

# The Fertility, Marriage, and Gender Equality Quandary

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# Motivation

- Three trends underpin the grand gender convergence in the last century:
  1. Falling fertility (Guinnane 2011)
  2. Declining marriage (Stevenson and Wolfers 2007)
  3. Converging gender (income) gaps (Goldin 2014)
- Existing research and policymakers often treat them in isolation

# This Paper

- Document a three-way trade-off between (1) high fertility, (2) widespread dual parenthood, and (3) gender income equality
- Develop a **unified model** of marriage market equilibrium, extending Choo and Siow (2006), to explain the empirical facts
- Calibrate to the transition experience of Mexico
- Consider a dynamic extension with endogenous gender human capital gap

# Key Findings

- Reducing women's child-rearing costs stands out as the unique policy that could mitigate the trade-off
- Quantitative results on Mexico from 1990 to 2015:
  - Gender-neutral TFP explains half of declining fertility and marriage
  - Gender-biased TFP and the gender education gap reversal account for the narrowing gender income gap
- Gendered impacts of single parenthood result in dynamic propagation

# Roadmap

- Empirical findings
- Model
- Quantitative analysis
- Dynamic extension
- Conclusion

## Motivating Facts

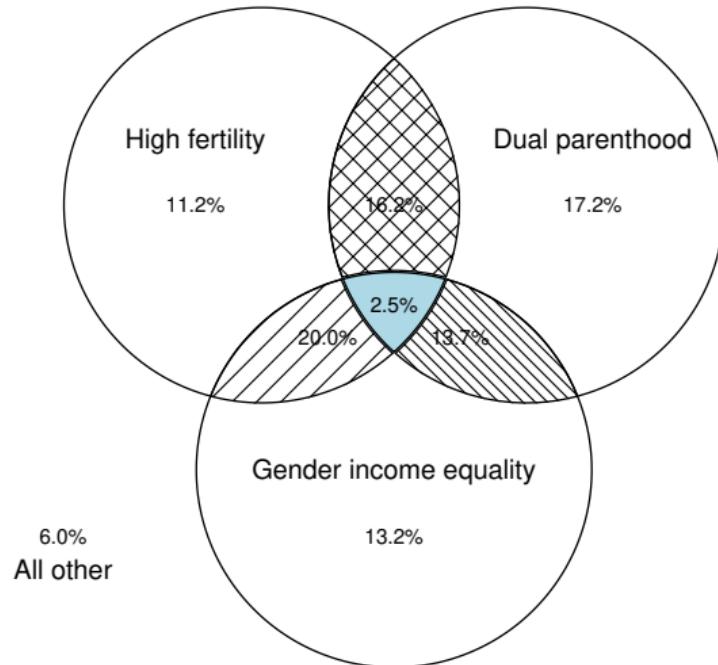
# Data Source

- **OECD sample:** 37 OECD countries from 1970 to 2014, 721 observations
  - Total fertility rate (UN)
  - Share of out-of-wedlock birth (OECD database)
  - Gender gaps in median earnings (OECD database)
- **World sample:** 95 countries from 1990 to 2019, 1130 observations
  - Total fertility rate (UN)
  - Share of children living with both parents (Brenøe and Wasserman 2025)
  - Female share of labor income (World Inequality Database)
- **U.S. sample:** 50 states and D.C. in 2023
  - Live births per 1000 women aged 15-44 (CDC)
  - Single-mother household share (ACS)
  - Gender earnings gap (ACS)

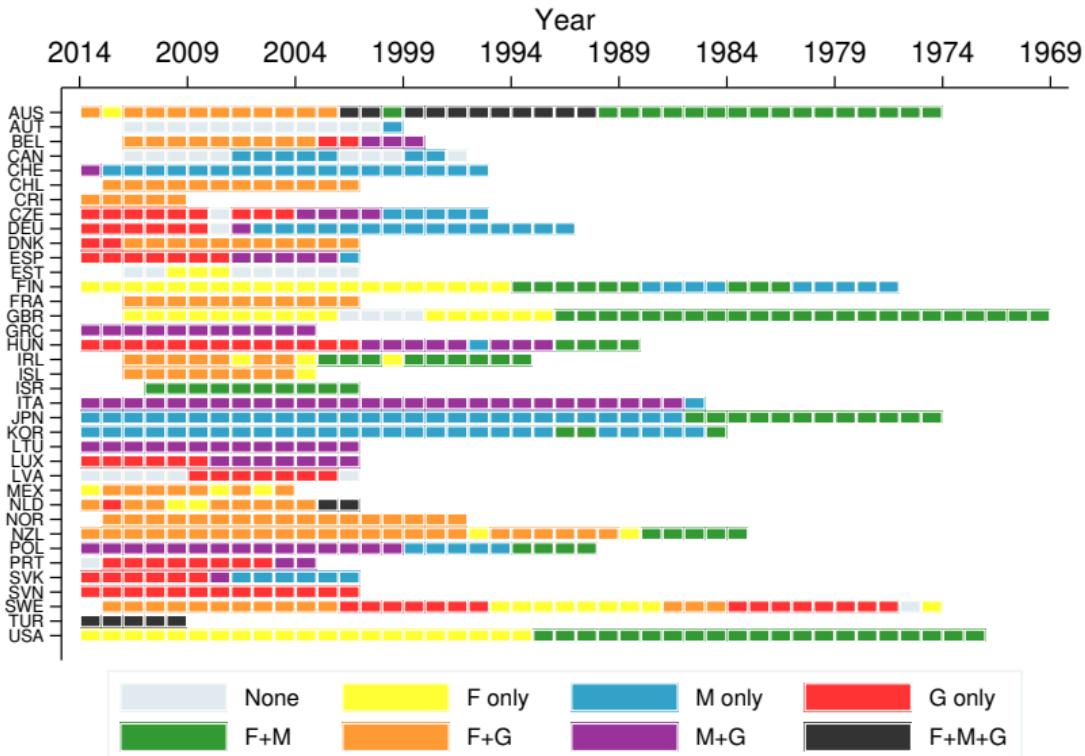
# Quantifying the Trade-Off

- In the spirit of the **dartboard approach** (Ellison and Glaeser 1997), assign values to dummy variables
  - High fertility
  - Dual parenthood
  - Gender income equalityaccording to sample medians
- Visualize the intersections using Venn diagrams
- The random benchmark of the intersection is  $0.5 \times 0.5 \times 0.5 = 12.5\%$

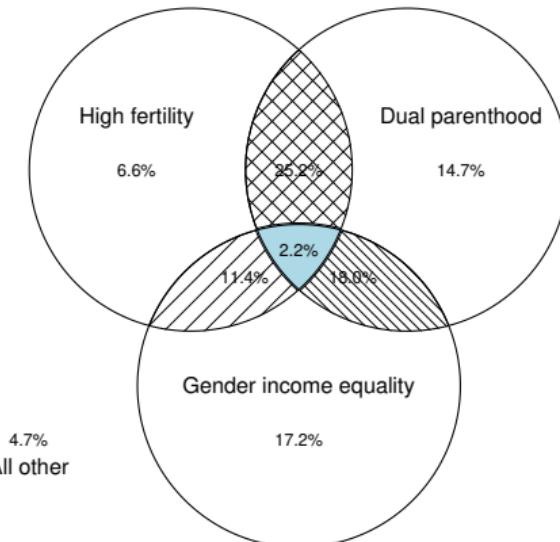
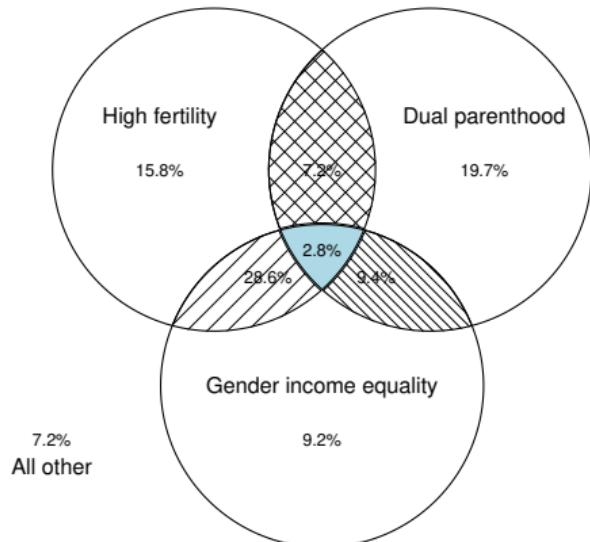
# OECD Sample



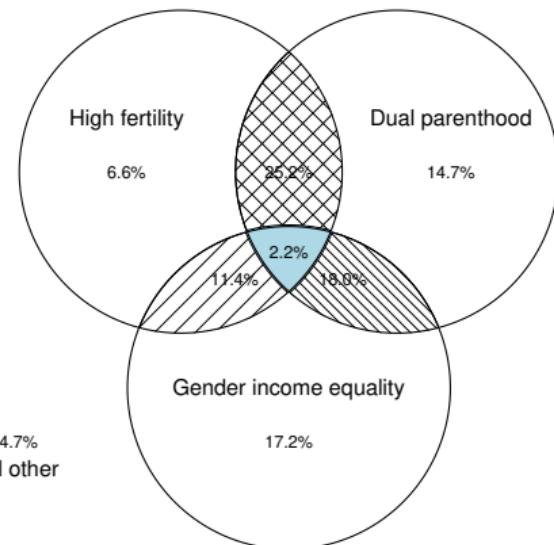
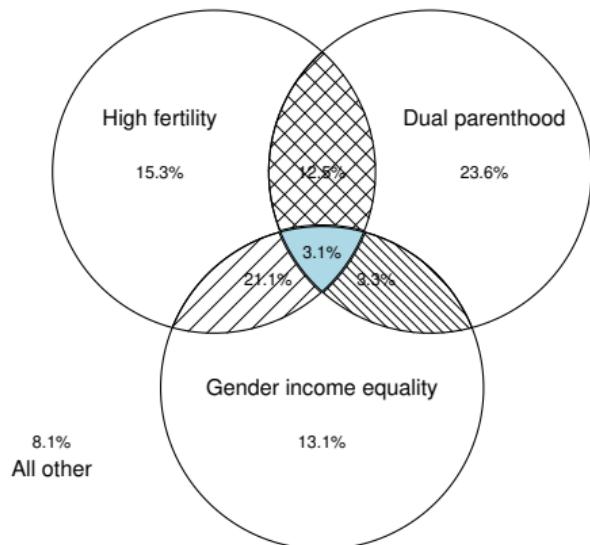
# OECD Sample



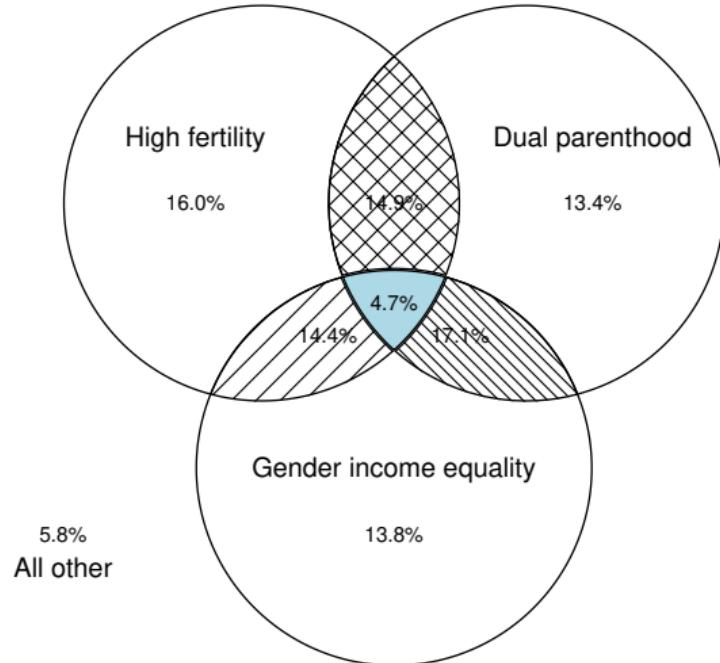
# OECD Sample by Income



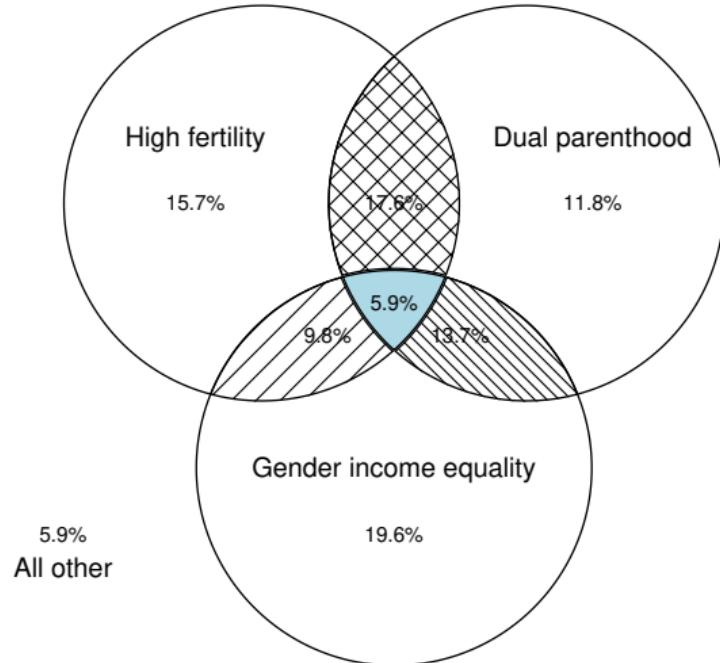
# OECD Sample by Education



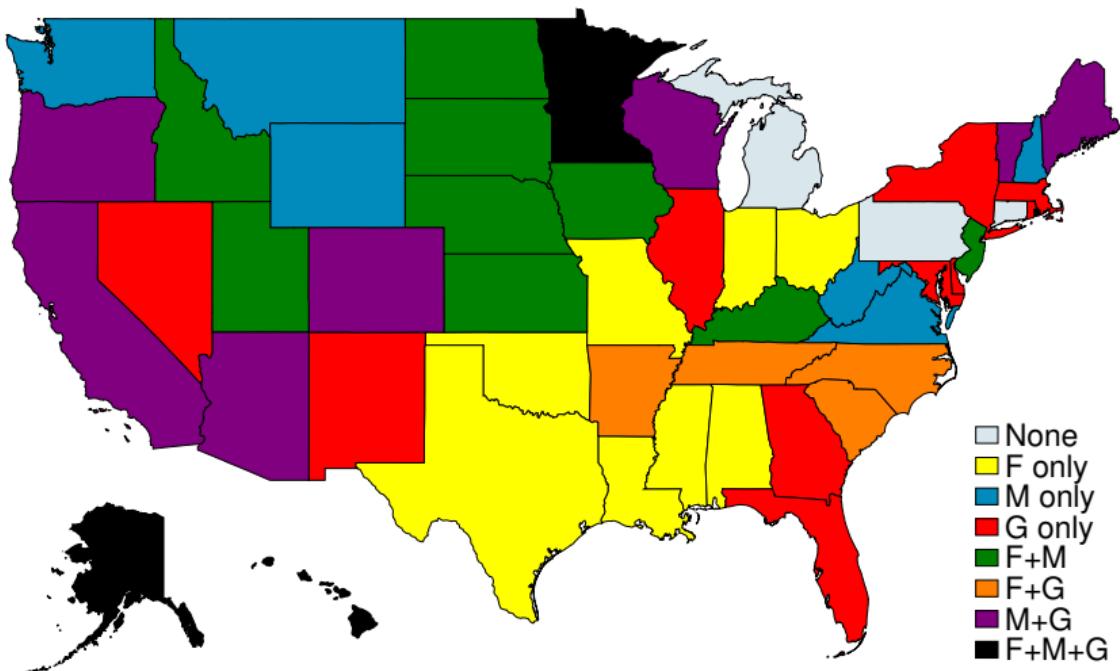
# World Sample



# U.S. Sample



# U.S. Sample



Model

# Basic setup

- Individual of equal mass with gender  $g \in \{\sigma, \varphi\}$  and preference

$$u^g(c^g, n) = \left( (1 - \beta) \cdot (c^g)^{\frac{\rho-1}{\rho}} + \beta \cdot n^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \quad (1)$$

where  $\rho > 1$  so that  $u(c, 0)$  is well-defined

- Homogeneous wage within gender  $w^\sigma$  and  $w^\varphi$
- Wage gap is defined as

$$\Gamma^w = \frac{w^\sigma}{w^\varphi} \quad (2)$$

# Marriage and Fertility – Men

- If single, men consume their labor income but have no children

$$V^{\vec{\sigma}, s} = u(w^{\vec{\sigma}}, 0) \quad (3)$$

- Once married, husbands work and transfer  $\alpha$  share of income to wives

$$V^{\vec{\sigma}, m} = u((1 - \alpha)w^{\vec{\sigma}}, n^m) \cdot \lambda \quad (4)$$

- $\alpha$  is an endogenous outcome in the marriage market equilibrium
- $\lambda$  is the psychic benefit of marriage

# Marriage and Fertility – Single Women

- Single female solves

$$V^{\varnothing,s} = \max_{c^{\varnothing,s}, l^s, n^s} u(c^{\varnothing,s}, n^s) \quad (5)$$

subject to budget and time constraints

$$c^{\varnothing,s} = w^{\varnothing} l^s \quad l^s = 1 - \chi n^s$$

- Simple consumption-fertility trade-off through endogenous labor supply

# Marriage and Fertility – Married Women

- Wives need to balance fertility and consumption

$$V^{\varnothing, m} = \max_{c^{\varnothing, m}, l^m, n^m} u(c^{\varnothing, m}, n^m) \cdot \lambda \quad (6)$$

subject to budget and time constraints

$$c^{\varnothing, m} = \underbrace{\alpha w^\sigma}_{\text{transfer from husband}} + \underbrace{w^\varnothing l^m}_{\text{own labor income}}, \quad l^m = 1 - \chi n^m$$

- Within marriage, fertility is subject to veto  $\implies$  females determine fertility

# Marriage Market Equilibrium

- Each individual draws an idiosyncratic taste shock  $\epsilon$  on marriage, distributed Fréchet with scale  $\theta$
- Let  $\mathcal{M}^g$  denote the share of gender  $g$  being married

$$\mathcal{M}^\sigma = \frac{1}{1 + (V^{\sigma,s}/V^{\sigma,m})^\theta}, \quad \mathcal{M}^\Omega = \frac{1}{1 + (V^{\Omega,s}/V^{\Omega,m})^\theta}. \quad (7)$$

- Equilibrium requires

$$\mathcal{M}^\sigma = \mathcal{M}^\Omega = \mathcal{M}, \quad (8)$$

with  $\alpha$  and  $n^m$  acting as market-clearing “prices”

# Aggregate Quantities

- Aggregate fertility rate  $n$  and share of children with both parents

$$n = \mathcal{M} \cdot n^m + (1 - \mathcal{M}) \cdot n^s \quad (9)$$

$$\mathcal{D} = \frac{\mathcal{M} \cdot n^m}{n} \quad (10)$$

- Average hours worked per female is

$$l^\varnothing = \mathcal{M} \cdot l^m + (1 - \mathcal{M}) \cdot l^s = 1 - \chi n \quad (11)$$

- Gender income gap

$$\Gamma^y = \frac{y^\sigma}{y^\varnothing} = \frac{\Gamma^w}{l^\varnothing} \quad (12)$$

# Marriage Market

- Men are homogeneous and are on the long side of the marriage market
- Transfer  $\alpha$  makes males indifferent between single and marriage

$$V^{\sigma^*, m} = u((1 - \alpha)Ah^{\sigma^*}, n^m) = u(Ah^{\sigma^*}, 0) = V^{\sigma^*, s} \implies \alpha(n^m) \quad (13)$$

- On the other hand,  $n^m$  is a function of  $\alpha$  from married women's utility maximization  $\implies n^m(\alpha)$
- The marriage market equilibrium is characterized by a **fixed-point problem** of  $(\alpha, n^m)$

# Equilibrium Conditions

- A price vector  $(\alpha, n^m)$  clears the marriage market
- For any  $\mathcal{M}$ , men's optimal choice yields  $\alpha$  as a function  $n^m$ :

$$\alpha = 1 - \left[ \left( \left( \frac{\mathcal{M}}{1-\mathcal{M}} \right)^{\frac{1}{\theta}} \cdot \frac{1}{\lambda} \right)^{\frac{\rho-1}{\rho}} - \frac{\beta}{1-\beta} \cdot \left( \frac{n^m}{w^\sigma} \right)^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}} \quad (14)$$

which is increasing and convex in  $\alpha - n^m$  space

- The FOC for married women determines  $n^m$  as a function of  $\alpha$ :

$$n^m \cdot \left[ \left( \frac{(1-\beta)\chi}{\beta} \right)^\rho \cdot (w^\varphi)^{\rho-1} + \chi \right] = 1 + \alpha \Gamma^w \quad (15)$$

which is increasing and linear in  $\alpha - n^m$  space

# Equilibrium Characterization

- Lemma 1: For any wage pair  $\{w^\sigma, w^\varphi\}$ , there exists a unique fixed point  $(\alpha, n^m)$  that clears the marriage market
- Lemma 2: The gains from marriage are  $V^{g,m}/V^{g,s} = \lambda \cdot (1 + \alpha \Gamma^w)$
- Equilibrium-implied relationship

$$\mathcal{M} = \frac{(\lambda \cdot (1 + \alpha \Gamma^w))^\theta}{1 + (\lambda \cdot (1 + \alpha \Gamma^w))^\theta}, \quad (16)$$

$$\Gamma^y = \frac{\Gamma^w}{l^\varphi}, \quad (17)$$

$$l^\varphi = 1 - \chi n. \quad (18)$$

# Three-Way Trade-Off

## 1. High fertility and high dual-parenthood

High  $n$  implies low  $l^{\Omega}$ . To sustain high  $\mathcal{M}$ ,  $\Gamma^w$  must be sufficiently large. Thus,  $\Gamma^y$  is necessarily high

## 2. High fertility and gender income equality

High  $n$  again implies low  $l^{\Omega}$ . To achieve low  $\Gamma^y$ ,  $\Gamma^w$  must be very small. Because  $\alpha$  is bounded above by one, a very small wage gap reduces  $\mathcal{M}$

## 3. High dual-parenthood and gender income equality

Because  $\alpha$  is bounded above, high  $\mathcal{M}$  requires large  $\Gamma^w$ . To offset this and achieve low  $\Gamma^y$ ,  $l^{\Omega}$  must be high. Thus, fertility  $n$  is low

# Any Way Out?

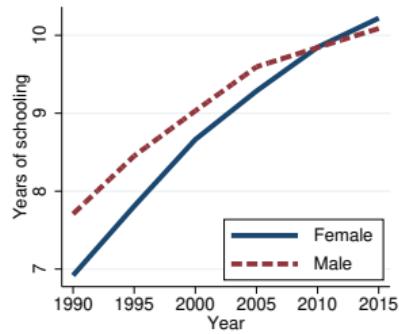
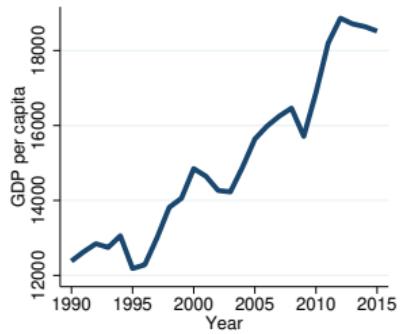
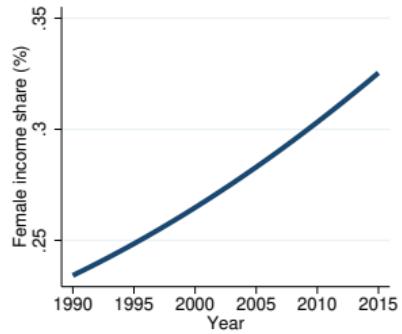
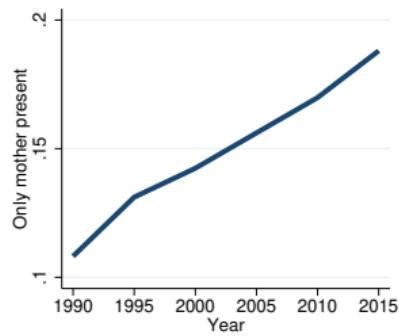
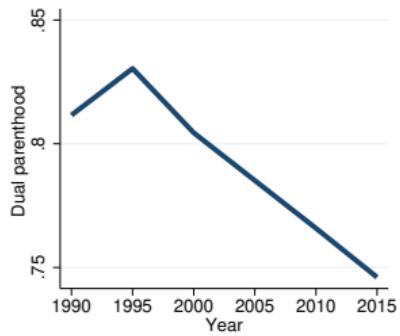
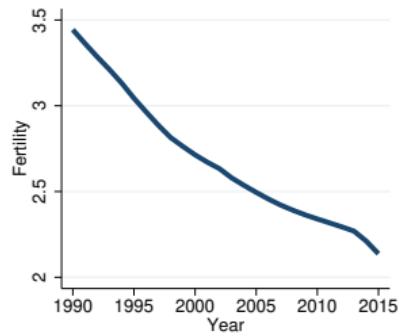
- Policy effects
  1. Pro-marriage policies (higher  $\lambda$ )  $\implies$  Higher  $\mathcal{M}$ , higher  $n$ , but also greater  $\Gamma^y$
  2. Pro-equity policies (lower  $w^{\Omega}$ )  $\implies$  Achieve lower  $\Gamma^y$ , but lower  $\mathcal{M}$  and  $n$
  3. Pro-fertility policies (lower  $\chi$ )  $\implies$  Higher  $\mathcal{M}$ , higher  $n$ , but reduces  $\Gamma^y$  because  $n \cdot \chi$  falls in equilibrium
- Policies reducing child-rearing costs for women mitigate the trade-off
- One problem left: policy costs relative to GDP rise disproportionate as productivity grows

## Quantitative Analysis

# Data and Variable Definition

- Choose Mexico due to (1) data availability, (2) dramatic fertility decline alongside economic growth, and (3) gender education gap reversal
- Assume that  $\{w_t^{\text{♀}}, w_t^{\text{♂}}\}$  as the exogenous driving force
- Decompose wage trends into three components:
  - $A_t = w_t^{\text{♂}}$ : gender-neutral productivity
  - $\Gamma_t^h$ : gender gap in human capital
  - $B_t = \frac{w_t^{\text{♂}}/w_t^{\text{♀}}}{\Gamma_t^h}$ : gender-biased productivity

# Mexico's Transition



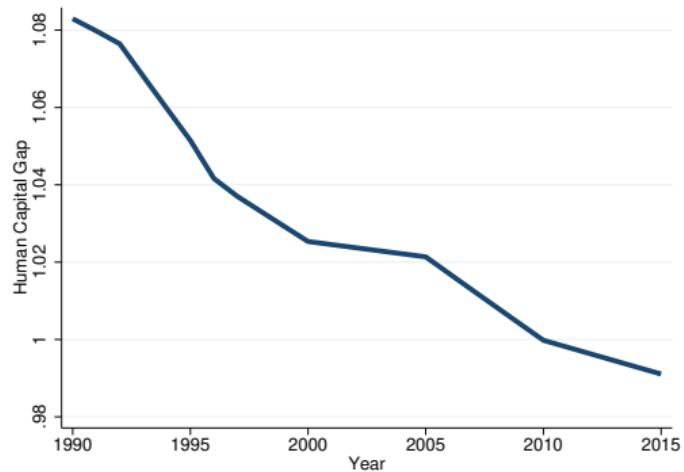
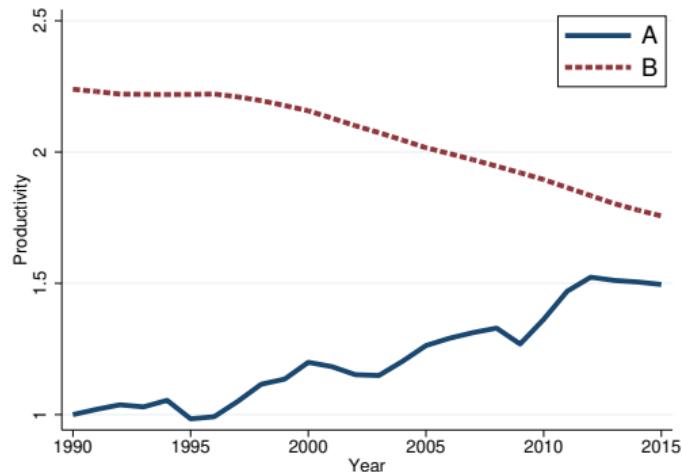
# Calibration Strategy

1. Fix  $\chi = 0.075$  (de La Croix and Doepke 2003)
2. Compute  $\Gamma_t^h$  using years of schooling and Mincerian returns and back out  $\{A_t, B_t\}$  from average income and female income share
3. Jointly calibrate the remaining parameters

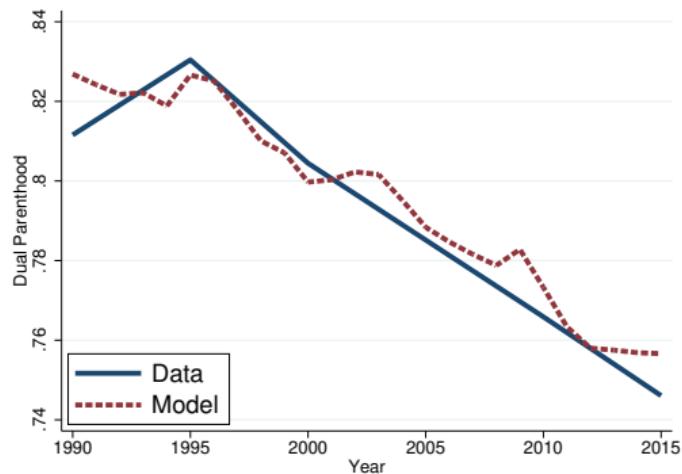
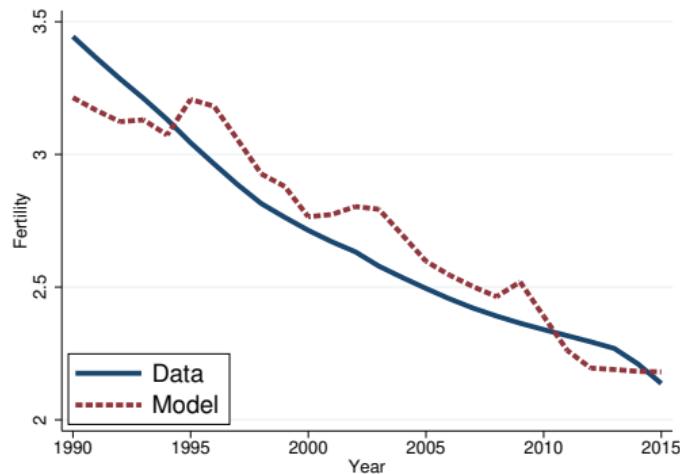
$$\underbrace{\beta = 0.104}_{n \text{ weight}}, \quad \underbrace{\rho = 1.5}_{c-n \text{ substitutability}}, \quad \underbrace{\lambda = 1.03}_{\text{psychic benefit}}, \quad \underbrace{\theta = 3.4}_{\text{shock dispersion}}$$

to fit trends in fertility and dual parenthood

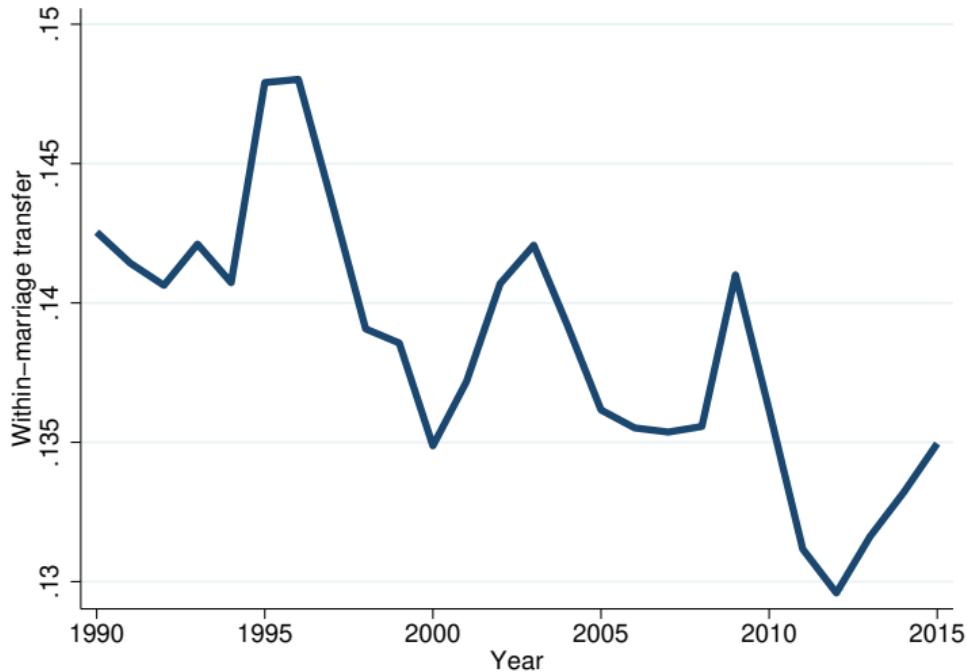
# Calibration Results (1)



# Calibration Results (2)

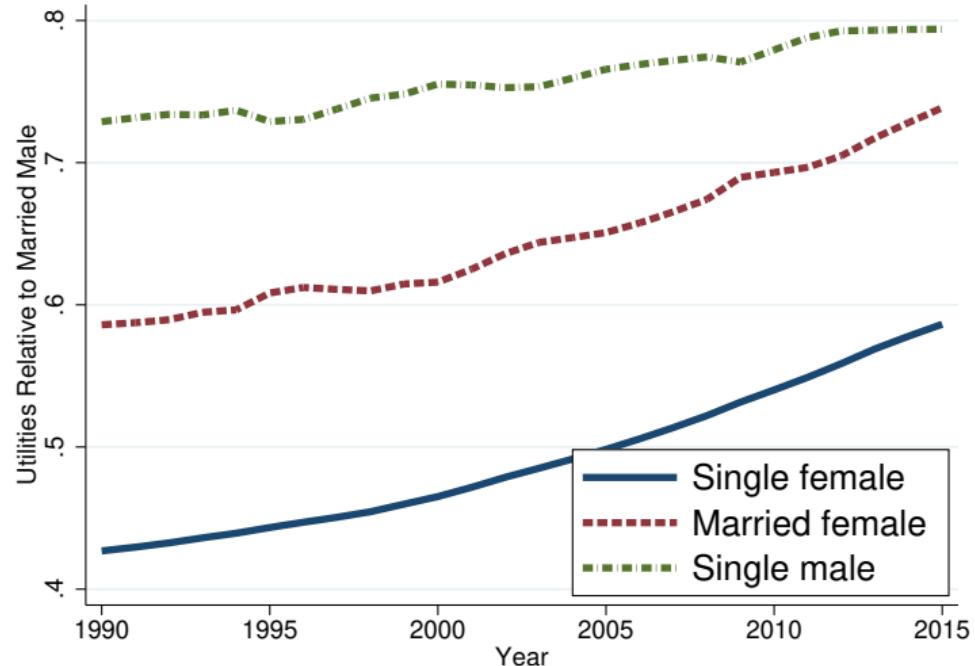


# Within-Marriage Transfers

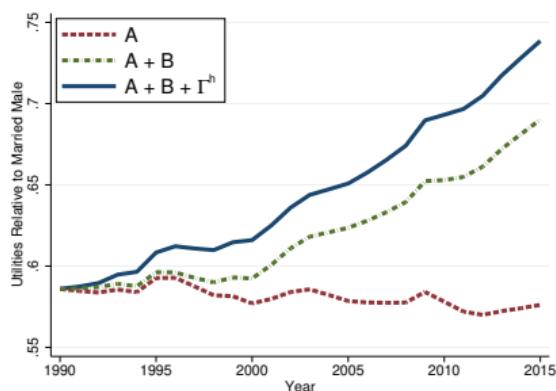
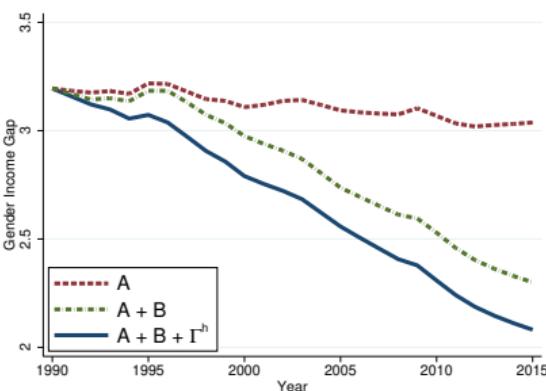
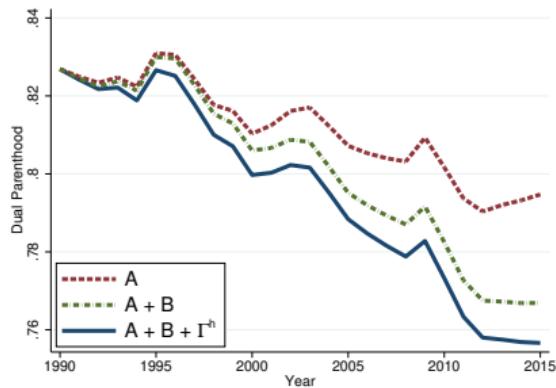
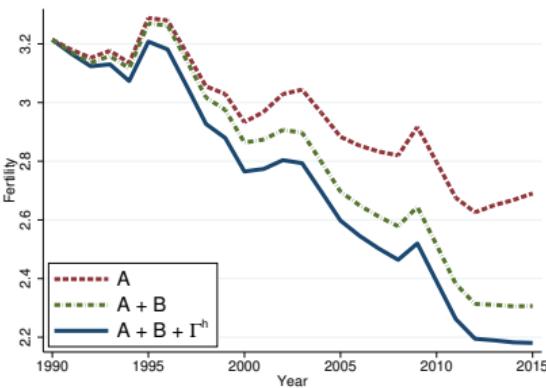


- Smaller decline in  $\alpha_t$  relative to  $n_t^m$  because  $\Gamma_t^w$  falls

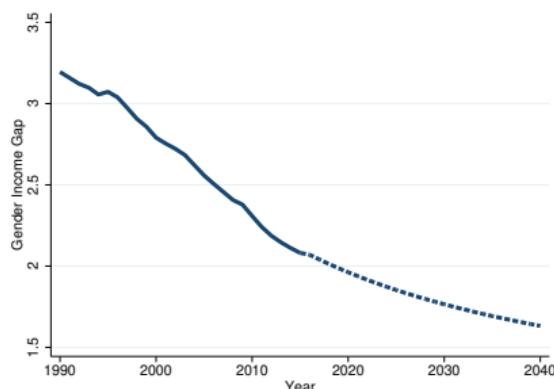
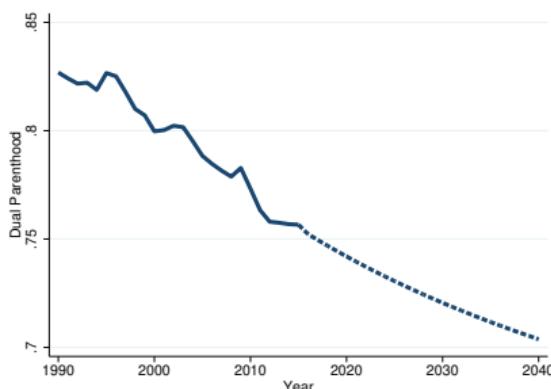
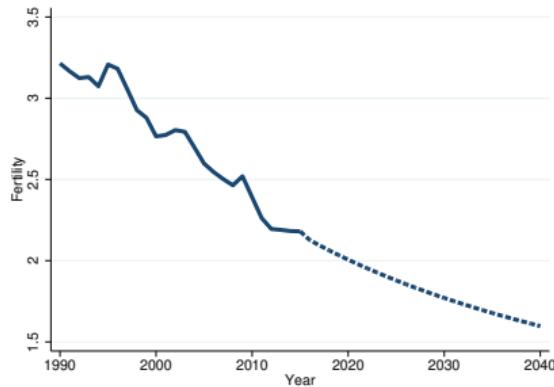
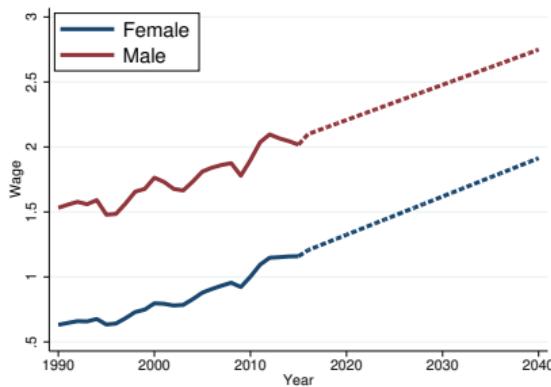
# Relative Utilities



# Decomposition



# Model-Based Prediction



## Dynamic Extension

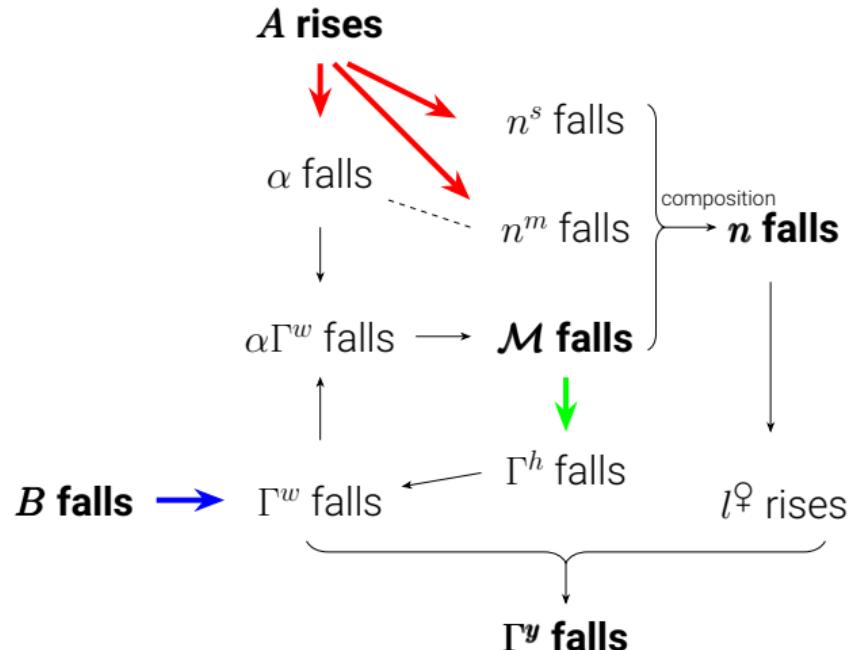
# Endogenous Gender Human Capital Gap

- Assume that gender human capital gap depends on marriage

$$\frac{\Gamma_{t+1}^h}{\Gamma_t^h} = (\mathcal{M}_t)^\psi, \quad \psi < 0. \quad (19)$$

- Motivated by Bertrand and Pan (2013), Autor et al. (2019, 2023), Wasserman (2020), Reeves (2022), Frimmel et al. (2024)
- “The evidence supports an emerging consensus that growing up in a family without biological married parents produces more adverse consequences for boys than for girls.”  
– Wasserman (2020)

# Dynamic Mechanism



Two exogenous forces and one propagation mechanism

# Conclusion

- A three-way trade-off between fertility, marriage, and gender equality
- A unified framework to explain the empirical pattern
- Family policies offer a way out, but are getting costlier
- Quantitative analysis of Mexico's transition path
- Dynamic propagation through human capital formation