Structural transformation and U-shaped female employment

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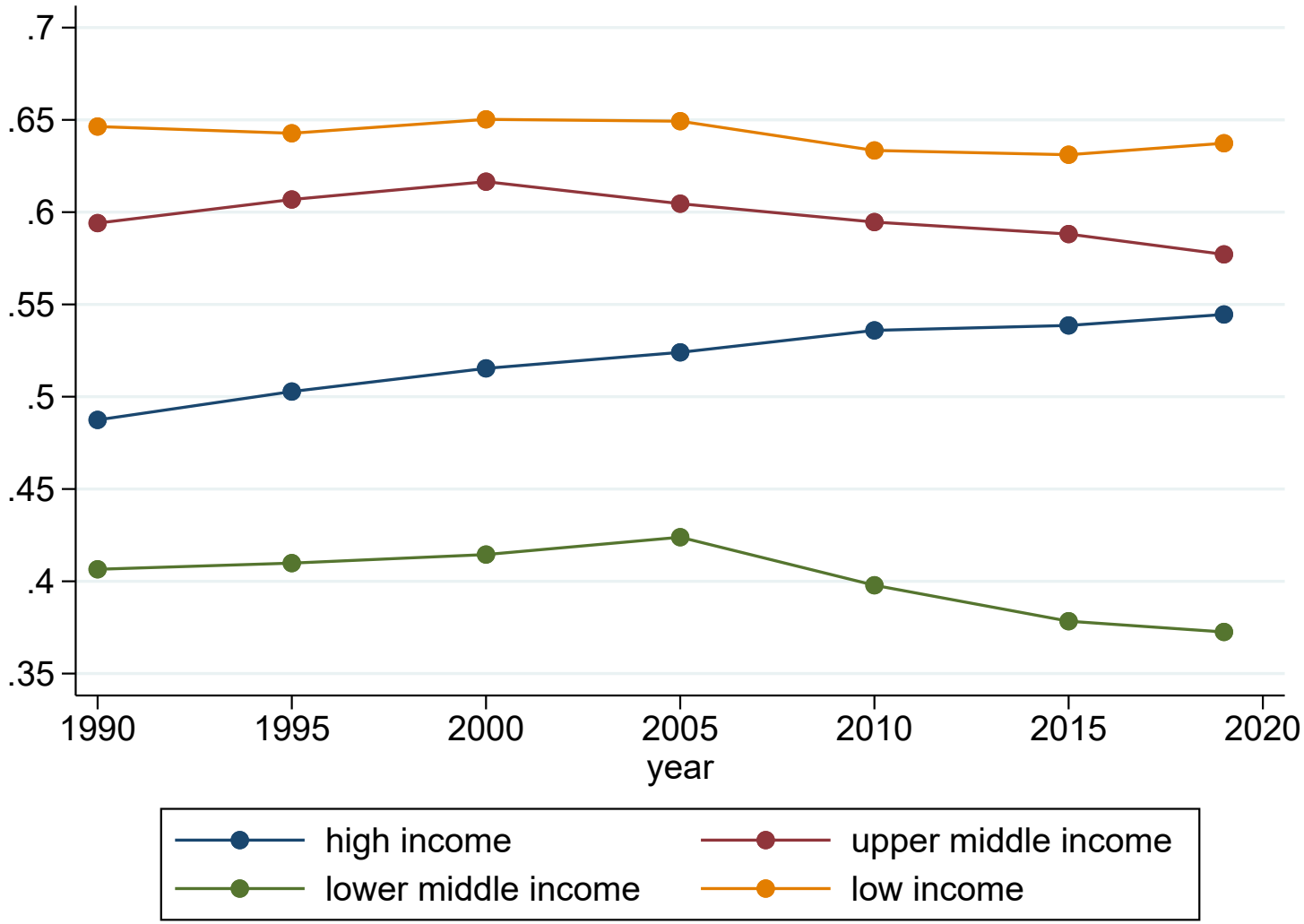
Backgroud and motivation

- All high-income countries witnessed a rise in female employment and gender convergence in earnings since WW2
- But not a universal phenomenon
  - female employment has been falling during other time windows and/or in other countries

Female employment around the world



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

Total fertility rate

This paper

- Aim 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
- Difference sectors vary in productivity growth and female intensity
- Uneven productivity growth feeds into gender trends via differences in female intensity (gender comparative advantages)

Our approach

- Build consistent measure of female employment for the US over 1870-2020; 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
  - **structural transformation** across agriculture, manufacturing and services
  - **marketization** within services: from home production to market services

Related work

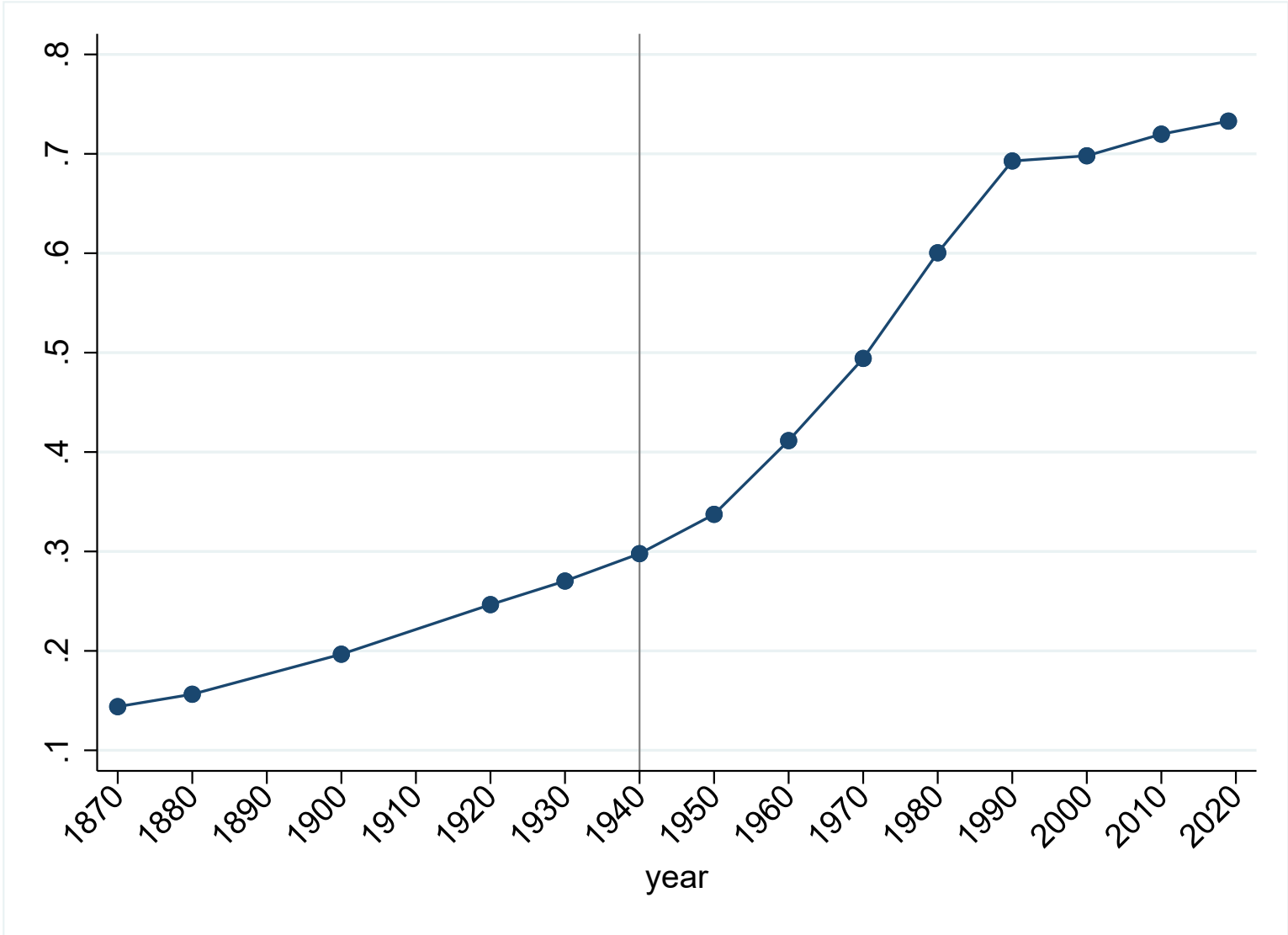
- U-shape idea has been pioneered in early work by Sinha (1965), Boserup (1970), Durand (1975), Goldin (1986)
  - based on technology adoption in agriculture, income effects, urbanization, etc.
  - Goldin (1995) shows U-shape on a cross-section of countries in 1980s
  - Goldin (1990): female participation 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*; but with early (and inconsistent) attempts to capture some unpaid work when done "regularly" or "most of the time"
  - post-1940: *ILO employment*; but definition of unpaid work not entirely consistent over time and likely restrictive
- Key difficulty: identifying unpaid family work (mostly female) *when this was more widespread*

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.

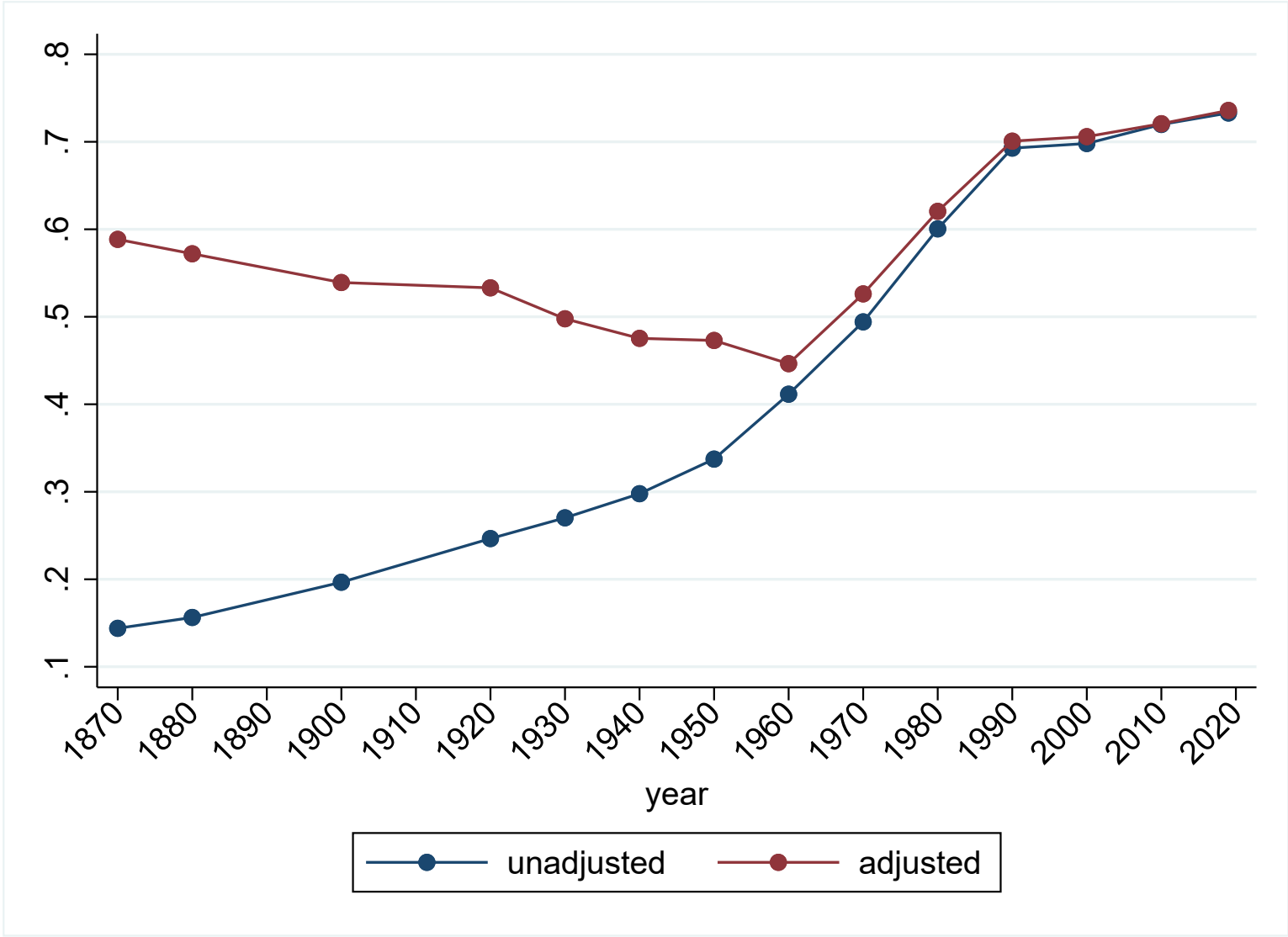
Undercount of women in agriculture (Smuts, 1960)

- 1890: about 40% population on farms
- 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

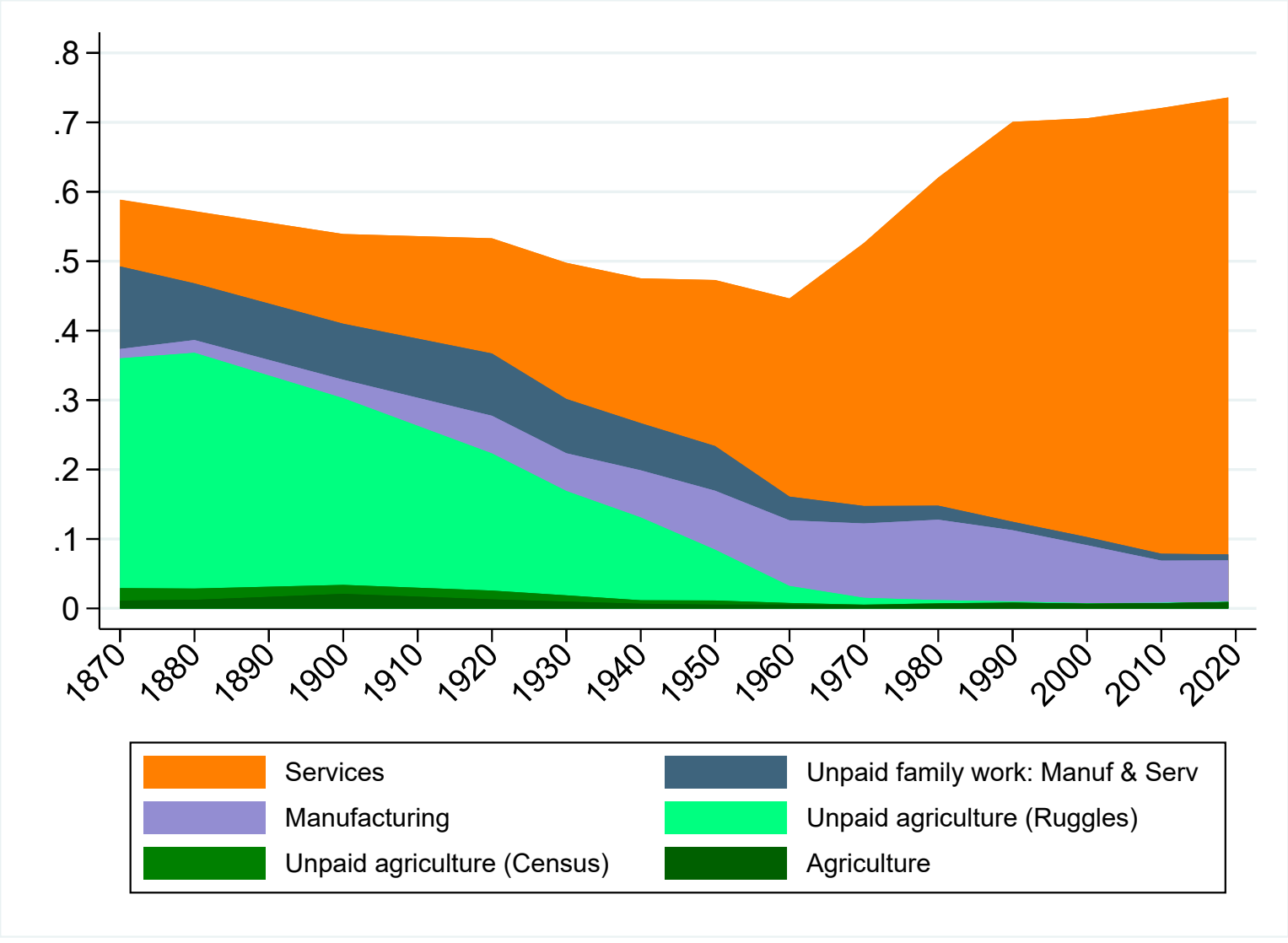
- Assign to labour force women on farms, whose head of household is farmer, whether or not they report an occupation
- Method extended to non-farm families in which the head is self employed

(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

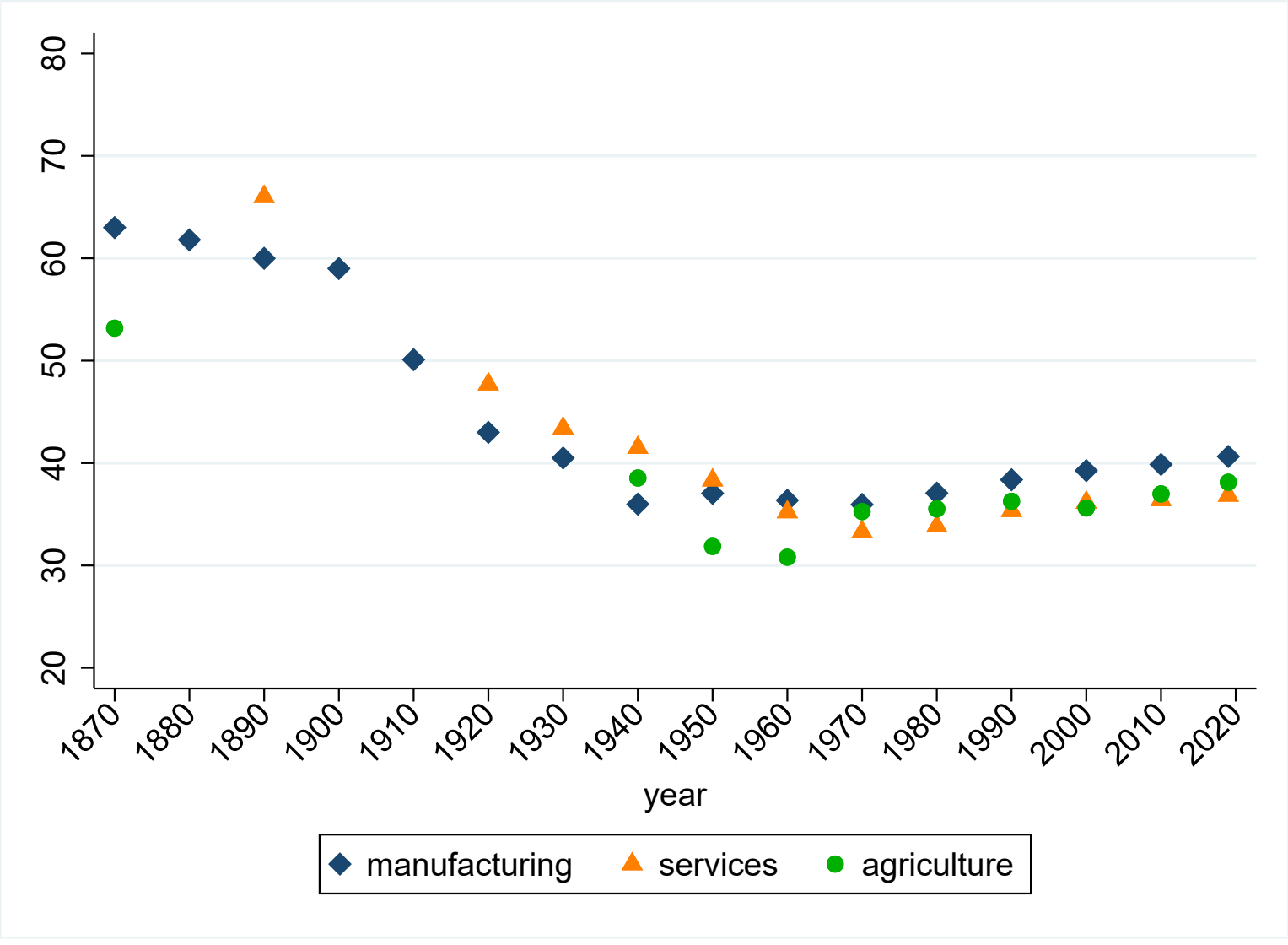
Hours

- Bodycount only captures extensive margin of employment.
- But intensive margin 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 farm shorter than paid hours (Surveys of farmers; Time-use studies).
  - 1870: Farm laborers worked 10-14h per day, 6 days a week; 44/40 weeks a year for men/women
  - 1920s: Housewives on farm spent 10-15h per week in unpaid agricultural work

Paid 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, 1884-1901**
  at the U of California
  - Drawing from Surveys of Workers by 10+ state bureaus
  - Complete data sets: about 100,000 workers in 14 states (Data we can use: 52.5k men and 25.5k women in 12 states)
  - cover all 3 sectors, but very thin on agriculture
- **Women Working project, 1920s and 1930s**
  (Harvard University Library's Open Collections Program)
  - 20-30 studies (mostly firms surveys), little info on men
- **1940–: US Census**

Female paid hours (per employed person)



Men

Unpaid Hours: Sources and estimates

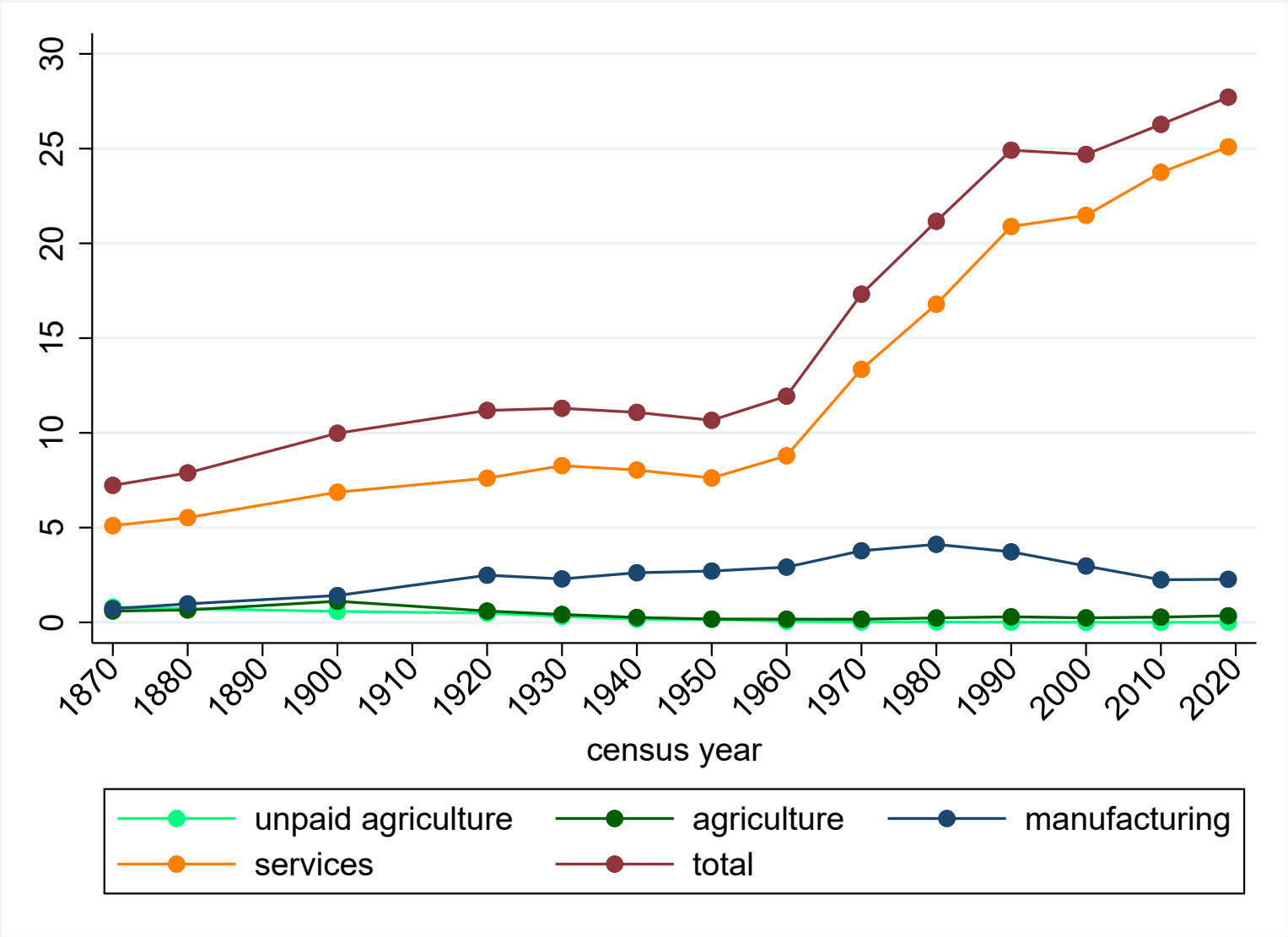
- **Purnell Act Time-Diary Studies of Homemakers, 1925**
  - select 12 studies covering farm population during 1920s and 1930s (N=2523)
  - based on detailed diaries of weekly activities
  - highly-educated women are over-represented as diaries required reading and writing skills (Vanek, 1973)
  - homemakers work on average 12 hours per week in spring (comparable to census week) during 1926-36
  - likely underestimate due to selection criteria
  - does not include time to prepare meals for farm laborers (about 2.1h, US Bureau of Human Nutrition, 1944)
- **1940–: US Census**
  - hours in unpaid work in agriculture in 1940 and 1950 about 94% of paid hours for men and 84% for women
  - (different sample and definition from Purnell diaries)

Hours: Further elaborations

- **Services**
  - Interpolate 1890-1920;
  - impose same trend as manufacturing pre-1890
- **Agriculture**
  - Assume constant 1870-1890 (Kendrick 1961, Barger 1955).
  - Interpolate afterwards.
- **Unpaid work in family farms**
  - Lower bound: Purnell Time-Diaries: 12h
  - Upper bound: Unpaid hours in 1940-1950 census (close to fulltime)
  - Show range of estimates
- **Unpaid work in services/manufacturing**
  - pick 12h (lower bound for unpaid hours in agriculture)

Female hours per person (I)

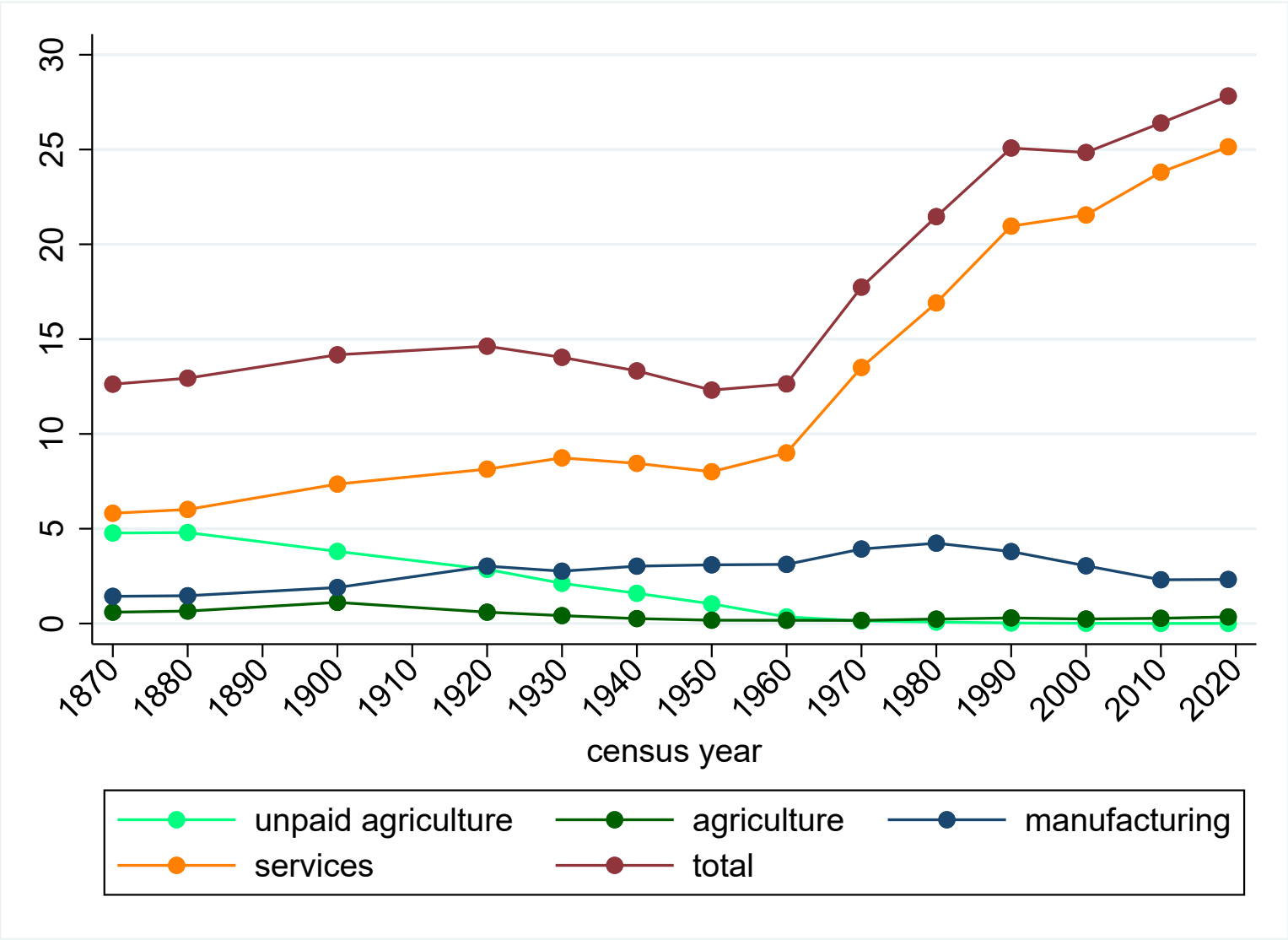
(excluding Ruggles 2015 imputation)



Men Ramey-Francis Market Hours

Female hours per person (II)

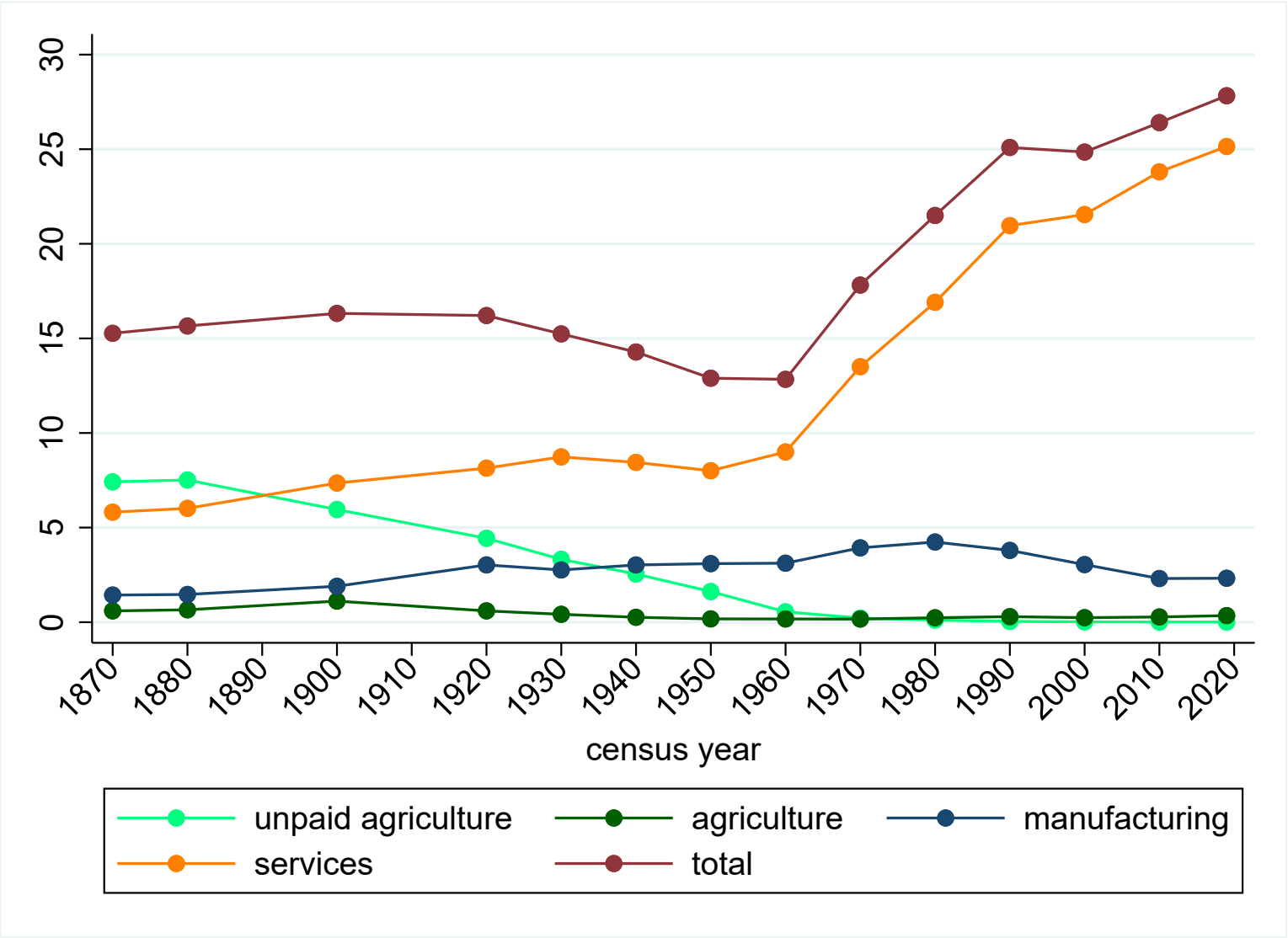
a. lower bound for unpaid hours in agriculture (12h)



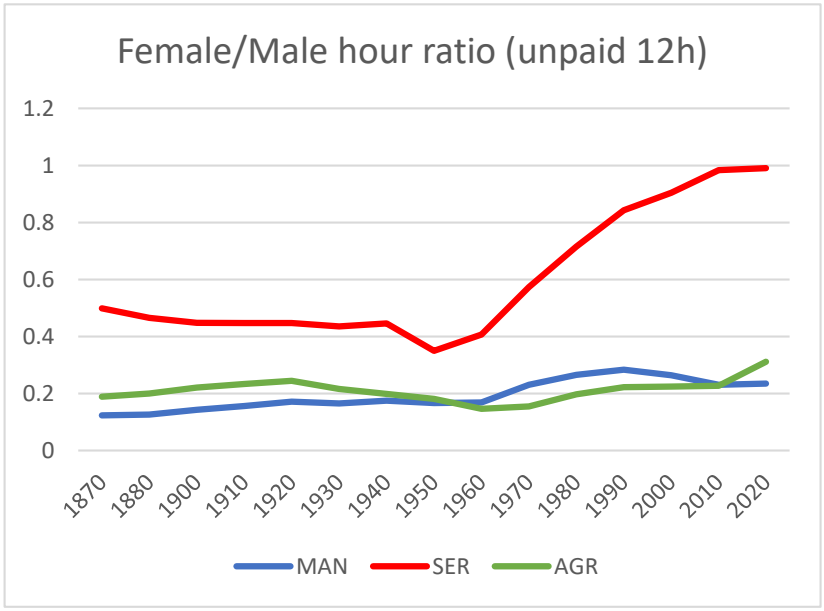
Men

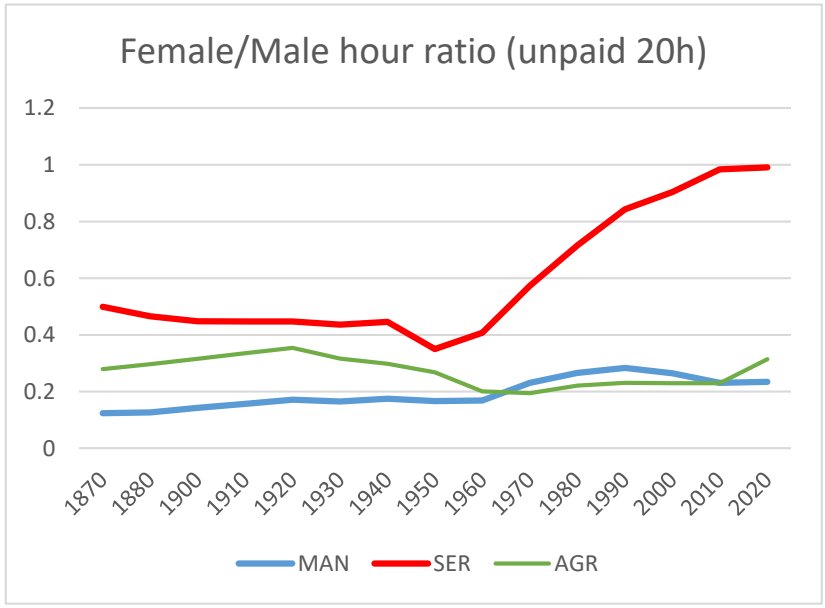
Female hours per person (III)

b. mid-range for unpaid hours in agriculture (20h)



Female hours relative to male





Summary of historical evidence 1870-2020

- Important role of unpaid family work during 19th century for understanding female employment and market hours.
- Female employment exhibited a U-shape, with 1960 as the turning point.
- Female market hours were flat or fell mildly until 1960, then increased substantially.
- Male market hours were falling throughout.
- Among market sectors, the service sector is the most female intensive.

Model

The model economy: Building blocks

- **Households** derive utility from consumption of agriculture, manufacturing and service output
  - gross complements in utility
  - minimum requirement on agricultural consumption
- 3 market sectors: **agriculture**, **manufacturing**, **services**
  - productivity growth: agr , man $>$ serv
  - female intensity: serv $>$ agr, man
- Family farms are part of the agriculture sector.
  - Sold to the market and included in the GDP.
- Home production produces close substitutes to market services; for own use.
  - It has slower productivity growth than the service sector.

Firms

- Production function for the representative 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

$$\begin{aligned} U(c_a, c_m, c_z, c_l) &= \ln c + \phi \ln c_l; \\ c &= \left[\omega_a (c_a - \bar{c})^{\frac{\varepsilon-1}{\varepsilon}} + \omega_m c_m^{\frac{\varepsilon-1}{\varepsilon}} + \omega_z c_z^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}} \end{aligned}$$

where $\varepsilon < 1$ and $\bar{c}$ is minimum agriculture consumption.

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

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

where $\sigma > 1$ (good substitutes)

Households (II)

- Allocate time to market work, home production and leisure.
- Home production:

$$c_h = Y_h = A_h N_h, \quad N_h = \left[\xi_h l_{fh}^{\frac{\eta-1}{\eta}} + (1-\xi_h) l_{mh}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

- Leisure time L_l is a function of male and female leisure:

$$c_l = N_l, \quad N_l = \left[\xi_l l_{fl}^{\frac{\eta_l-1}{\eta_l}} + (1-\xi_l) l_{ml}^{\frac{\eta_l-1}{\eta_l}} \right]^{\frac{\eta_l}{\eta_l-1}}$$

  where $\eta_l < 1$ indicates that male and female leisure time are gross complement in utility.
- Budget constraint:

$$\sum_{i=a,m,s} p_i c_i \leq w_m \left(L_m - l_{mh} - l_{ml} \right) + w_f \left(L_f - l_{fh} - l_{fl} \right)$$

Assumptions

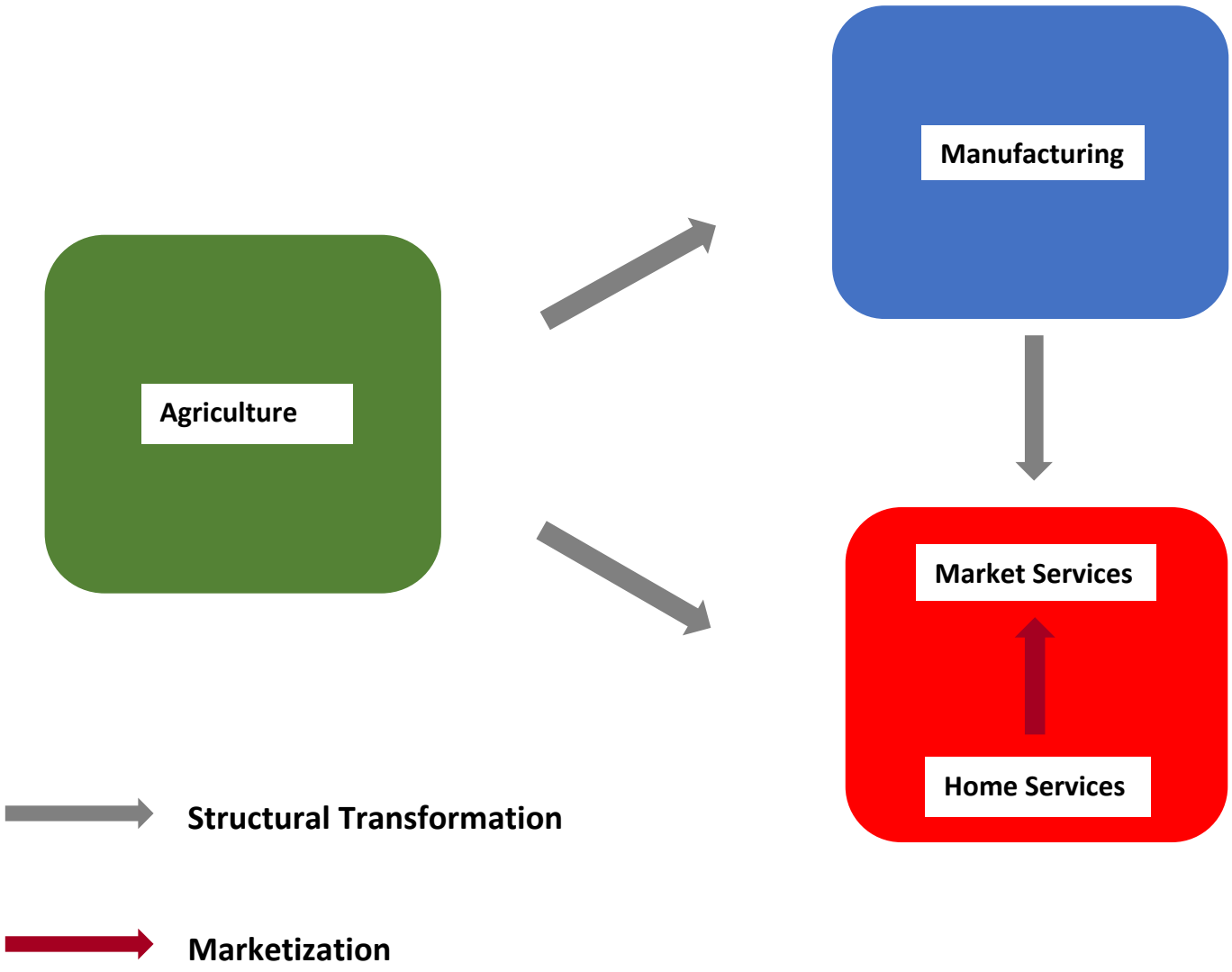
- Comparative advantages:
  - $(\xi_s, \xi_h) > (\xi_a, \xi_m)$: service production more intensive in female labour than agriculture and manufacturing.
- Uneven productivity growth
  - $\gamma_s > \gamma_h$: productivity growth in the service sector is faster than home production.
  - $(\gamma_a, \gamma_m) > \gamma_s$: productivity growth is slower in the service sector

Labour reallocation

- **Structural transformation**.
  Faster productivity growth and minimum consumption requirement in agriculture reallocates labour away from agriculture:
  - Substitution effect through consumption complementarity ($\epsilon < 1$)
  - Income effect through minimum agriculture consumption requirement ($c_{\bar{a}} > 0$)

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

Labour reallocation



Marketization

- Relative expenditure shares

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

- Relative labour shares

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

Structural transformation

- Manufacturing vs Services

$$
\begin{aligned}
E_{ms} &= \hat{A}_{ms}^{\varepsilon-1}\left[\left(\frac{\xi_m}{\xi_s}\right)^{\eta}\left(\frac{I_s(w)}{I_m(w)}\right)\right]^{\frac{\varepsilon-1}{\eta-1}}\left(\frac{1}{E_{sh}}+1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}} \\
\hat{A}_{ms} &\equiv \frac{A_m}{A_s}\left(\frac{\omega_m}{\omega_z}\right)^{\frac{\varepsilon}{\varepsilon-1}}\psi^{\frac{\sigma}{1-\sigma}}.
\end{aligned}
$$

- Manufacturing vs Agriculture

$$
\begin{aligned}
E_{ma} &= \left(1-\frac{\bar{c}}{y_a}\right)\bar{E}_{ma}(w) \\
\bar{E}_{ma}(w) &= \hat{A}_{ma}^{\varepsilon-1}\left(\left(\frac{\xi_m}{\xi_a}\right)^{\eta}\left(\frac{I_a(w)}{I_m(w)}\right)\right)^{\frac{\varepsilon-1}{\eta-1}}; \\
\hat{A}_{ma} &\equiv \frac{A_m}{A_a}\left(\frac{\omega_m}{\omega_a}\right)^{\frac{\varepsilon}{\varepsilon-1}}
\end{aligned}
$$

Total work

- The equilibrium can be reduced to three equations solving for female time allocation to leisure l_{fl}/L_f, agriculture output y_a and gender wage ratio w.

$$\frac{l_{fl}}{L_f} = \frac{l_l(w)}{l(w)\left(\frac{E_{ml}(w)}{\left(1-\frac{\bar{c}}{y_a}\right)\bar{E}_{ma}(w)} + \sum_{i\neq a} E_{il}(w)\right)}.$$

  where l_l and l are both function of gender wage ratio.

- There is an 'income effect' on leisure (total work) through the minimum agriculture consumption requirement.

Stage 1: Structural transformation and decline in agriculture

19th century, large agricultural sector

- structural transformation ($\gamma_a > (\gamma_s, \gamma_h)$, $c_{\bar{a}}/y_a$ large) dominates marketization ($\gamma_s - \gamma_h > 0$ but small)
- $\rightarrow$ agriculture declines, both home and market services expand, leisure increases
  $\rightarrow$ market hours fall
- The fall is larger for men than for women because service is more female intensive.

Stage 2: Marketization and rise in services

Starting mid-20th century, the share of agriculture sector is small and agriculture consumption requirement not important ($c_{\bar{a}}/y_a$ small)

- marketization dominates structural transformation
  $\rightarrow$ market services rise and home production falls.
- market services are intensive in female labour
  $\rightarrow$ rise in female market hours.

- Due to gender-specific comparative advantage, gender neutral shock such as uneven productivity growth has gender-biased consequences

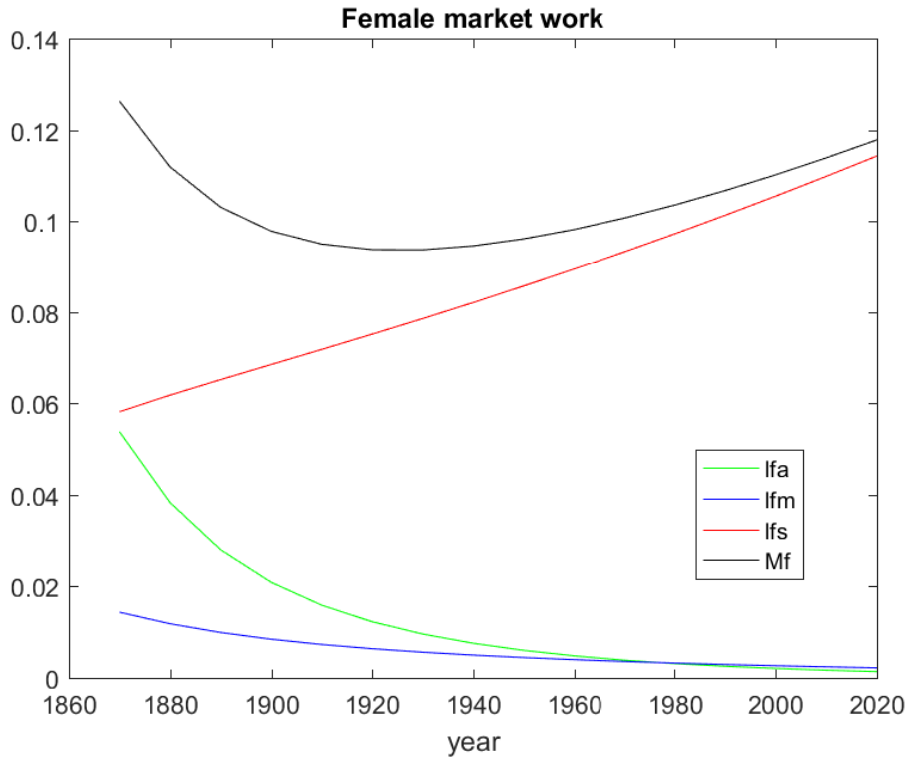
Quantitative illustration

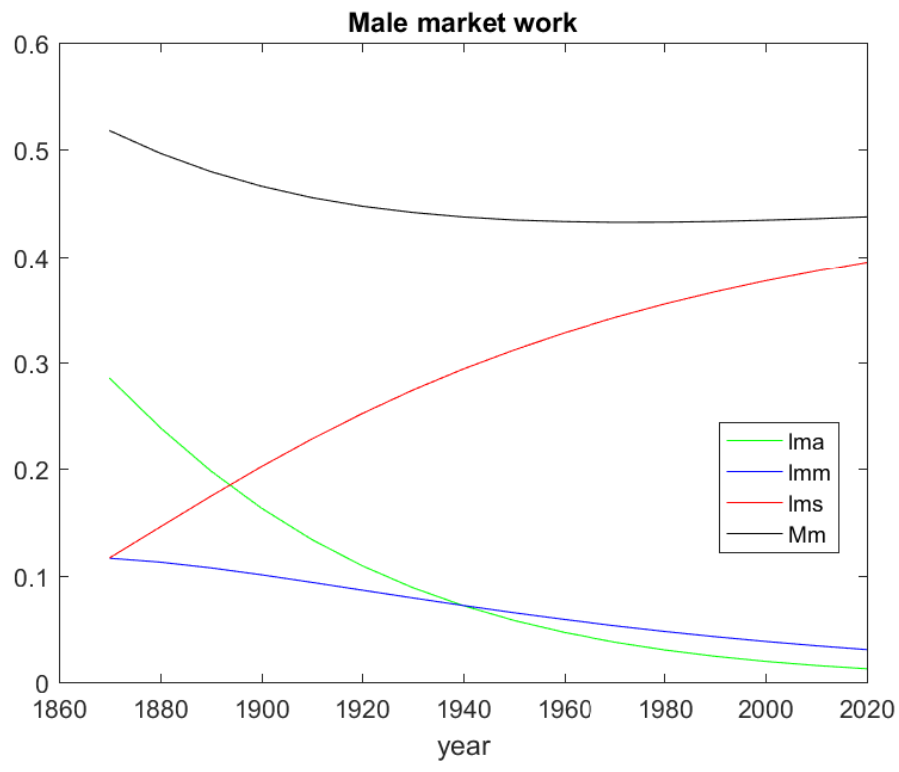
As an illustration of the quantitative properties of the model

- Productivity growth:
  $\gamma_a = 2.5\%, \gamma_m = 1.5\%, \gamma_s = 0.5\%, \gamma_h = 0$
- Elasticity: $\epsilon = 0.002, \sigma = \eta = 2, \eta_l = 0.1$
- Agriculture consumption requirement is half of agriculture output in 1870, $\bar{c}/y_a = 0.5$
- Given gender wage ratio, female and male hours in 2019, use the MRTS condition to derive ξ_j, obtain

  $\rightarrow \xi_a = 0.31, \xi_m = 0.28, \xi_s = 0.45, \xi_h = 0.51, \xi_l = 0.26$

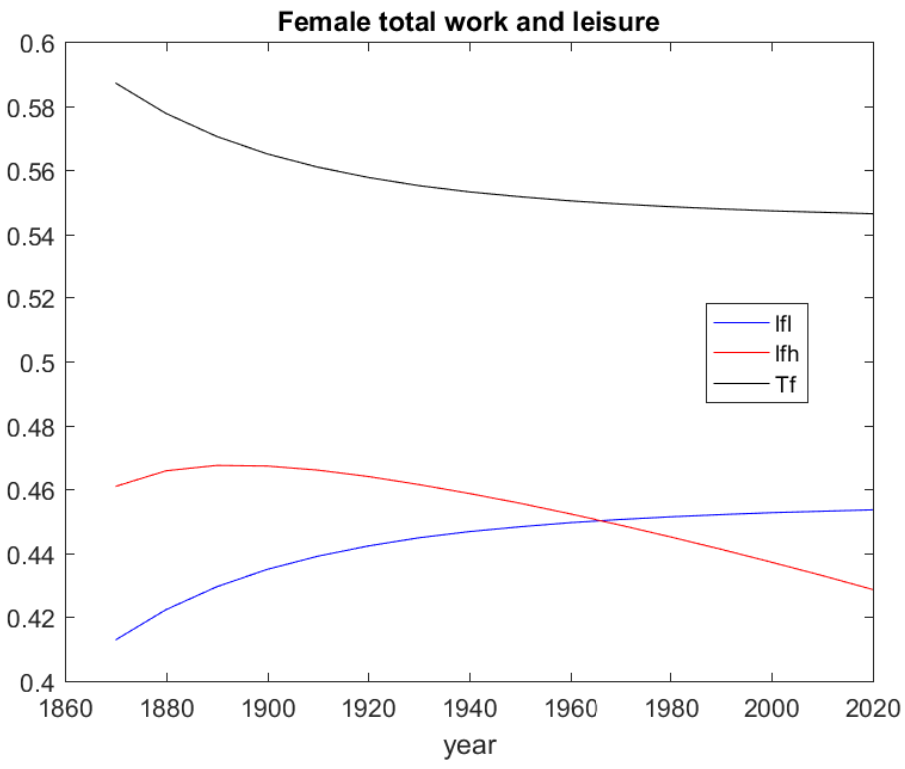
Structural transformation and market hours

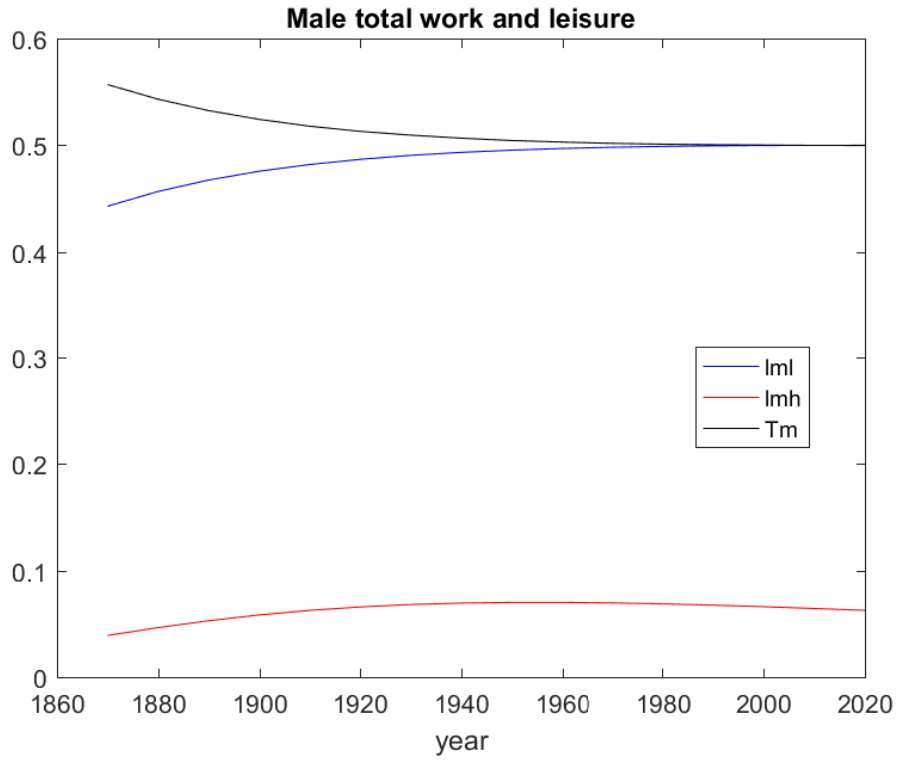




- Generate a U-shaped female market hours and a falling male market hours

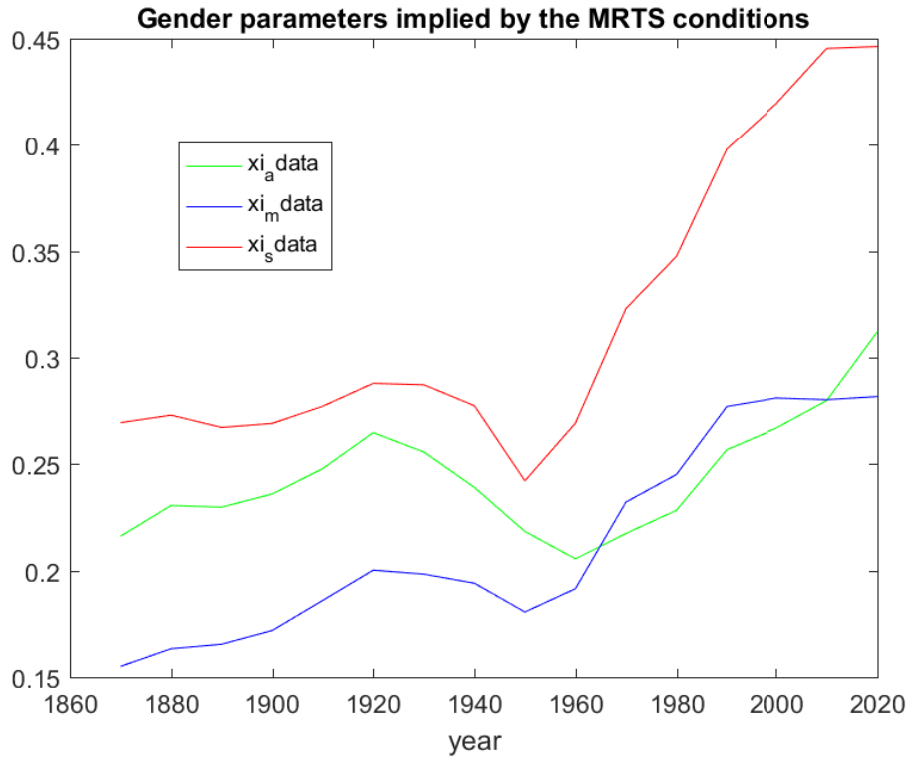
Structural transformation and total hours





- Generate a sharper fall in total work initially.

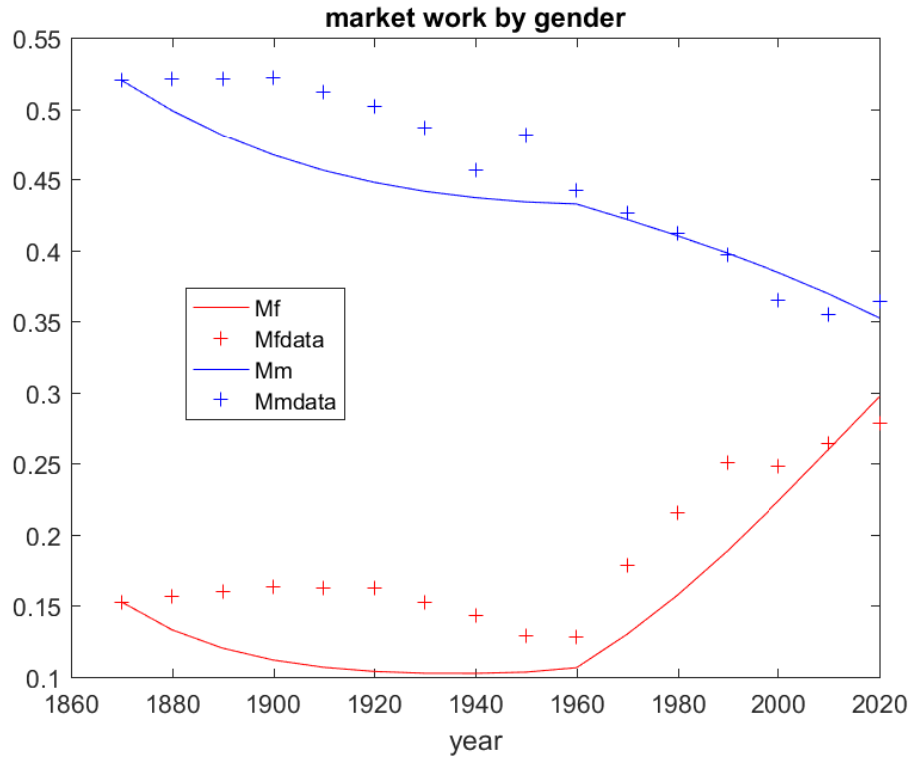
Role of gender-specific parameters



- Increase in the ξ_j after 1960 (gender-specific changes exogenous to the model, e.g. gender norms or gender-specific technology).
  $\rightarrow$ Assume ξ_j constant till 1960 then increase smoothly.

Market hours by gender

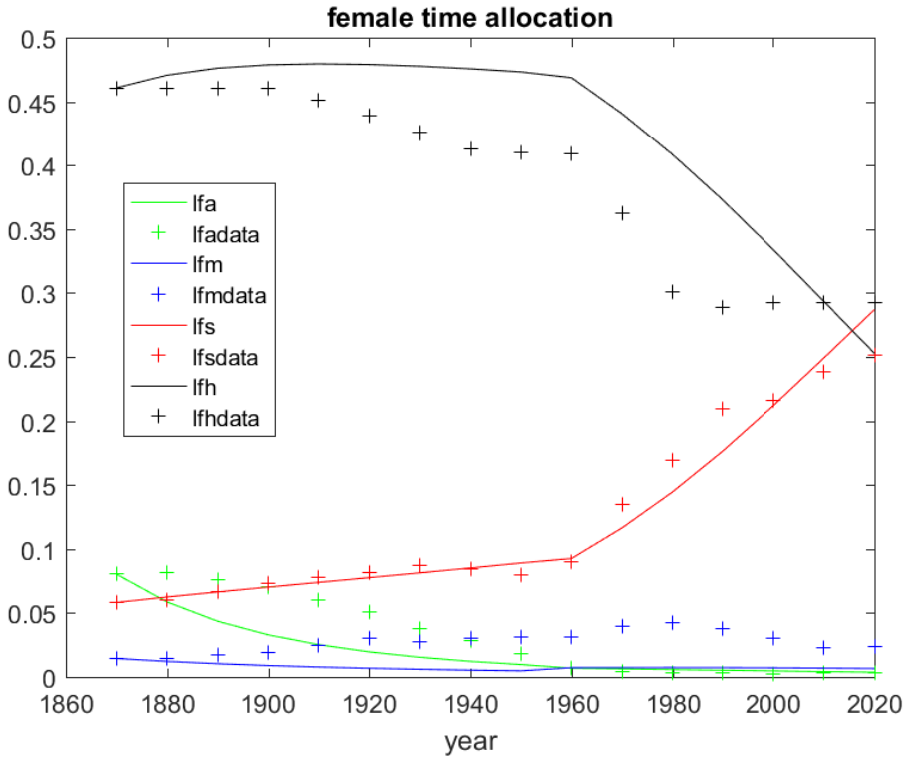
Pre-1960: ST only. Post-1960: ST + changes in ξ_j



- Structural transformation alone captures very well dynamics of market hours by gender prior to 1960.

Female time allocation

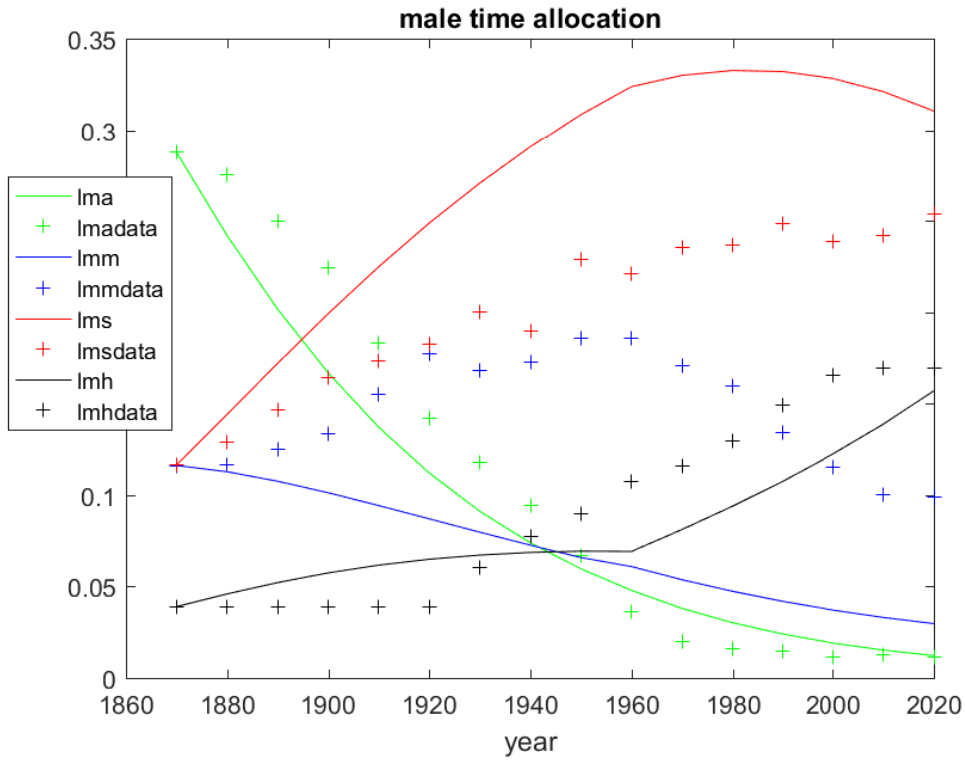
Pre-1960: ST only. Post-1960: ST + changes in ξ_j



- Good fit for female time allocation, structural transformation alone does a good job prior to 1960.

Male time allocation

Pre-1960: ST only. Post-1960: ST + changes in ξ_j



- Good fit for agriculture and home production but not so well across manufacturing and services.

Further steps

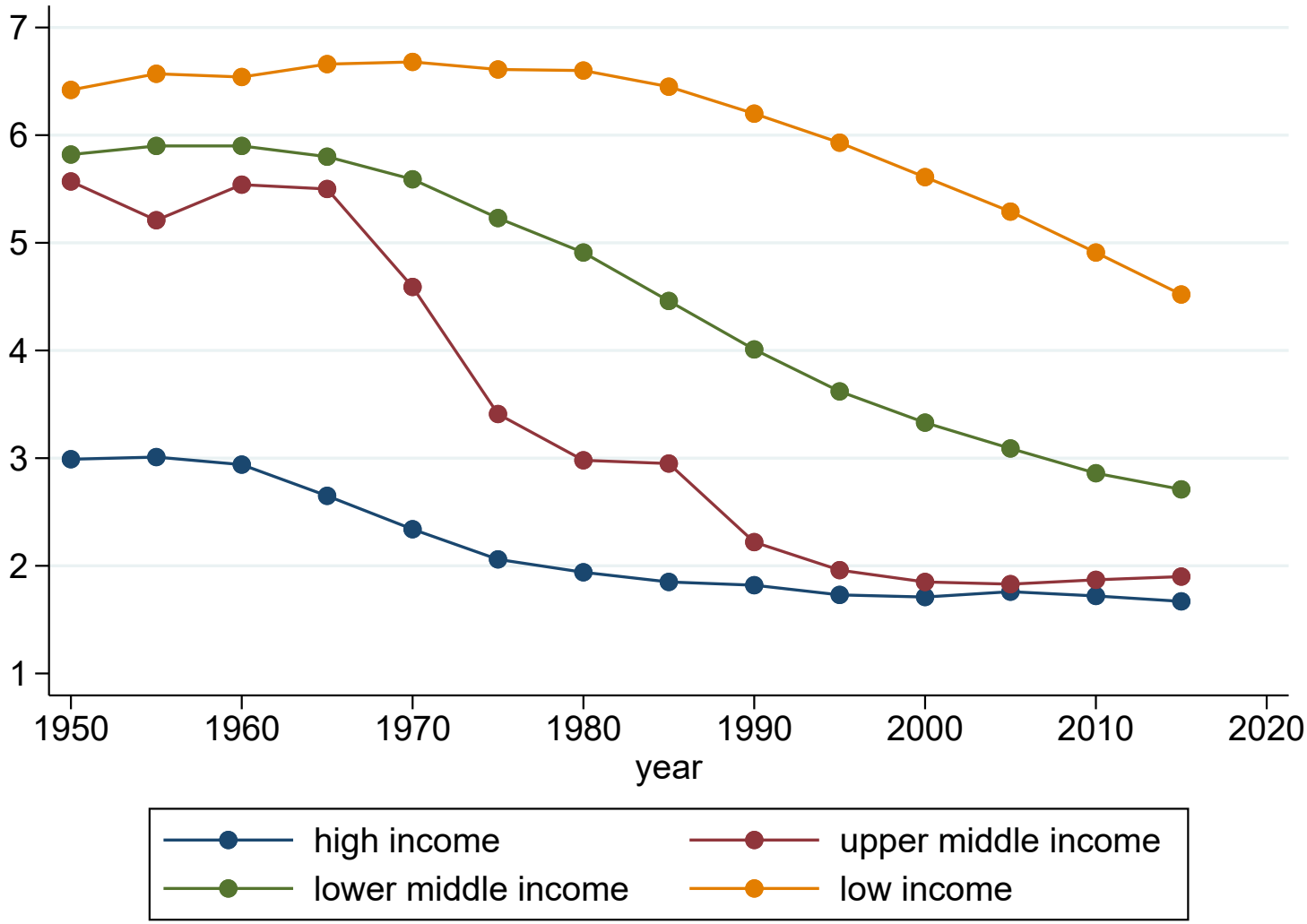
- Further work on data
  - Wages: Historical Statistics of the United States 1870-1930 & additional micro data from state-level surveys
- Decompose the contribution of the process of structural transformation on changing time allocation by gender.
  - Role of differential productivity growth across sectors
  - Role of agriculture consumption requirement
  - Role of changes in ξ_j due to other gender-specific factors

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 1870-2020 in the US; U-shape.
- Develop unified framework to explain these trends
  - *Declining part of U-shape*:
    faster productivity growth and minimum consumption requirement in agriculture implies shrinking agriculture (especially family farms) and rising leisure
    $\rightarrow$ 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

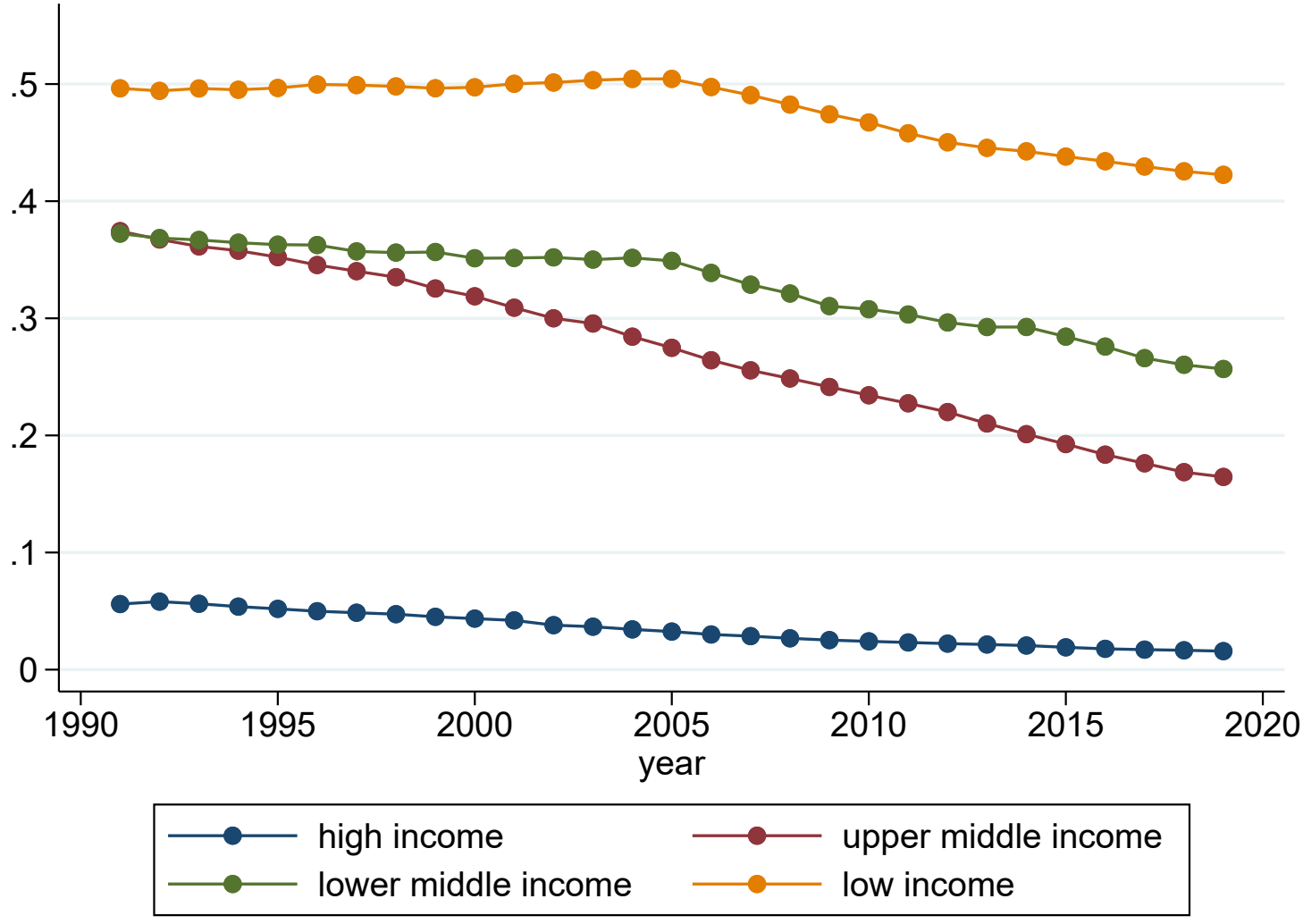
Total fertility rate



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

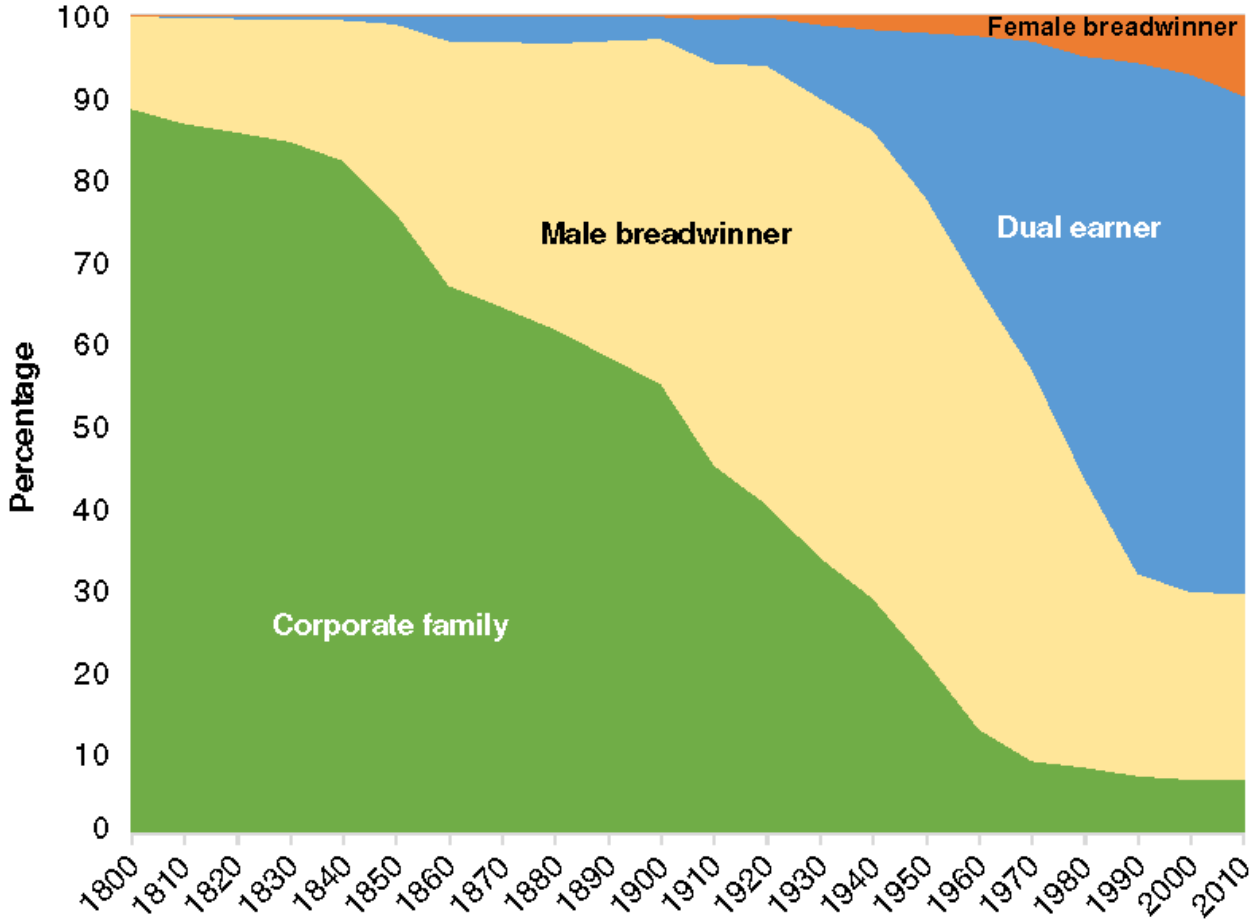
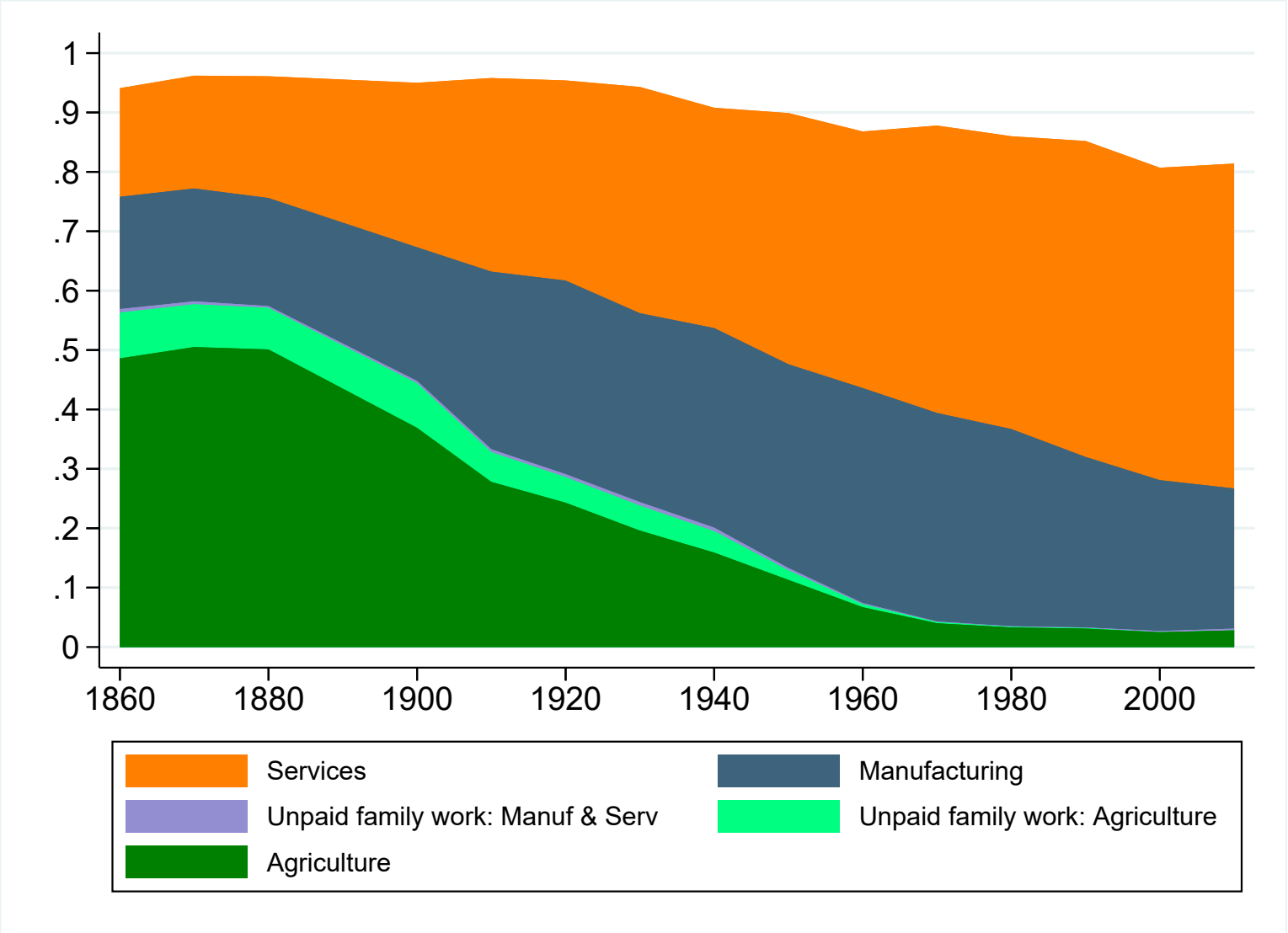


Figure: Reprint from Ruggles (2015) Figure 4

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

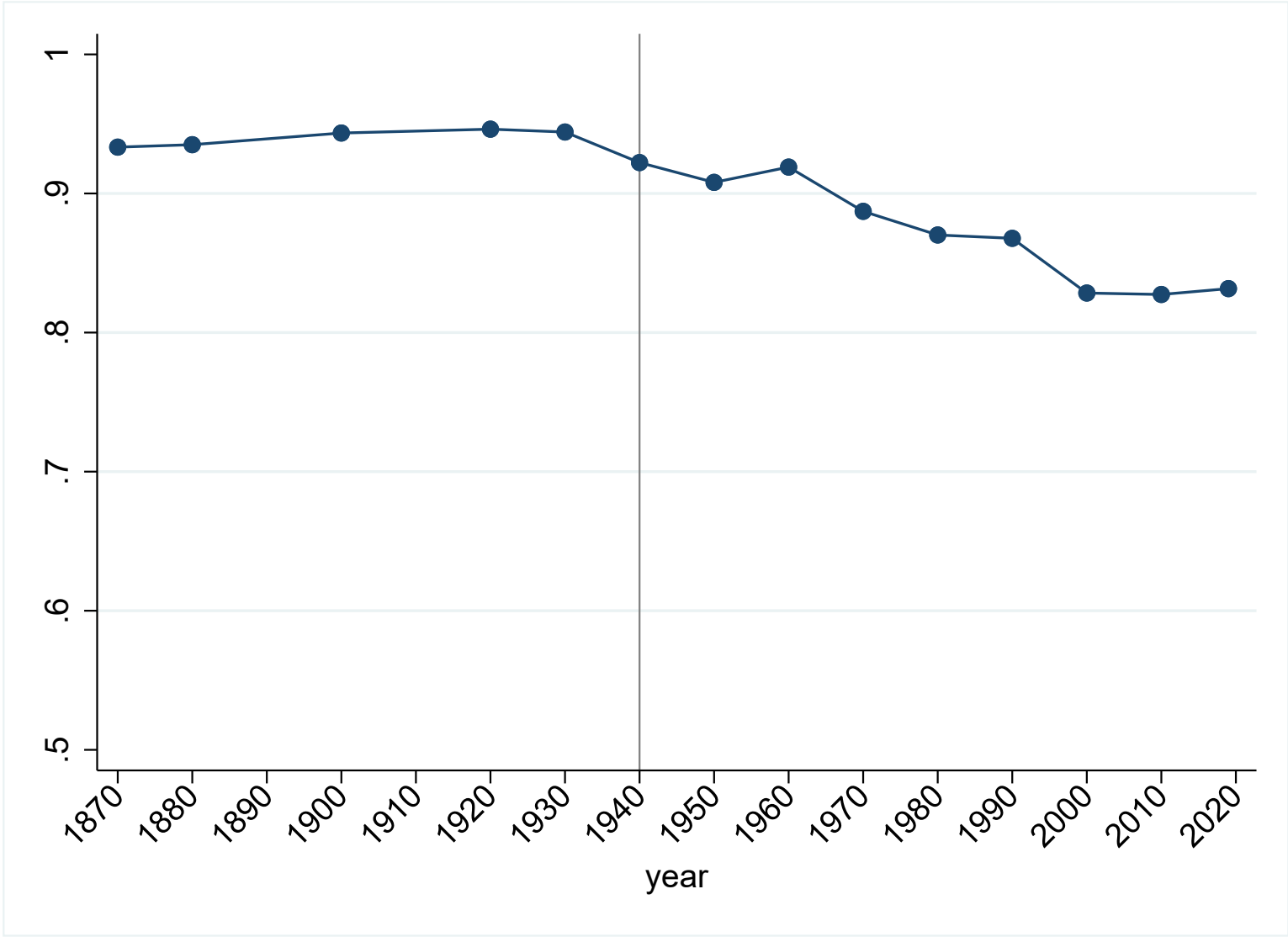
Sectoral composition of male employment



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

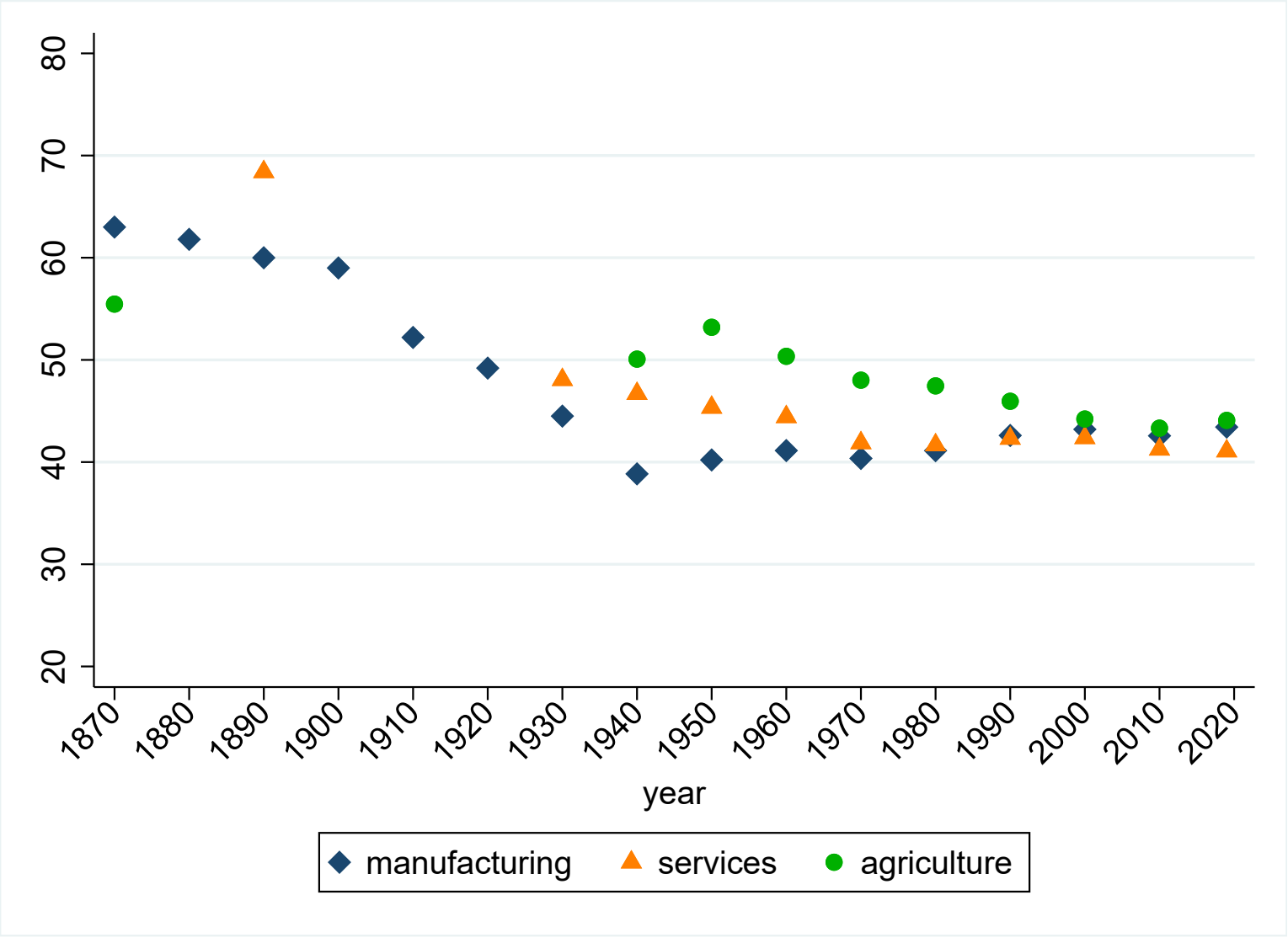
back

Male employment in the US Census



Notes: Men aged 18-64. back

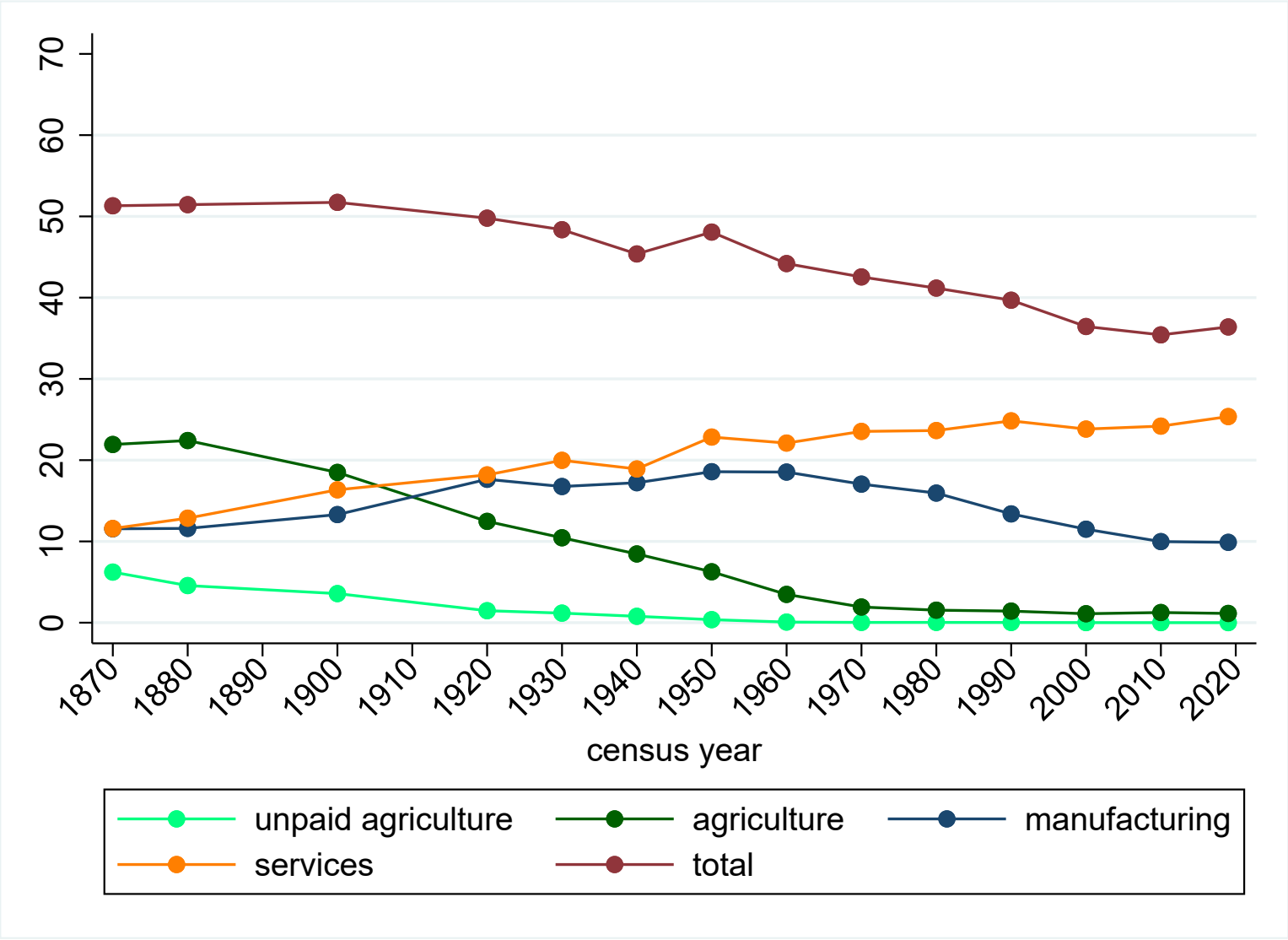
Male hours (per employed person)



back

Male hours per person (I)

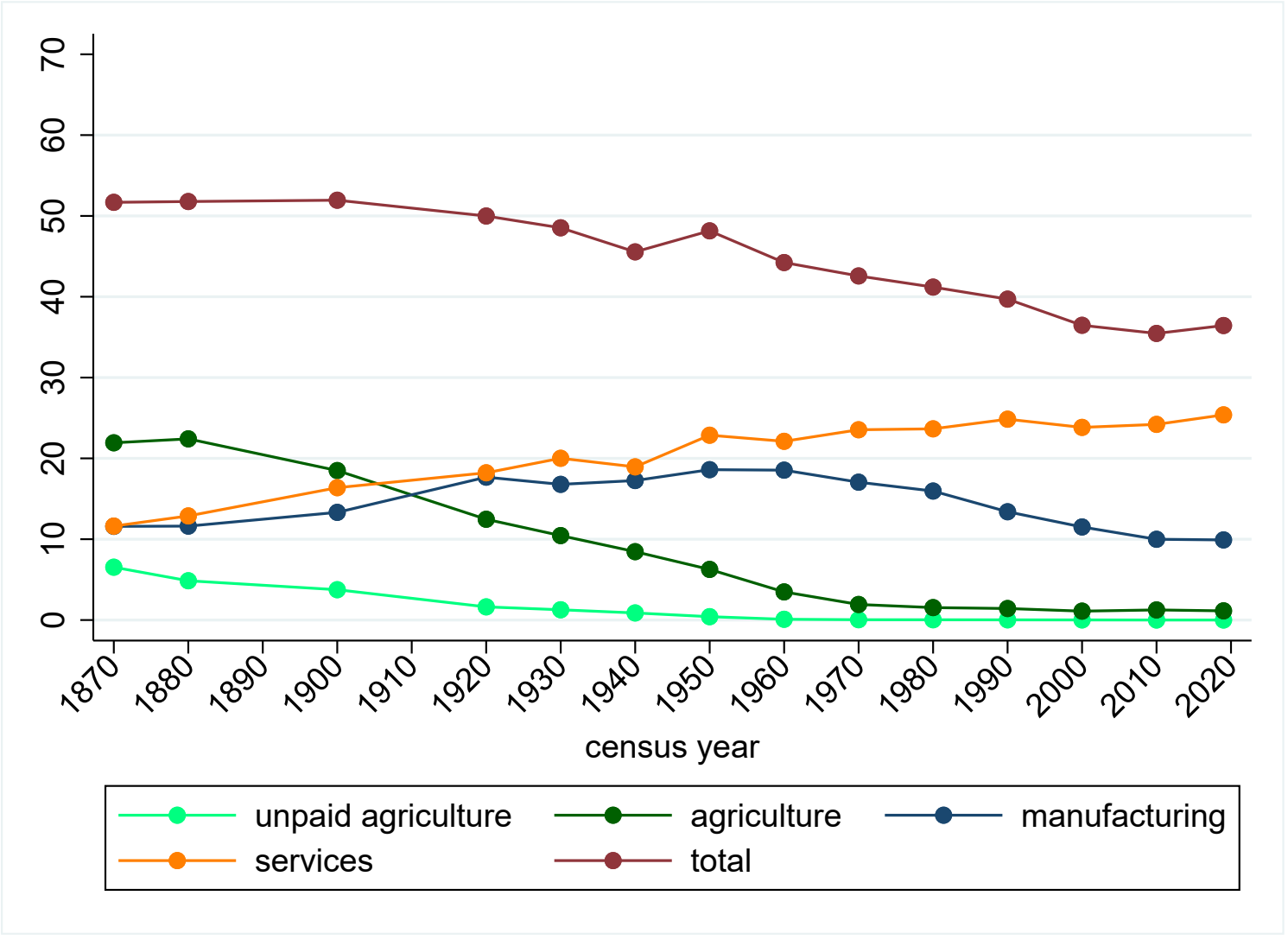
(excluding Ruggles 2015 imputation)



back

Male hours per person (II)

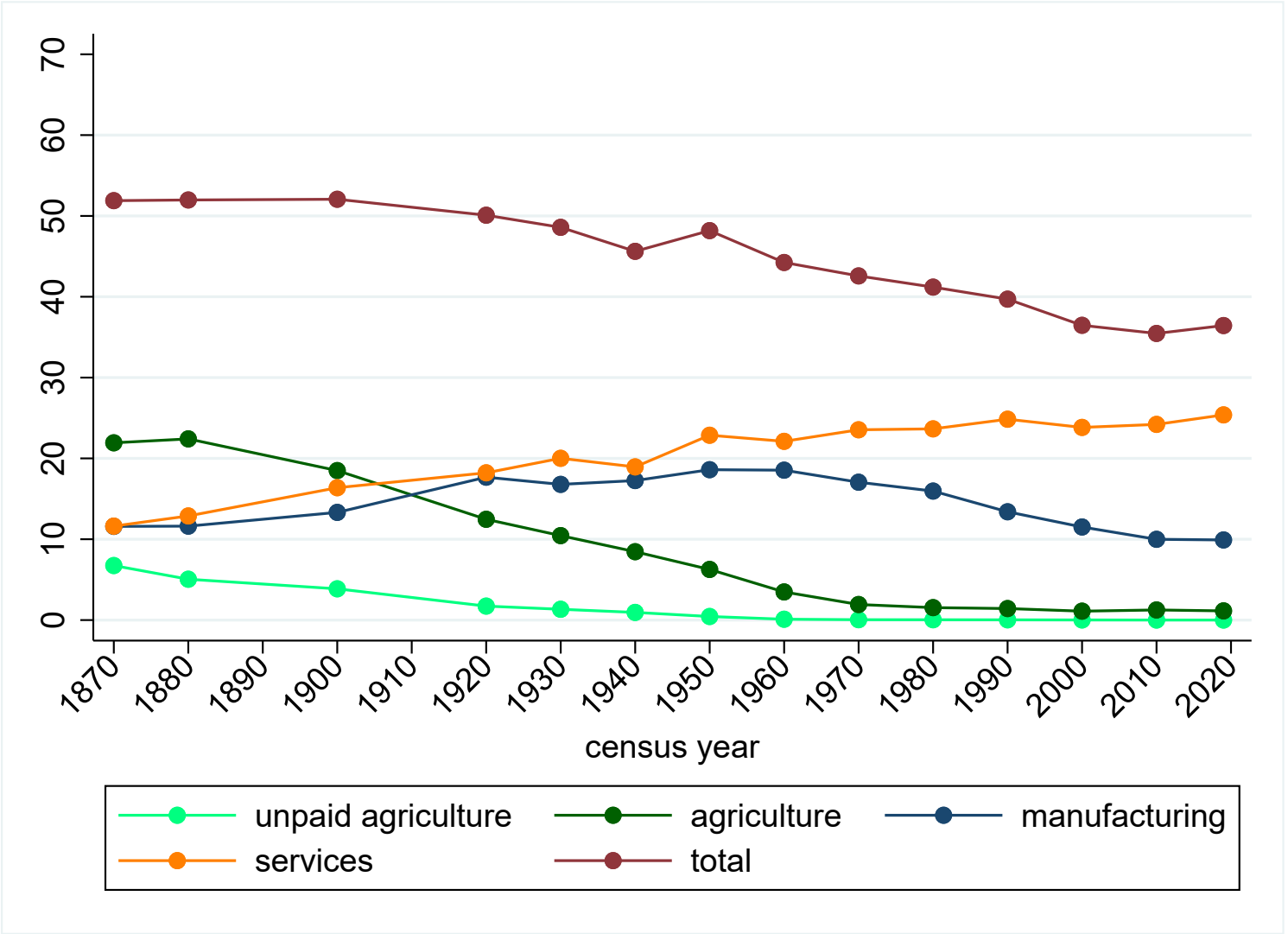
1. lower bound for unpaid hours in agriculture (12h)



back

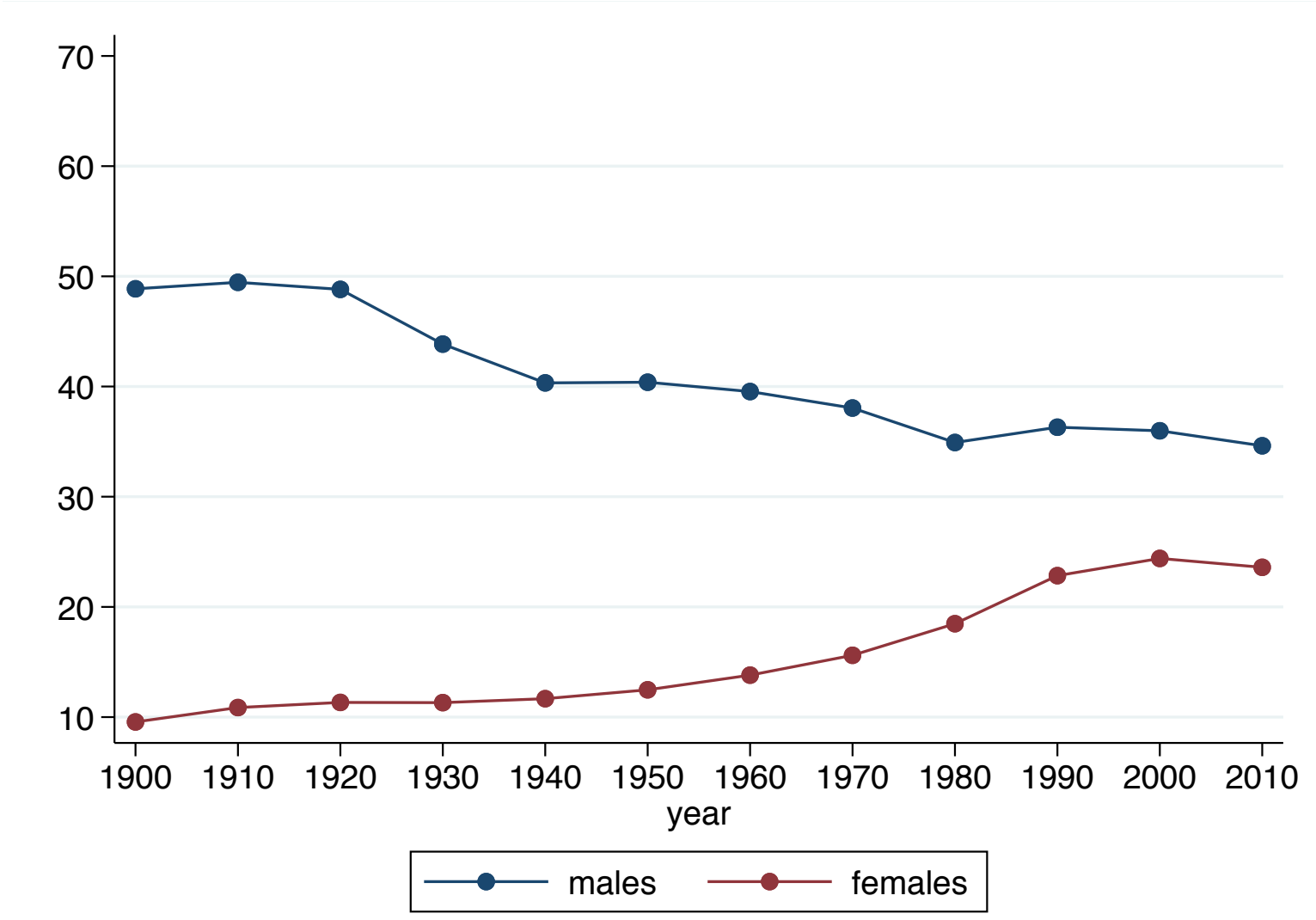
Male hours per person (III)

2. mid-range for unpaid hours in agriculture (20h)



back

Market Hours from Ramey and Francis (2009)



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

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