Measuring Gendered Values of Time for Married Couples by Life Stage based on an Intertemporal Household Utility-Maximization Model

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Background
Toward a More Gender-Equal Society

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Even division in paid work and unpaid care tasks

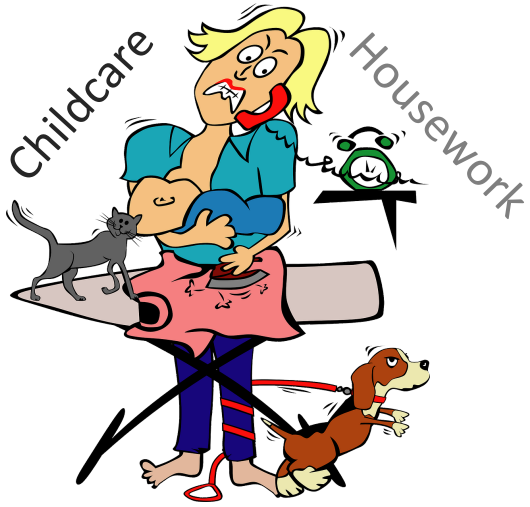
↓

Equal education and employment opportunities

In reality, how do men and women share the responsibilities for work and care tasks?

Source: United Nations' 17 Sustainable Development Goals (SDGs)

Background
Gender, Life Stage, Childcare & Time Use



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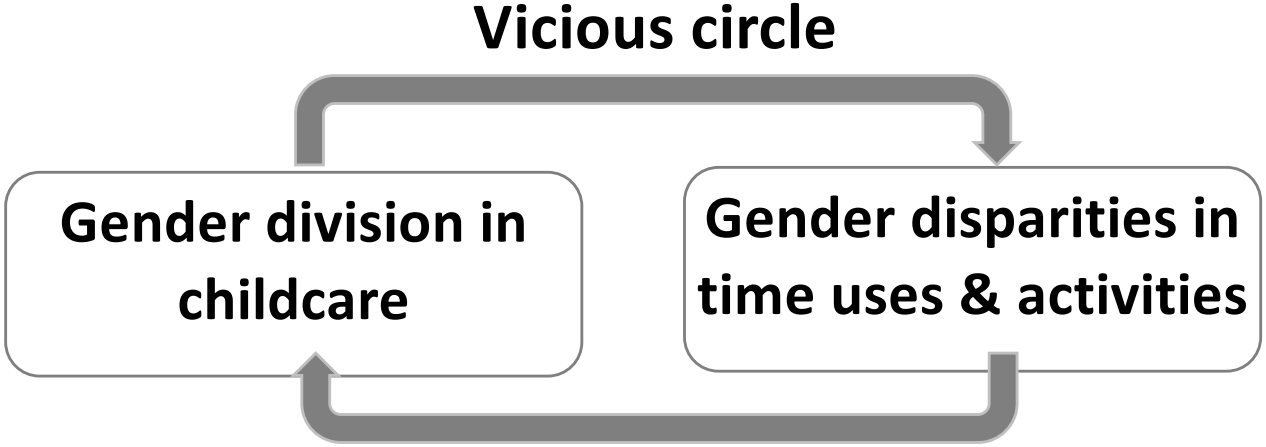

(Johnson & Johnson, 2008)

The presence of young children is a key factor……

- <u>Women have limited time available:</u>
  Complex trips, preferred part-time offers, short commute, high opportunity cost of travel
  (Apps & Rees, 2005; Borghorst et al., 2021; Carta & Philippis, 2018; Jacob et al., 2019; Kawabata & Abe, 2018; McGuckin & Murakami, 1999; Rouwendal, 1999)
- <u>Men have simpler trips and less constrained time use, but:</u>
  Long work hours and commute
  (Apps & Rees, 2005; Carta & Philippis, 2018; Kawabata & Abe, 2018; McGuckin & Murakami, 1999)

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Gender, Life Stage, Childcare & Time Use

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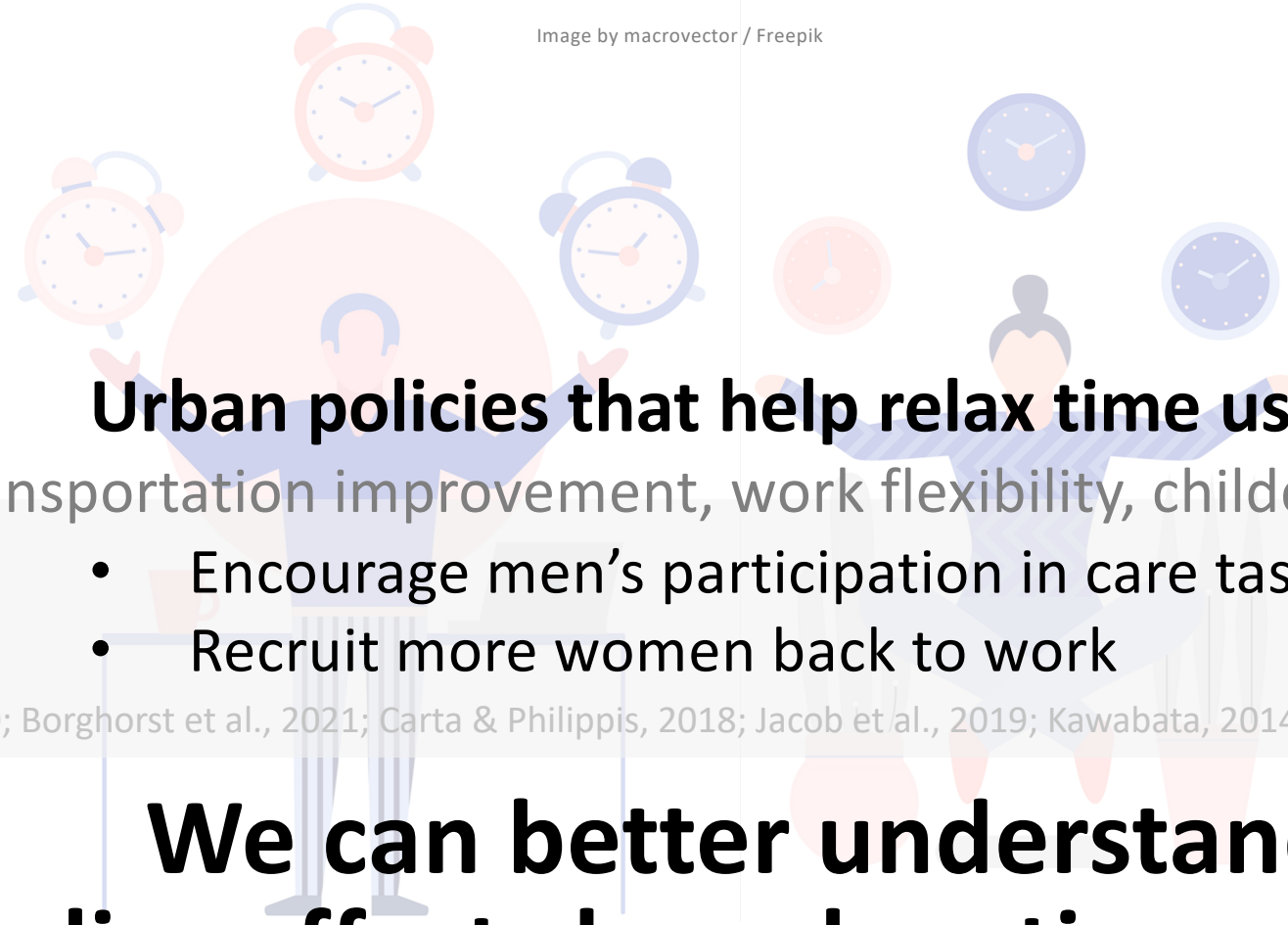

Urban policies that help relax time use

(e.g., transportation improvement, work flexibility, childcare support)

- Encourage men's participation in care tasks
- Recruit more women back to work

(Alon et al., 2020; Borghorst et al., 2021; Carta & Philippis, 2018; Jacob et al., 2019; Kawabata, 2014; Kawabata & Abe, 2018)

We can better understand policy effects based on time values by gender and by life stage.

Background
Gender & Value of Time (VOT)

The pioneering time allocation theory (Becker, 1965)

- VOT is equal to after-tax wage rate.

Measuring the gender differences in VOT by wage rate?

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Background
Gender & Value of Time (VOT)

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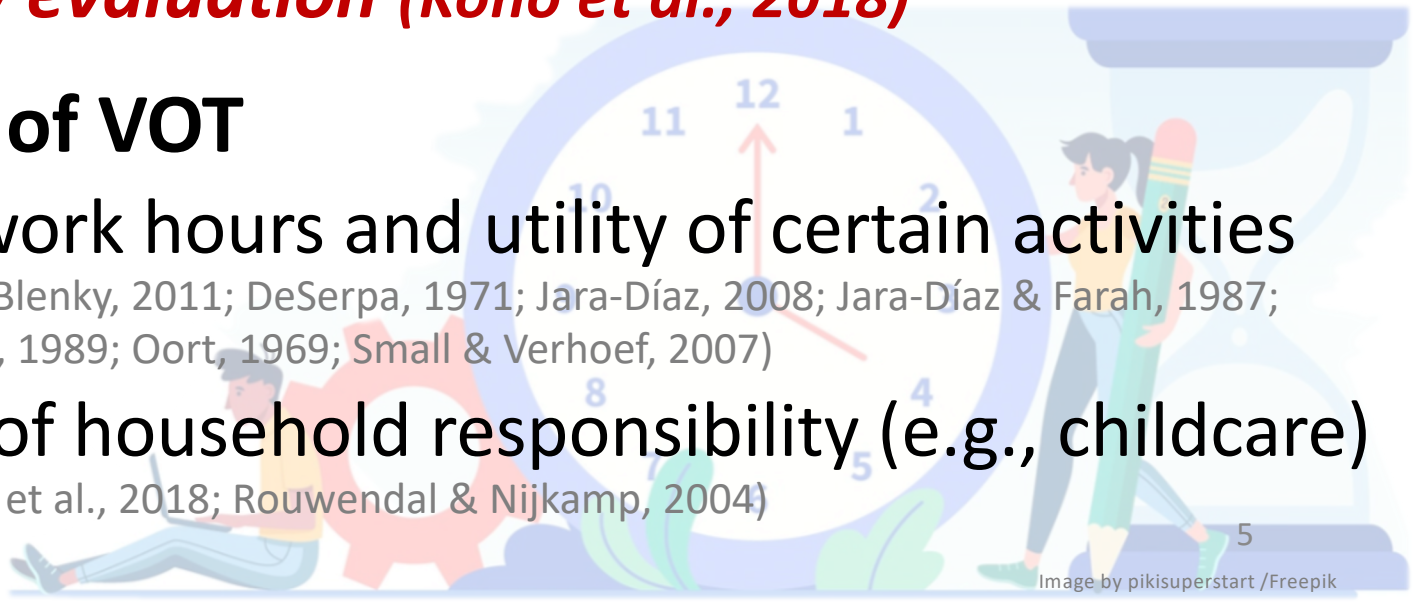
Measuring the gender differences in VOT by wage rate?

Not able to reflect the situations in real life (e.g., gender pay gap)

May bias policy evaluation (Kono et al., 2018)

The endogeneity of VOT

- Exogenous work hours and utility of certain activities
  (Bianchi et al., 1998; Blenky, 2011; DeSerpa, 1971; Jara-Díaz, 2008; Jara-Díaz & Farah, 1987; Jara-Díaz and Ortúzar, 1989; Oort, 1969; Small & Verhoef, 2007)
- The burden of household responsibility (e.g., childcare)
  (Gronau, 1973; Jacob et al., 2018; Rouwendal & Nijkamp, 2004)



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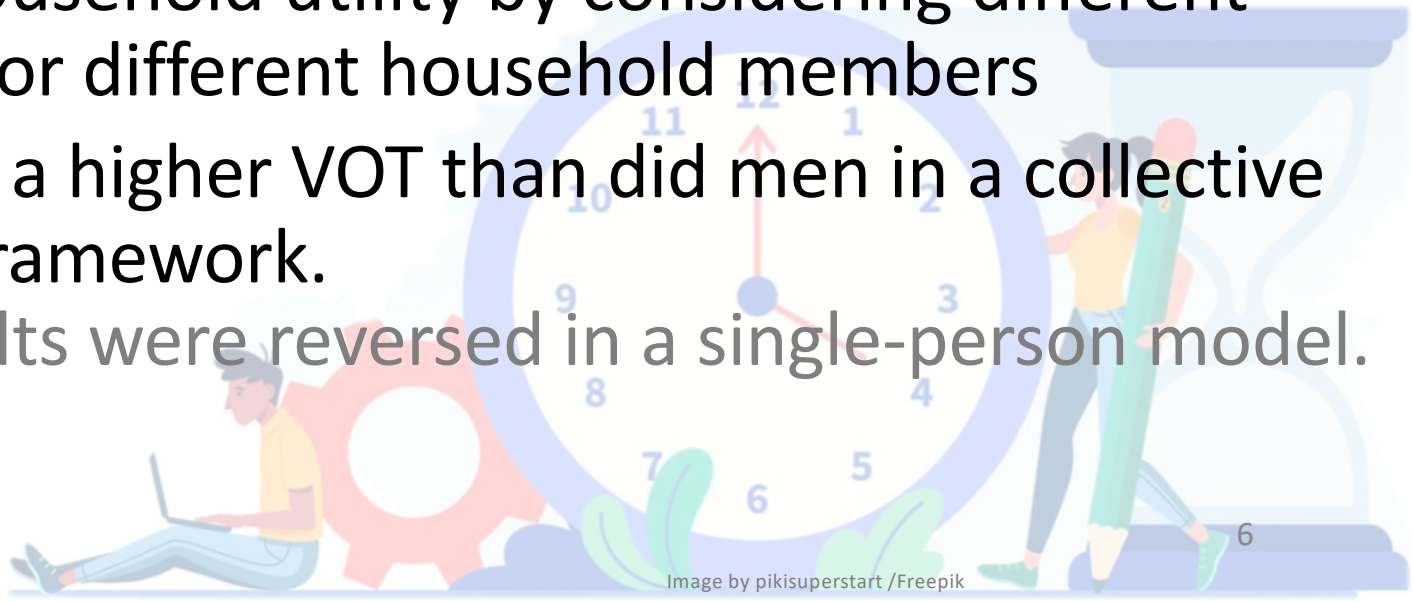
Background
Gender & Value of Time (VOT)

The time use model of DeSerpa (1971)

- Derive the endogenous VOT from the enjoyment and relative importance of activities.
- Reveal the trade-offs between the time on work, commute and other activities

Household time use & allocation (Jara-Díaz & Candia, 2021)

- Maximize household utility by considering different constraints for different household members
- Women had a higher VOT than did men in a collective household framework.
  But the results were reversed in a single-person model.



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Intuitive!

Perhaps due to different marginal utility of income

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Research Questions

1. Does the presence of young children affect married couples' time values and time use?
2. To what extent do urban policies improve welfare by relaxing time use?

Source: https://okcredit.in/blog/what-is-the-importance-of-time-value-of-money/

Intertemporal Household Model
Assumptions & Definitions

- **Assume the households in the same category (ϕ)**

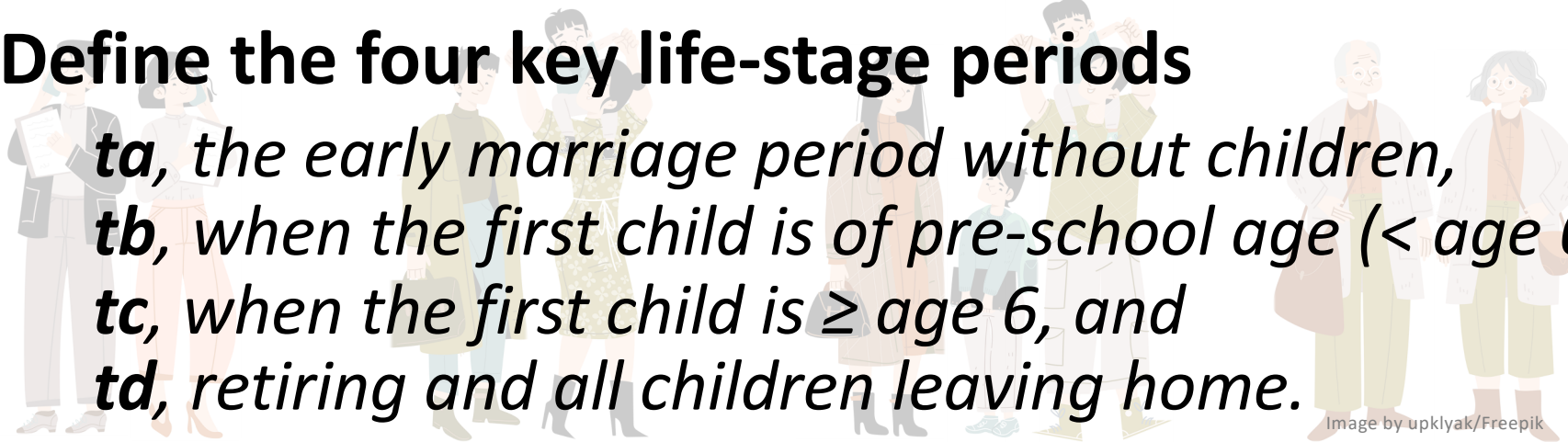
  Homogeneous *before they enter the marriage.*

  Life-span equilibrium: *Achieve the same level of utility toward the end of their lives*

- **To empirically estimate time values, we linearly approximating** household's life-span utility by the first-order Taylor expansion (Bates, 1987; Blayac & Causse, 2001; Jiang & Morikawa, 2007; MVA Consultancy, 1987; Viscusi & Evans, 1990)

- **Define the four key life-stage periods**

  ta*, the early marriage period without children,*
  tb*, when the first child is of pre-school age (< age 6),*
  tc*, when the first child is ≥ age 6, and*
  td*, retiring and all children leaving home.*



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  td, retiring and all children leaving home.

Intertemporal Household Model
Maximize life-span utility

$$V^{\phi} = \max_{\substack{z_t^h, z_t^w, \upsilon_t, q_t, \\ l_t^h, l_t^w, \\ t_{K,t}^h, t_{K,t}^w, t_{K,t}^{hw}}} \sum_{t=1}^{\bar{t}} \frac{HU_t^{\phi}\left(U_t^{\phi,h}\left(z_t^h, \upsilon_t, q_t, l_t^h, t_{K,t}^h, t_{K,t}^{hw}; K_t\right), U_t^{\phi,w}\left(z_t^w, \upsilon_t, q_t, l_t^w, t_{K,t}^w, t_{K,t}^{hw}; K_t\right)\right)}{\tau^{t-1}},$$

where children's wellbeing $\upsilon_t = \upsilon_t\left(I_t, t_{K,t}^h, t_{K,t}^w, t_{K,t}^{hw}\right)$

s.t. *Budget constraint (λ^{ϕ}):*

$$\sum_{t=1}^{\bar{t}}\left[\left(z_t^h + z_t^w + p_{q,t}q_t + \left(I_t + e^0 - \bar{e}\right)K_t\right) \Big/ \prod_{t=1}^{t}\left(1+r_{t-1}\right)\right] = \sum_{t=1}^{\bar{t}}\left[\left(w_t^h T_{W,t}^h + w_t^h T_{W,t}^w + y_t\right) \Big/ \prod_{t=1}^{t}\left(1+r_{t-1}\right)\right]$$

Member m's time constraint ($\mu_t^{\phi,m}$):

$$l_t^m + t_{K,t}^m + t_{K,t}^{hw} = \bar{T}_t^m - T_{W,t}^m - T_{C,t}^m \qquad m \in \{h=husband, w=wife\}$$

Technological constraint (κ_t^{ϕ}) for childcare :

$$\bar{t}_{K,t}\left(K_t^{young}\right) \le t_{K,t}^h + t_{K,t}^w + t_{K,t}^{hw}$$

$\lambda^{\phi}, \mu_t^{\phi,m}, \kappa_t^{\phi}$: Lagrange multipliers of income, time, and technology constraints, respectively.

Source: DeSerpa (1971) and Jara-Díaz & Candia (2021)

Intertemporal Household Model
Some theoretical takeaways

Under the assumption of life-span equilibrium

- **Within-individual trade-off**

  An individual can trade time spent on one activity for time spent on another activity over different time periods, in which the time values are determined.

- **Within-couple trade-off**

  A married couple could trade between the husband's and wife's time uses, in which their time values are determined.

Intertemporal Household Model
Trade-off between different activity time

- **Life-span equilibrium is reached:** $V^{\phi} = \bar{V}^{\phi}$
- **Linear regression model:**

$$Y^{\phi} = \beta_0^{\phi} + \sum_{t=tb,tc} \beta_t^{\phi} K_t +$$

$$VOTR_{tb}^{\phi,h} \sum_{tb} \left(T_{W,tb}^{h} + T_{C,tb}^{h} \right) + VOTR_{tb}^{\phi,w} \sum_{tb} \left(T_{W,tb}^{w} + T_{C,tb}^{w} \right) + VOCTS_{tb}^{\phi} \sum_{tb} \bar{t}_{K,tb}$$

$$VOTR_{tc}^{\phi,h} \sum_{tc} \left(T_{W,tc}^{h} + T_{C,tc}^{h} \right) + VOTR_{tc}^{\phi,w} \sum_{tc} \left(T_{W,tc}^{w} + T_{C,tc}^{w} \right) + VOCTS_{tc}^{\phi} \sum_{tc} \bar{t}_{K,tc} + \varepsilon$$

,

where Y^{ϕ} is the household's remaining budget.

Value of time as a resource (VOTR)

$$VOTR_t^{\phi,m} = \frac{\bar{\mu}_t^{\phi,m}}{\lambda^{\phi}}$$

Value of childcare time saving (VOCTS)

$$VOCTS_t^{\phi} = \frac{\bar{\kappa}_t^{\phi}}{\lambda^{\phi}}$$

$m \in \{h=husband, w=wife\}$, $t \in \{tb, tc\}$ $\lambda^{\phi}, \mu_t^{\phi,m}, \kappa_t^{\phi}$:Lagrange multipliers associted with income, time, and technology constraints, respectively.

Data

- 2004-2018 Keio Household Panel Survey/Japan Household Panel Survey (KHPS/JHPS)
  - 249 Households with a married heterosexual couple
  - Each household provides at least one year of data in *tb* and *tc*, respectively:
    - Age of children
    - Employment status
    - Labor income
    - Housing price
    - Time use on work, commute & childcare

Source: Panel Data Research Center (PDRC) at Keio University

Empirical Approach

- To define the minimum childcare time required, we use K-means clustering analysis (Gan et al., 2007)
  - Group similar households into the same cluster
    (e.g., the numbers of infants/toddlers and preschoolers)
  - Define the minimum using the 5th percentile in each cluster
- To estimate VOTR & VOCTS, we conducted a two-stage analysis (Cao et al., 2009; Mokhtarian & Cao, 2008; Niebuhr et al., 2012; Russo et al., 2014)
  - Stage 1: Instrumental variable (IV) estimation for commute time
  - Stage 2: LS with the estimated commute time from Stage 1
- To obtain robust statistical inferences, we computed bootstrap confidence interval (Efron & Tibshirani, 1993)
  - Replicate the sample 1000 times

Main Findings

1. Does the presence of young children affect married couples' time values and time use?

Main Findings

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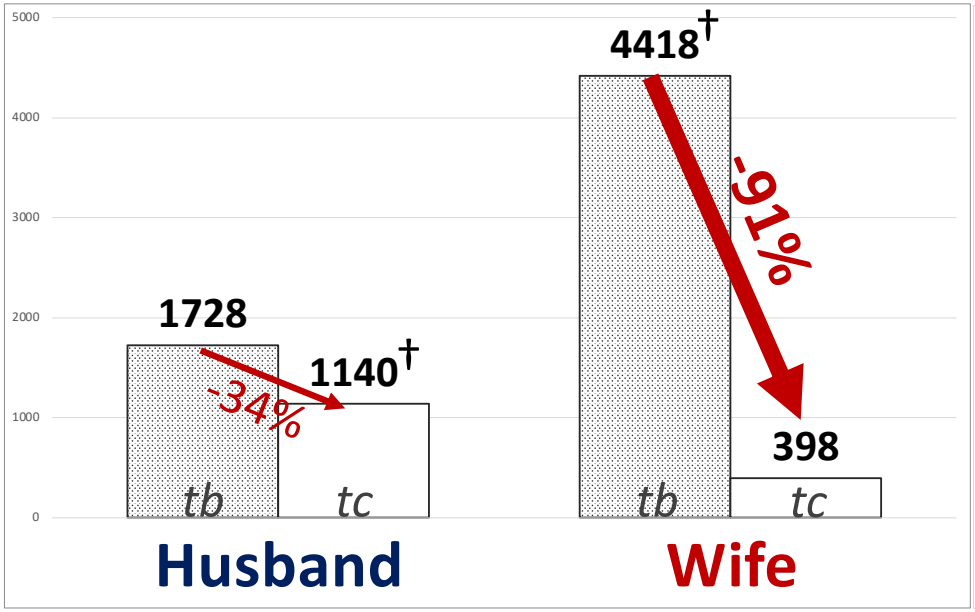
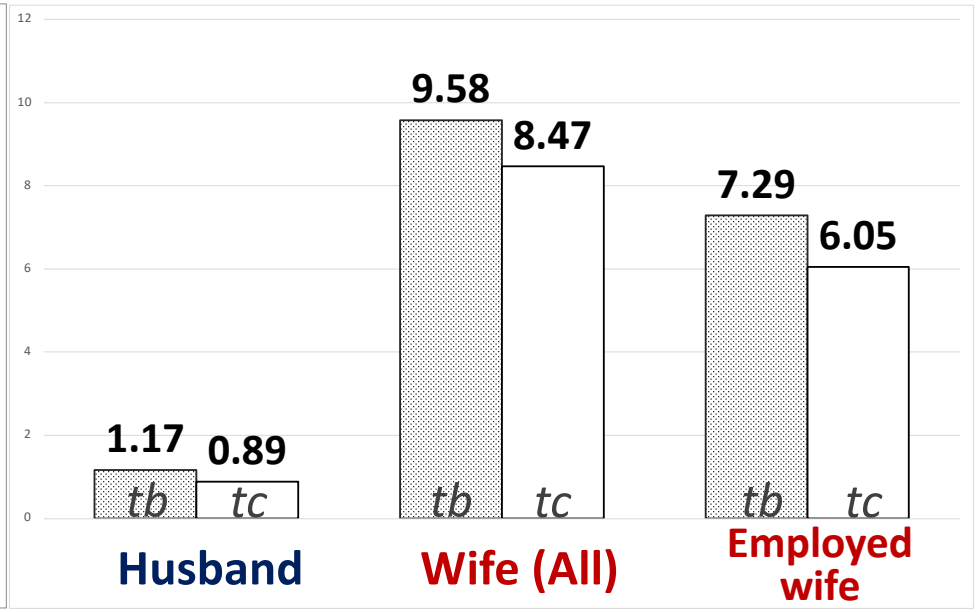
   YES, especially for the wives

Main Findings
Value of Time as a Resource (VOTR)



VOTR (yen/hr) with IV



Daily childcare time (hr)

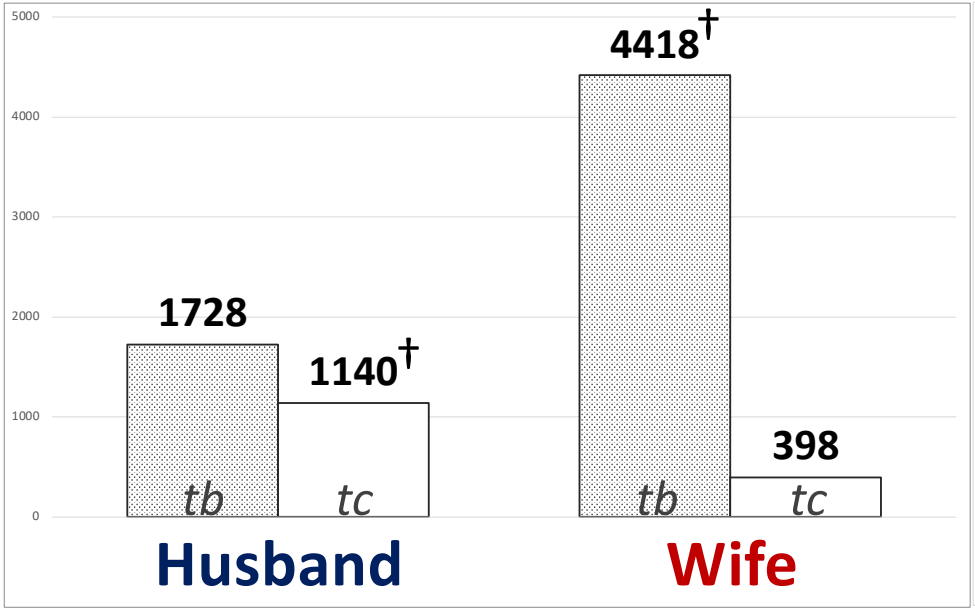
† *90% bootstrap C.I.* ***tb:*** *when the first child < age 6;* ***tc:*** *when the first child ≥ age 6*

Relative changes between VOTRs indicate that

- The wives are primarily responsible for childcare.
- The presence of young children affects the wives more than the husbands.
- Consistent with previous research

(Borghorst et al., 2021; Carta & Philippis, 2018; Jacob et al., 2019; Kawabata & Abe, 2018; Rouwendal & Rietveld, 1994)

Main Findings
Life-Span Equilibrium: Time Use Trade-off



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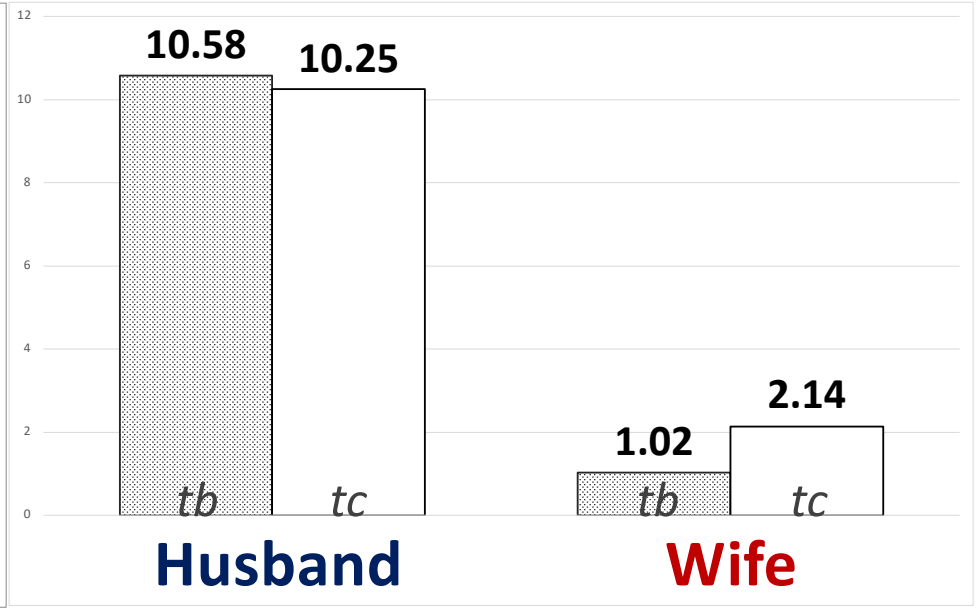


Daily work & commute time (hr)

† *90% bootstrap C.I.*

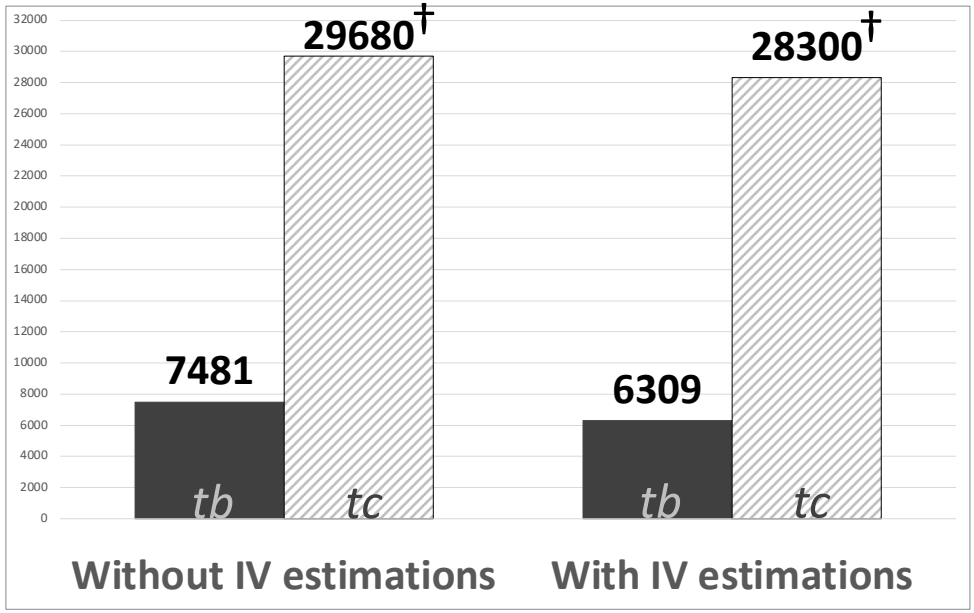
Within-individual

- Trade-off is evident for the wives but not for the husbands.

Within-couple

- The couple trade off the time use for each other.

Main Findings
Value of Childcare Time Saving (VOCTS)



Household VOCTS (yen/hr)

	Binding	Nonbinding
Period tb		
Number of households	2	247
Employment rate		
Husband	100%	98.4%
Wife	100%	18.2%
Period tc		
Number of households	4	245
Employment rate		
Husband	100%	99.2%
Wife	100%	39.2%

Differences in the employment rate

† *90% bootstrap C.I.*

The high VOCTS in tc for the households with a binding constraint implies

- Having difficulties with childcare
- Dual-income couples: Not able to reconcile work-family lives after a long, exhausting working day

Note: Less than 2% of the sample households have a binding technological constraint

Main Findings
Implications for VOT as a commodity (VOTC)

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Period *tb*

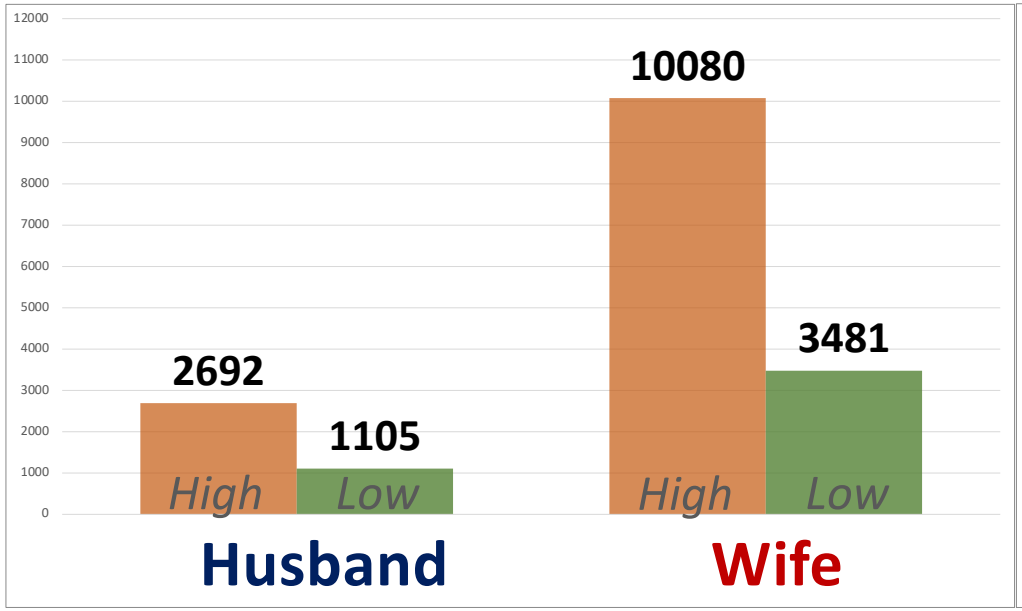
- The household's VOTC for the husband's childcare could be zero given that the husband's VOTR and the household's VOCTS are insignificant.
- The positive VOTC for the wife's childcare time suggests that the household can gain utility from the wife's childcare.

Period *tc*

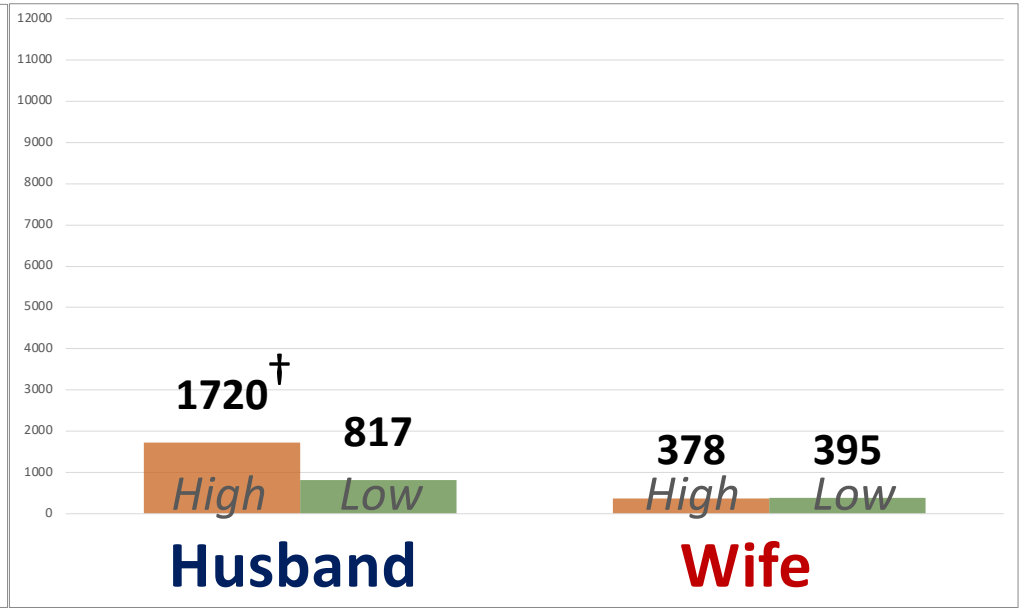
- The households with a binding constraint are likely to have disutility of childcare, given negative VOTCs for childcare time.
- Recall: Our sample households with a binding constraint were dual-income couples.

Note: Less than 2% of the sample households have a binding technological constraint

Main Findings
VOTR vs. Income Level



VOTR (yen/hr) with IV by husband's income level in *tb*



VOTR (yen/hr) with IV by husband's income level in *tc*

† *90% bootstrap C.I.*

The high-income couples tend to have higher VOTRs than their low-income counterparts

- Consistent with previous literature review (Small & Verhoef, 2007)
- However, no significant differences are revealed.

Main Findings
VOTR vs. Wage Rate

	Husband	Wife
Average wage rate (yen/hour)	1922	411
VOTR/Wage rate		
Period tb	90%	1075%*
Period tc	59%*	97%

* *VOTR is within 90% bootstrap C.I.*

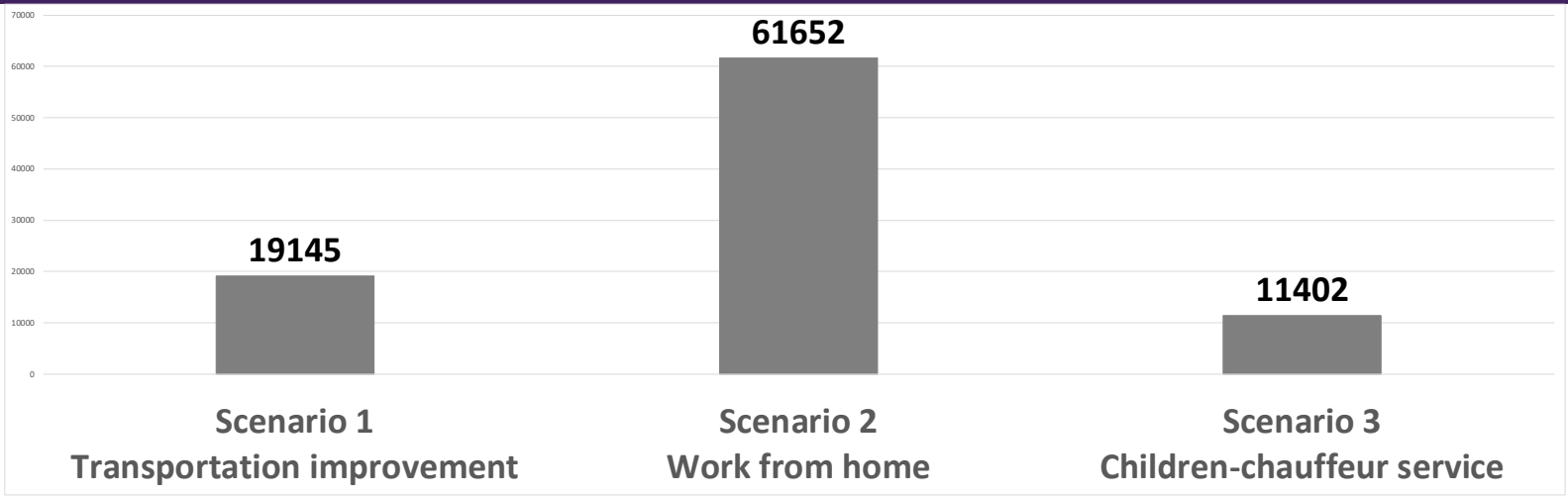
The ratio of VOTR to the average hourly wage……

- The ratio for the husbands is consistent with previous research.
  (Kato, 2013; Small & Verhoef, 2007)
- To precisely evaluate policy impacts, attention should be paid to the high ratios for the wives with children.

Policy Scenarios

2. To what extent do urban policies improve welfare by relaxing time use?

Policy Scenarios
Social Welfare Simulations



Average household welfare gain (yen/year)

Note: Only the VOTRs and VOCTS with IV in 90 % bootstrap C.I. are used for simulation.

<Scenario 1: Transportation improvement>

- Reducing wives' commute time by one minute in *tb*
- Conventional methods yield 6422 yen/year (e.g., VOT: 1482 yen/hr in Kato (2013))

<Scenario 2: Work from home (WFH)>

- Enabling the WFH option once per week for the husbands in *tc*

<Scenario 3: Child-chauffeuring service provided by city>

- Utilizing the service once per week in *tc* due to work conflicts

(For a household with a binding constraint, the welfare gain is 709,800 yen/year.)

Conclusions

1. **Wives have a greater VOTR than their husbands when their children are young.**
   - Wives face a tighter time constraint
2. **The presence of children mostly affects the time use of the wives.**
   - Consistent with previous studies
   - Wives take the primary childcare responsiblities
3. **Within-individual and within-couple time-use trade-offs are observed.**
4. **Some dual-income households cannot enjoy childcare due to their long, exhausting working days.**

Conclusions

Our research can readily evaluate the benefit of different urban policies by considering time values by gender and by life stage.

Limitations & Future Research

- Low employment rate of the wives in the sample
- Small sample size
- Endogenous number of children
- Lack of household location characteristics (e.g., job variety, childcare service)

Acknowledgements

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