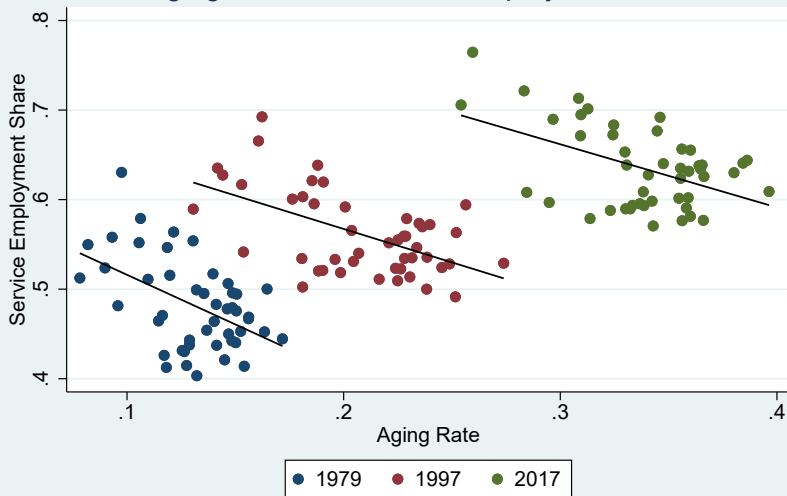


Employment by Sector and Occupation, Male



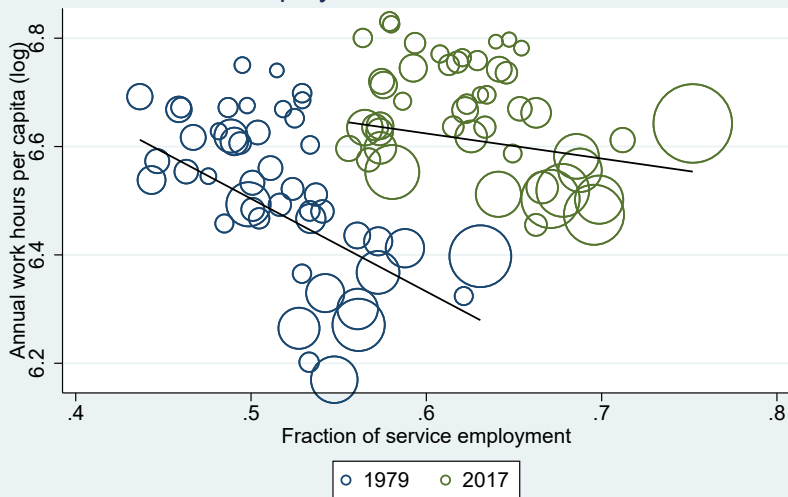
Employment by Sector and Occupation, Female

Aging Rate and Service Employment Share



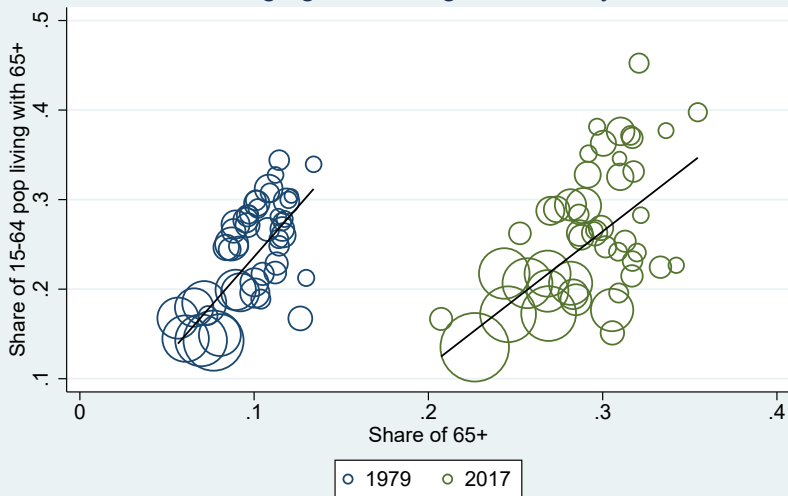
Source: MIC Basic Survey of Employment Structure

Service Employment and Female Work Hours



Source: MIC Basic Survey of Employment Structure. Bubble size is proportional to female 15-64 pop.

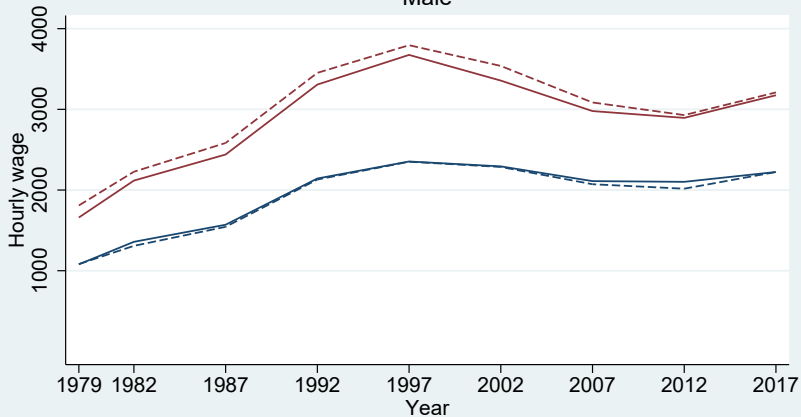
Aging and Living with Elderly



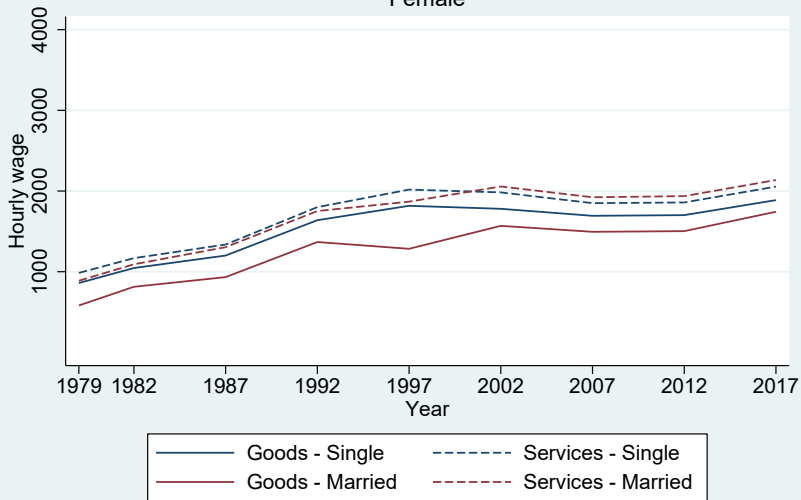
Bubbles represent prefectures. Bubble size is proportional to population.

Hourly Wage by Sector

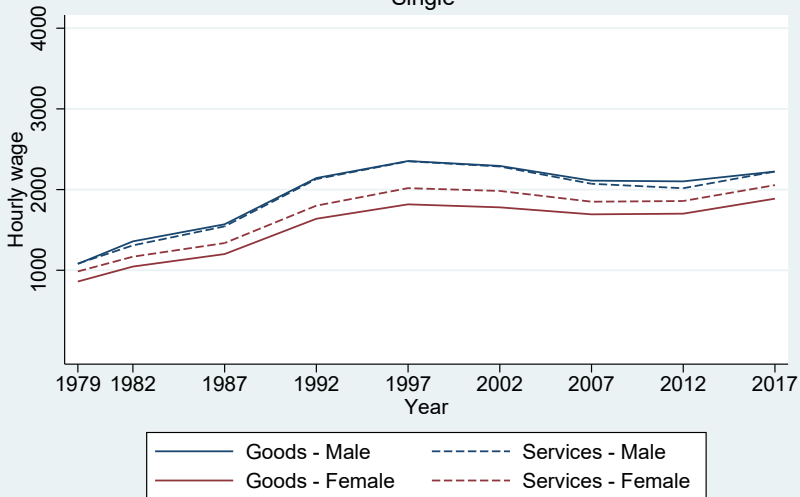
Male



Hourly Wage by Sector Female

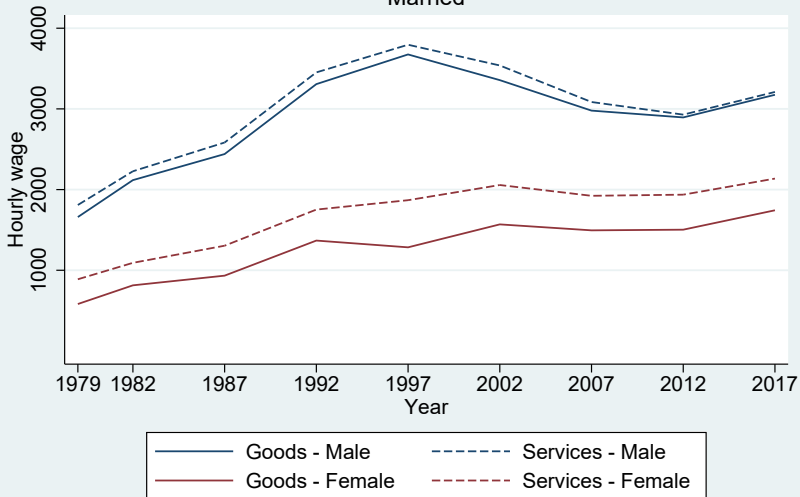


Hourly Wage by Sector Single



Hourly Wage by Sector

Married



・日本語概要

本資料においては、総務省の就業構造基本調査等の調査票情報をもとに、女性の就業行動の地域差の要因を検討すると共に、実証的事実を踏まえた一般均衡モデルを構築した。重要な事実として、65歳以上の高齢者と同居している家計（すなわち拡大家族）の割合が高い都道府県では、女性の労働時間が長い傾向にあることが分かった。さらに、この相関関係は、独身女性ではなく、既婚女性の就労行動に起因していることも明らかとなった。この事実の背景として、以下の二つの可能性が考えられる。一つ目は、高齢者と同居している割合の高い地域というのは、一般に地方部で所得が低い地域であり、配偶者（夫）の賃金も低いがゆえに、いわゆる所得効果によって女性が長時間働く可能性である。二つ目は、高齢者と同居している場合、親（高齢者）が子供の世話をすることができるため、女性が長時間働けるといいう可能性である。誘導形の分析の結果、二つ目の説明が重要であるとの示唆を得、これを説明するための数量的一般均衡モデルを構築した。モデルの詳細については、スライドの方程式体系を参照されたい。