Structural transformation and U-shaped female employment

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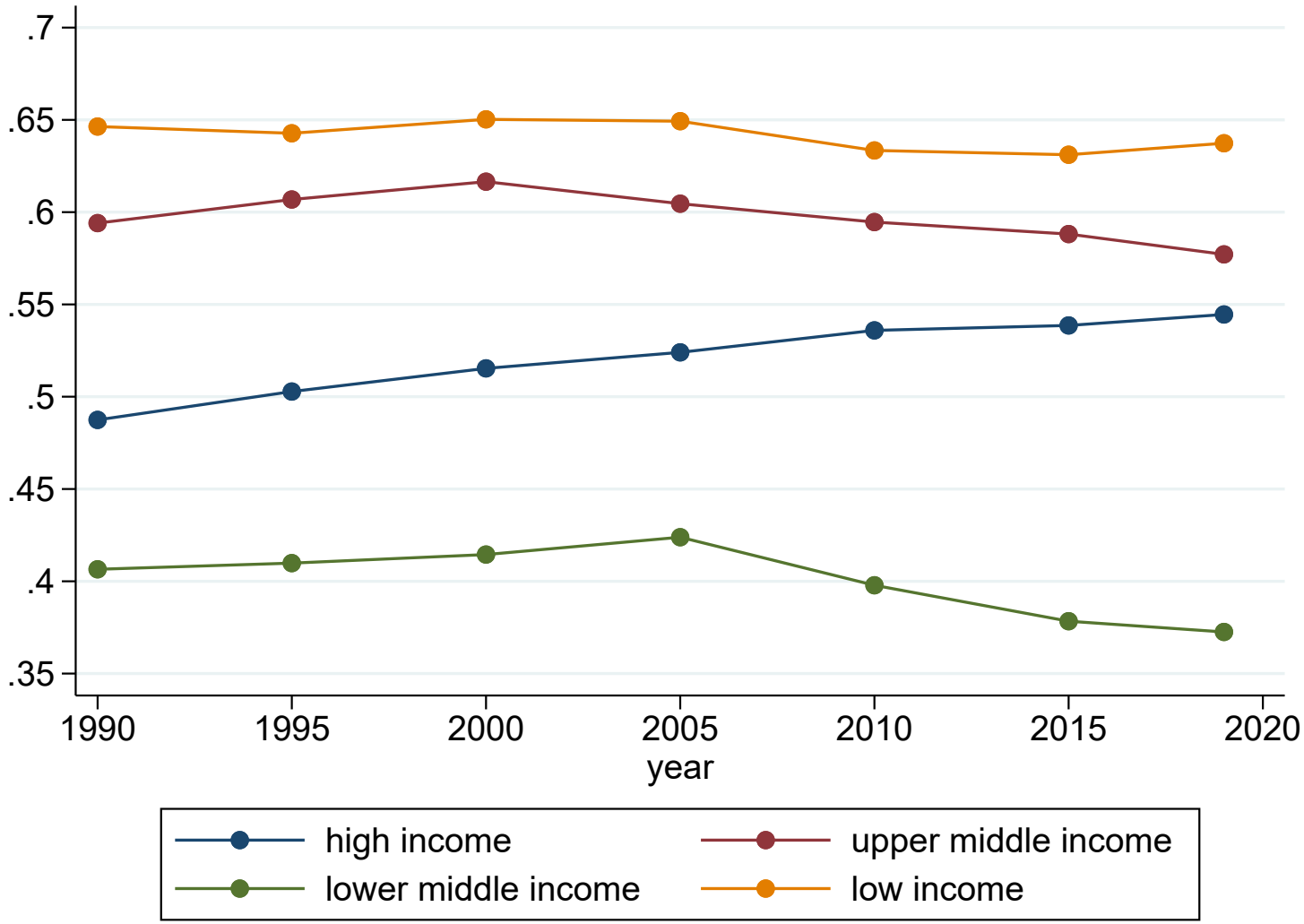
Background and motivation

- All high-income countries witnessed a rise in female employment since WW2
- But not a universal phenomenon
  - female employment has been falling during other time windows and/or in other countries
- This paper aims to understand various phases in the evolution of female employment through the lens of structural transformation
  - labour reallocation across agriculture, manufacturing and services
  - with focus on unpaid family work

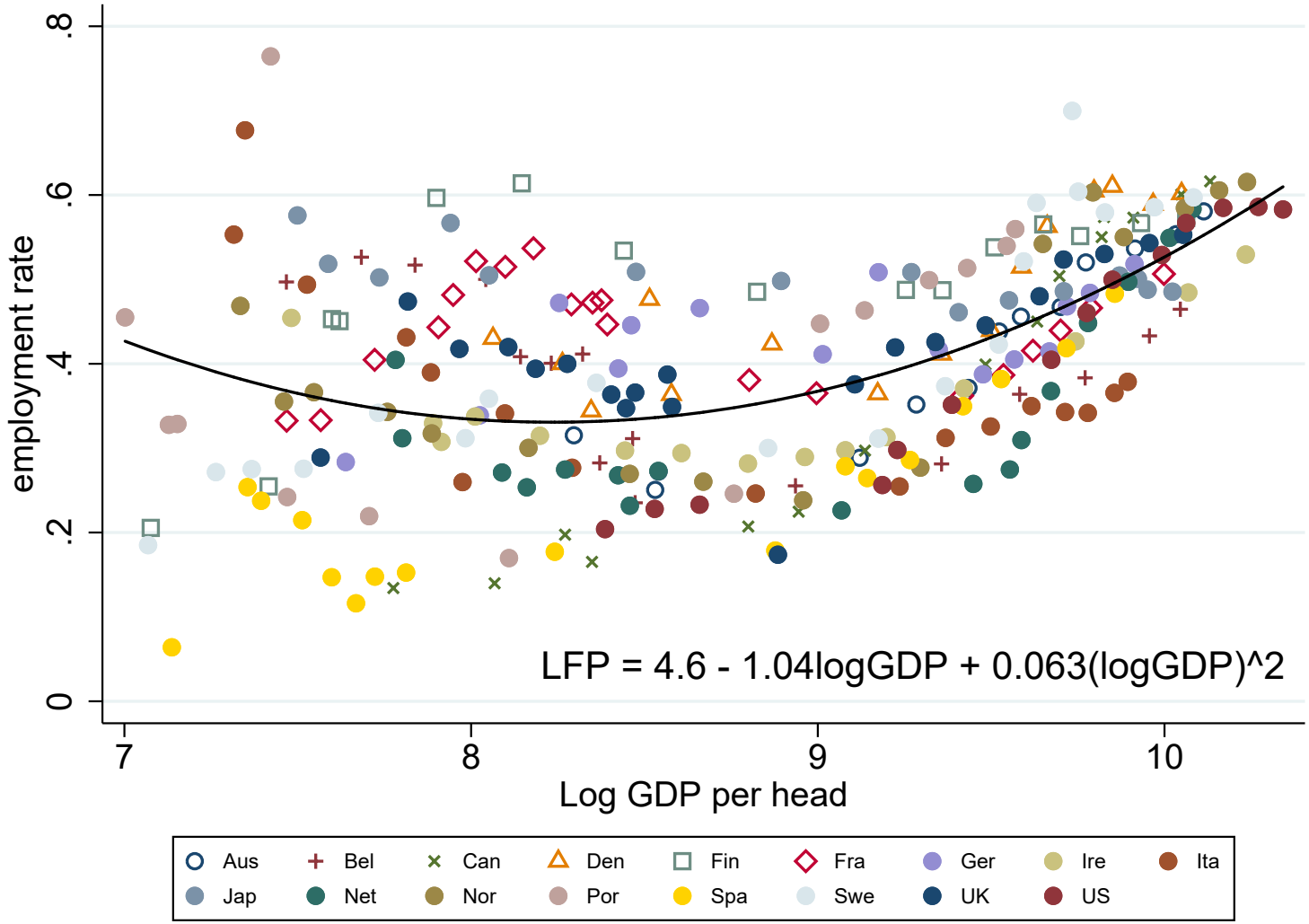
Female employment around the world



Sample: women aged 25+; groups according to GNI pc. Source: WDI & ILO

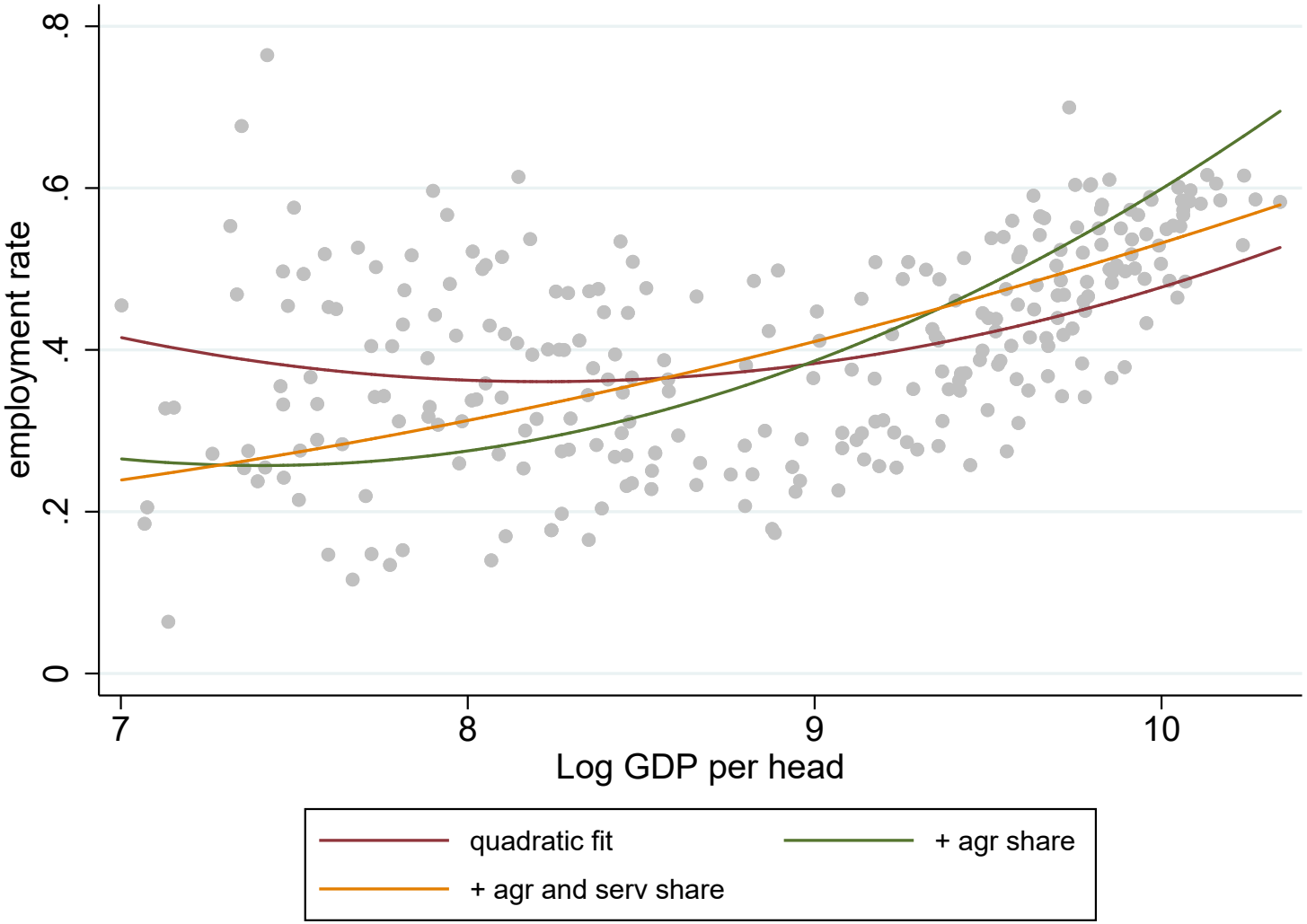
Total fertility rate

Female employment and economic development



Notes: 17 advanced economies, 1840-2005, age 15+. Source: Olivetti (2014).

Female employment and structural transformation



Notes: 17 advanced economies, 1840-2005, age 15+. Regressions include country and year FE. Source: Olivetti (2014).

Our approach

- Build consistent measure of female employment for the US over 1860-2010; intensive and extensive margins
  - Data on persons employed from Census; correction for unpaid family work and under-reporting
  - Information on hours per employed pre-1940 from various sources (time use surveys, census of manufacturing, state-level sources)
  - Post-1940 information on hours from US census
- Unified framework for understanding U-shaped evolution of female employment
  - **modernization** within agriculture: decline in family farms and rise in modern agriculture
  - **structural transformation** across agriculture, manufacturing and services
  - **marketization** within services: from home production to market services

Related work

- U-shape idea has been pioneered in early work by Sinha (1965), Boserup (1970), Durand (1975), Goldin (1986)
  - based on technology adoption in agriculture, income effects, urbanization, etc.
  - Goldin (1995) shows U-shape on a cross-section of countries in 1980s
  - Goldin (1990): female participation likely decreasing from late 19th–early 20th century, based on a revision of the 1890 Census statistics so as to include undercounted occupations.
- Interplay between female employment and rise in services modeled by Lee and Wolpin (2006), Akbulut (2011), Ngai and Petrongolo (2017), Rendall (2018), Buera et al (2019)
  - framework and quantitative evaluation for recent decades

Data

Employment definition and measurement

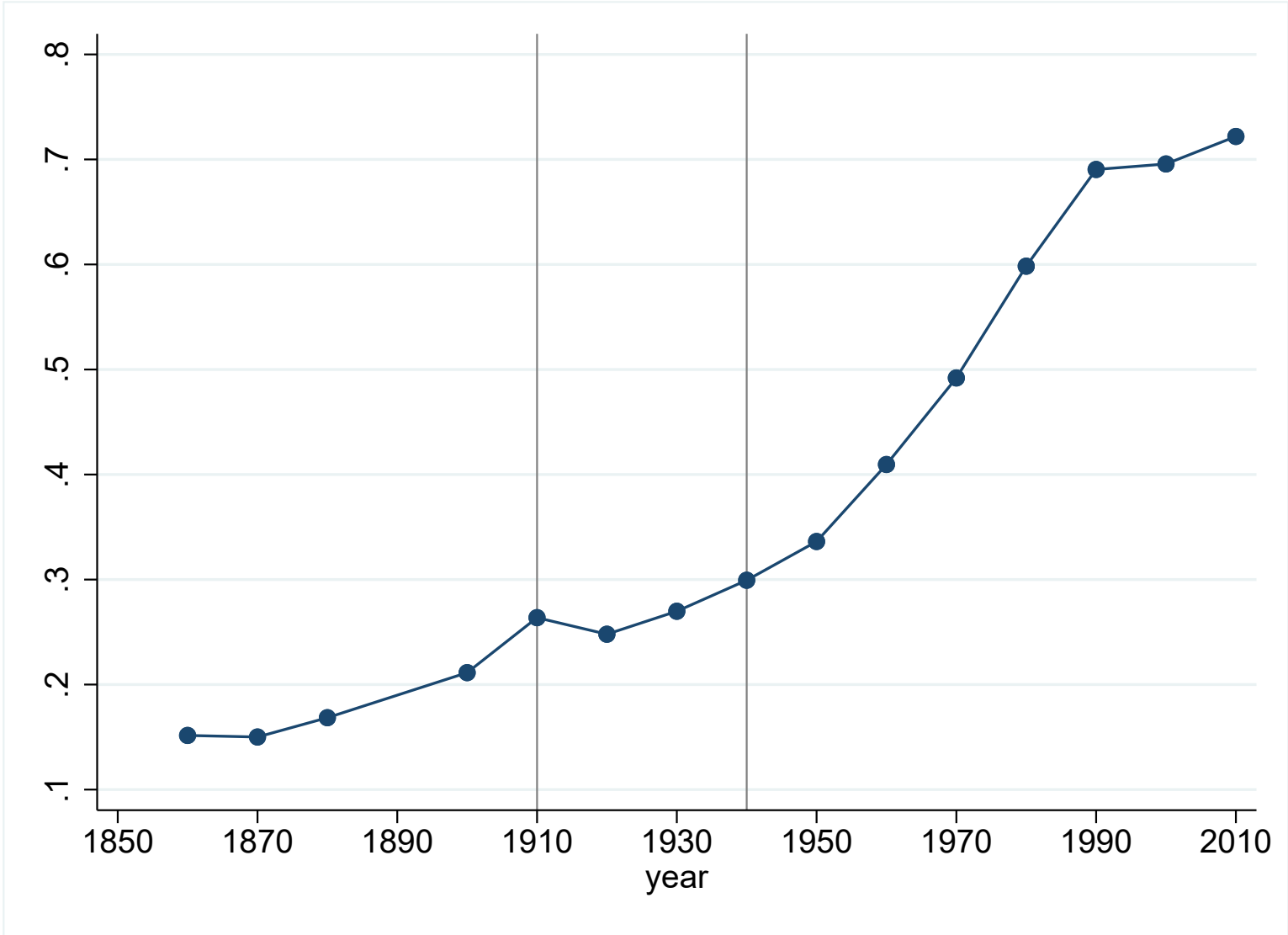
- ILO definition of employment covers *work for pay, profit or family gain in cash or kind*
  - in particular it covers unpaid (*contributing*) family workers
  - *relatives who assist without pay in a family-operated income-producing enterprises such as a farm, store, handicraft industry* (Durand, 1975)
- ILO definition well established, but measurement is not consistent over time and in country-level sources
- U.S Census: pre-1940 *gainful employment*; measure of unpaid family work not entirely consistent post-1940
- Key difficulty: identifying unpaid family work (mostly female) *when this was more widespread*

Unpaid family work 1990-2019

Importance of Unpaid Family Work

- Measure of employment:
  female employment and structural transformation
- Comparison of female employment, gender gaps, structural transformation and productivity across time and countries:
  - Productivity: GDP includes value-added of family business
  - Pre-mature de-industrialization in developing countries
- Unpaid family work v.s. home production (treated differently in time-use and GDP)
  - skills and networks
  - income-generating, female bargaining power in the family
  - gender norms (Boserup 1970, Alesina Giuliano and Nunn 2013)

Female employment in the US Census



Notes: Women aged 18-64. Men

Unpaid family work in agriculture

Ruggles (2015): importance of family enterprise in 19th century, through to mid-20th century. Family economies

- "production was carried out by families";
- 1890, about 40% of US population lived on farm; "all family members that were old enough contributed to farm production."
- Nonfarm family business: shoemakers, tailors, boarding etc.

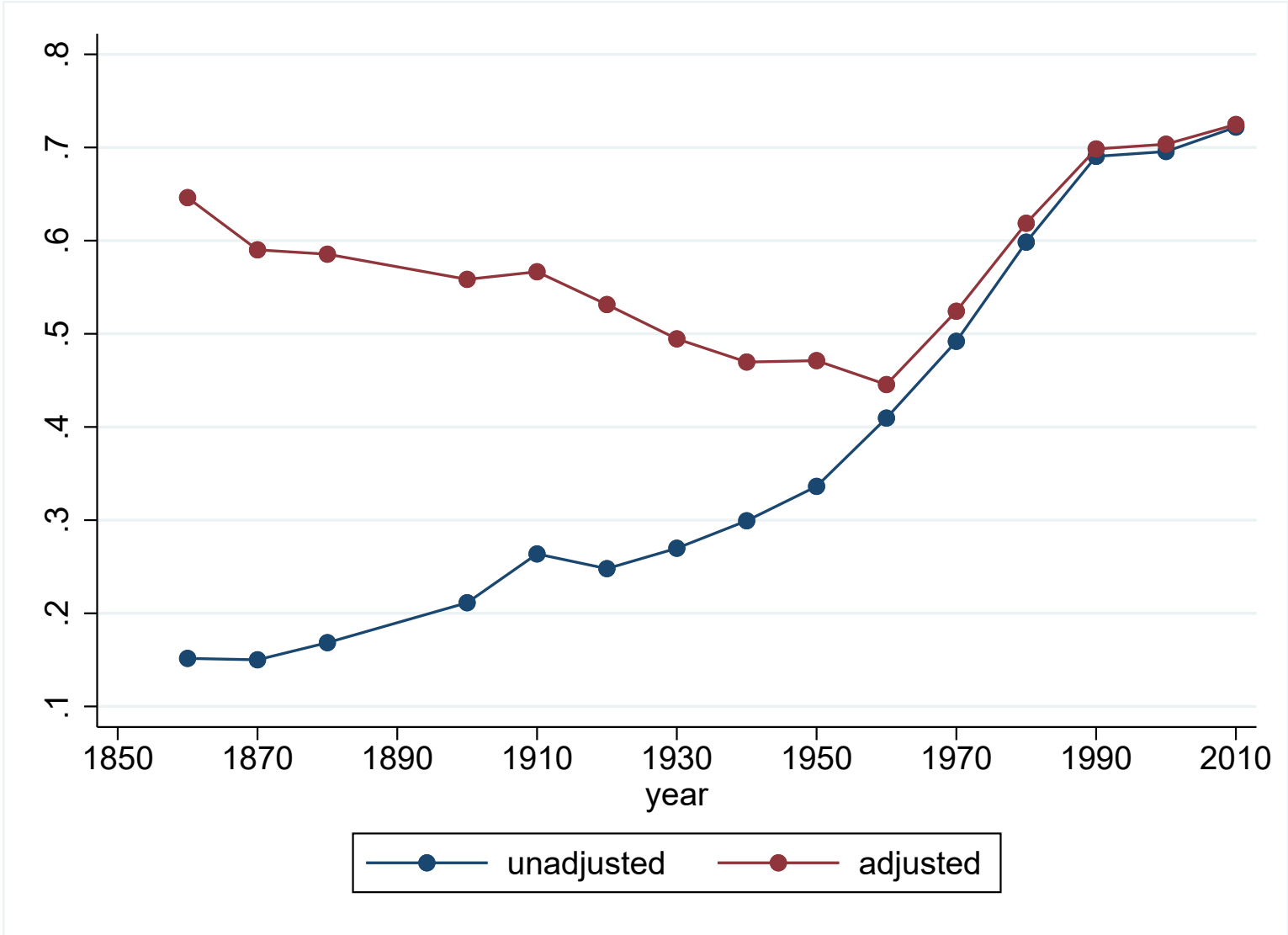
Undercount of women in agriculture (Smuts, 1960)

- about 4m white married women on farm
  - census reported about 23k in agricultural occupations.
- 1950: about 14% population on farm
  - nearly 200k as unpaid family labourers

Ruggles (2015) adjustment for unpaid work

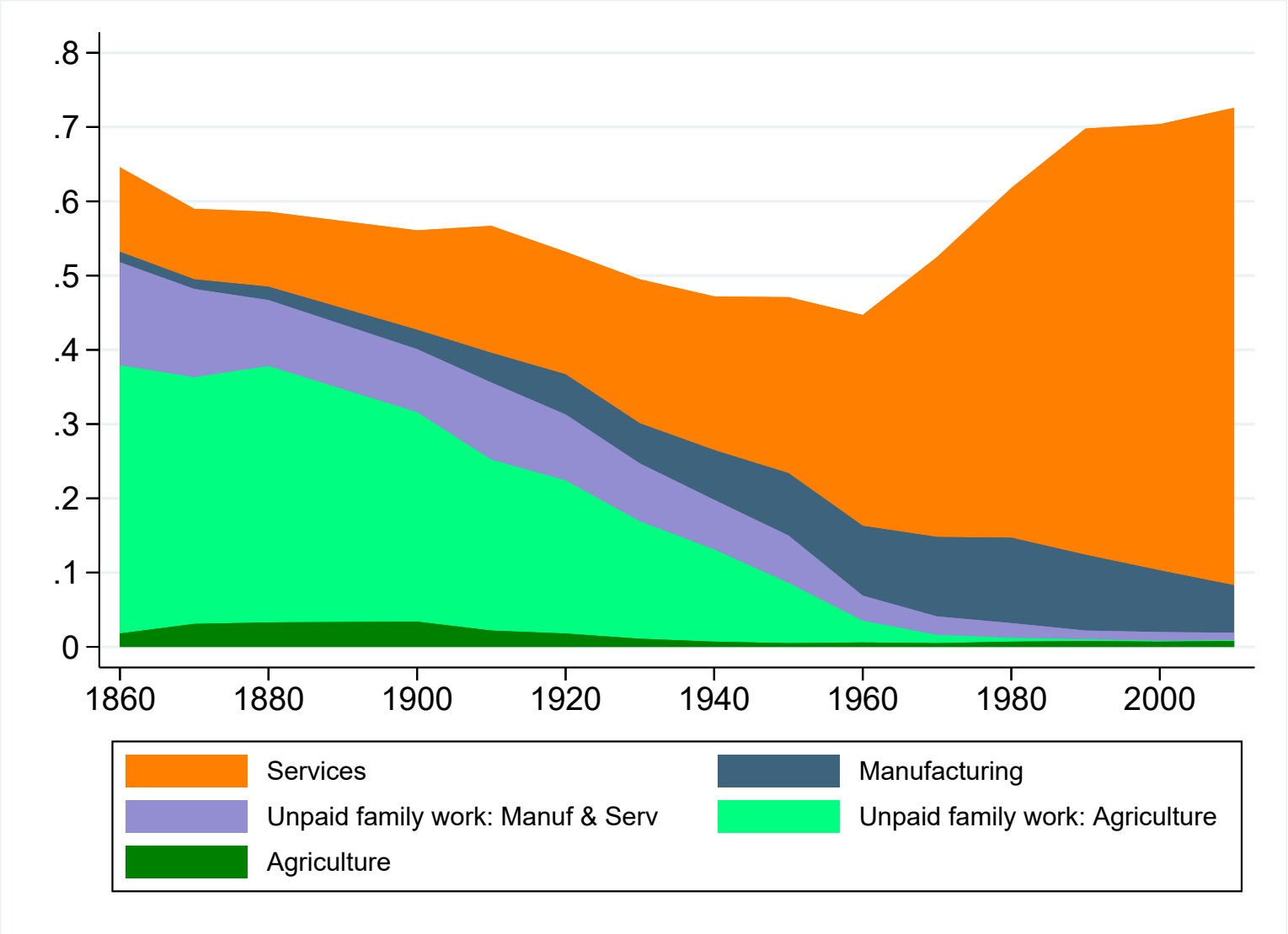
- Assign to labour force women on farms, whose head of household is farmer, whether or not they report an occupation
- Method extended to non-farm families in which the head is self employed

(Adjusted) female employment in the US Census



Notes: Women aged 18-64.

Sectoral composition of female employment



Women aged 18-64. Ruggles (2015) adjustment.

Men Structural Transformation

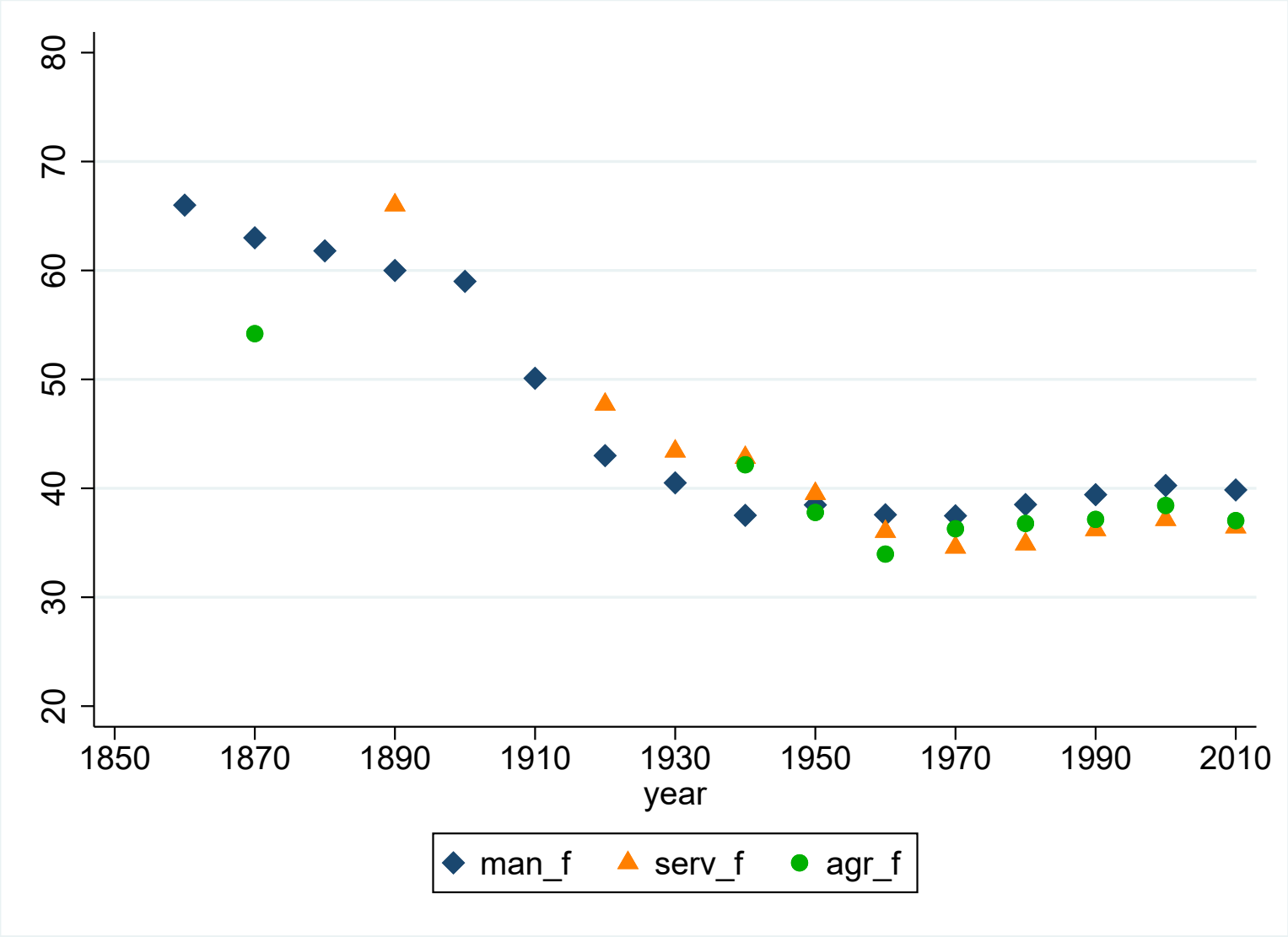
Hours

- Bodycount only captures extensive margin of employment.
- But intensive margin highly relevant as hours per employed vary widely over time and across genders and sectors
- Weekly hours fell substantially for all non-farm employees (Costa, 2000)
  - 1880s: 10 hours per day, 6 days a week;
  - 1940: 8 hours per day, 5 days a week
  - Post 1940: further reductions via paid holidays, etc.
- Unpaid hours on family farm shorter than paid hours in agriculture (Surveys of farmers; Time-use studies).
  - 1870: Farm labourers worked 10-14h per day, 6 days a week; 44/40 weeks a year for men/women
  - 1920s: Housewives on farm spent 10h per week in unpaid agricultural work; up to 15h in spring/summer

Hours: Sources

- **Historical Statistics of the United States, 1860-1930**
  - Drawing from: Census of Manufacturers, Weeks Report, Aldrich Report, series produced by E Jones, A Rees and J Owen (Whaples, 1990)
  - good coverage for manufacturing; by gender from 1914
- **Historical Labor Statistics Project, 1874-WWI** (University of California)
  - reports published by 20+ State Bureaus that gathered sectoral labor statistics
  - cover all 3 sectors, but very thin on agriculture
  - micro data, 13.4k men and 5.2k women in total, 1890-1894
- **Women Working project, 20s and 30s** (Harvard University Library's Open Collections Program)
  - 4,000+ studies, but little info on men
- **1940–: US Census**

Female hours (per employed person)

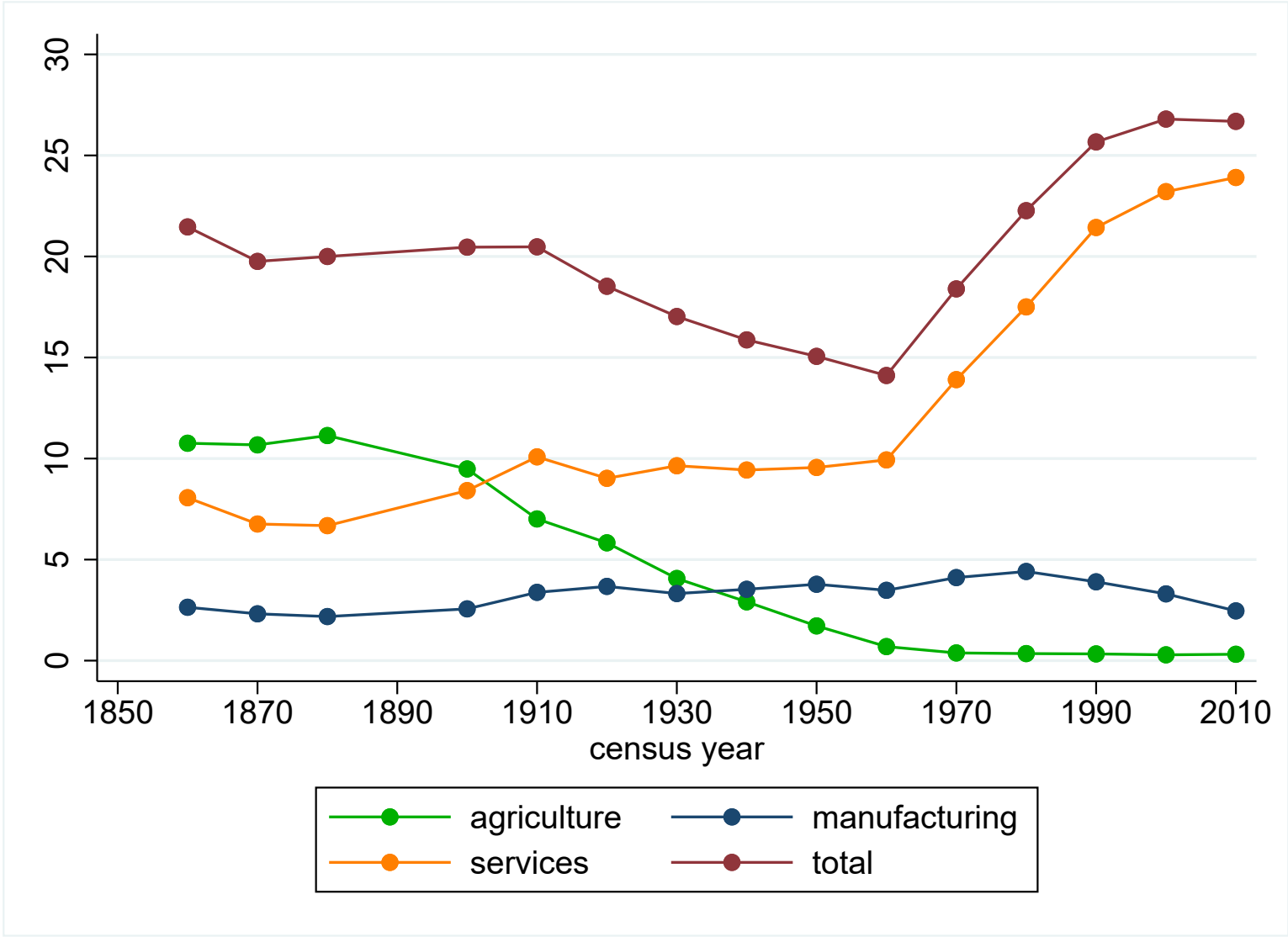


Men

Hours: Further elaborations

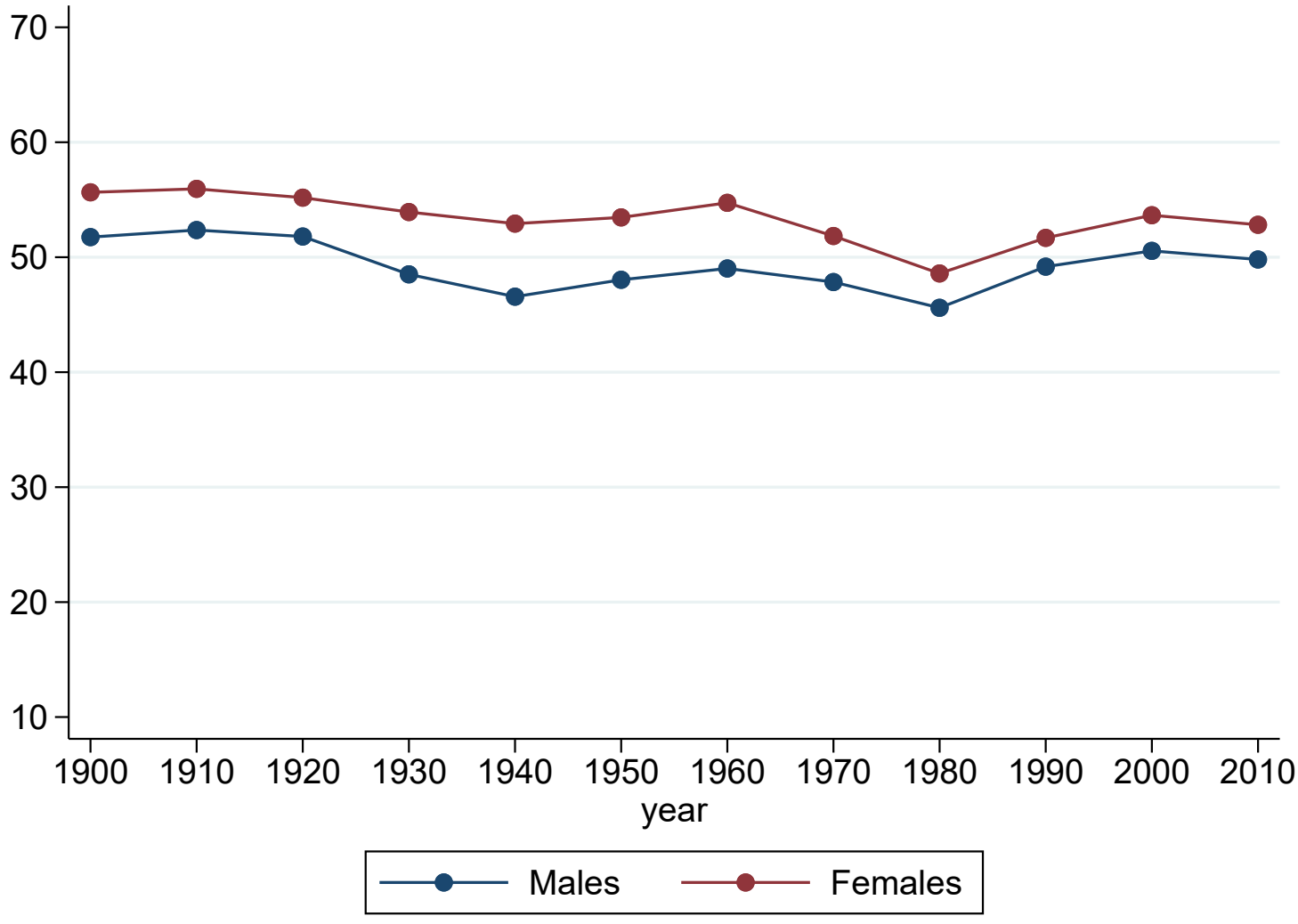
- **Services**
  - Interpolate 1890-1920;
    impose same trend as manufacturing pre-1920
- **Agriculture**
  - Assume constant 1860-1890 (Kendrick 1961, Barger 1955).
    Interpolate afterwards.
- **Unpaid work in family farms**
  - Purcell Act Time-Diary Studies of Homemakers:
    Housewives on farm spent 10h per week in unpaid agricultural work; up to 15h in spring/summer

Female hours (extensive & intensive margins)



Men

Total work (Home + Market)



Men and women aged 18-64. Source: Ramey and Francis (2009)

Summary of historical evidence

- U-shaped female employment and structural transformation
  - decline associated with declining agriculture
  - rise associated with rising services
- Important role of unpaid family work during 19th century
- Women over-represented in both family farms and service sector
- Total work rather stable for men and women
  - dominant margin of substitution is across different **sectors of work**: agriculture (paid and unpaid), manufacturing, services and home production

Model

The model economy: Building blocks

- **Households** derive utility from consumption of agriculture, manufacturing and service output
  - gross complements in utility
  - subsistence requirement on agricultural consumption
- 3 market sectors: **agriculture**, **manufacturing**, **services**
  - productivity growth: agr , man $>$ serv
  - female intensity: serv $>$ agr, man
- **Family farm** and **home production** sector:
  - Family farms produce close substitutes to market agriculture, sold to the market;
    $\rightarrow$ labour input is part of employment.
  - Home production produces close substitutes to market services; for own use.
  - Both have slower productivity growth than corresponding market sectors.

Market firms

- Production function for the representative market firm:

$$Y_j = A_j N_j, \quad N_j = \left[\xi_j l_{fj}^{\frac{\eta-1}{\eta}} + (1-\xi_j)\, l_{mj}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}; \quad j = a, m, s$$

  - A_j is sector-specific productivity, growing at γ_j
  - ξ_j is sector-specific gender weight, capturing comparative advantages

- Competitive labour markets and perfect mobility:

$$w \equiv \frac{w_f}{w_m} = \frac{\xi_j}{1-\xi_j} \left(\frac{l_{mj}}{l_{fj}} \right)^{1/\eta}; \quad j = a, m, s$$

Households (I)

- Utility has 3 consumption arguments: agr, man, serv

$$U\left(c_{\tilde{a}}, c_m, c_{\tilde{s}}\right) = \left[\omega_a \left(c_{\tilde{a}} - \bar{c}\right)^{\frac{\varepsilon-1}{\varepsilon}} + \omega_m c_m^{\frac{\varepsilon-1}{\varepsilon}} + \omega_s c_{\tilde{s}}^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

where $\varepsilon < 1$ (poor substitutes) and $\bar{c}$ is subsistence consumption.

- Services: produced at home or purchased from the market:

$$c_{\tilde{s}} = \left[\psi c_h^{\frac{\sigma-1}{\sigma}} + (1-\psi)\, c_s^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 1$ (good substitutes)

- Agricultural goods: purchased from market or family farms:

$$c_{\tilde{a}} = \left[\psi_n c_n^{\frac{\sigma_n-1}{\sigma_n}} + (1-\psi_n)\, c_a^{\frac{\sigma_n-1}{\sigma_n}}\right]^{\frac{\sigma_n}{\sigma_n-1}}$$

where $\sigma_n > 1$ (good substitutes)

Households (II)

- Allocate time to market firms, family farms and home production.
- Technology in family farm and home production:

$$y_j = A_j N_j, \quad N_j = \left[\xi_j l_{fj}^{\frac{\eta-1}{\eta}} + (1-\xi_j) l_{mj}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}; j = n, h$$

- Budget constraint:

$$\sum_{i=a,n,m,s} p_i c_i \leq w_m (L_m - l_{mh} - l_{mn}) + w_f (L_f - l_{fh} - l_{fn}) + p_n y_n$$

where home production is for own use while family farm output is sold at market price p_n.

Assumptions

- ILO definition of employment, for each gender g:
  $= l_{gn} + l_{ga} + l_{gm} + l_{gs}$
- Comparative advantages:
  - $\xi_n > \xi_a$: family farms more intensive in female labour
  - $\xi_s, \xi_h > \xi_a, \xi_m$: service production more intensive in female labour than agriculture and manufacturing.
- Uneven productivity growth
  - $\gamma_a > \gamma_n, \gamma_s > \gamma_h$: productivity growth in market firms benefits from economies of scale
  - $\gamma_a > \gamma_s$: productivity growth is faster in agriculture than services

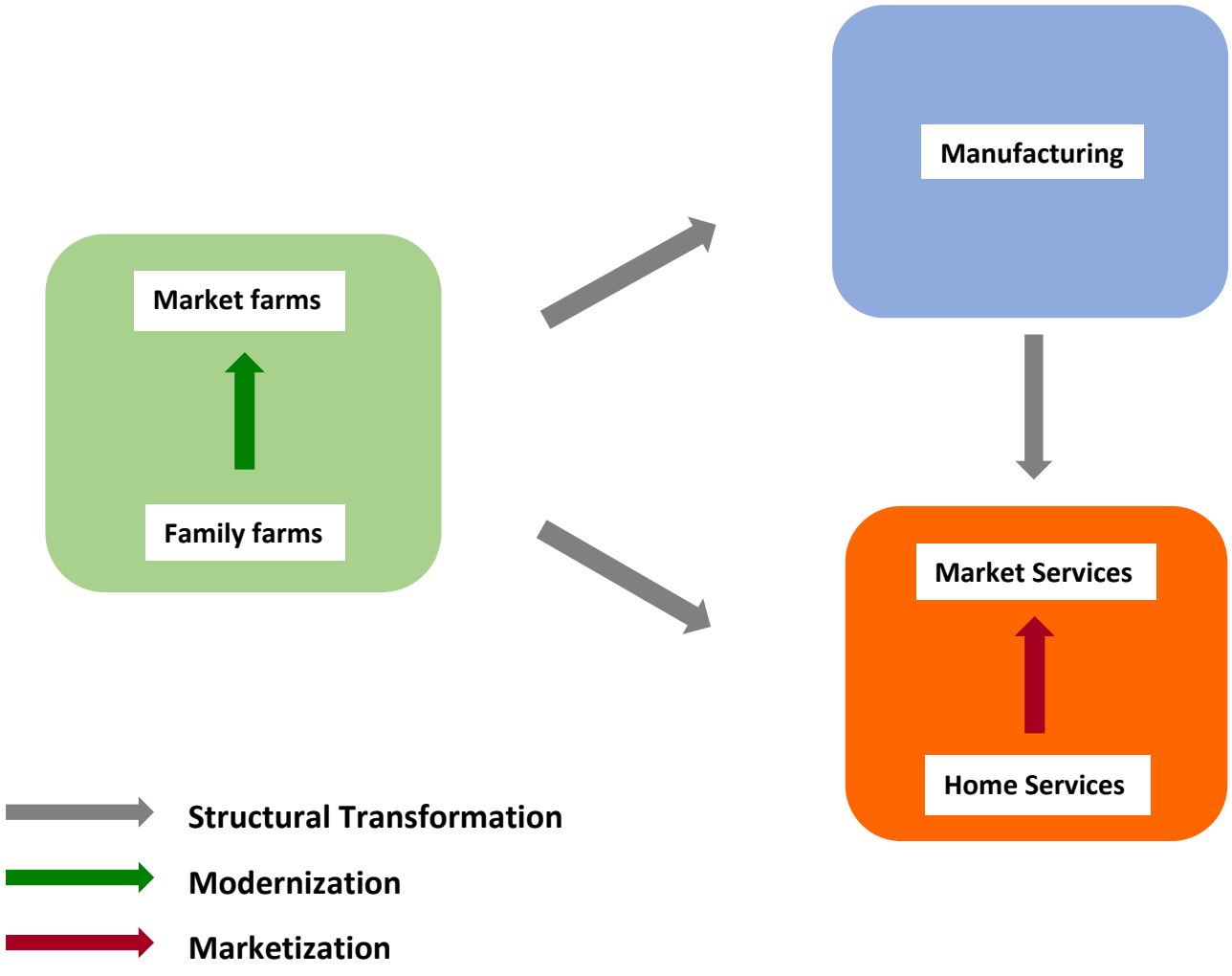
Labour reallocation

- **Modernization**.
  As output of market agriculture and family farms are good substitutes, faster productivity growth in market agriculture reallocates labour from family to market agriculture

- **Structural transformation**.
  Faster productivity growth in agriculture reallocates labour from agriculture to services:
  - Baumol effect through consumption complementarity
  - Income effect through the subsistence term

- **Marketization.**
  As home and market services are good substitutes, faster productivity growth in market services reallocates labour from home to market services

Labour reallocation



Stage 1: Fall in agriculture and female employm.

19th century, large agricultural sector

- structural transformation ($\gamma_{\tilde{a}} > \gamma_{\tilde{s}}$, $\bar{c} > 0$)
  $\rightarrow$ agriculture shrinks and services expand
- modernization drives decline of family sector
  compositional change ($\gamma_a > \gamma_n$) $\rightarrow$ even faster productivity growth in overall agriculture, stronger ST
- marketization weak ($\gamma_s - \gamma_h > 0$ but small),
- **ST dominates marketization** $\rightarrow$ home services expand and total employment falls
- Female employment falls via decline in family farms and expansion in home services.
- Bring manufacturing into the picture: stronger female trends

Stage 2: Rise in services and female employment

Starting mid-20th century, overall agriculture sector is small

- modernization nearly complete;
- structural transformation is weaker
- **marketization dominates ST** $\rightarrow$ home service falls and total employment rises
- Female employment rises via decline in home services and expansion of market services
- Bring manufacturing into the picture ($\gamma_m > \gamma_{\tilde{s}}$): ST implies labor reallocation from manufacturing into services; stronger female trends.

- Due to gender specialization, gender neutral shock such as uneven productivity growth has gender-biased consequences

Equilibrium Allocation

- Endogenous variables:
  - Gender time allocation into each of five sectors
  - Output prices in agriculture (family and market farms), manufacturing, market services.
  - Gender wage ratio
- The system of equilibrium equations can be reduced to two equations solving for female home share l_{fh}/L_f and gender wage ratio w
- Female employment is $1 - l_{fh}/L_f$.

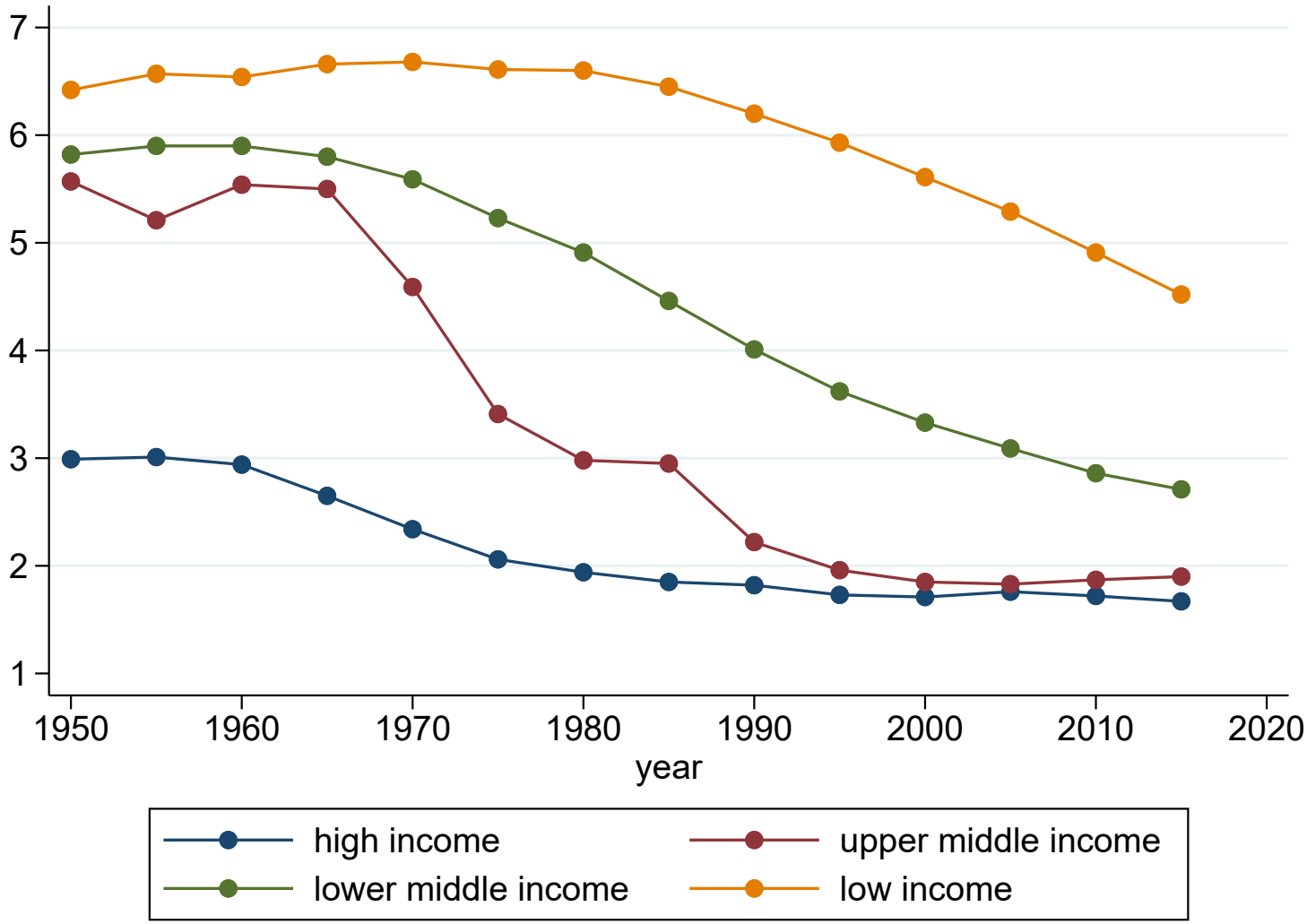
Equilibrium Conditions

Key findings

- In cross-country data, female employment declines at early stages of development, and then rises again
  – in sync with decline in agriculture and rise in services
- Build a measure of female employment during 1860-2010 in the US; U-shape.
- Develop unified framework to explain these trends
  - *Declining part of U-shape*:
    faster productivity growth in agriculture implies shrinking agriculture, especially family farms, and declining female employment
  - *Rising part of the U-shape*:
    slower productivity growth in services (especially home services) implies rising services and declining home production, accompanied by rise in female employment

Additional slides

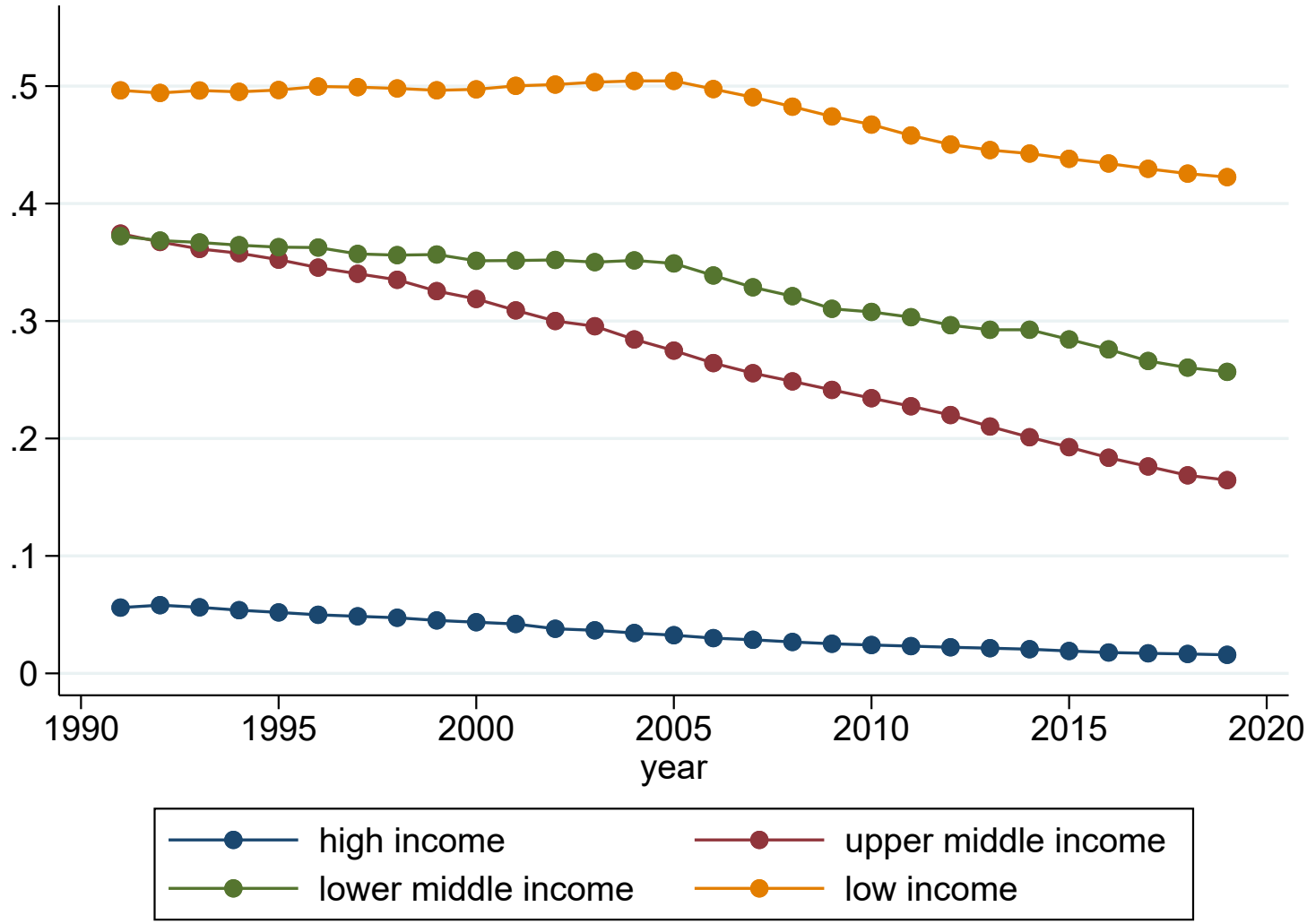
Total fertility rate



Live births per woman; groups according to GNI pc. Source: UN

back

Unpaid family workers as % of employment



Notes: groups according to GNI pc. Source: WDI & ILO.

back

Transformation of US Families

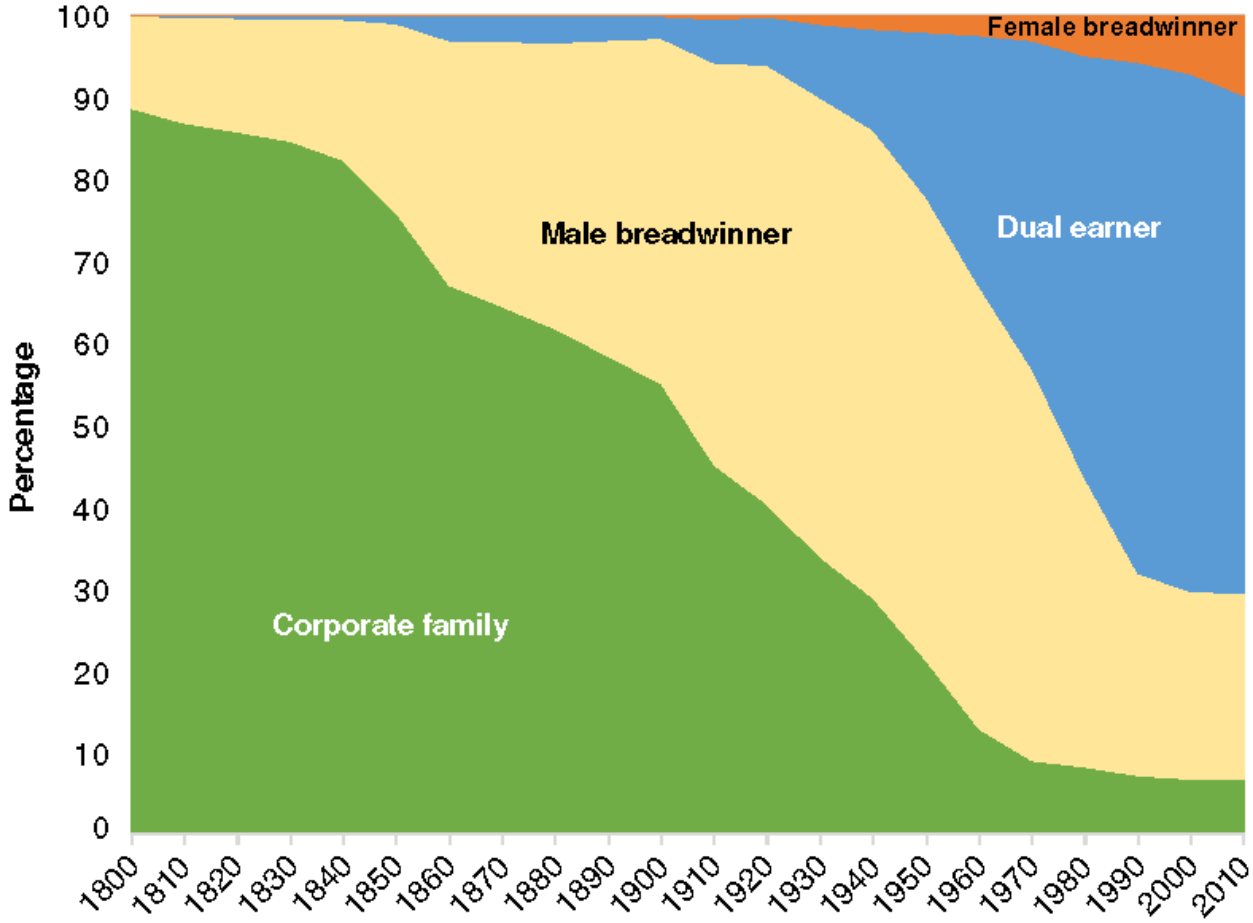
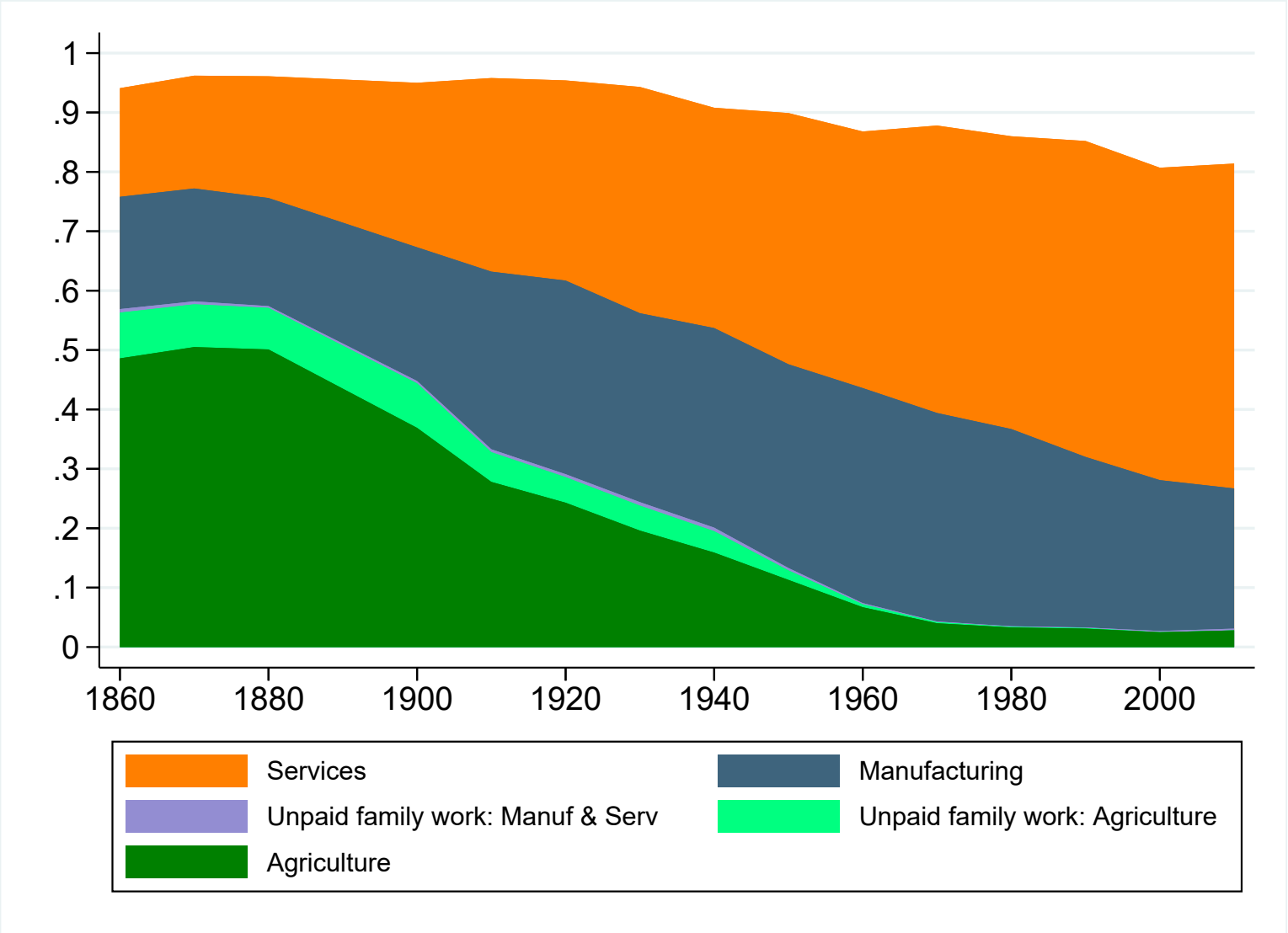


Figure: Reprint from Ruggles (2015) Figure 4

Notes: US couples aged 18-64. Source: Ruggles (2020). back

Sectoral composition of male employment



Notes: men aged 18-64. Ruggles (2015) adjustment.

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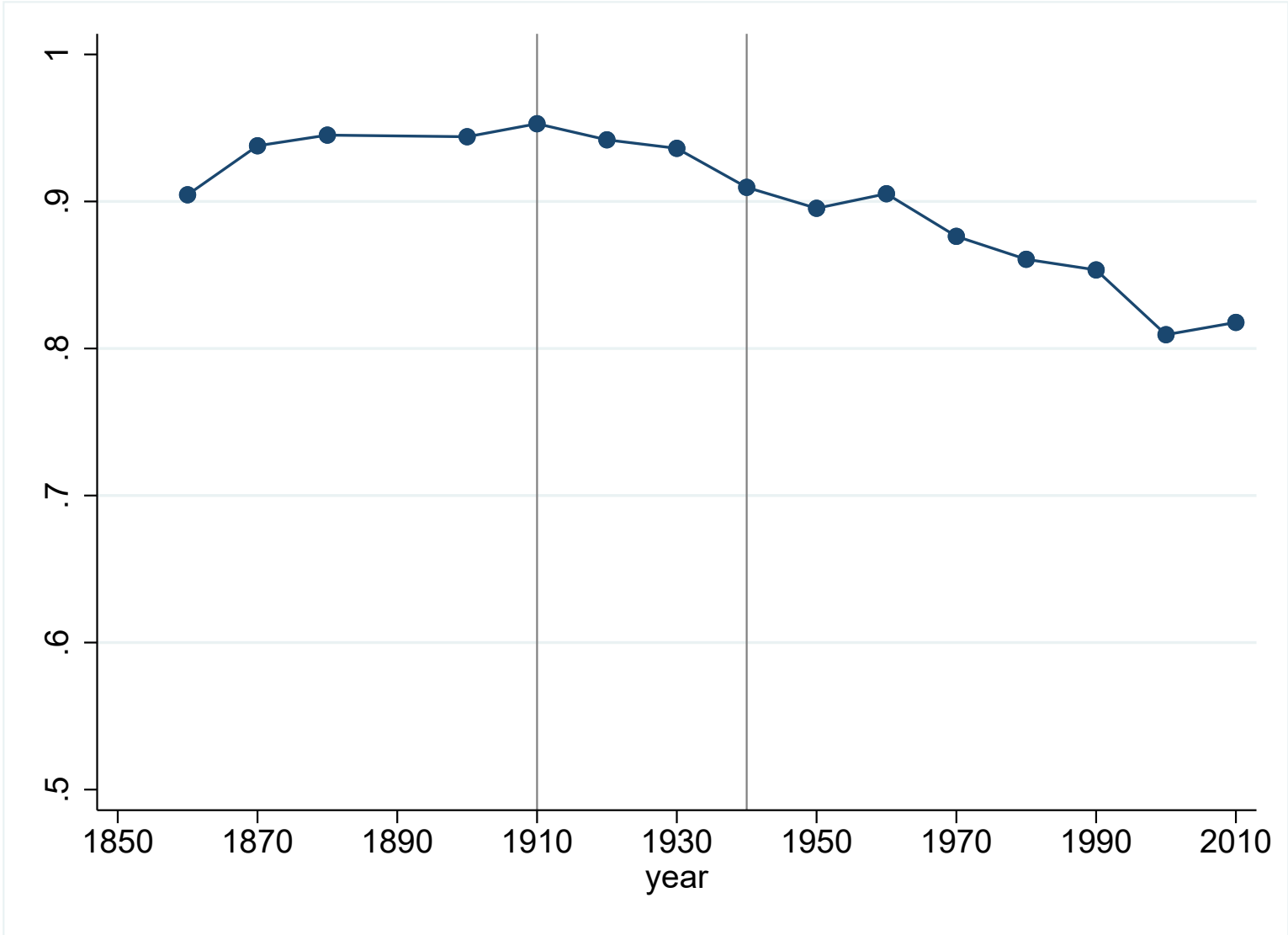
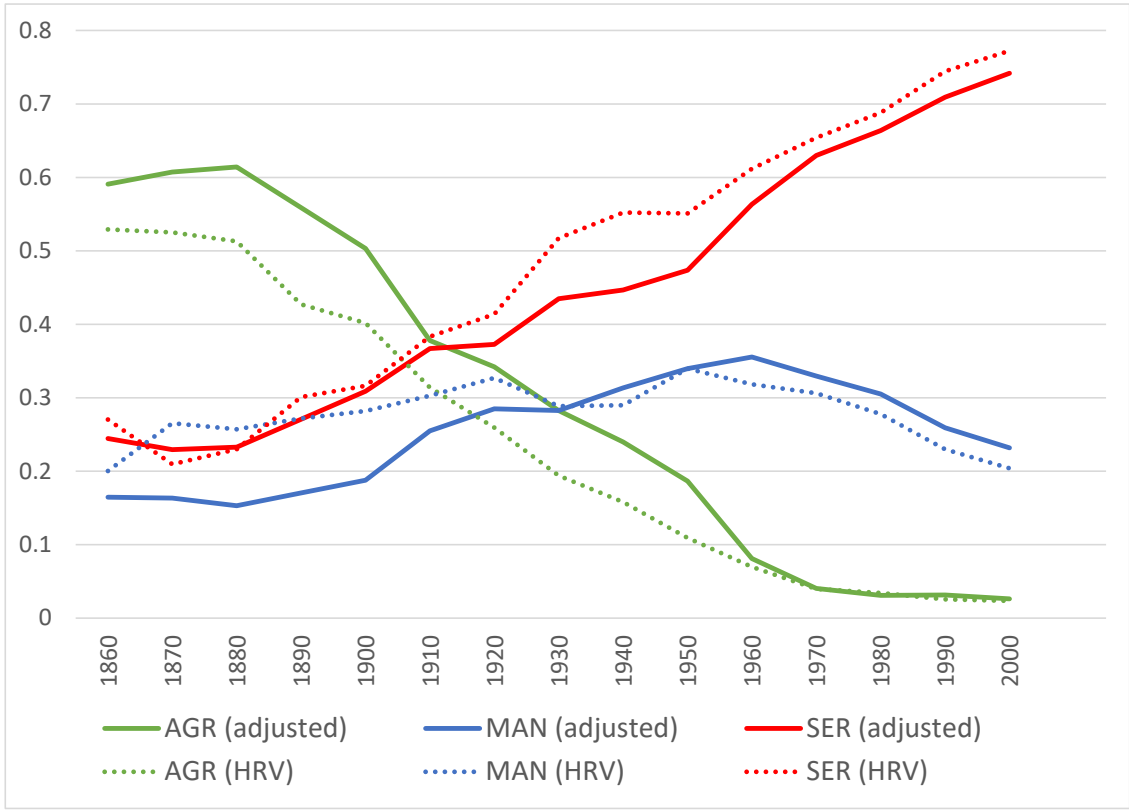
Male employment in the US Census



Notes: Men aged 18-64. back

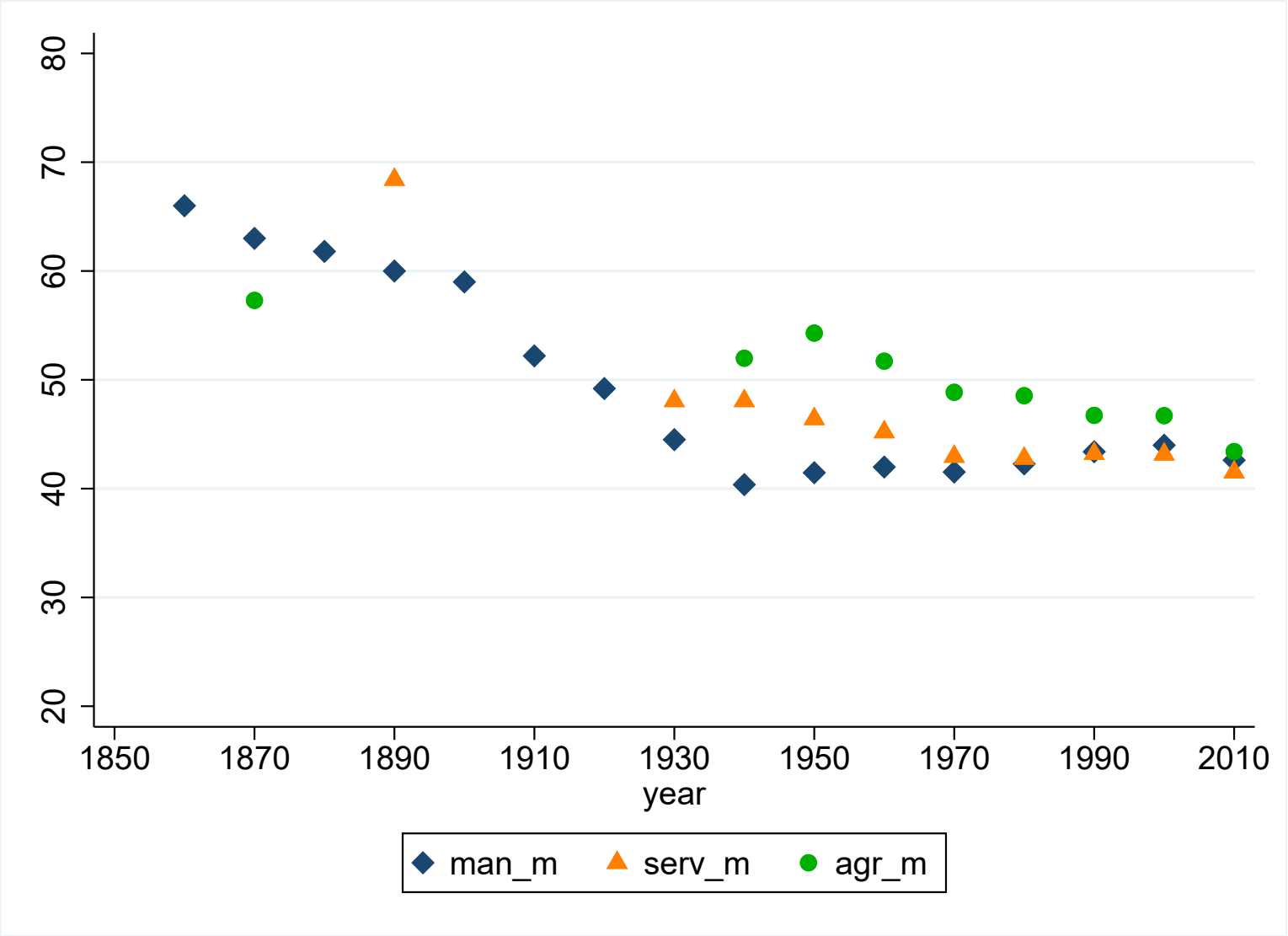
Structural Transformation



Herrendorf, Rogerson and Valentinyi U.S. employment shares:
1840-1920, Historical Statistics – Lebergott (1966) and Weiss (1986, 1987), incomplete record of unpaid family workers, especially for women
1929-2008, BEA – exclude unpaid family workers.

Back

Male hours (per employed person)



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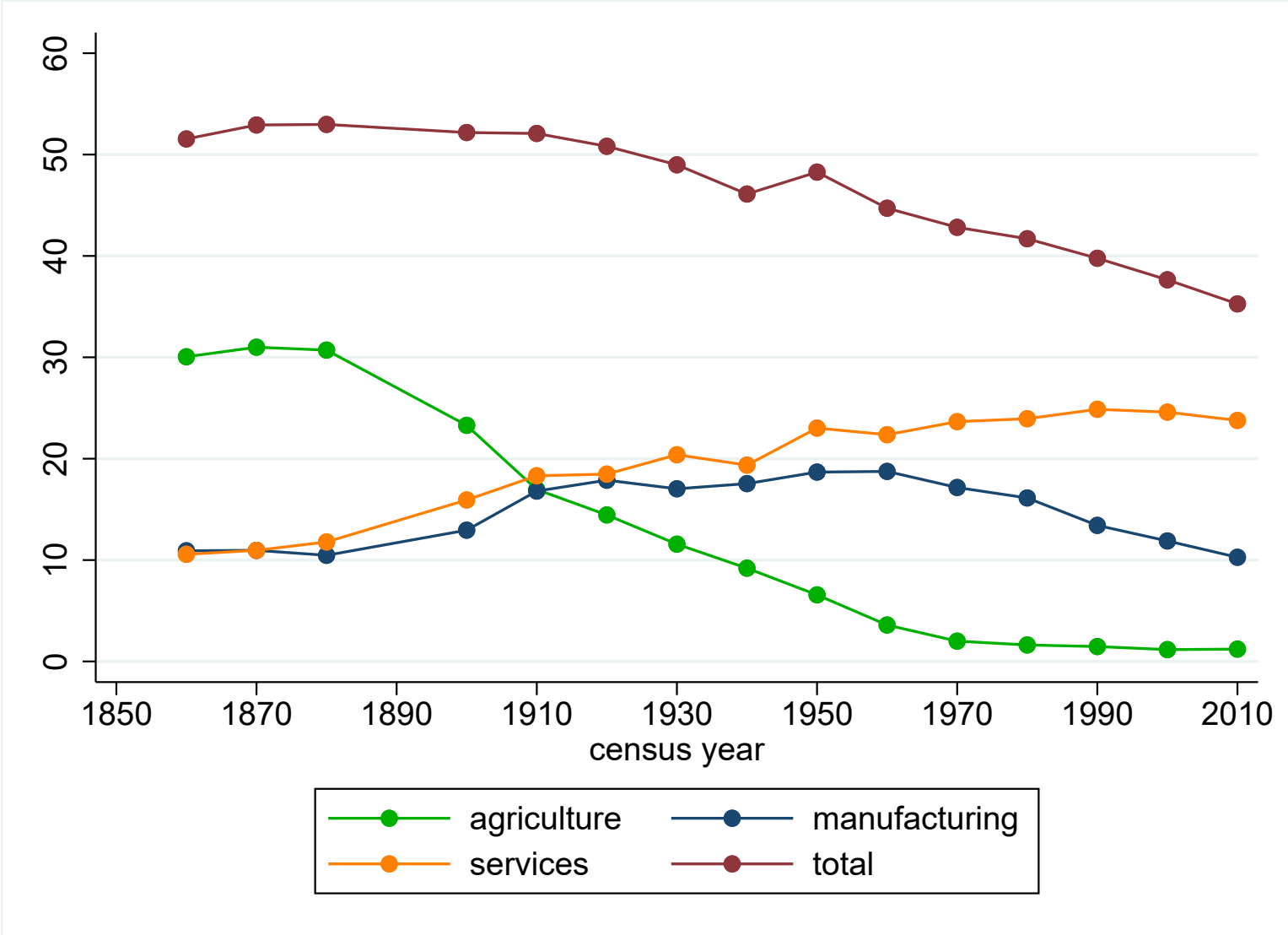
Male hours (extensive & intensive margins)



back

Modernization

- Optimality condition and market clearing imply

$$\frac{p_n}{p_a} = \frac{\psi_n}{1-\psi_n}\left(\frac{Y_a}{Y_n}\right)^{(1/\sigma_n)}$$

- Expenditure shares $E_{an} = p_a Y_a / p_n Y_n$:

$$E_{an} = \left(\frac{A_a}{A_n}\right)^{\sigma_n - 1}\left[\left(\frac{\xi_n}{\xi_a}\right)^{\frac{\eta}{\eta-1}}\left(\frac{I_n}{I_a}\right)^{\frac{1}{\eta-1}}\right]^{\sigma_n - 1}\left(\frac{1-\psi_n}{\psi_n}\right)^{\sigma_n},$$

  where $I_j = \frac{w_f L_{fj}}{w_f L_{fj} + w_m L_{mj}}$ is female income share

- Labour shares

$$\frac{l_{fa}}{l_{fn}} = \left(\frac{A_a}{A_n}\right)^{\sigma_n - 1}\left(\frac{\xi_a}{\xi_n}\right)^{\sigma_n - 1}\left(\frac{I_n}{I_a}\right)^{\frac{\sigma_n - \eta}{\eta - 1}}\left(\frac{1-\psi_n}{\psi_n}\right)^{\sigma_n}$$

Back

Marketization

- Expenditure shares

$$E_{sh} = \left(\frac{A_s}{A_h}\right)^{\sigma-1} \left[\left(\frac{\xi_h}{\xi_s}\right)^{\frac{\eta}{\eta-1}} \left(\frac{l_h}{l_s}\right)^{\frac{1}{\eta-1}}\right]^{\sigma-1} \left(\frac{1-\psi}{\psi}\right)^{\sigma}$$

- Labour shares

$$\frac{l_{fs}}{l_{fh}} = \left(\frac{A_s}{A_h}\right)^{\sigma-1} \left(\frac{\xi_s}{\xi_h}\right)^{\sigma-1} \left(\frac{l_h}{l_s}\right)^{\frac{\sigma-\eta}{\eta-1}} \left(\frac{1-\psi}{\psi}\right)^{\sigma}$$

Back

Structural transformation

- Manufacturing vs Services

$$E_{ms} = \left(\frac{A_m}{A_s}\right)^{\varepsilon-1} \left[\left(\frac{\xi_s}{\xi_m}\right)^{\frac{\eta}{\eta-1}} \left(\frac{I_m}{I_s}\right)^{\frac{1}{\eta-1}}\right]^{1-\varepsilon} \left(\frac{1}{E_{sh}}+1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}} B_{ms}$$

- Agriculture vs Services

$$E_{as} = \frac{1}{1-\frac{\bar{c}}{c_{\tilde{a}}}} \left(\frac{A_a}{A_s}\right)^{\varepsilon-1} \left[\left(\frac{\xi_s}{\xi_a}\right)^{\frac{\eta}{\eta-1}} \left(\frac{I_a}{I_s}\right)^{\frac{1}{\eta-1}}\right]^{1-\varepsilon} \frac{\left(\frac{1}{E_{sh}}+1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}}}{M^{\varepsilon}\left(\frac{1}{E_{an}}+1\right)^{\frac{\sigma_n}{\sigma_n-1}}} B_{as}$$

where M reflects modernization within agriculture and B_{ij} are combinations of preference parameters for goods i and j

Back

Female employment and the gender wage ratio

- Demand equation: budget constraint and demand for goods/services

$$\frac{l_{fh}}{L_f} = \frac{l_h(w)\left(1 - \frac{\rho(w)\bar{c}}{L_m + wL_f}\right)}{l(w)\sum_{i=\tilde{a},m,s,h} E_{ih}(w)}; \qquad \rho(w) \equiv \frac{p_{\tilde{a}}}{w_m},$$

- Supply equation: female time constraint and optimal input ratios

$$\frac{l_{fh}}{L_f} = \frac{l_h(w)}{\sum_{j=a,m,s,h,n} l_j(w) E_{jh}(w)}$$

- Equilibrium gender wage ratio w solves:

$$l(w) \sum_{i=\tilde{a},m,s,h} E_{ih}(w) = \left[1 - \frac{\rho(w)\bar{c}}{L_m + wL_f}\right]\left[\sum_{\forall j} l_j(w) E_{jh}\right]$$

Back