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Abstract

Women's contribution to the economy has been markedly underestimated in predominantly agricultural societies, due to their widespread involvement in unpaid agricultural work. Combining data from the US Census and several early sources, we create a consistent measure of male and female employment and hours for the US for 1870-2019, including paid work and unpaid work in family farms and non-farm businesses. The resulting measure of hours traces a U-shape for women, with a modest decline up to mid-20th century followed by a sustained increase, and a monotonic decline for men. We propose a multisector economy with uneven productivity growth, income effects, and consumption complementarity across sectoral outputs. During early development stages, declining agriculture leads to rising services – both in the market and the home – and leisure, reducing market work for both genders. In later stages, structural transformation reallocates labor from manufacturing into services, while marketization reallocates labor from home to market services. Given gender comparative advantages, the first channel is more relevant for men, reducing male hours, while the second channel is more relevant for women, increasing female hours. Our quantitative illustration suggests that structural transformation and marketization can account for the overall decline in market hours from 1880-1950, and one quarter of the rise and decline, respectively, in female and male market hours from 1950-2019.

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1 Introduction

Most high-income countries have witnessed a spectacular increase in women's participation to the labor market during the second half of the 20th century. Rising female participation, however, is not a universal phenomenon. In fact, female employment has declined in the developing world during recent decades, as well as in high-income countries during other historical windows. Consequently, the relationship between female employment and GDP per head exhibits a non-monotonic pattern resembling a U-shape. In contrast, male employment tends to decline consistently across the different stages of development.

This paper empirically and theoretically examines the relationship between gender trends in work and economic development through the lens of two processes: structural transformation across the broad sectors of agriculture, manufacturing and services, and the marketization of home production. For this purpose, we build a consistent measure of male and female work for the US over 1870-2019, encompassing extensive and intensive margins, with an emphasis on the measurement of unpaid work in family businesses in the pre-1940 period. Alongside the correct characterization of women's contribution to the economy, the measurement of unpaid work in family farms matters for the estimation of agricultural productivity and structural transformation (Gollin et al., 2013).

We build trends on persons in work using data from the Census of Population from 1870 onwards. Starting in 1940, the Census definition of employment coincides with the current ILO definition, covering both paid and unpaid employment. The bulk of the latter reflects unpaid work in family businesses, mostly family farms. Before 1940, only gainful work is counted as employment, and we estimate the incidence of unpaid employment based on the share of persons living on farms and the (gainful) occupation of their household head. In particular, if a woman lives on the farm, does not report a gainful occupation, and is married to a self-employed farmer, we classify her as an unpaid family worker, motivated by evidence that farms relied heavily on family labor (Ruggles, 2015). Indeed, early time use data show that rural homemakers were working long enough hours on the family farm to be considered employed according to modern definitions. Based on adjusted estimates, the female employment-to-population ratio falls from 56% in 1870 to 45% in 1940, before rising to 74% in 2019, while male employment declines throughout the sample period, from 96% in 1870 to 84% in 2019.

Employment trends are accompanied by important intensive-margin variation, both over time and across sectors, which we document using data from several sources. The Census contains information on hours since 1940, but there exists no unified or consistent source before then. For the earlier period we combine information from the Census of Manufacturers, and several one-off reports and surveys commissioned by state Bureaus of Labor. Historians have long been working with these sources. Some of them have been reorganized into wider collections such as the Historical Statistics of the United States, 1860-1930, the Historical Labor Statistics Project at the University of California (Carter et al., 1991), and the "Women Working, 1800-1930" project of the Harvard University Library's Open Collections Program – among others. These projects typically cover paid hours in specific occupations, sectors or geographies. The data are mostly available as tabulations, except for the Historical Labor Statistics Project, which has digitized individual records for about 100 thousand workers. Thanks to early labor regulations and a structured work week, coverage for the manufacturing sector is reasonably systematic and information on hours seems more reliable than for other sectors (Whaples, 1990). Coverage is sparser for the broad service sector and quite limited for agriculture.

We obtain estimates of unpaid hours on the farm by drawing on early time-use surveys, known as the Purnell diaries Ramey 2009, which primarily sampled rural homemakers between the 1920s and the 1950s. According to the diaries, the typical homemaker on the farm would devote about 15.5 hours to farm activities per week in the 1920s, down to 7.5 hours in the 1950s, not including the time necessary to cater for farm employees or lodgers, if present. Due to sampling methods and the difficulty to record unpaid agricultural work, hours series from the early time-use surveys are inevitably affected by more severe measurement error than the post-1940 Census data. Drawing from the available sources, we also show realistic lower- and upper-bounds for unpaid hours.

Combining data on bodies and (paid and unpaid) hours from the sources described, we obtain a mid-range value of 21 hours per week for women's market work in 1880 across the three sectors, down to 15 in 1940, reaching 21 again in 1980 and further rising to about 28 in recent years. The resulting U-shape in female hours has a shallower left branch than the corresponding body-count, because hours worked in unpaid farm work – prevalent over the earlier period – are markedly lower than in regular, gainful employment. The entire fall in market hours before 1940 is accounted for by the decline in unpaid agricultural work, and the post-1940 increase is accounted for by the rise in services. For men, hours fall monotonically from about 61 in 1880, to 35 in 2019, reflecting the large decline in (paid) agriculture until about 1960 and the decline in manufacturing since then.

We complement evidence on work in the market with (more limited) evidence on work in the home, including childcare and household chores. This differs from unpaid work in family businesses because it produces services for own use, as opposed to producing goods that are sold on the market and contributing to household income. The distinction between the two is not only relevant for measuring female employment and the overall agricultural share. In fact, work by Boserup (1970) and Alesina et al. (2013) suggests that it also matters for long-term trends in female emancipation, as women's involvement in income-producing activities would be better conducive to the evolution of gender roles than their consignment to the provision of home services.

To measure the time spent in home production, we combine data from harmonized time use surveys that started in the 1960s with data from the Purnell diaries, for 1924-1943, and data from the Nationwide Study of Living Habits for the 1950s (DeGrazia, 1962). As the Purnell diaries mostly covered rural homemakers, our home production data for the pre-1950 period are best representative for this category. Our series show that women's involvement in home production has been relatively stable until 1960, with about 40 hours of home production per week, falling to about 15 hours per week over the following six decades.

To account for the simultaneous evolution of male and female work and the industry structure, we model a multisector economy in which individuals consume output from three sectors – agriculture, manufacturing and services – and allocate their time to market work, home-production and leisure. Consumers have a taste for variety, hence the three types of goods are poor substitutes in consumption. In addition, the presence of a minimum food requirement in the consumption of agricultural produce implies that the demand for agricultural output is less income elastic than demand for manufacturing and service outputs. Services can be produced both in the market and the home, with market- and home-produced varieties being close substitutes for each other. Productivity growth is uneven across sectors, being higher in agriculture and manufacturing than in services. Within the broad service sector, productivity grows faster in the market than in the home, as the scale of market production is better conducive to labor specialization and technology adoption.

As outputs from the three sectors are poor substitutes, faster productivity growth in agriculture and manufacturing leads to structural transformation and a rise in services, via Baumol's relative price mechanism. Conversely, faster productivity growth in market than home services, which are good substitutes for each other, leads to marketization of home production. The simultaneous evolution of hours of work and the industry structure can be summarized in two main phases. At early stages of development, when the agricultural sector is large, structural transformation is the main force at play, leading to declining agriculture, rising service production both in the market and the home, and rising leisure via income effects. This implies a decline in market work, via both the rise in home services and leisure. At later stages of development, once the agricultural share is small, structural transformation mostly shapes labor reallocation from manufacturing into services. At the same time, a large service economy implies an important marketization process, reallocating work from home to market services and raising market hours.

Patterns of gender specialization determine the relative strength of these forces for men and women. Both male and female market hours fall along the initial phase of agricultural decline, while agriculture is still the core employer for both genders. But the later phase of manufacturing decline and service growth has differential impacts on male and female hours. As men and women specialize in manufacturing and services, respectively, the first channel is more relevant for men, implying a decrease in male hours, while the second channel is more relevant for women, implying an increase in female hours. Under the combination of structural transformation, marketization and gender specialization, the evolution of female market hours describes therefore a U-shape, while male market hours monotonically decline.

Having obtained analytical results for the mechanisms proposed, in a quantitative illustration we establish that the model can reasonably reproduce the observed trends in male and female work under plausible combinations of relevant parameters, including the timing of the turning point in female market hours. In addition to the core processes of marketization and structural transformation, we consider the evolution of gender specialization, reflecting within-sector gender-biased shifts in labor demand (similarly as in Heathcote et al., 2010) – for instance the mechanization of agriculture or brawn-saving technologies in manufacturing – as well as social norms, labor regulations, and additional frictions (as in Kleineberg and Chiplunkar, 2023 and Lee, 2024). The calibrated structural transformation and marketization forces can account for the overall decline in market hours for both genders from 1880 and 1950, but only one quarter of the rise and decline, respectively, in female and male market hours from 1950 to 2020. While pre-1950 gender trends reflect almost exclusively the reallocation of labor across sectors, post-1950 trends are driven to a larger extent by within-sector forces.

The U-shape hypothesis was postulated by Sinha (1967) and further advanced by Boserup (1970), Durand (1975) and Goldin (1990, 1995), among others, discussing various factors at play. In agricultural societies, women are heavily involved in the labor force. As economies grow, following mechanization in agriculture and industrialization, production moves out of the household and into large-scale agriculture and factories, in tandem with urbanization. Female participation declines, following a combination of income effects and comparative (dis)advantages and social customs limiting women's entry in manufacturing. As development progresses, the improvement in women's education and the expansion of white-collar jobs attract women into the labor market, due to higher opportunity costs of home making and female comparative advantages in the service economy. Evidence shown by Goldin (1995) lends support to the U-shape hypothesis on a cross-section of countries observed in the early 1980s, as does later work on cross-country panels (Mammen and Paxson, 2000; Olivetti, 2014; Doss et al., 2024). Evidence from within-country evolutions is more limited, due to the difficulty of measuring unpaid work, and agricultural work more generally, before WW2. Goldin (1990)'s analysis of 1890 Census data suggests that female participation in the US was likely as high in 1890 as in 1940, with the bottom of the U occurring somewhere in between. We build on this body of work by harmonizing several data sources for the earlier period, characterizing both the extensive and intensive margins of female work since 1880. In addition, we formalize the link between gender trends and the changing industry structure in a unified framework that explains labor reallocation within and across sectors.

Our paper is also closely related to a body of work that emphasizes the relationship between the rise of the service economy and female employment, including (among others) Ngai and Petrongolo (2017), Bridgman et al. (2018), Buera et al. (2019) and Rendall (2024). These papers emphasize that the service sector creates jobs for which women have a comparative advantage and, similarly as in our paper, the framework of Ngai and Petrongolo (2017) generates structural transformation and marketization of home production as consequences of uneven productivity growth. By focusing on gender and industry trends over recent decades, this literature is silent about the role of agricultural decline in shaping female work in the pre-WW2 period. We argue that a perspective on the earlier period is valuable not simply to understand gender trends in economic history, but – importantly – to shed light on the ongoing transition out of agriculture in the developing world.

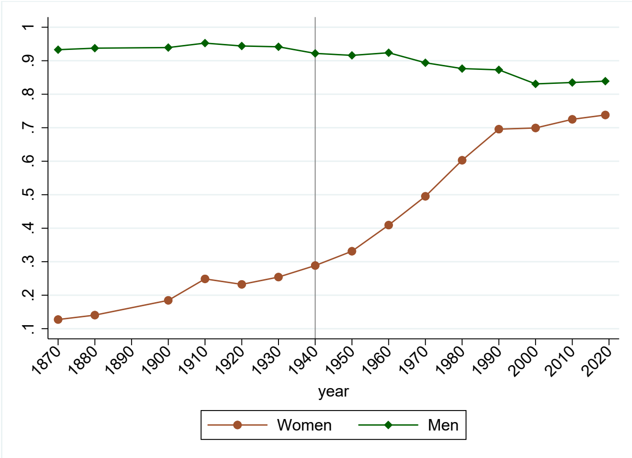
Finally, our paper contributes to work on structural transformation and the evolution of aggregate hours. Ngai and Pissarides (2008) model the implications of uneven productivity growth for aggregate market hours, Vandenbroucke (2009) and Boppart and Krusell (2020) emphasize the role of income effects in hours' decline, and Bick et al. (2022) combine structural transformation and the decline in the fixed cost of wage work to model intensive and extensive margins. We bring a gender dimension to this literature and highlight that the combination of structural transformation and marketization can simultaneously explain both monotonically declining hours for men and U-shaped hours for women.

The rest of the paper is organized as follows. The next Section presents evidence on employment dating back to 1870, using individual records from the Census and the American Community Survey. Section 3 presents evidence on market hours, home production and wages, combining several data sources. Section 4 proposes a model with structural transformation and marketization to rationalize the empirical trends. Section 5 gives a simple quantitative illustration of model properties and Section 6 concludes.

2 Evidence: Extensive margin

We measure employment on micro data from the US Census of Population and American Community Survey (ACS). Ideally, and to speak directly to the role of unpaid work at early stages of development, we wish to measure employment based on the ILO definition, covering work for pay, profit or family gain in cash or kind. In particular, this definition covers unpaid family workers, i.e. relatives that assist without pay in a family-operated income-producing enterprise. While the ILO definition of employment is well-established nowadays, it is typically not available in historical data. In the US Census, it only becomes available in 1940, with some inconsistencies in detailed definitions in the decades that follow. For example, from 1940 onwards, unpaid family workers were considered employed if they worked at least 15 hours per week, while the threshold for paid work is one hour per week. Before 1940, employment is mostly defined as reporting any gainful occupation, although attempts to cover unpaid work started in 1910, with the indication that women working regularly on the family farm should be classified as a farm laborers even if they are not paid wages. It is additionally stated that "a wife working for her husband ... should be returned as an employee, even though not receiving wages," without imposing qualifications about farm work. More restrictive definitions of unpaid work were used in

Figure 1: Employment to population ratio, 1870-2019.



The sample includes individuals aged 18-64. Individual weights are used in the calculation of employment rates. The definition of employment changes from "gainful employment" to "ILO employment" in 1940. Source: US Census and ACS, 1870-2019.

1920 and 1930, regarding people working on the farm "regularly and most of the time".[1] In summary, the key drawback in the Census data is the lack of a systematic estimate of unpaid family work when this was more widespread.

Figure 1 plots male and female employment rates from 1870 onwards (with the exception of 1890, as the corresponding individual files were lost), based on the definitions available in the Census. To limit interferences from trends in schooling and retirement we restrict our sample to the population aged 18-64. The female employment to population ratio rises from about 16% to 72% over the past 150 years. The 1910 blip reflects the adjustment for unpaid work described above. Male employment stays at or above 90% until mid-20th century and later gradually falls to 84%. The high rates of gainful employment among men before 1940 suggests that unpaid family work was of little relevance for male employment. The main endeavor in what follows is therefore to systematically account for unpaid work among women.

While there is no unified data source that allows us to directly estimate the undercount of female employment in the Census, evidence from various sources suggests that Census employment only captured a small portion of female work, especially in agriculture. Smuts (1960) notes that social attitudes towards women's employment as well as the unstructured/unpaid nature of female work in agriculture were reflected in early Census instructions, which implied enumerators should use caution in counting women as gainfully employed. To give a sense of magnitudes, he reports that in 1890, when about 4 million white married women lived on farms, the Census only counted about 23 thousand of them in farm occupations. In 1950, when the population living on farms was much smaller, nearly 200 thousand white married women were counted as unpaid family farm workers. His conclusion is that "hundreds of thousands [women] were counted as

[1] See the Census documentation for information on overall comparability of employment status over time and instructions to enumerators: see 1910; 1920; 1930 for criteria used in specific years.

housewives in 1890, even though they did enough work on family farms to be counted as farm laborers in [more] recent censuses" (Smuts, 1960, p. 77-78). Additional evidence is provided by the Purnell diaries of the 1920s and 1930s (described in Section 3.3), documenting that homemakers living on farms were spending on average enough hours on farm work to be classified as employed according to the ILO definition.

Relatedly, work by Ruggles (2015) on the role of the family enterprise in US economic history documents that production was largely carried out within family units – mostly family farms – for most of the 19th century and the early 20th century, and wage work that was sufficient to entirely support a household was rare before 1900. Up until 1850, more than half of the US population lived on farms, and more than one third still did so in 1900. Farms relied heavily on family labor, and "all family members who were old enough contributed to farm production." Family businesses were also common in the non-farm sector, e.g. in retail, hospitality, repair, and small-scale manufacturing and, similarly as on family farms, family members were typically involved.

To account for unpaid employment in family businesses, we adopt the adjustment proposed by Ruggles (2015), which consists in classifying as employed women without a gainful occupation who live on the farm and whose head of household is a self-employed farmer. Ruggles (2015) also proposes an analogous adjustment for the non-farm population, by classifying as employed women without a gainful occupation, whose head of household is self-employed. We implement both corrections, although the latter adjustment is much less relevant quantitatively than the former. Also, we introduce a symmetric adjustment for men who are not head of households. As one would expect, this hardly affects the resulting male employment rates.[2]

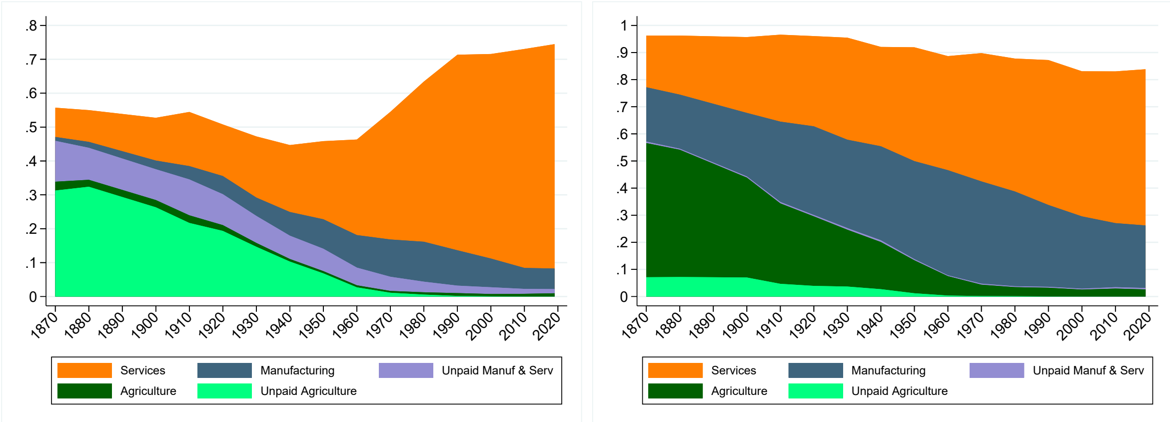
The resulting employment rate is shown in Figure 2, which also illustrates its industry composition (where imputed family workers are assigned the industry of their head of household). Panel A shows a clear U-shape in female employment, starting at 56% in 1870, reaching a trough in 1940 at 45% and then rising again to 74% in 2019.[3] The bulk of the decline in female employment up until 1940 is associated to the decline of unpaid work on farms, which virtually disappeared by 1960. The bulk of the rise in female employment since 1940 is instead associated to the rise in services, employing 66% of

[2]While data for 1940 onwards are meant to identify unpaid family workers, the 15h hours restriction imposed misses an important fraction of unpaid, casual workers. We therefore apply the Ruggles (2015) adjustment in all Census years for workers who are not in a gainful occupation. The implied adjustment is quantitatively negligible from 1960 onwards.

[3]Goldin (1990) suggests a lower bound adjustment of about 10 percentage points to the baseline 2.5% labor force participation of white married women in 1890. Approximately two thirds of this adjustment (see Table 2.9) correct for the undercount of unpaid farm wives, 20% of which – Goldin argues – should be included in the workforce. The 20% figure is meant to capture the fact that farm housewives spent on farm activities close to 20% of the fulltime workweek (as we will also document in section 3.3). In our data, 2.1% of white married women were in paid employment in 1900, 36% of them lived on a farm, of which 99% are not in paid employment. If we were to include in the labor force 20% of those on farms, the implied adjustment of about 7 percentage points would be close to Goldin's estimate. Our estimates for the adjusted female employment rate are also consistent with those obtained by Chiswick and Robinson (2021), who revise Ruggles (2015)'s calculations for 1860, 1920 and 2015-19.

Figure 2: Adjusted employment rates and industry shares, 1870-2019.

Panel A: Women Panel B: Men



The sample includes individuals aged 18-64. Employment figures are adjusted to take into account unpaid family work, according to Ruggles (2015). Individual weights are used in the calculation of employment rates. Source: US Census and ACS, 1870-2019.

women in 2019, corresponding to 89% of those in work. For men (Panel B), the adjusted employment rate replicates very closely the unadjusted employment rate of Figure 1. The slight decline in male employment reflects declining agriculture up until the 1960s, and declining manufacturing afterwards, partly offset by the rise in services.

Note finally that, in Figure 2, the 1910 blip in female employment remains even once we apply the Ruggles (2015) adjustment: this implies that the 1910 enumeration instructions included in the labor force women whose head of household was not self-employed (otherwise they would be included in the adjusted series). In what follows, as is common practice among economic historians (Goldin, 1990), we therefore drop 1910 Census data from our sample, as the exceptions introduced to the count of unpaid workers seem to make the 1910 data hardly comparable to data for adjacent decades.

3 Evidence: Intensive margin

To measure the evolution of male and female labor inputs over time, we next account for the intensive margin of employment. The distinction between extensive and intensive margins is especially relevant along two dimensions. First, hours per (paid) employed person decreased substantially during our sample period, with more modest variation across sectors and genders. Costa (2000) documents that typical weekly hours fell from 60 in the 1890s to 48 in the 1920s, following the reduction of the normal working day from 10 to 8 hours. The transition from the 6-day to 5-day workweek during the 1920s and 1930s brought usual hours down to 40 in 1940, and smaller reductions have been achieved since then with the introduction of various forms of leave, whether paid or unpaid. Together with the decline in average hours, their cross-sectional dispersion also substantially decreased, as the largest hours declines were concentrated at the top of the distribution. Second, hours were much shorter among paid than unpaid family workers. For example, in the early 20th century, farm laborers possibly worked in a day close to the number of hours that farm housewives would work in a week.[4]

3.1 Paid hours

As no unified database covers working hours before 1940, when systematic hours coverage starts in the Census, we draw from a variety of pre-1940 sources. First, we use data collected in the *Historical Statistics of the United States* (HSUS), covering the period 1860-1930. The main underlying sources are the Census of Manufacturers, the Weeks Report, the Aldrich Report, and the series produced by Ethel Jones, Albert Rees and John Owen, described in detail by Whaples (1990, chapter 2).[5] The most reliable estimates refer to the manufacturing sector, where specified hours schedules were introduced earlier (Whaples, 2001). Coverage of the service sector is limited, and there is no information on agricultural workers. Data from HSUS are only made available as industry averages and are disaggregated by gender from 1914 onwards.

For a broader coverage, we draw from a collection of state-level studies made available through the *Historical Labor Statistics Project* (HLSP) at the University of California, which collates information from more than 150 reports published between 1874 and WWI by 20 State Bureaus. A subset of these studies has been pooled and digitized in recent decades.[6] The complete dataset available through HLSP covers about 100 thousand workers in 14 states, surveyed between 1884 and 1901, working for pay in manufacturing, services or agriculture. Leaving out studies that focus on child labor or with missing information on occupation, our sample includes approximately 52 thousand men and 25 thousand women across 12 states.[7] Appendix A.1 provides details on data coverage and describes how we harmonize information on hours, earnings, occupation and industry across the available studies. Whenever information on age is available, we restrict to the population aged 18-64. For each gender and industry, we aggregate hours worked across broad occupations (professional, clerical, skilled manual, unskilled manual, and teachers) using occupation shares by gender and industry from the Census. This weighting procedures aims to recover representative hours estimates by gender and industry whenever the within-industry sampling of occupations is not representative.[8] As the earliest data outside the manufacturing sector start in the 1880s with the HLSP, our evidence and discussion on the intensive margin of employment also starts in 1880.

Finally, for the 1920s and 1930s, we draw from the *Women Working, 1800-1930 Project* (WWP) of the Harvard University Library's Open Collections Program, which

[4]Relatedly, evidence shown by Dinkelman and Ngai (2022) on the cross-section of African countries implies that high female employment coexist with relatively low hours at early stages of development.

[5]See the Millennial Edition at https://hsus.cambridge.org/HSUSWeb/HSUSEntryServlet.

[6]The data and documentation are available at https://eh.net/database/historical-labor-statistics-project-series/. See Carter et al. (1991) for a detailed description of the project. Costa (2000) pools micro data from ten of these studies, excluding agriculture, including about 11,000 men and 1,100 women.

[7]California, Connecticut, Indiana, Iowa, Kansas, Maine, Michigan, Montana, New Hampshire, Ohio, Rhode Island, Wisconsin. See Figure A2 for a visual representation of our sample.

[8]We use occupation weights from the 1880 and 1900 Census for studies carried out during 1884-1894 and 1895-1901, respectively.

covers more than 4,000 studies. This collection is helpful to bridge the gap between earlier sources and the Census, but contains only scant information on male workers.

To estimate hours in manufacturing, we use HSUS data for 1880 and 1914-1930. As no gender disaggregation is available before 1914, we impose identical hours for men and women in 1880, in line with evidence that average hours in textiles, in which women are over-represented, were extremely close to average hours in manufacturing as a whole. Hours by gender for 1890 and 1900 are estimated on the HLSP data. The series we build from these sources show a substantial decline in weekly hours per worker in manufacturing, from 61.8 in 1880, to 44.5 and 40.5 in 1930 for men and women, respectively.

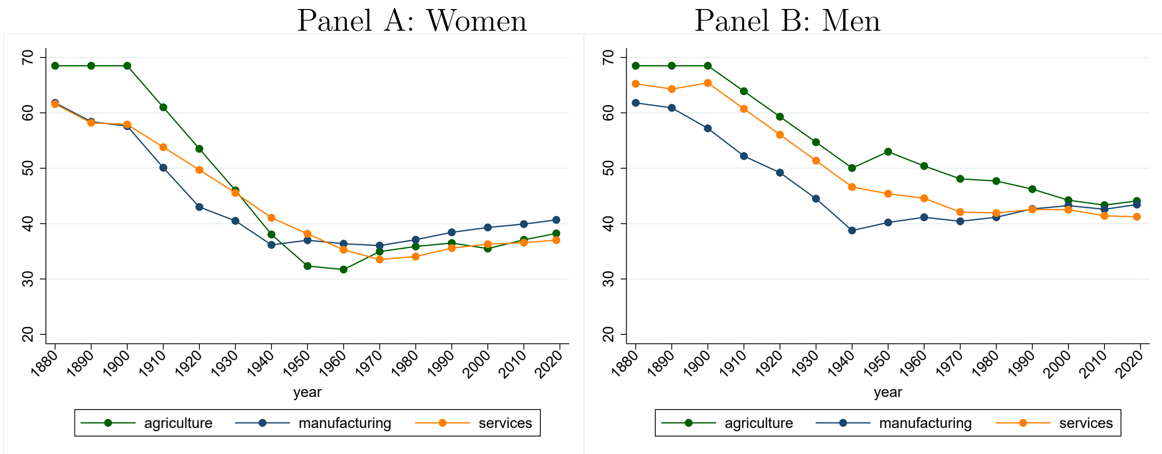
In the service sector, male and female hours in the HLSP hovered around 64 and 58, respectively, between 1884-1901.[9] While coverage outside of manufacturing is extremely rare before the 1880s, a Report by the US Bureau of Labor on the condition of women and child wage-earners in the 19th century gives evidence of substantially longer workweeks in services than in the early 20th century (12-15 daily hours among domestic servants in 1869, 12-14 hours among laundresses; see US Bureau of Labor, 1910, vol 9, p. 183-184). This evidence is suggestive of a downward trend in service hours in the decades leading to the 1890s, and we impose the same downward trend between 1880-1890 as measured for manufacturing. For the 1920s (1920-1928), six establishment level studies in the WWP cover women's hours in trade and laundries, giving an average of 48 per week. For the 1930s (1934-1936), three similar studies (covering trade, hospitality and laundries) give an average of 43 per week. Limited information on men is reported for comparison purposes (e.g. 49 hours per week in the hospitality sector in 1934). For women, we use all data available from the 1880s to the 1930s, while for men we linearly interpolate service hours from 1890-1940. The interpolated data are closely in line with figures reported by Kendrick (1961, Table A-IX) for the trade sector.

For agriculture, information on working hours is especially scant, as the activity was not lending itself to systematic reporting. Much of the workforce was self employed and, even among laborers, work schedules were mostly determined by daylight, weather, and seasonal conditions. Within the HLSP, only two studies (both for Kansas) report information on working hours, for a total of 20 observations on men and women combined in the mid-1880s, and an average of 68.5 hours per week. This is within the 60-84 hour range given by a 1870 Report of the Bureau of Statistics of Labor for the typical work week in agriculture.[10] As no other similar sources of working hours in agriculture are available for the late 19th century, we keep hours per worker in agriculture constant at 68.5 for 1880-1900, as also suggested by discussions in Kendrick (1961, p. 354) and

[9]A subset of HLSP studies includes information on marital status (for about 36,000 men and 4,000 women). Male hours do not significantly vary by marital status. For women, we detect no significant difference in services, but married women work nearly two hours less per week than single women in manufacturing. This difference plays a negligible role in the aggregate series, since only 8% of women employed in manufacturing are married.

[10]The document is an account of the Bureau's survey of working men and women of Massachusetts, available at http://archives.lib.state.ma.us/handle/2452/757004.

Figure 3: Paid hours per employee, 1880-2019.



The series plotted represent average weekly hours per employee, conditional on being in paid employment. Sources: HSUS, HLSP, and WWP (1880-1930); US Census of Population and ACS (1940-2019). *Further details on data elaborations pre-1940.* 1. *Agriculture*: 1880-1900 based on constant hours from HLSP for 1884-1901, not disaggregated by gender; 1910-1930 based on linear interpolation between 1900-1940. 2. *Manufacturing*: 1880 from HSUS, not disaggregated by gender; 1890 and 1900 from HLSP (obtained as averages for 1884-1894 and 1895-1901, respectively); 1910-1930 from HSUS (where 1910 corresponds to 1914 in HSUS). 3. *Services*: 1880 based on backward extrapolation, imposing the same trend as in manufacturing; 1890-1900 from HLSP (obtained as averages for 1884-1894 and 1895-1901, respectively); 1910 based on linear interpolation between 1900-1940; 1920 and 1930 from the WWP for women (obtained as averages for 1924-28 and 1934-36, respectively) and based on linear interpolation between 1900-1940 for men. Whenever using individual data, the sample is restricted to 18-64 year old and individual weights are used to obtain averages.

Barger (1955) about lack of any definite trend in hours in agriculture before 1900. We then interpolate a linear trend in agricultural hours between 1900 and 1940.[11]

For 1940 onwards, hours are obtained from the Census and ACS for men and women aged 18-64. Based on the sources and adjustments described, the combined series for hours per (paid) worker are plotted in Figure 3. Average hours decline in all three sectors until mid-20th century and remain stable thereafter, with moderate differences across sectors and genders.

3.2 Wages

We build a series for the gender wage ratio using a combination of HSUS, HLSP and Census data. Micro data from the HLSP include information on weekly wages for all three sectors and allow us to estimate wage ratios for 1884-1901, controlling for a small set of characteristics. Results from wage regression on these data are reported in Table 1. The specification in column 1 includes all observations with non-missing data on weekly wages, and only controls for gender and study fixed effects, which capture systematic

[11] Our estimate for agricultural hours in 1880-1910 is higher than Kendrick's, who reports an annual average of 51.3 weekly hours for 1879-1899 (see Table IX, p.310), factoring in seasonal variation of agricultural work. Our hours measure is supposed to be representative of the Census reference week (typically in April), which coincides with agriculture's peak season. We can use our early individual-level data to build a comparable hours construct to Kendrick's. According to the HLSP, annual weeks worked in agriculture are 40 on average. Adjusting weekly hours in agriculture (68.5) by a factor of 0.77 (40/52 weeks) gives 52.3 average hours over the whole year, comparable to Kendrick's estimate.

Table 1: Wage regressions, 1884-1901.

	(1)	(2)	(3)	(4)
Sectors:	All	Man+Serv	All	Man+Serv
Female	-0.884	-0.606	-0.511	-0.497
	(0.0552)	(0.0329)	(0.0309)	(0.0283)
Skilled manual			0.201	0.223
			(0.0246)	(0.0269)
Clerical			0.245	0.272
			(0.0441)	(0.0472)
Professional			0.619	0.633
			(0.0618)	(0.0617)
Other controls	study FE	study FE age, age^2	study FE age, age^2	study FE
Observations	55611	45776	52004	44751
Adj. R^2	0.562	0.441	0.605	0.522

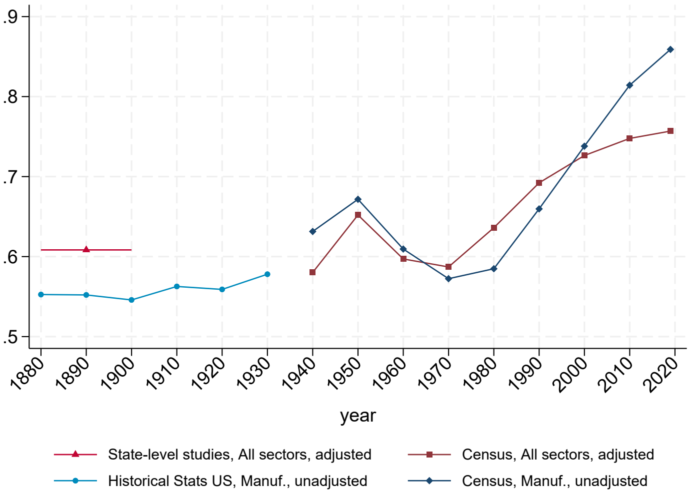
Notes. The sample includes individuals aged 18-64 with non missing information on weekly wages. The dependent variable is log weekly wages. The omitted occupation category is "unskilled manual". Source: HLSP, 1884-1901.

differences in study-level contexts, including the years and states in which surveys were carried out. The resulting gender gap around 88 log points corresponds to a wage ratio of about 0.4, consistent with the ratio reported by (Goldin, 1990, Table 3.2) for 1890. Column 2 obtains a smaller raw gap of 61 log points on a subsample that excludes agriculture. Columns 3 and 4 additionally control for gender differences in age and occupation. Column 3 refers to the whole economy and shows that a large portion of the gender gap – especially in agriculture – is explained by these characteristics, consistent with large income effects in female participation in the late 19th century (Goldin, 2006), leading to negative selection of women into paid employment. Columns 4 obtains a very similar gender gap if one exclude agricultural workers. In summary, the adjusted gender gap in weekly wages in the late 19th century is about is 50 log points, corresponding to a wage ratio of 0.6.

Census data are used to run equivalent regressions for 1940 onwards. As education is available in the Census (but not in the historical data), the Census-based regressions control for four education categories, age and its square. For comparability with the earlier data, weekly wages are used, and the sample is restricted to individuals working at least 35 hours per week and 40 weeks per year. The resulting gender ratio for the whole sample period is represented by the red plot in Figure 4, showing a roughly untrended wage ratio until 1970, followed by a clear upward trend. Both the level of the wage-ratio and the 1950 blip are consistent with estimates reported by O'Neill (1985, Table 1) for 1939-1982, obtained on data from the Current Population Reports of the U.S. Department of Commerce.

A longer time series for the wage ratio for the earlier period can be obtained from

Figure 4: Female to male wage ratio



Notes. Sources: HSUS, 1884-1901; HSUS, 1880-1930; US Census and ACS, 1940-2019.

the HSUS, with the caveats that this is based on aggregate data (thus wages may not be adjusted for characteristics) and only covers manufacturing employees. This series can be complemented by Census data post-1940. The resulting series for manufacturing is represented by the blue plot in Figure 4. The manufacturing (unadjusted) series lies below the adjusted series for the whole economy in the earlier period, when women in paid employment have on average worse observable characteristics than men. However, the post-1980 wage convergence was faster in the manufacturing sector.

Pooling together the various wage sources, we conclude that the wage ratio was hovering around 0.6 until about 1970, and then growing steadily in more recent decades, surpassing 0.75 in 2019.

3.3 Unpaid market hours

We have noted that unpaid work was the predominant dimension of female employment in the earlier part of our sample period. While hours sources described above only cover paid employees, we draw information on unpaid hours from early time-use studies. The 1925 Purnell Act provided federal funds for a nationally representative study of "The Present Use of Time by Homemakers," to be conducted by the US Department of Agriculture, focusing mostly on the time use of homemakers on the farm, with additional comparison samples on rural non-farm and town homemakers (USDA, 1944).[12] This nationally representative study has been replicated across a number of state Agricultural Experiment Stations and in other contexts between the mid-1920s and the mid-1950s, with a combined sample of nearly 4,000 homemakers (see Vanek, 1973 and Ramey, 2009 for a detailed description). The combined collection of studies has become known as the

[12]Unlike farm households, who sell farm products on the market, agricultural produce of rural non-farm household, if any, is for own consumption (see for example, Arnquist and Roberts, 1929).

Purnell diaries. Figure 5 illustrates the geographic distribution of households covered, by urban/rural status.

Evidence from these studies effectively established that, according to modern labor standards, women on the farm would be considered as employed.[13] Farm-based homemakers contributed to several agricultural activities, varying across products and geographies. As discussed in Wilson (1929) for Oregon, Wasson (1930) for South Dakota and Rankin (1928) for Nebraska, there is evidence that women in these states were systematically involved in dairy work and caring for poultry, including in large-scale farming.[14] Rankin (1928) also notes that about 20% of homemakers on farms helped with field work for about a month per year. More than half of the farms in his sample kept their own accounts, of which women were in charge at least in part in 60% of the cases (Rankin, 1928, Table 6). Women's work did not seem to vary significantly with farm tenure, whether they were owner, part-owner or tenant.[15]

To obtain an estimate of unpaid agricultural work, we restrict our analysis to homemakers living on the farm (3246 observations overall). Table 2 reports descriptive statistics on this sample. In most cases, the statistics are from summary tabulations from the printed reports. For the USDA (1944) study, we also have access to household level data for a subsample digitised by Gershuny and Harms (2016).[16] Columns 1 and 2 pool all available observations from each study, regardless of the specific survey month(s). Columns 3-6 refer to the spring months – whenever this information is separately available. Virtually all women contributed to farm work in the 1920s and early 1930s (columns 1 and 3). Alongside the historical decline in the prevalence of family farms, the share of farm homemakers actively helping declined to 77% in the late 1930s, and further shrank to 58% in the early 1950s. On average, women were working 9.6 weekly hours on the farm year-round (from column 2), with some decline over time.[17] This average is in line with the estimate of 1 hour 22 minutes per day by Pidgeon (1937, p. 354). As expected, hours worked in spring (column 4) tend to be higher than average annual hours.

A subset of studies provide information on the distribution of farm hours. Columns 5 and 6 report, respectively, the share of women who worked at least 15 hours per week in

[13]Kneeland (1929) notes that "The woman on the farm carries a double job; she is farmer as well as homemaker [...] Of her the old saying still has significance: *Man works from sun to sun, but woman's work is never done.*"

[14]Rankin (1928) reports an average of around 100-120 chickens per farm.

[15]The data analyzed in Rankin (1928) are from a 1924 survey of South Dakota farm homes and from a 1919 questionnaire administered to crop-reporters wives. Unfortunately, these studies do not include detailed time use information, so they cannot be used as a source of weekly hours. We learn that farmers and non-employed farm homemakers worked 12-hour day shifts in summer and 9-hour day shifts in winter, where work refers to any activity that is not eating meals, rest, recreation, and sleep.

[16]This is a subset of 348 farm and non-farm households that could be linked to the 1920 and 1930 Censuses (see Gershuny and Harms, 2016, for details). We are grateful to Jonathan Gershuny for sharing the household-level data with us.

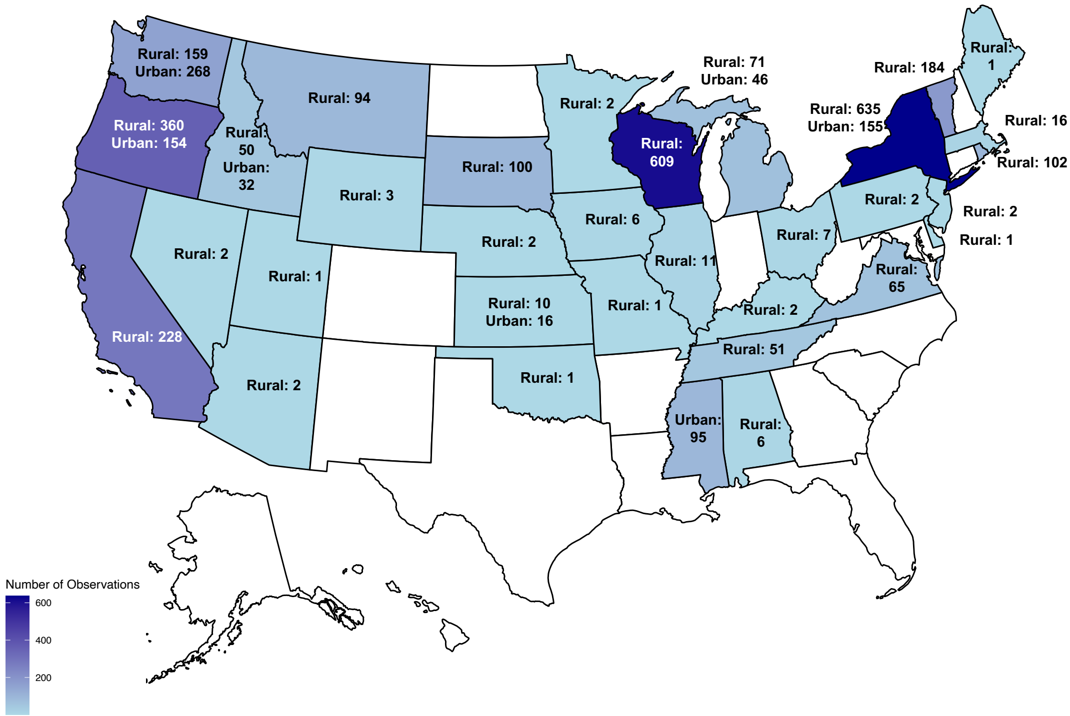
[17]The unpaid farm hours decline is consistent with evidence presented in Wright (1988) who argues that, at the turn of the 20th century, US farmers became increasing involved in product and capital markets, leading to an increase in the use of paid farm hands and a decline in the home share of total farm labor.

Table 2: Participation of Farm Homemakers to Farm Activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Overall		Spring				Obs.	Year	State
Study	%Helped	Hours	%Helped	Hours	%Work 15+	Hours			
1920s									
USDA (1944)		9.0					559	1924-28	USA
GH2016 subset of USDA (1944)	92	7.8	98	13.9	39	27.1	348		
Wilson (1929)	97	11.3	99	13.9	26.7	24.9	288	1926-27	Oregon
Crawford (1927)		9.7					49	1927	Idaho
Kneeland (1929)		11.2					700	1928	USA
Arnquist and Roberts (1929)[a]		9.9		15.1			137	1929	Washington
1930s and 1940s									
Richardson (1933)	95	8.8	95	10.3	27	23.9	92	1929-31	Montana
Wasson (1930)	99	11.5		14			100	1930	South Dakota
Kneeland (1932)		9.2					642	1932	USA
Warren (1940)			80	6.8			497	1936	New York
Muse (1946) [b]			77	12	26	26.4	183	1943	Vermont
1950s									
Wiegand (1954)	58	7			20		95	1952	New York
Cowles and Dietz (1956)		8					85	1953	Wisconsin

Descriptive summary of Purnell Time-Use Diaries for farm homemakers. Households surveyed in the USDA (1944) study are from 15 states, with the largest numbers residing in California, Michigan, New York and Massachusetts. GH2016 denotes the subsample of USDA (1944) used in Gershuny and Harms (2016). [a]"Spring" denotes the time period from April 1st to October 31st. [b]Data refer to Summer.

Figure 5: The Geographic Distribution of Observations the Purnell Time-Use Diary Studies.



Figures represent the number of individual observations by state and rural/urban status.

spring, and the average hours above this cutoff. The 15-hour cutoff was used in the 1940 census to define employment for respondents working as unpaid family members, while the modern ILO definition would classify any amount of unpaid work as employment. According to the Census 1940 definition, between 20%-40% of homemakers on farm would be classified as employed, while the vast majority of them would be considered employed according to the ILO definition (see column 1). This lends support to our employment imputation method for housewives on farms, described in Section 2. The conditional hours worked range between 24-27 over the sample period.

To build a series for unpaid hours that would be compatible with variables available in the Census, whose reference day is April 1st since 1930, we use (whenever available) the hours measure recorded in spring. When the season of survey is not available, we assume hours reported to be the average over the year, and we convert it into a springtime-equivalent by using the ratio of spring to overall hours from those studies for which both are available within the same decade. Using these elaborations on the data of Table 2, we estimate that homemakers are working on average 15.4 hours on farm activities in the 1920s, 10 hours in the 1930s and 1940s, and 7.5 hours in the 1950s.[18]

[18]This seems to be a natural grouping of decades, because there is only one study for the 1940s (Muse, 1946), and information on the extensive margin of farm work (77%) makes the population covered by this study more similar to the population covered by the 1930s than the 1950s studies.

There are reasons to believe that these represent an underestimate of the average homemaker's involvement in unpaid work in agriculture. First, adequate levels of literacy and numeracy were required to keep detailed records of activities (Figure A3 shows an example of the typical diary), implying that the survey would oversample highly-educated women. The Whittemore and Neil (1929) study for Rhode Island explains "It was planned to take random samples, getting them from all possible variations of education, and financial and social status in rural sections of the state. As will be shown later, however, it was found almost inevitably that the result was a selection along the lines of superior intelligence or training." Indeed, in his sample "only 11 of the 96 reporting on their education failed to complete eight grades. 46 of the remaining women graduated from high school and 31 went to college". Wilson (1929) study for Oregon reports that only 16% of respondents did not complete high school, and 12% completed college. One would expect that, due to income effects, families of relatively high socio-economic status would be more likely to hire outside labor to work on the farm, reducing the time involvement of housewives.

Second, homemakers are less likely to be surveyed in harvest seasons, when they are busier with farm work, leading to an under-representation of longer workweeks. Arnquist and Roberts (1929) note "the difficulty of securing records at the busiest season," which is spring in their study for Washington State. Similarly, in the Wilson (1929) study, only 18% of Oregon homemakers are surveyed in summer.

Third, whenever hired labor was present on the farm, employees were usually boarded and fed by the homemaker (Vanek, 1973, Crawford, 1927, page 8), and time spent on these activities should be counted under farm work, as it contributed to farm production. Rankin (1928, Table 8) reports that 40% of farms hired laborers. In more than 90% of cases, employees were boarded by the employer for over 7 months of the year on average. Harvest and seasonal fluctuations caused 65.5% of farms to hire additional helpers, who were offered 3 meals per day in 70% of farms, and one meal in the remaining 30%. While the diaries would typically pool under "food preparation" the time to feed one's family and farm employees, Crawford (1927, Plate IV) highlights a 3.5 hour difference in the time devoted to food activities by farm and non-farm rural households, and the Bureau of Human Nutrition (USDA, 1944, Table 5) reports an average 2.3 hour difference. All other components of domestic work are very similar in the two studies across farm and non-farm rural households, thus it is likely that the extra meal preparation time for farm households served to feed farm laborers.

Given these points, we consider the estimates above (from 15 hours in the 1920s to 7.5 hours in the 1950s) as a lower bound for the actual amount of unpaid hours worked by the average homemaker in agriculture. As an upper bound, we use information on unpaid hours in agriculture provided by the Census from 1940 onwards, available for those who work at least 15 hours per week. Based on this "restrictive" definition, unpaid women in agriculture work on average 32.7 hours per week during 1940-50, which is only slightly lower than the corresponding paid hours (35.3).

To build the full series of unpaid hours in the population, we extend information from the Purnell diaries in a few directions. First, absent other sources before the 1920s, we predict unpaid hours backwards based on the trend observed for paid hours. For the post-1950 period, we use the 1950 estimate, although the actual value used has little empirical relevance from 1960 onwards, when unpaid farm work becomes negligible. Second, we impute the same unpaid hours estimate to men without a paid occupation, living on farms, and whose head of household is a self-employed farmer. Again, this choice has little bearing on the estimation of total hours, as the share of men in this situation is negligible. Third, we extend estimates based on the Purnell diaries to (the smaller share of) unpaid workers in manufacturing and services. This assumption is motivated by Cowan (1983)'s observation that home-based activities in agriculture, manufacturing and service production during the late 19th and early 20th centuries involved similar hours' investments by household members (although there are differences in the typically male and female tasks within each broad sector). Similarly as for agriculture, Census data for 1940-1950 provide an (upper-bound) estimate for unpaid hours in manufacturing and services.

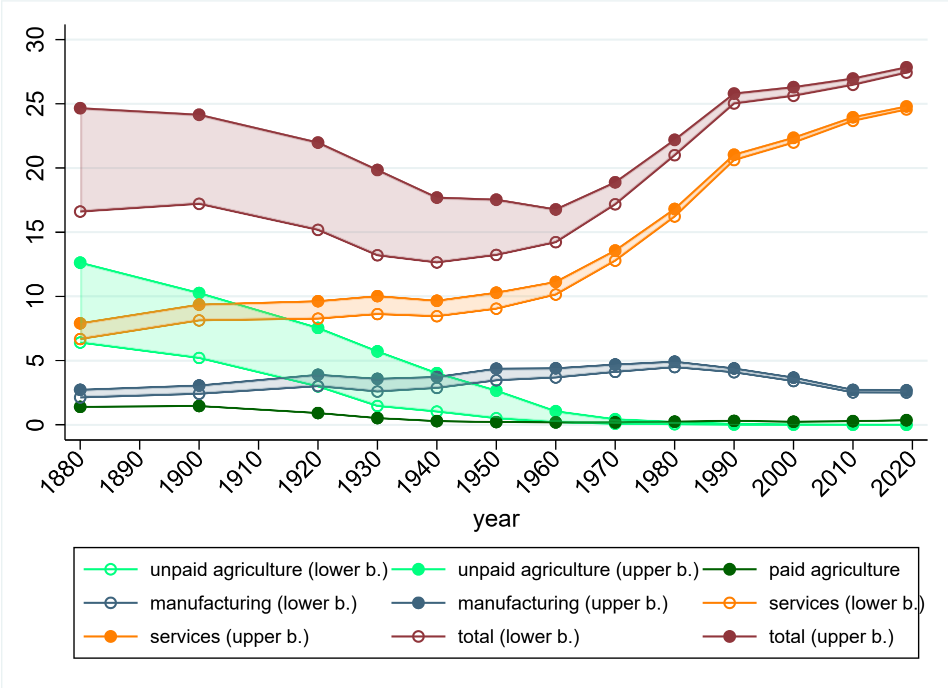
3.4 Market hours per person

To obtain a series for labor inputs in the three sectors, we combine the paid hours series from Figure 3, the unpaid hours estimate described above, and the employment shares plotted in Figure 2. We let unpaid hours estimates range between the lower bound obtained on data from the Purnell diaries and the upper bound provided by the Census estimates of unpaid hours. The resulting series are shown in Figure 6, where the shaded areas represent variation between upper and lower bounds. As the unpaid work margin is nearly irrelevant for men, upper and lower bounds are very tight, unlike for women.

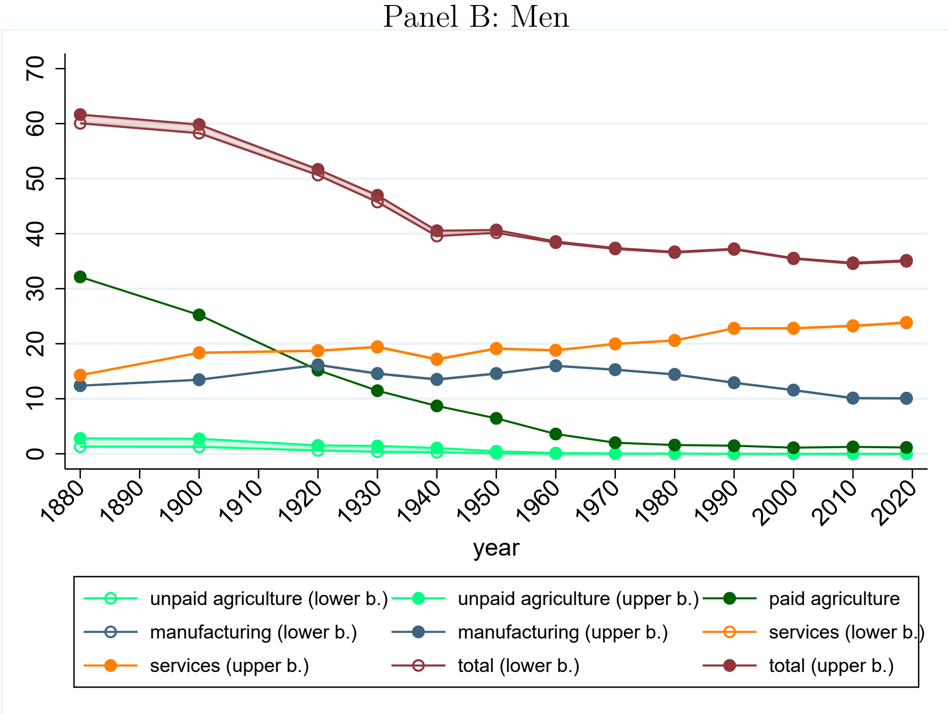
Based on the lower-bound estimates for unpaid work, total hours for women describe a shallow U-shape, starting off at about 17 hours per week and slowly declining to 13 hours in 1940, before rising to about 27 hours in the next eight decades. Based on the upper-bound, hours describe a sharper U-shape, starting off just above 25 hours per week in 1880, with the turning point at 16 hours around 1960. Unsurprisingly, the upper bound estimate closely mimics the extensive margin of employment in Figure 2, as it is based on an hours measure that is very close to the fulltime equivalent. For intermediate values of unpaid hours, female work follows an asymmetric U-shape, with a mild decline until mid-century and a sustained increase thereafter. Regardless of the point estimate used, the U-shape reflects the early decline in unpaid agriculture and the later rise in services. For men, hours decline substantially until 1940, reflecting the decline in agriculture, and only weakly after 1940, as the decline in male hours in manufacturing is partly offset by an increase in services.

Figure 6: Market hours per person, 1880-2019.

Panel A: Women



Panel B: Men



The series are obtained by combining the paid hours series from Figure 3, the unpaid hours estimate from section 3.3, and the employment shares plotted in Figure 2 (having allocated unpaid work outside agriculture to manufacturing and services in equal shares). We let unpaid hours estimates range between the lower bound obtained on data from the Purnell diaries and the upper bound provided by Census estimates of unpaid hours in 1940 and 1950.

3.5 Home production

Data on home production are also drawn from a various sources. Before systematic surveys of time use started in the 1960s, the Purnell diaries provide useful and detailed information on hours spent in standard home chores (e.g. cooking, cleaning, care of clothing) and childcare. While the main focus of the Purnell studies is the rural homemaker, the inclusion of comparison samples for urban areas as well as women in paid employment is valuable to build an estimate of home production hours for the representative woman. Some studies also include information on time use by other household members (e.g. husbands, older children), but coverage for men is indeed quite limited and less representative, hence the estimates obtained would provide a much more accurate measure of home production for women than for men.

Table A2 lists the studies used to obtain home hours by gender, marital, employment, rural and farm status – whenever disaggregations are feasible. Data on farm-based homemakers from the first block of studies coincide with the data described above to estimate unpaid agricultural hours. Several of these studies are also used by Vanek (1973) and Ramey (2009).

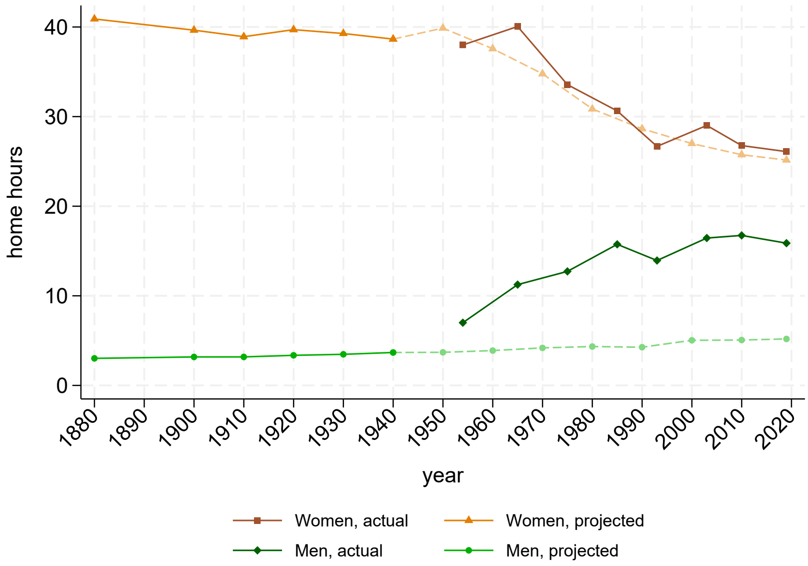
As one would expect, the category best covered in these data is represented by married, nonemployed women, who were spending on average 52.7 hours per week in home production, with very little variation across decades or urban/rural status. For other groups, coverage is more limited, due to both the data sampling framework and the low share of women in paid employment. Married employed women were spending on average 34.1 and 26.7 hours in home production in urban and rural areas, respectively. The only sources available for single women refer to those employed in urban areas, giving an average of 7.2 hours per week. For men, home hours are generally much lower, between 1.5-3 hours for the employed and 12 for the nonemployed. As home hours reported in Table A2 hardly vary for each demographic group between the 1920s and the 1950s, but vary markedly across groups, we follow a similar procedure to Ramey (2009) to predict average hours by gender over 1880-1940, based on constant hours per group (by gender, marital status, rural/urban, paid employment status) and evolving population shares from the Census.[19]

For the 1950s, we draw information on home hours from the Nationwide Study of Living Habits discussed by DeGrazia (1962). The Study was conducted in spring 1954 and covered a large, nationally representative sample of men and women aged 20-59. Participants were asked to record the activities performed over two days between 6am-11pm in 15-minute slots. DeGrazia (1962) reports average weekly home production hours of 41.4 for women and 7.1 for men, on an overall sample of 4,910 diaries (without a gender breakdown in the number of observations).

For later decades we use data from harmonzed time use surveys: America's Use of

[19]We adapt Ramey (2009)'s procedure to our setting, considering some additional studies and extrapolating our predictions back to 1880. Our predictions for 1900-1940 are very close to Ramey (2009)'s.

Figure 7: Home production hours



Notes. Sources for actual hours: DeGrazia (1962) for 1954; Harmonized time use surveys for 1965 onwards. Source for projected hours: constant hours per group (defined by gender, marital status, rural/urban, paid employment status) from Purnell diaries 1920-1950 and evolving population shares from Census.

Time (1965-1966), Time Use in Economics and Social Accounts (1975-1976), Americans' Use of Time (1985), National Human Activity Pattern Survey (1992-1994), and American Time Use Surveys (2003-2019). These data are used and described in detail by – among others – Ramey and Francis (2009) and Aguiar and Hurst (2007). We consistently define home production from 1965 onwards as the time spent on home chores, childcare and other care.

The resulting series are plotted in Figure 7. For women, the projected series is fairly flat pre-1950, around 40 hours per week. The lack of decline in home production hours during the first half of the 20th century has been initially highlighted by Cowan (1983). The apparent paradox of stable hours against the backdrop of the diffusion of home appliances could be rationalized by much improved standards of cleanliness and nutrition, which raised demands for home-produced services (Mokyr, 2000). For comparison, the dashed line also shows projections for 1950 onwards. These are very similar to actual hours, available from 1954, and in particular they closely replicate the gradual fall in actual hours from about 40 in the 1950s to 25 in 2019. For men, projected hours rise only very slightly from about 3 in 1880 to 5.2 in 2019. For the decades when actual hours are available, the projections markedly underestimate the rise to about 16 hours in recent years. This difference casts doubts on the representativess of the Purnell samples for men, given the relative small number of men surveyed.[20]

[20]Leisure hours are obtained as the difference between 100 – an estimate of the weekly hour endowment, net of sleep and personal care time – and total work in the home and the market.

4 The Model

We propose a three-sector model to illustrate the evolution of men's and women's work through the lens of structural transformation and marketization. The model economy is populated by households, each consisting of one male and one female member, consuming agriculture, manufacturing and service output, and allocating their time to leisure, market work and home-production. Services can be produced both in the market and the home, while agriculture and manufacturing output are exclusively produced in the respective market sectors, and unpaid work on the farm is treated as part of the agriculture sector.[21] Goods and labor markets are perfectly competitive and wages are equalized across sectors for each gender.

4.1 The Setup

The representative household enjoys utility from consumption of agricultural output (c_a), manufacturing goods (c_m) and services (c_z), as well as leisure (c_l):

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

with $\omega_i > 0$, $\sum_i \omega_i = 1$, $\bar{c} > 0$ and $\varepsilon < 1$. The $\bar{c}$ term denotes subsistence consumption, imposing a minimum consumption requirement of agricultural output, and $\varepsilon < 1$ indicates poor substitutability across different consumption goods.

Services can be purchased in the market (c_s) or produced at home (c_h), delivering the consumption bundle c_z:

$$c_z = \left[\psi c_s^{\frac{\sigma-1}{\sigma}} + (1-\psi) c_h^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where $\psi \in (0,1)$ and we impose $\sigma > 1$ to indicate that market and home services are good substitutes.

The representative firm in each market sector $j = a, m, s$ uses a combination of male and female labor to produce output according to the following technology:

$$Y_j = A_j N_j, \quad N_j = \left[\xi_j l_{fj}^{\frac{\eta-1}{\eta}} + (1-\xi_j) l_{mj}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \tag{3}$$

where A_j denotes sector-specific productivity and N_j is a CES aggregator of male and female labor (l_{mj} and l_{fj}, respectively), with an elasticity of substitution η and a female weight ξ_j, which determines within-sector female intensity.

[21] In Section B.5 we will model family farms as a separate sector and discuss the implication of this extensions for our results.

Home services are produced with a similar technology as market services:

$$c_h = Y_h = A_h N_h, \quad N_h = \left[\xi_h l_{fh}^{\frac{\eta-1}{\eta}} + (1-\xi_h)\, l_{mh}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \tag{4}$$

Household leisure c_l is an aggregator of male and female leisure time

$$c_l = N_l, \quad N_l = \left[\xi_l l_{fl}^{\frac{\eta_l-1}{\eta_l}} + (1-\xi_l)\, l_{ml}^{\frac{\eta_l-1}{\eta_l}} \right]^{\frac{\eta_l}{\eta_l-1}}. \tag{5}$$

where $\eta_l < 1$ indicates leisure complementarity.

The household's budget constraint is given by:

$$\sum_{j=a,m,s} p_j c_j \leq w_m \left(L_m - l_{mh} - l_{ml} \right) + w_f \left(L_f - l_{fh} - l_{fl} \right), \tag{6}$$

where p_j denotes the market price of good j, and w_g and L_g, $g = m, f$, denote wages and total time endowment for each gender.

Finally, goods and labor market clearing satisfies:

$$c_j = Y_j; \qquad \sum_{j=a,m,s} l_{gj} = L_g - l_{gh} - l_{gl}; \quad j = a, m, s; \quad g = m, f. \tag{7}$$

4.2 Equilibrium

Optimization by households and firms defines the equilibrium time allocation. Households choose the demand for each good and the time allocation of each member to maximize utility in (1), subject to (2)-(6), taking prices and wages as given. Firms choose the demand for female and male labor to maximize profits, subject to technology (3). Equilibrium prices and wages satisfy the market clearing conditions (7).

Profit maximization implies that wages equal the value of the marginal product of labor in each sector and perfect labor mobility in turn implies wage equalization across sectors:

$$p_j \frac{\partial Y_j}{\partial l_{gj}} = w_g; \quad g = m, f; \quad j = a, m, s. \tag{8}$$

A similar condition holds for the household's optimization, so we define the implicit price of home production and leisure as:

$$p_j \equiv \frac{w_g}{\partial c_j / \partial l_{gj}}; \quad g = m, f; \quad j = h, l. \tag{9}$$

Using (8) and (9), the wage ratio is equal to the marginal rate of substitution between male and female labor in all sectors (including home production and leisure):

$$w \equiv \frac{w_f}{w_g} = \frac{\xi_j}{1-\xi_j} \left(\frac{l_{mj}}{l_{fj}} \right)^{\frac{1}{\eta_j}}; \qquad j = a, m, s, h, l, \tag{10}$$

where $\eta_j = \eta$ for $j = a, m, s, h$. This condition implies that sectors with higher female weight ξ_j employ female time more intensively.

Using the optimality conditions (8)-(9), Appendix B.1 derives relative prices across any two sectors as:

$$\frac{p_j}{p_k} = \frac{A_k \xi_k^{\frac{\eta_k}{\eta_k - 1}} I_k^{\frac{1}{1-\eta_k}}}{A_j \xi_j^{\frac{\eta_j}{\eta_j - 1}} I_j^{\frac{1}{1-\eta_j}}}; \qquad \forall j, k = a, m, s, h, l, \tag{11}$$

where women's income share in sector j, I_j, is a function of the wage ratio w:

$$I_j \equiv \frac{w_f l_{fj}}{w_f l_{fj} + w_m l_{mj}} = \left[1 + \left(\frac{1-\xi_j}{\xi_j}\right)^{\eta_j} w^{\eta_j - 1}\right]^{-1}. \tag{12}$$

Using the definition of income shares, the female time allocation across any two sectors can be expressed as a function of relative expenditures $E_{kj} \equiv (p_k Y_k / p_j Y_j)$:

$$\frac{l_{fk}}{l_{fj}} = \frac{I_k}{I_j} E_{kj}; \quad \forall j, k. \tag{13}$$

By substituting (13) into (10) we obtain the male time allocation:

$$\frac{l_{mk}}{l_{mj}} = \left[\frac{\xi_j (1-\xi_k)}{(1-\xi_j)\xi_k}\right]^{\eta} \frac{I_k}{I_j} E_{kj}; \quad \forall j, k. \tag{14}$$

These results highlight the role of expenditure shares in shaping the time allocation of men and women. Given the equilibrium wage ratio, (13) and (14) imply that forces that increase expenditure in sector k relative to sector j also induce labor reallocation from k to j for both men and women. The intensity of labor reallocation for each gender is mediated by gender intensities, ξ_j and ξ_k. Relative expenditures are driven by the processes of marketization and structural transformation, introduced below.

4.3 Marketization and structural transformation

The evolution of expenditure shares reflect changes in relative prices and income effects. To model these changes we impose two key assumptions.

First, we assume that productivity in agriculture and manufacturing grows faster than in market services, and productivity in market services in turn grows faster than in home production:

$$\gamma_a, \gamma_m > \gamma_s \geq \gamma_h, \tag{15}$$

where $\gamma_j \equiv \dot{A}_j / A_j$, $j = a, m, s, h$.

The combination of uneven productivity growth in the first inequality, $\gamma_a, \gamma_m > \gamma_s$, and consumers' taste for variety, $\varepsilon < 1$, generates the Baumol's relative price effects, such that labor reallocates towards services, the sector with slower productivity growth. This relative price effect, alongside the Engel's income effects associated to the minimum requirement of agricultural consumption ($\bar{c} > 0$), drive the decline in agriculture and rise in services.

The combination of uneven productivity growth in the second inequality, $\gamma_s \geq \gamma_h$, and substitutability across home and market services, $\sigma > 1$, generates marketization, i.e. labor reallocates from home to market services, the type of services with faster productivity growth.

Second, we assume that services, whether in the market or the home, use female labor more intensively than agriculture and manufacturing:

$$\xi_s, \xi_h > \xi_a, \xi_m. \tag{16}$$

Assumptions (15)-(16) are motivated by evidence on sector-specific productivity growth and female intensity, which are presented in Section 5.

We characterize marketization first, based on the household's demand for home and market services. Setting the marginal rate of substitution between market and home services from (2) equal to their relative price in (11), Appendix B.2 shows that marketization can be described by the expenditure ratio:

$$E_{sh} \equiv \frac{p_s Y_s}{p_h Y_h} = \left(\frac{A_s}{A_h}\right)^{\sigma-1} \left(\frac{\psi}{1-\psi}\right)^{\sigma} g_{sh}, \tag{17}$$

where $g_{sh} \equiv \left[\left(\frac{\xi_s}{\xi_h}\right)^{\eta} \frac{I_s}{I_h}\right]^{\frac{\sigma-1}{\eta-1}}$ captures the relative gender intensity in market and home services. Given $\sigma > 1$, faster growing A_s gradually reallocates expenditure from home to market services.

Following similar steps in Appendix B.2, we next describe structural transformation based on expenditure ratios across agriculture, manufacturing and services. The expenditure ratio between manufacturing and total services is given by:

$$E_{mz} = \left(\frac{A_m}{\left[A_s^{\sigma-1}\psi^{\sigma} + g_{sh}^{-1}(w) A_h^{\sigma-1}(1-\psi)^{\sigma}\right]^{\frac{1}{\sigma-1}}}\right)^{\varepsilon-1} \left(\frac{\omega_m}{\omega_z}\right)^{\varepsilon} g_{mz}, \tag{18}$$

where $g_{mz} \equiv \left[\left(\frac{\xi_m}{\xi_s}\right)^{\eta} \frac{I_s}{I_m}\right]^{\frac{\varepsilon-1}{\eta-1}}$. The term $\left[A_s^{\sigma-1}\psi^{\sigma} + g_{sh}^{-1}(w) A_h^{\sigma-1}(1-\psi)^{\sigma}\right]^{\frac{1}{\sigma-1}}$ is a productivity index for overall services. The decline in the relative manufacturing expenditure hinges on the relative price effect: given $\varepsilon < 1$, faster growing A_m reallocates expenditure from manufacturing into total services.

The expenditure ratio between agriculture and total services is given by:

$$E_{az} = \frac{1}{1 - \frac{\bar{c}}{Y_a}} \left(\frac{A_a}{\left[A_s^{\sigma-1}\psi^{\sigma} + g_{sh}^{-1}(w) A_h^{\sigma-1}(1-\psi)^{\sigma}\right]^{\frac{1}{\sigma-1}}}\right)^{\varepsilon-1} \left(\frac{\omega_a}{\omega_z}\right)^{\varepsilon} g_{az}, \tag{19}$$

where $g_{az} \equiv \left[\left(\frac{\xi_a}{\xi_s}\right)^{\eta} \frac{I_s}{I_a}\right]^{\frac{\varepsilon-1}{\eta-1}}$. Similarly as for E_{mz}, the relative price effect via $\varepsilon < 1$ and faster growing A_a reallocates expenditure from agriculture into services. In addition, income effects operate via the fall in the subsistence consumption relative to the aggregate agriculture output ($\bar{c}/Y_a$), implying that the composition of household expenditures moves away from agriculture as households grow richer.

While results (18) and (19) are defined in terms of total services z, structural transformation across the three market sectors a, m, and s can be obtained from the decomposition of the value of total services into home and market components:

$$p_z Y_z \equiv p_s Y_s + p_h Y_h = (1 + E_{sh}^{-1}) p_s Y_s. \tag{20}$$

Combining (18)-(20) yields

$$E_{js} = \left(1 + \frac{1}{E_{sh}}\right) E_{jz}; \quad j = m, a. \tag{21}$$

Having established in (18)-(19) that expenditure shifts from agriculture and manufacturing to overall services, result (21) establishes that such shift is particularly pronounced in favor of market services, because of the additional marketization force E_{sh}.

Finally, the expenditure ratios between manufacturing and agriculture is derived as:

$$E_{ma} = \left(1 - \frac{\bar{c}}{Y_a}\right) \left(\frac{A_m}{A_a}\right)^{\varepsilon-1} \left(\frac{\omega_m}{\omega_a}\right)^{\varepsilon} g_{ma}, \tag{22}$$

where $g_{ma} \equiv \left[\left(\frac{\xi_m}{\xi_a}\right)^{\eta} \frac{I_a}{I_m}\right]^{\frac{\varepsilon-1}{\eta-1}}$.

As changes in the time allocation of men and women follow changes in relative expenditures, marketization reallocates labor from home to market services, contributing to a rise in market hours for both men and women. This channel is quantitatively more important for women, as home services are relatively intensive in female labor. Structural transformation reallocates labor from agriculture and manfaucturing into home and market services. This channel is quantitatively more important for men, as agriculture and manufacturing are relatively male intensive. The rise in services includes home services, hence it contributes to a fall in market hours.

4.4 Leisure and the wage ratio

The equilibrium time allocation is completed by the determination of leisure time, as shown in Appendix (B.3):

$$\frac{l_{fl}}{L_f} = \frac{I_l}{I\left[(E_{ma} E_{lm})^{-1} + \sum_{j \neq a} E_{jl}\right]}, \tag{23}$$

where

$$E_{lm} = \phi \left[1 + \frac{1}{\bar{E}_{ma}} + \frac{1}{E_{ms}}\left(1 + \frac{1}{E_{sh}}\right)\right], \tag{24}$$

$$\bar{E}_{ma} \equiv \left(\frac{A_m}{A_a}\right)^{\varepsilon-1} \left(\frac{\omega_m}{\omega_a}\right)^{\varepsilon} g_{ma},$$

and $I \equiv \frac{w_f L_f}{w_m L_m + w_f L_f}$ denotes women's income share in the economy.

Result (23) highlights income effects on leisure time. As subsistence consumption becomes relatively less important relative to agricultural output, E_{ma} increases, leading to an increse in female leisure (as well as in male leisure via condition (14)). Income effects fade away as $\bar{c}/Y_a \to 0$, thus the model generates an increase in leisure at early stages of development and relatively constant leisure afterwards.

Using the time budget constraint (7), the share of leisure time can be expressed as a function of the wage ratio (see Appendix B.4 for derivation):

$$\frac{l_{fl}}{L_f} = \frac{I_l}{I_a \left(E_{ma} E_{lm}\right)^{-1} + \sum_{\forall j \neq a} I_j E_{jl}}. \tag{25}$$

The combination of (23), (25) and the agricultural production function (3) delivers an expression that links relative expenditures E_{ij} and female income shares I_j, which all depend on one endogenous variable – the wage ratio w. This yields the equilibrium wage ratio, which can be substituted in (13)) and (14) to chacterize the equilibrium time allocation for men and women across market sectors, home services, and leisure.

4.5 Market Hours

Sections 4.3-4.4 laid out all ingredients of equilibrium market hours for each gender:

$$M_g \equiv l_{ga} + l_{gm} + l_{gs} = L_g - l_{gh} - l_{gl}; \quad g = m, f. \tag{26}$$

Given time endowment L_g, changes in market hours reflect changes in home production and leisure, which are in turn driven by marketization and structural transformation. Marketization raises market hours for both genders, via lower l_{gh} and higher l_{gs}. Structural transformation reduces market hours by increasing both leisure and home hours via income effects – raising l_{gl} and l_{gh} – and relative price effects – reallocating labor from agriculture and manufacturing into overall services, including home services l_{gh}.

The evolution of market hours for each gender reflects the relative strength of structural transformation and marketization along different phases of development. Structural transformation is especially strong at early development stages, when the agricultural share is large and its fast productivity growth sheds labor into both leisure and services via income and relative price effects, hence market hours are predicted to fall for both genders. This force weakens as the economy grows, the agricultural share shrinks and the service share grows.[22] Assumption (16) on gender intensities implies that manufacturing is relatively male intensive and home production is relatively female intensive. Thus, while marketization becomes the dominant force for women during later development stages, structural transformation continues to be the dominant force for men. The reduc-

[22] Structural transformation at early stages of development may be weakened by frictions in the process of labor reallocation out of agriculture, which are absent in our framework, but are quantified by Donovan et al. (2023).

tion of home hours via marketization reverses the trend in female market hours, while deindustralization prolongs the decline in male market hours. Thus the interaction of marketization and structural transformation can potentially deliver a U-shaped trend in female market hours and a monotonically declining male market hours.[23]

5 A quantitative illustration of model properties

We provide a quantitative illustration of the mechanisms proposed, to establish that the model can reasonably reproduce the observed trends in male and female work under plausible combination of relevant parameters, including the location of the turning point in female market hours.

In addition to the core processes of marketization and structural transformation, we characterize gender-specific factors, embodied in time endowments, L_f/L_m, and gender intensities $\{\xi_a, \xi_m, \xi_s\}$. The latter represent within-sector, gender-biased labor demand shifts (similarly as in Heathcote et al., 2010). These may reflect technological changes that alter comparative advantages – for instance the mechanization of agriculture or brawn-saving technologies in manufacturing – as well as social norms, labor regulations, and additional frictions that shape within-sector demands for gender inputs (see for example Kleineberg and Chiplunkar, 2023 and Lee, 2024).

5.1 Calibration

The model parameters are calibrated to match all data targets at $T = 1950$, as data quality is less reliable for the earlier period. The key data ingredients are the time allocation by gender and sector and the wage ratio. We import estimates of elasticity parameters $(\eta_j, \sigma, \varepsilon)$ from related work. Having set η_j, condition (10) determines ξ_{jT} $\forall j = a, m, s, h, l$, based on the hours ratio in each sector and the wage ratio at T. This calibration implies $\xi_{aT} = 0.24$, $\xi_{mT} = 0.24$, $\xi_{sT} = 0.30$, $\xi_{hT} = 0.60$, and $\xi_{lT} = 0.28$. Female intensity is highest in home services, followed by market services, consistent with assumption (16).

Having normalized $A_{aT}L_{fT} = 1$ and defined the effective productivity terms

$$\hat{A}_{sht} \equiv \frac{A_{st}}{A_{ht}} \left(\frac{\psi}{1-\psi} \right)^{\frac{\sigma}{\sigma-1}}; \quad \hat{A}_{mst} \equiv \frac{A_{mt}}{A_{st}} \left(\frac{\omega_m}{\omega_z} \right)^{\frac{\varepsilon}{\varepsilon-1}} \psi^{\frac{\sigma}{1-\sigma}}; \quad \hat{A}_{mat} \equiv \frac{A_{mt}}{A_{at}} \left(\frac{\omega_m}{\omega_a} \right)^{\frac{\varepsilon}{\varepsilon-1}}, \tag{27}$$

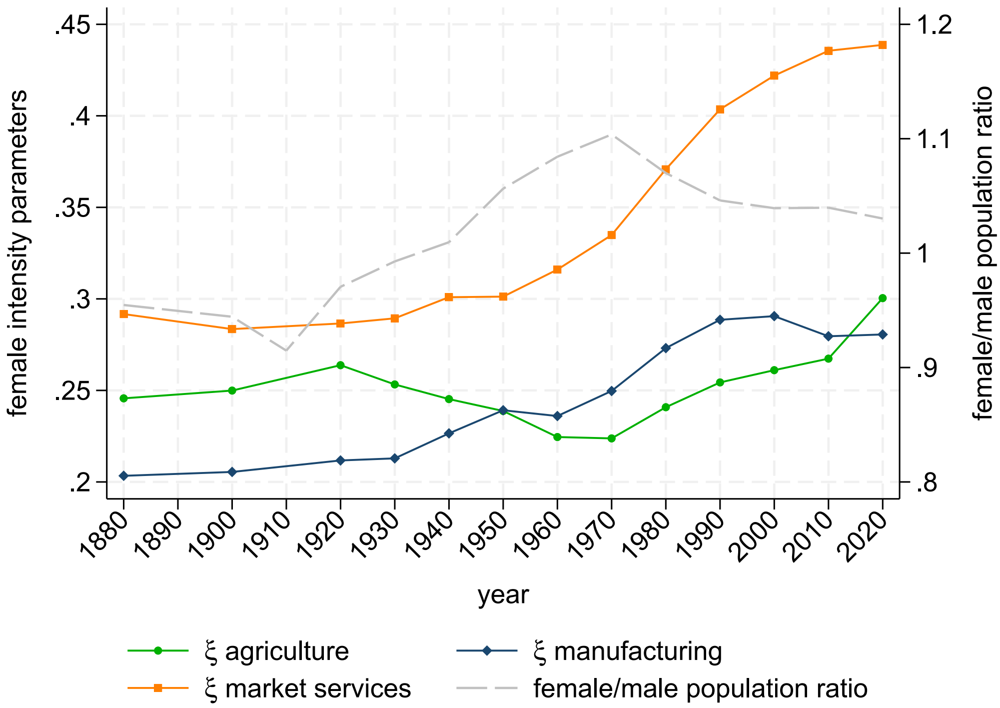
we set the preference parameter ϕ and $\{\hat{A}_{shT}, \hat{A}_{msT}, \hat{A}_{maT}\}$ to match the wage ratio w_T and the time allocation l_{gjT}/L_{gT}, $\forall j = a, m, s, h$. Specifically, using data on the wage ratio, hours ratio and ξ_{jT}, values of I_{jT} and E_{kjT} are obtained from equations (12) and (13). Equations (17), (18) and (21) are then used to back out $\hat{A}_{shT}$ and $\hat{A}_{msT}$. For a given value of $\bar{c}/Y_{aT}$, equation (22) is used to back out $\hat{A}_{maT}$. Finally, equation (24) pins

[23] Eventually, male market hours will start rising when manufacturing becomes sufficiently small and marketization becomes the dominant force for both genders.

down ϕ.[24] This model calibration matches exactly the time allocation and the wage ratio in 1950, and we will assess the model's quantitative performance based on predictions for $t \neq 1950$.

The evolution of the outcomes of interest before and after 1950 are driven by sector-specific productivity growth, income effects, and gender-specific time endowments and demand shifts. We use the gender population ratio as a proxy for the relative time endowments L_{ft}/L_{mt}, for t =1880-2019. The gender-specific demand shifts are measured as the changes in ξ_{jt} in the market sectors $j = a, m, s$, obtained from condition (10). The resulting series are plotted in Figure 8. Consistent with assumption (16), female intensity in market services is higher than in agriculture and manufacturing throughout the sample period.

Figure 8: Gender-specific factors, 1880-2019.



Note: The ξ_{jt} series are obtained from equation (10), using data on sector-specific hour ratios and the wage ratio. Hours in market sectors are set at the mid-point between upper and lower bounds shown in Figure 6. The wage ratio is averaged (at 0.59) during 1880-1970, given absence of a definite trend in Figure 4, and calibrated to the series "Census, all sectors, adjusted" for 1970-2019.

Using 1950-2020 BEA data on value-added and hours in agriculture, manufacturing and services, we estimate productivity growth rates $\gamma_a = 3.6\%$, $\gamma_m = 2.5\%$ and $\gamma_s = 1.4\%$. For the home sector, Bridgman et al. (2018, 2022) estimate $\gamma_h = 0.6\%$. Our calibration uses these estimates as constant productivity growth over the whole period. Section 5.3 discusses earlier (but scant) estimates of productiity growth, and their relevance for

[24]Given the structure of E_{jk} expressions derived in Section 4.3, we do not need to separately identify relative productivity A_{jT}/A_{kT} and preference terms ω_j and ψ in (27).

Table 3: Parameters

Model free parameters		
Parameters	Values	Source
$\gamma_a, \gamma_m, \gamma_s$	3.6%, 2.5%, 1.4%	BEA for 1950-2020
γ_h	0.6%	Bridgman et al. (2022) for 1950-2020
σ	2	Various estimates in Aguiar et al. (2012)
ϵ	0.002	Herrendorf et al. (2013)
η, η_l	2, 0.2	Ngai and Petrongolo (2017)
L_{ft}/L_{mt}	Figure 8	Census data
Calibrated parameters		
Parameters	Values	Target
$A_{aT}L_{fT}$	1	Normalization
ϕ	1.07	Relative hours in leisure/manufacturing in 1950
ξ_h, ξ_l	0.60, 0.28	Wage and hours ratio in home and leisure in 1950
$\hat{A}_{maT}$	0.31	Hours ratio in manufacturing/agriculture in 1950
$\hat{A}_{msT}$	6.73	Hours ratio in manufacturing/services in 1950
$\hat{A}_{shT}$	1.02	Hours ratio in market services/home in 1950
$\bar{c}$	0.016	Employment share in agriculture in 2019
$\xi_{at}, \xi_{mt}, \xi_{st}$	Figure 8	Equilibrium condition (10)

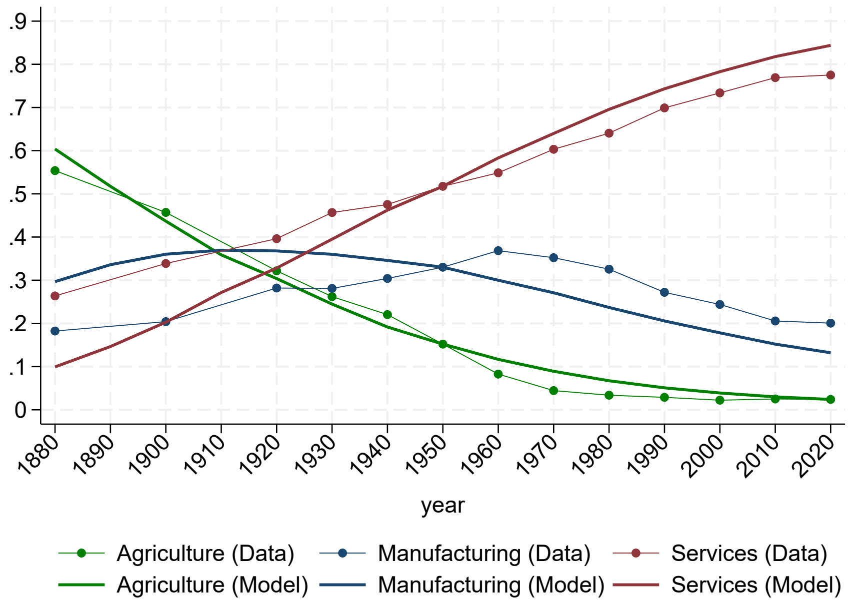
the model's quantitative predictions. Based on sectoral growth rates, we build series for $\{\hat{A}_{sht}, \hat{A}_{mst}, \hat{A}_{mat}\}$.

Finally, we calibrate subsistence consumption $\bar{c}$ to match the agricultural share in 2019. The intuition is that $\bar{c}/Y_{aT}$ captures the strength of income effects, hence higher $\bar{c}$ implies a faster transition out of agriculture and a lower agricultural share in 2019. This procedure yields $\bar{c}/Y_{aT} = 0.32$, i.e. subsistence consumption is about a third of agricultural output in 1950. Using predicted output Y_{aT}, we obtain $\bar{c} = 0.016$. This in turn implies that $\bar{c}/Y_{at}$ declines from 64% in 1880 to 16% in 2019. All parameter,s with the respective sources and targets, are summarized in Table 3.

5.2 Model predictions

Predicted and actual sector shares in the economy are shown in Figure 9, where predictions encompass the evolution of gender-specific factors, structural transformation and marketization. By construction, all sector shares are matched exactly in 1950 and the agricultural share is also matched in 2019. The model replicates very well the pre-1950 decline in agriculture. It also replicates the shallow hump-shape in the manufacturing share, but over-predicts its level in the early decades. Hence the model underpredict the service share in early decades – but replicates quite closely its post-1940 growth. These trends almost entirely reflect marketization and structural transformation. While relative gender supply may interact with sector-specific gender intensities to drive sectorial changes, quantitatively this channel is negligible.

Figure 9: Market sector shares, 1880-2019.



Notes. The series represent hour shares by sector. "Services" refer to market services. Hours in the data series are obtained from the mid-point between upper and lower bounds shown in Figure 6. Predictions encompass the role of structural transformation and marketization (differences in γ_j, $j = a, m, s, h$ and $\bar{c} > 0$), gender-specific labor demand (varying ξ_{jt} over time), and the population ratio (varying L_{ft}/L_{mt} over time).

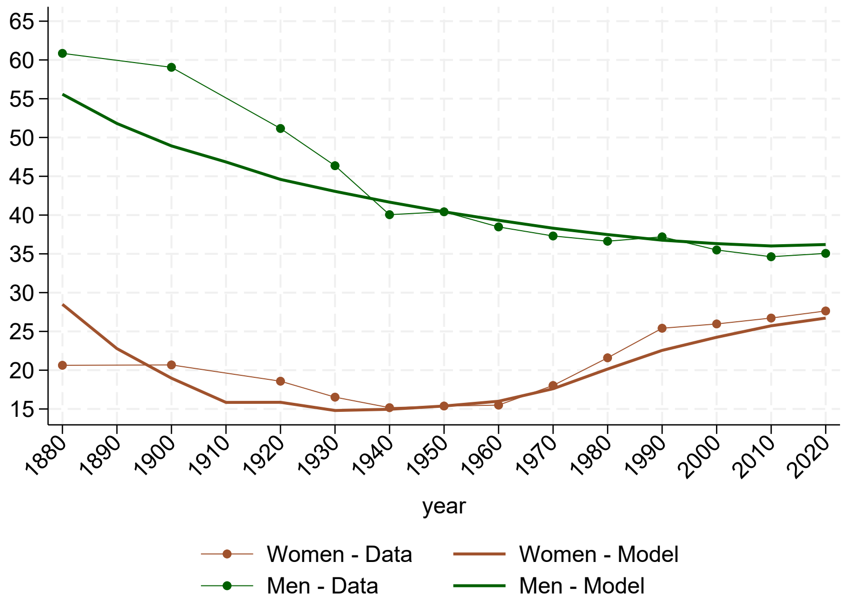
The evolution of market hours is shown in Figure 10. The model reproduces the U-shape we observe for female market hours, with a turning point around mid-century, and the decline in male market hours. Quantitatively, however, the model under-predicts the pre-1950 decline in male hours and over-predicts the early decline in female hours.

Figure 11 separately highlights the role of each force in driving gender trends, keeping other forces constant. Specifically, to shut down structural transformation and marketization we set all productivity growth rates equal to $\gamma_m = 2.5\%$ and $\bar{c} = 0$; to shut down gender-specific demand forces we keep $(\xi_{at}, \xi_{mt}, \xi_{st})$ constant at their 2019 values;[25] to shut down the gender endowment channel we set L_{ft}/L_{mt} equal to its average value over the sample period (1.01).

We normalize all series to their 1950 values. For women, structural transformation and marketization are the only forces that can predict the pre-1950 decline in market hours (solid line). In fact, changes in gender-specific demand would predict an almost monotonic increase in hours throughout the sample period (dashed line), and changes in the population ratio are virtually neutral (dotted line). In the later period, the rise in female hours mostly reflects changes in gender-specific demand and, to a lesser ex-

[25] One way to interpret this (as in Ngai and Petrongolo, 2017) is to think of ξ_{jt} as the combination of technological factors and a wedge that captures evolving regulations, discrimination and social norms, affecting the relative demand for women in each sector. Over time, the wedge is expected to shrink. Hence, keeping gender-specific labour demand at its 2019 level is equivalent to considering a baseline in which the wedge is minimized.

Figure 10: Market hours by gender, 1880-2019.



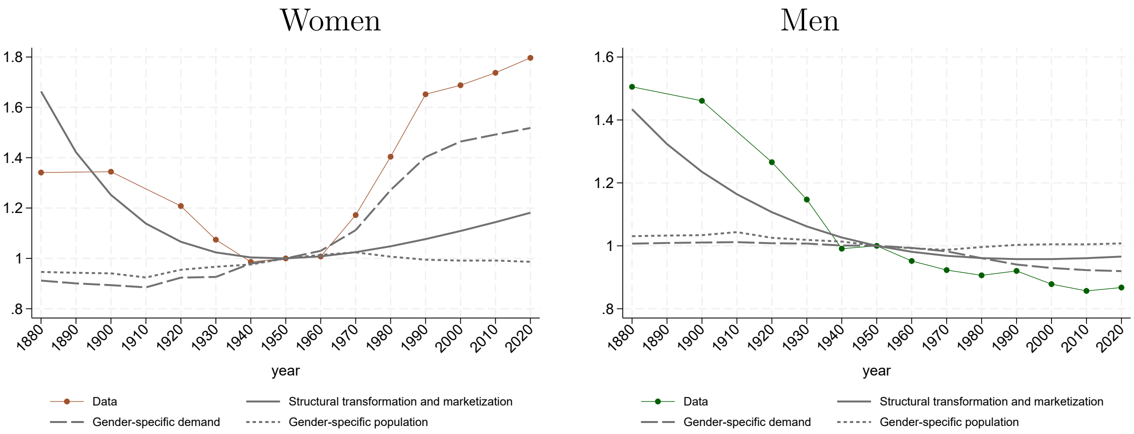
Notes. Market hours include time worked in agriculture, manufacturing and market services. Hours in the data series are obtained from the mid-point between upper and lower bounds shown in Figure 6. Predictions encompass the role of structural transformation and marketization (differences in γ_j, $j = a, m, s, h$ and $\bar{c} > 0$), gender-specific labor demand (varying ξ_{jt} over time), and the population ratio (varying L_{ft}/L_{mt} over time).

tent, structural transformation and marketization. For men, the pre-1950 decline can be mostly explained by structural transformation and marketization, while the other two forces have very little explanatory power. In the later period, the fall in male hours reflect a combination of structural transformation, marketization, and changes in gender-specific demand. In sum, structural transformation and marketization together account for almost the whole predicted fall in market hours for both genders pre-1950, and 23% of the rise in female market hours, and 26% of the fall in male market hours post-1950.[26]

Predictions for the wage ratio are shown in Figure 12. The solid line in Panel A represents the change in the wage ratio predicted jointly by all three forces. The model reproduces well the relatively flat wage ratio up until 1960, and the following rise, except for the pre-1910 increase that is not present in the data. Panel B represents the role of the three model forces. In the pre-1950 period, population changes tend to offset the rise in the wage ratio predicted by structural transformation and marketization. In the post-1950 period, most of the wage convergence is explained by gender-specific demand shifts.

[26]Structural transformation and marketization imply a 18% rise in female market hours and a 3.4% decline in male market during 1950-2020. In the data, the increase for female market hours is 80% and the decline for male market hours is 13%.

Figure 11: Market hours by gender: A decomposition of various forces, 1880-2019.



Notes. Market hours include time worked in agriculture, manufacturing and market services. The data series is the mid-range value for unpaid hours in Figure 6. Structural transformation and marketization reflect varying γ_j across sectors and $\bar{c} > 0$; gender-specific labor demand reflects changes in ξ_{jt}; gender-specific population reflects changes in L_{ft}/L_{mt}.

5.3 Pre-1950 productivity growth

In the absence of systematic data on productivity growth at the sector level before 1950, our baseline calibration extrapolates average, post-1950 productivity growth for each sector to the earlier decades. Below we discuss the limited available evidence for the pre-1950 period and their significance for our model's predictions.

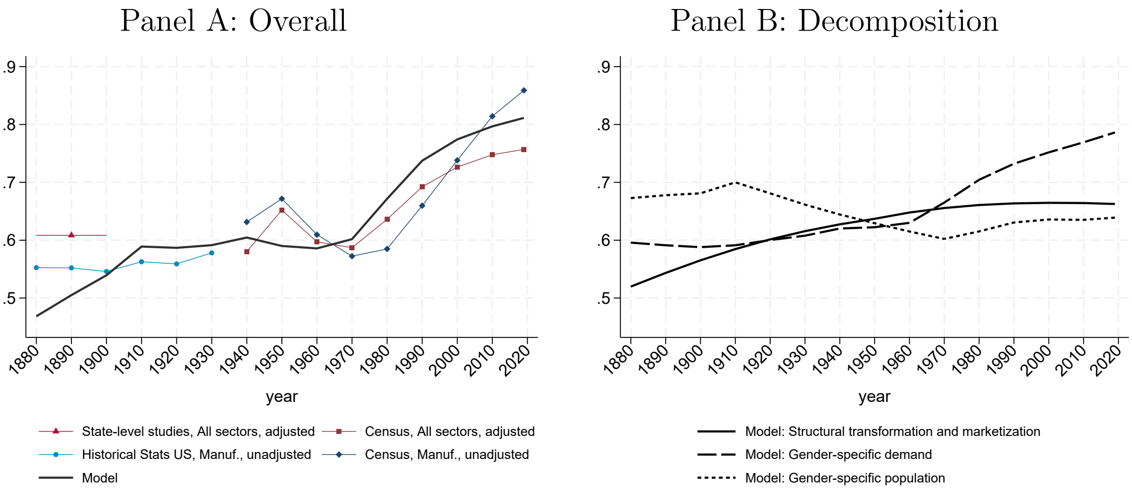
Gallman (1960) and Gallman and Weiss (1969) provide estimates of value-added and price indexes for manufacturing and services, respectively, from which we obtain series for real value-added using equation (11). By combining these with our hours series, we estimate a 2.6% productivity growth in manufacturing and 1.1% in market services for the period 1880-1900. These estimates are strikingly similar to the values obtained from the BEA for the post-1950 period, reported in Table (3), hence our calibration exercise seems to be consistent with the additional information available for manufacturing and market services.

Early data for farm real value-added are available from Kendrick (1961), for 1874-1953. By combining them with our hours estimates (including both paid and unpaid hours in agriculture), we estimate a 2.0% productivity growth rate in agriculture, well below the 3.6% estimate we obtain on post-1950 BEA data. This difference is in line with some consensus that the trend in agricultural productivity accelerated in the 1930s (see, among others, Dennis and Iscan, 2009). Relatedly, the 1999 Economic Report of the President notes that the farm price index only started falling relative to the industry price index after in the 1930s, and was mildly increasing before that.[27]

The increase in agricultural productivity growth may reflect, among other factors, compositional changes linked to the gradual decline of family farms in favor of large-

[27]The model predicts an increase in the relative price of agriculture vs. manufacturing during 1880-1950 if productivity grows faster in agriculture (see equation (11)).

Figure 12: Predictions for the wage ratio, 1880-2019.



Notes. Data on the wage ratio are described in Section 4. Predictions in Panel A encompass the role of structural transformation and marketization (differences in γ_j, $j = a, m, s, h$ and $\bar{c} > 0$), gender-specific labor demand (varying ξ_{jt} over time), and the population ratio (varying L_{ft}/L_{mt} over time). Predictions in Panel B represent the role of each force in isolation.

scale agriculture, which is more open to innovation and technology adoption. Appendix B.5 considers a model extension that distinguishes between family and modern farms within the agricultural sector and highlights compositional effects of the transition to modern agriculture. As the outputs of family and modern farms are close substitutes, faster productivity growth in modern farms draws labor out of family farms, leading to modernization of agriculture. This process is conceptually similar to the marketization of home services but, unlike marketization, modernization *per se* does not directly impact market hours, as work on family farms are part of market work. There is, however, a compositional effects via overall productivity growth in agriculture and the strength of structural transformation.

With slower productivity growth in agriculture in the earlier period, our model predicts a slower decline in agriculture, alongside male and female market hours. If we set $\gamma_a = 2\%$ in the pre-1950 period, while keeping other parameters unchanged, structural transformation and marketization together account for 67% of the decline in agriculture share, 47% of the decline in male hours and 49% of the decline in female hours during 1880 to 1950 – as opposed to 104%, 90% and 157%, respectively, in the baseline calibration of Figure 11.

However, the implications of our model for the relationship between market hours and the agricultural share are general, i.e. they do not necessarily hinge on agricultural productivity growth. In fact, our model predicts that *any factor* that leads to a decline in agriculture implies falling market hours for both genders. We have noted above the role of income effects (captured by $\bar{c}/Y_{at}$) in shifting expenditure away from agriculture, which was calibrated to match the decline in the agricultural share during 1950 to 2019. In addition, the definition of $\hat{A}_{mat}$ in (27) implies that changes in the relative taste for agricultural output ω_m/ω_a would have an equivalent impact on the relative expenditure in agriculture as changes in relative productivity A_m/A_a.[28] If one re-sets agricultural productivity growth to 2% during 1880-1950, but allows for a stronger income effect in earlier period through a rise in ω_m/ω_a to match the decline in agricultural share, structural transformation and marketization account for 60% and 115% of the decline in male and female hours, respectively, being much closer to the predictions of structural transformation and marketization obtained with the baseline calibration of Figure 11. The main lesson we draw from these quantityative predictions is that the decline in agricultural share is the key factor behind the decline in market hours.

Turning finally to the home sector, various sources suggest faster growth during earlier decades of the 20th century than the 0.6% growth rate estimate by Bridgman (2016) for the post-1950 period. Indeed Bridgman (2016)'s estimates for 1929-1950 average 2.1% per year and, while there are no available estimate for the earlier period, productivity growth during the whole first half of the 20th century may have been higher than in the second half, reflecting waves of improvements in home technology, from the diffusion of basic facilities like electricity and running water to the adoption of electrical appliances (Greenwood et al., 2005; Vidart, 2023).

Under higher home productivity growth pre-1950, our model would predict a lower marketization force at early stages of development. In the special case of equal productivity growth inside and outside the home, $\gamma_h = \gamma_s = 1.4\%$, marketization is entirely absent, leading to a slightly larger decline in female market hours, with virtually no impact on male hours. The main consequence is a smaller rise in services during 1880-1950 (from 0.18 to 0.52) and larger rise in manufacturing (from 0.26 to 0.33), bringing both predictions closer to the data shown in Figure 9.

6 Conclusions

By combining data from the US Census and several early sources, we create a consistent measure of male and female work for the US over the period 1870-2019, encompassing intensive and extensive margins. Over time, women's hours trace a U-shaped pattern, with a modest decline up to mid-20th century, followed by a sustained increase. In contrast, men's hours consistently decline throughout the entire sample period.

We analyze these trends in a multisector model economy with uneven productivity growth, income effects, and consumption complementarity across sectoral outputs. These ingredients drive shifts in labor allocation across agriculture, manufacturing and services and the marketization of home production. During early development stages, declining agriculture leads to rising services (both in the market and the home) and leisure. In later stages, structural transformation reallocates labor from manufacturing into services, while marketization reallocates labor from home to market services. The first phase sees

[28] As shown by Comin et al. (2021), changes in the preference parameters ω_j in the CES utility function (1) can capture income effect in a more general, non-homothetic CES utility function.

declining hours for both genders. In the later phase, marketization boosts female hours, as women are over-represented in home services, while the fall in male hours reflects the consequences of deindustrialization. Our quantitative analysis of the mechanisms proposed suggests that structural transformation and marketization can account for the whole decline in market hours for both genders from 1880 to 1950 and about one quarter of the rise and fall, respectively, in female and male market hours from 1950 to 2020.

We note that measuring women's unpaid work in family farms is crucial to accurately capture women's contribution to the economy in predominantly agricultural societies and to understand the U-shaped relationship between female work and development. The underlying patterns of labor reallocation offer insights not only into long-run trends in hours, but also into the experiences of developing countries during recent decades. Several developing countries are currently going through phases of declining agriculture and female participation, as seen in China and India over the past two decades. Our paper has highlighted mechanisms that would facilitate the transition to rising female participation through structural transformation, including technology adoption in agriculture and market services, alongside the removal of institutional and/or cultural barriers to the marketizaton of home services.

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A Data Appendix

A.1 HLSP Work Surveys

Table A1 summarizes information available in the studies collated in the HLSP. All 31 surveys contain information on earnings, but information on hours is only available in 19 of them.

Hours worked, earnings, and occupation/industry – when available – are typically not measured consistently across studies. Most studies report weekly hours, but a few report daily hours distinguishing between weekdays and weekends, or start and end times of a normal working day. These definitions are standardized to measure weekly hours in a 6-day working week. Earnings are mostly reported on a weekly basis, but in some instances (even within the same study), the survey reports earnings on a daily, hourly or annual basis. These definitions are standardized to measure weekly earnings in a 6-day working week using the complementary available information on hours, weeks or months worked. For example, in cases where we know hourly earnings and daily hours we compute weekly earnings as hourly earnings times daily hours times 6. In all studies with missing information on hours worked earnings are reported on a weekly basis.

To characterize occupations consistently, we build a crosswalk between each study-specific classification and the Census 1950 classification (occ1950) to organize occupations in six broad categories (farmer, professional and managerial, clerical and sales, skilled, unskilled, teachers). Teachers are reported separately from professionals because the information on hours worked refers to teaching hours rather than total hours worked. Across all studies teachers report approximately 39 weekly teaching hours. Male and female teachers report the same number of hours.

Information on industry is not included in some studies and, when not available, we infer it from the detailed information on occupations (and the crosswalk between occ1950 and ind1950 in the Census) to classify workers in the three main sectors:

- *Agriculture* (including: agriculture, forestry and fishing);
- *Manufacturing* (including: mining, manufacturing, construction, utilities, electricity, gas and water supply);
- *Services* (including: wholesale and retail trade, hotels and restaurants, transport, storage and communication, finance, insurance, real estate, business services, education, health and personal services).

Figure A1 plots distributions of working hours by gender and sector (except in agriculture, where we collate male and female observations, due to a very small sample size). In each sector and gender, there is a very clear mode at 60 hours per week.

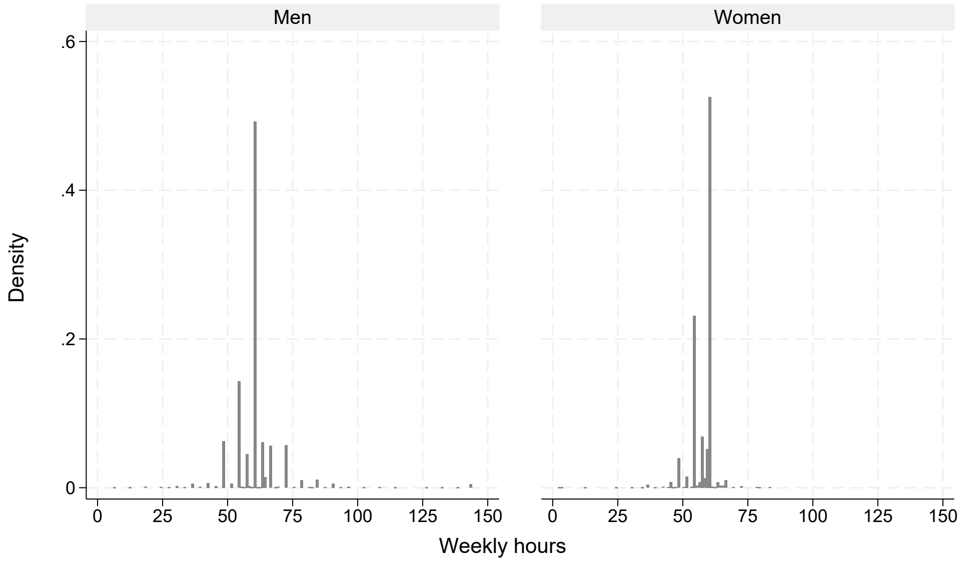
Table A1: Data availability in HLSP studies.

Study Subjects	Year	State	Number of observations	Share Female	Percent of observations with non-missing: Age	Weekly Earnings	Weekly Hours	Weeks Worked
Teachers	1884	IA	346	0.48	100	98	99	0
Wage-Earners	1884-1887	KS	1,152	0.02	100	98	100	100
Farmers	1888	CT	538	0.14	0	100	0	100
Male Stone Workers	1888	MI	710	0	100	100	100	100
Furniture makers	1889	MI	5,165	0.04	100	100	0	100
Male Workers Agri Implements	1890	MI	3,849	0	100	100	0	100
Wage-Earners	1890	ME	1,073	0.07	100	100	100	100
Male Workers Agri Implements, Outside Detroit	1890	MI	4,819	0	100	100	0	100
Male Wage-Earners	1891	MO	257	0	100	100	0	99
Wage Earners	1892	CA	3,335	0.18	100	96	88	0
Indianapolis women wage earners	1893	IN	492	1	100	100	100	100
Male Railways Employees	1893	MI	5,926	0	100	100	99	100
Farm Proprietors	1894	MI	2,157	0.45	0	100	0	0
Female Wage-Earners	1894	KS	1,749	1	100	100	100	0
Male Wage-Earners	1894	KS	1,115	0	100	100	100	0
Female Domestics in Agriculture	1894	MI	2,262	1	100	100	0	100
Male Farm Laborers	1894	MI	5,515	0	100	100	0	100
Male Wage-Earners	1894	NH	711	0	0	94	89	100
Farm Proprietors	1895	WI	939	0.25	0	100	0	0
Male Wage-Earners	1895	KS	507	0	100	98	97	100
Males, Workers Hack and Bus Lines	1895	MI	1,932	0	100	100	0	99
Males, Owners Hack and Bus Lines	1895	MI	1,194	0	100	99	98	0
Males, Street Railways Workers	1895	MI	1,200	0	100	100	0	100
Wage-Earners in Pawtucket	1895	RI	10,615	0.33	100	100	0	0
Male Wage-Earners	1895	WI	1,470	0	100	100	99	100
Male Wage-Earners	1896	KS	537	0	100	94	92	100
Wage-Earners	1897	KS	1,186	0.11	100	90	90	0
Male Wage-Earners	1898	KS	361	0	0	98	96	0
Wage-Earners	1899	KS	1,029	0.13	100	91	85	100
Female Wage-Earners	1901	OH	6,818	1	100	100	100	100
Female Wage-Earners in Akron & Other Cities	1901	OH	7,714	1	100	100	100	100
Overall			76,673	0.33	93.86	99	48	70

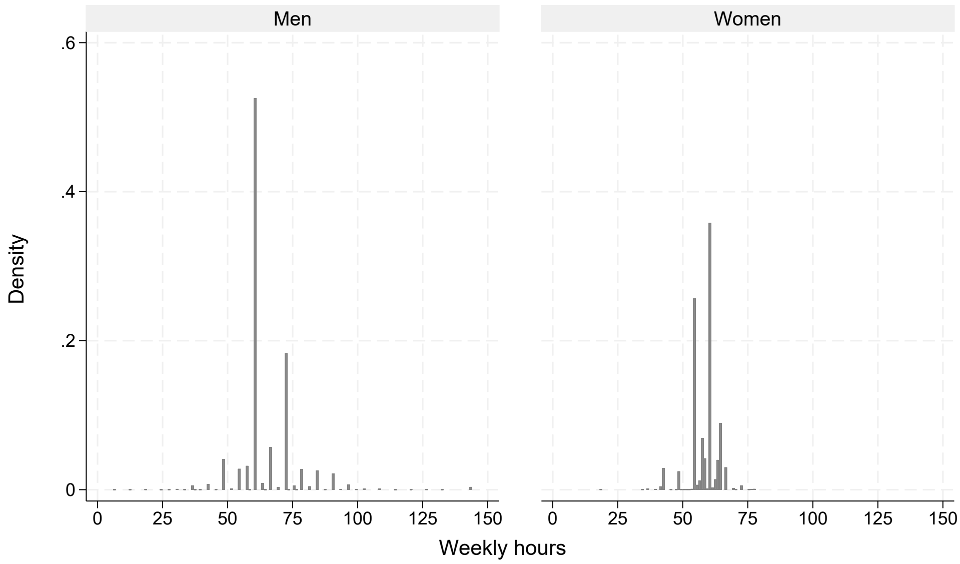
Notes: Occupation is available for all observations. *Data Sources*: The University of California Historical Labor Statistics Project. The codebooks and data are available at https://gpih.ucdavis.edu/hlsp.htm. See Carter, Ransom and Sutch (1991) for a description of the Historical Labor Statistics Project and an overview of the data.

Figure A1: Distribution of weekly hours in the HLSP, 1894-1901.

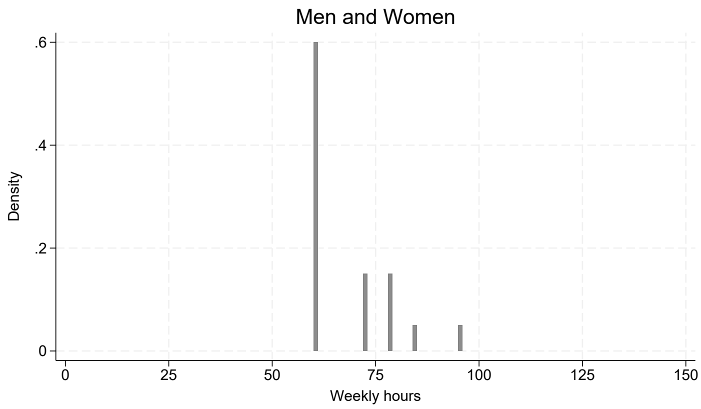
Panel A: Manufacturing



Panel B: Services

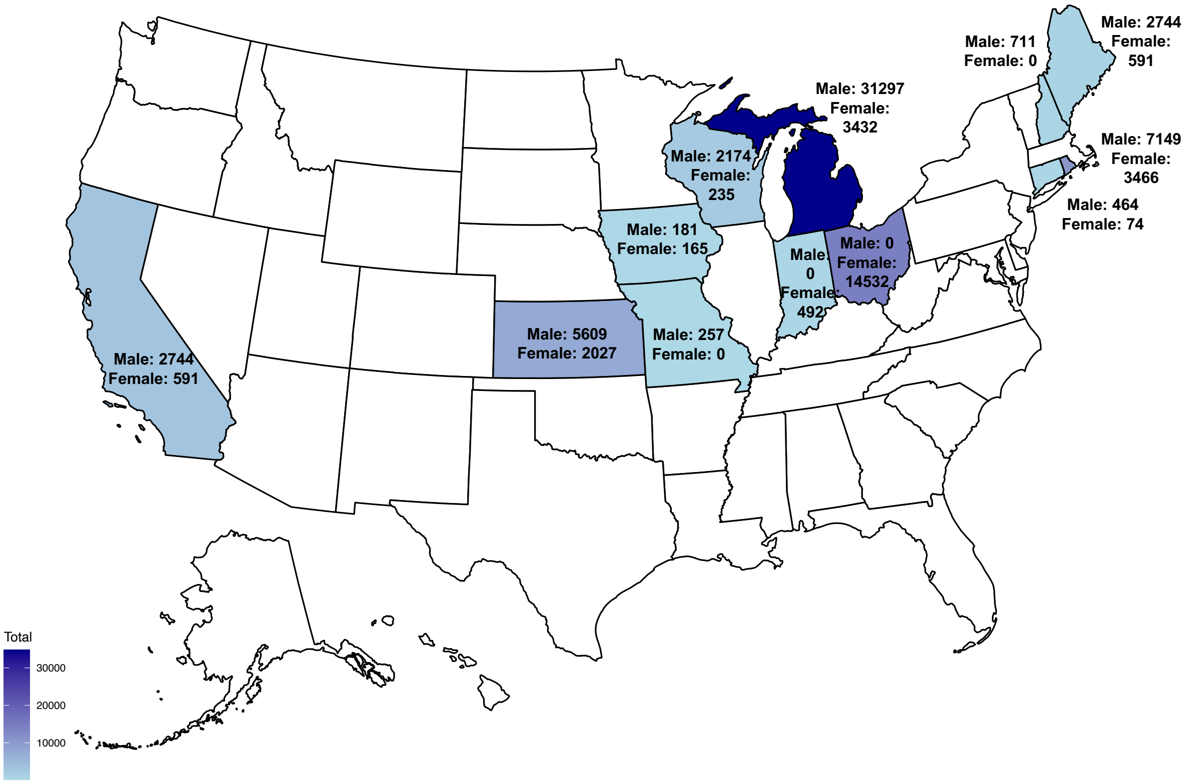


Panel C: Agriculture



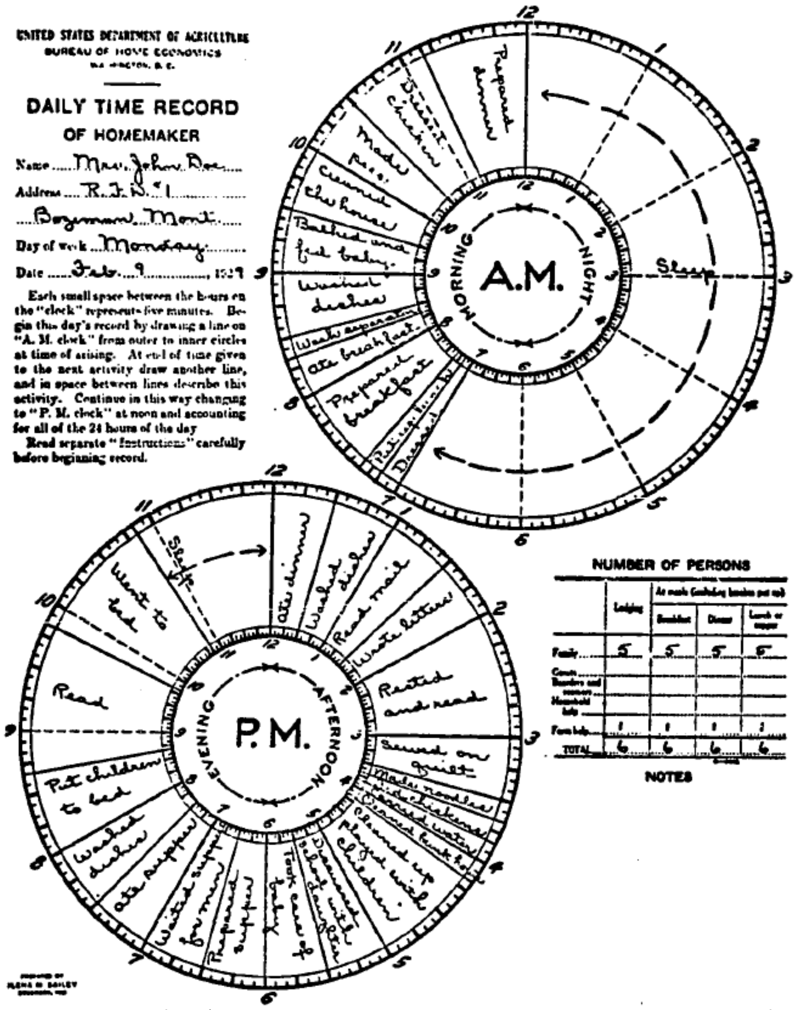
Notes. Histograms in the Figure combine working hours from state-level studies covered in the HLSP. Number of observations in Manufacturing: 7,983 men and 9,751 women; Services: 8,125 men and 2,420 women; Agriculture: 18 men and 2 women.

Figure A2: Geographic distribution of HLSP studies.



The maps shows the number of observations with non-missing information on earnings and hours worked. Data Source: The Historical Labor Statistics Project at the University of California.

Figure A3: A typical record of the use of time during one day of a rural homemaker.



Each circle represents 12 hours, for AM and PM activities, respectively. The circumference is split into 144 five-minutes intervals. Respondents were required to draw radial lines to indicate the time spent on each activity. Source: Vanek (1973, Figure 2.1).

A.2 Time-Use Studies

Table A2 below summarizes the information available from all pre-1965 time use studies used to estimate unpaid hours in farm work and home production. These studies span the period 1924-1958 and cover different populations geographically (by state and urban/rural), employment status and marital status.

Figure A3 shows an example of an early time-use diary.

Table A2: Home and paid hours by gender, marital status, employment and rural/urban.

Study	Year	State	Number of Observations	Home Hours	Unpaid Farm Hours	Paid Hours	Farm	Rural	Marital	Emp
				Women						
USDA (1944)	1924-28	USA	559	51.7	9.0	0.6	1	1	1	0
Wilson (1929)	1926-27	OR	288	51.6	11.3	0.9	1	1	1	0
Crawford (1927)	1927	ID	49	62.7	9.7	.	1	1	1	0
Kneeland (1929)	1928	USA	700	52.3	11.2	.	1	1	1	0
Arnquist and Roberts (1929)	1929	WA	137	53.0	10.0	.	1	1	1	0
Richardson (1933)	1930	MT	91	53.7	9.2	0.8	1	1	1	0
Wasson (1930)	1929-31	SD	100	53.2	11.5	0.3	1	1	1	0
Kneeland (1932)	1932	USA	642	51.7	9.2	0.0	1	1	1	0
Warren (1940)	1936	NY	497	52.1	6.8	0.0	1	1	1	0
Muse (1946)	1943	VT	183	64.5	12.0	0.0	1	1	1	0
Wiegand (1954)	1952	NY	95	53.2	7.0	0.0	1	1	1	0
Cowles and Dietz (1956)	1953	WI	85	52.5	8.0	0.0	1	1	1	0
USDA (1944)	1926	USA	249	51.5	3.1	0.0	0	1	1	0
Wilson (1929)	1926-27	OR	71	54.9	3.9	0.0	0	1	1	0
Whittemore and Neil (1929)	1926-28	RI	102	54.1	4.3	0.0	0	1	1	0
Arnquist and Roberts (1929)	1929	WA	21	54.3	5.2	0.0	0	1	1	0
Kneeland (1932)	1932	USA	287	51.3	3.2	0.0	0	1	1	0
Wilson (1929)	1926-27	OR	154	51.5	1.58	0.0	0	0	1	0
Crawford (1927)	1927	ID	32	58.5	0.17	0.0	0	0	1	0
Arnquist and Roberts (1929)	1929	WA	39	52.7	1.6	0.0	0	0	1	0
Kneeland (1932)	1932	USA	112	51.1	0.14	0.0	0	0	1	0
Dickins (1945, white)	1943	MS	57	52.1	5.1	0.0	0	0	1	0
Dickins (1945, black)	1943	MS	38	50.7	6.4	0.0	0	0	1	0
Wiegand (1954)	1952	NY	102	51.8	0.0	0.0	0	0	1	0
GershunyHarms - USDA subsample*	1924-28	USA	10	37.6		21.0	all	1	1	1
Kuschke (1938)	1936	RI	31	26.8		23.5	all	1	1	1
Muse (1946)	1942	VT	13	38.8		12.8	1	1	1	1
Anderson and Fitzsimmons (1958)	1958	VA	16	48.7			all	1	1	1
Anderson and Fitzsimmons (1958)	1958	VA	49	31.9		45.4	all	1	1	1
Nelson (1933)	1931-32	NY	58	17.5		40.0	0	0	1	1
Kuschke (1938)	1936	RI	38	23.6			0	0	1	1
Dickins (1945, white)	1943	MS	17	39.1		17.8	0	0	1	1
Dickins (1945, black)	1943	MS	27	38.8		21.7	0	0	1	1
Wiegand (1954)	1952	NY	53	28.7		40.0	0	0	1	1
Nelson (1933)	1931-32	NY	942	7.0		40.0	0	0	0	1
Lundberg, Komakovsky, McInerny (1934)	1932	NY	286	8.0		42.5	0	0	0	1
				Men						
Wilson (1929)	1926-27	OR	288	1.8			1	1	1	1
Wilson (1929)	1926-27	OR	71	2.0			0	1	1	1
Arnquist and Roberts (1929)	1928	WA	124	2.2			1	1	1	1
Wilson (1929)	1926-27	OR	154	2.5			0	0	1	1
Muse (1946)	1943	VT	183	2.4			all	1	1	1
Lundberg, Komakovsky, McInerny (1934)	1932	NY	375	3.0			0	0	1	1
Dickins (1945, white)	1943	MS	80	1.6			0	0	1	1
Dickins (1945, black)	1943	MS	80	2.6			0	0	1	1

Notes: Data sources are cited in References. Dickins (1945) is the only study where time use is reported by race. In the study, gainful work is defined as working (for pay) at least 8 or more hours per week.

B Derivation of model results

B.1 Relative prices

Substituting the equilibrium condition (10) and the definition of women's income share (12) into the production function (3) gives

$$\frac{N_j}{l_{fj}} = \left(\frac{\xi_j}{I_j}\right)^{\frac{\eta_j}{\eta_j-1}}; \qquad \forall j. \tag{28}$$

Free mobility of female labour across any two sectors j and k implies:

$$p_j A_j \xi_j \left(\frac{N_j}{l_{fj}}\right)^{1/\eta_j} = p_k A_k \xi_k \left(\frac{N_k}{l_{fk}}\right)^{1/\eta_k}. \tag{29}$$

Substituting (28) into (29) gives result (11), describing relative prices across any two sectors as a function of the wage ratio.

B.2 Marketization and Structural Transformation

The household's optimal choice of home and market services implies that the marginal rate of substitution is equal to relative prices:

$$\frac{p_h}{p_s} = \frac{1-\psi}{\psi}\left(\frac{c_s}{c_h}\right)^{1/\sigma}. \tag{30}$$

Combining this with the relative price condition in (11) for $j = s$, $k = h$, gives relative expenditure as in (17).

Dividing the utility function (2) by c_s and substituting (30) gives:

$$\frac{c_z}{c_s} = \psi^{\frac{\sigma}{\sigma-1}}\left(\frac{1}{E_{sh}}+1\right)^{\frac{\sigma}{\sigma-1}}. \tag{31}$$

Consumption optimization across manufacturing and market services implies:

$$\frac{p_m}{p_s} = \frac{\omega_m}{\omega_z \psi}\left(\frac{c_z}{c_m}\right)^{\frac{1}{\varepsilon}}\left(\frac{c_s}{c_z}\right)^{\frac{1}{\sigma}}, \tag{32}$$

which can be rearranged as:

$$\frac{c_m}{c_s} = \left(\frac{\omega_m p_s}{\psi \omega_z p_m}\right)^{\varepsilon}\left(\frac{c_z}{c_s}\right)^{\frac{\sigma-\varepsilon}{\sigma}} \tag{33}$$

Substituting for c_z/c_s in (33) using (31) gives:

$$\frac{c_m}{c_s} = \left(\frac{\omega_m p_s}{\omega_z p_m}\right)^{\varepsilon}\psi^{\frac{\sigma(1-\varepsilon)}{\sigma-1}}\left(\frac{1}{E_{sh}}+1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}}, \tag{34}$$

and the relative expenditure:

$$E_{ms} \equiv \frac{p_m c_m}{p_s c_s} = \left(\frac{p_m}{p_s}\right)^{1-\varepsilon} \left(\frac{\omega_m}{\omega_z}\right)^{\varepsilon} \psi^{\frac{\sigma(1-\varepsilon)}{\sigma-1}} \left(\frac{1}{E_{sh}} + 1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}}, \tag{35}$$

Substituting relative prices (11), with $\eta_m = \eta_s$:

$$E_{ms} = \hat{A}_{ms}^{\varepsilon-1} \left[\left(\frac{\xi_m}{\xi_s}\right)^{\eta} \frac{I_s}{I_m}\right]^{\frac{\varepsilon-1}{\eta-1}} \left(\frac{1}{E_{sh}} + 1\right)^{\frac{\sigma-\varepsilon}{\sigma-1}} \tag{36}$$

$$\hat{A}_{ms} \equiv \frac{A_m}{A_s} \left(\frac{\omega_m}{\omega_z}\right)^{\frac{\varepsilon}{\varepsilon-1}} \psi^{\frac{\sigma}{1-\sigma}}. \tag{37}$$

The expenditure ratio between manufacturing and composite services E_{mz} in (18) can be derived by defining an implicit price for the composite service p_z as:

$$p_z c_z = p_s c_s + p_h c_h = \left(1 + E_{sh}^{-1}\right) p_s c_s \tag{38}$$

By definition:

$$E_{mz} \equiv \frac{p_m c_m}{p_z c_z} = \frac{p_m c_m}{(1 + E_{sh}^{-1}) p_s c_s} = \frac{E_{ms}}{1 + E_{sh}^{-1}}. \tag{39}$$

Substituting E_{ms} from (36) and E_{sh} from (17) gives expression (18).

Consumption optimization across manufacturing and agriculture implies:

$$\frac{p_m}{p_a} = \frac{\omega_m}{\omega_a} \left(\frac{c_a - \bar{c}}{c_m}\right)^{\frac{1}{\varepsilon}}. \tag{40}$$

Next define $\bar{E}_{ma} \equiv \frac{p_m}{p_a} \frac{c_m}{c_a - \bar{c}}$. Using (40) gives:

$$\bar{E}_{ma} = \left(\frac{p_m}{p_a}\right)^{\varepsilon-1} \left(\frac{\omega_m}{\omega_a}\right)^{\varepsilon}. \tag{41}$$

Substituting relative prices (11) gives:

$$\bar{E}_{ma} = \left[\frac{A_m}{A_a} \left(\frac{\xi_m}{\xi_a}\right)^{\frac{\eta}{\eta-1}} \left(\frac{I_m}{I_a}\right)^{\frac{1}{1-\eta}}\right]^{\varepsilon-1} \left(\frac{\omega_m}{\omega_a}\right)^{\varepsilon}. \tag{42}$$

The relative expenditure across agriculture and manufacturing is given by:

$$E_{ma} = \left(1 - \frac{\bar{c}}{Y_a}\right) \bar{E}_{ma}, \tag{43}$$

which is reported in equation (22).

Relative expenditure across agriculture and composite services is:

$$E_{az} = \frac{p_a c_a}{p_z c_z} = \frac{1}{1 + E_{sh}^{-1}} \left(\frac{E_{ms}}{E_{ma}}\right). \tag{44}$$

Substituting the expressions for E_{ms} and E_{ma} gives:

$$E_{az} = \frac{1}{1+E_{sh}^{-1}} \frac{\left[\frac{A_m}{A_s}\left(\frac{\omega_m}{\omega_z}\right)^{\frac{\varepsilon}{\varepsilon-1}} \psi^{\frac{\sigma}{1-\sigma}}\right]^{\varepsilon-1} \left[\left(\frac{\xi_m}{\xi_s}\right)^{\eta} \frac{I_s}{I_m}\right]^{\frac{\varepsilon-1}{\eta-1}} \left(1+E_{sh}^{-1}\right)^{\frac{\sigma-\varepsilon}{\sigma-1}}}{\left(1-\frac{\bar{c}}{Y_a}\right)\left[\frac{A_m}{A_a}\left(\frac{\omega_m}{\omega_a}\right)^{\frac{\varepsilon}{\varepsilon-1}}\right]^{\varepsilon-1} \left[\left(\frac{\xi_m}{\xi_a}\right)^{\eta} \frac{I_a}{I_m}\right]^{\frac{\varepsilon-1}{\eta-1}}}$$

which simplifies to

$$E_{az} = \frac{\left(1+E_{sh}^{-1}\right)^{\frac{1-\varepsilon}{\sigma-1}}}{1-\frac{\bar{c}}{Y_a}} \left(\frac{A_s}{A_a}\right)^{1-\varepsilon} \left(\frac{\omega_a}{\omega_z}\right)^{\varepsilon} \psi^{\frac{\sigma(\varepsilon-1)}{1-\sigma}} \left[\left(\frac{\xi_a}{\xi_s}\right)^{\eta} \frac{I_s}{I_a}\right]^{\frac{\varepsilon-1}{\eta-1}}.$$

Substituting for E_{sh} gives expression (19).

B.3 Leisure

From household optimization, using the implicit price of leisure in (9), the optimal consumption of manufacturing goods and leisure goods satisfies:

$$\frac{p_l}{p_m} = \frac{c\phi}{c_l \omega_m}\left(\frac{c_m}{c}\right)^{\frac{1}{\varepsilon}}, \tag{45}$$

which implies

$$E_{lm} = \frac{\phi}{\omega_m}\left(\frac{c}{c_m}\right)^{\frac{\varepsilon-1}{\varepsilon}}. \tag{46}$$

Using the the utility function (1), E_{lm} can be rewritten as:

$$E_{lm} = \phi\left[\frac{\omega_a}{\omega_m}\left(\frac{c_a-\bar{c}}{c_m}\right)^{\frac{\varepsilon-1}{\varepsilon}} + 1 + \frac{\omega_z}{\omega_m}\left(\frac{c_z}{c_m}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]. \tag{47}$$

Multiplying and dividing the (c_z/c_m) ratio by c_s, and using (31), (34) and (40) gives:

$$E_{lm} = \phi\left[\frac{\omega_a}{\omega_m}\left(\frac{p_m\omega_a}{p_a\omega_m}\right)^{\varepsilon-1} + 1 + \left(\frac{\omega_z}{\omega_m}\right)^{\varepsilon}\left(\frac{p_m}{p_s}\right)^{\varepsilon-1} \psi^{\frac{\sigma(\varepsilon-1)}{\sigma-1}}\left(\frac{1}{E_{sh}}+1\right)^{\frac{\varepsilon-1}{\sigma-1}}\right]. \tag{48}$$

Substituting relative expenditures (35) and (41) gives equation (24).

We next derive the fraction of leisure time in (23). Given the constant-return-to-scale home production function:

$$p_h c_h = p_h \frac{\partial c_h}{\partial l_{mh}} l_{mh} + p_h \frac{\partial c_h}{\partial l_{fh}} l_{fh}, \tag{49}$$

using the implicit price index for p_h in (9) gives:

$$p_h c_h = w_m l_{mh} + w_f l_{fh}, \tag{50}$$

and the same holds for leisure:

$$p_l c_l = w_m l_{ml} + w_f l_{fl}. \tag{51}$$

Thus the budget constraint (6) can be rewritten as

$$\sum_{\forall j} p_j c_j = w_m L_m + w_f L_f. \tag{52}$$

Dividing through by $p_l c_l$ and re-arranging:

$$\frac{p_l c_l}{w_m L_m + w_f L_f} = \frac{1}{\frac{E_{ml}}{\left(1-\frac{\bar{c}}{c_a}\right)\bar{E}_{ma}} + \sum_{i\neq a} E_{il}}; \tag{53}$$

Using the definition of I_j, we derive the first equation for the share of leisure time:

$$\frac{l_{fl}}{L_f} = \frac{I_l}{I\left(\frac{E_{ml}(w)}{\left(1-\frac{\bar{c}}{Y_a}\right)\bar{E}_{ma}(w)} + \sum_{i\neq a} E_{il}(w)\right)}. \tag{54}$$

B.4 Equilibrium wage ratio

To derive an implicit function for the wage ratio w, we obtain an alternatve expression for the share of leisure time by substituting (13) into the female time budget constraint (7):

$$L_f = \sum_{j=a,m,s,h,l} l_{fj} = l_{fl} \sum_{\forall j} \frac{l_{fj}}{l_{fl}} = l_{fl} \sum_{\forall j} \frac{I_j}{I_l} E_{jl}. \tag{55}$$

thus

$$\frac{l_{fl}}{L_f} = \frac{I_l}{I_a \frac{E_{ml}}{\left(1-\frac{\bar{c}}{Y_a}\right)\bar{E}_{ma}} + \sum_{\forall j\neq a} I_j E_{jl}}. \tag{56}$$

Equilibrium conditions (54) and (56) are functions of (l_{fl}, w, Y_a), which can be reduced to two equations and two unknown using the agricultural production function as follows. First, we rewrite (54) and (56) as functions of $\left(\frac{l_{fa}}{L_f}, w\right)$:

$$\frac{l_{fa}}{L_f} = \frac{I_a}{I\left[\left(1 + \left(1 - \frac{\bar{c}}{Y_a}\right)\bar{E}_{ma} \sum_{\forall j\neq a} E_{jm}\right)\right]}, \tag{57}$$

$$\frac{l_{fa}}{L_f} = \frac{I_a}{1 + \left(1 - \frac{\bar{c}}{Y_a}\right)\bar{E}_{ma} \sum_{\forall j\neq a} I_j E_{jm}} \tag{58}$$

Next, we express Y_a as a function of l_{fa} using the agricultural production function:

$$Y_a = A_a N_a = A_a L_f \left(\frac{N_a}{l_{fa}}\right)\left(\frac{l_{fa}}{L_f}\right), \tag{59}$$

Finally, substituting (59) into (57):

$$\frac{Y_a}{A_a L_f\left(\frac{N_a}{l_{fa}}\right)} = \frac{I_a/I}{1+\left(1-\frac{\bar{c}}{Y_a}\right)\bar{E}_{ma}\sum_{\forall j\neq a}E_{jm}}, \tag{60}$$

$$Y_a + (Y_a-\bar{c})\,\bar{E}_{ma}\sum_{\forall j\neq a}E_{jm} = \frac{I_a}{I}A_a L_f\left(\frac{N_a}{l_{fa}}\right) \tag{61}$$

$$Y_a = \frac{\frac{I_a}{I}A_a L_f\left(\frac{N_a}{l_{fa}}\right)+\bar{c}\bar{E}_{ma}\sum_{\forall j\neq a}E_{jm}}{1+\bar{E}_{ma}\sum_{\forall j\neq a}E_{jm}}, \tag{62}$$

and substituting (59) into (58):

$$\frac{Y_a}{A_a L_f\left(\frac{N_a}{l_{fa}}\right)} = \frac{1}{1+\left(1-\frac{\bar{c}}{Y_a}\right)\bar{E}_{ma}\sum_{\forall j\neq a}\frac{I_j}{I_a}E_{jm}} \tag{63}$$

$$Y_a + (Y_a-\bar{c})\,\bar{E}_{ma}\sum_{\forall j\neq a}\frac{I_j}{I_a}E_{jm} = A_a L_f\left(\frac{N_a}{l_{fa}}\right) \tag{64}$$

$$Y_a = \frac{A_a L_f\left(\frac{N_a}{l_{fa}}\right)+\bar{c}\bar{E}_{ma}\sum_{\forall j\neq a}\frac{I_j}{I_a}E_{jm}}{1+\bar{E}_{ma}\sum_{\forall j\neq a}\frac{I_j}{I_a}E_{jm}} \tag{65}$$

We have reduced the equilibrium conditions into two equations (62) and (65) with two unknown (Y_a, w). Together, they deliver an implicit function for the wage ratio w.

B.5 Family farms

The inclusion of unpaid farm work in agricultural employment is central to the accurate measurement of female employment and the size of the overall agricultural sector. However, the distinction between paid and unpaid work in agriculture does not feature in the model, in which paid and unpaid hours are perfect substitutes in the determination of agricultural output.[1]

Importantly, the distinction between paid and unpaid farm work does not play a role *per se* in driving the U-shape in female market hours or the decline in male market hours, as unpaid hours in family businesses are counted within market work. However, if family businesses have slower productivity growth than modern enterprises due for example to economies of scale, the decline in family farms contributes to agricultural productivity growth via compositional changes.

In a simple extension below, we explicitly model the distinction between family and modern farms by introducing separate production functions, in which family farms (indexed by n) and modern farms (indexed by r) combine male and female labor according to the same technology introduced in (3), with A_r growing faster than A_n.

The sale of family farm produce contributes to households disposable income, and

[1]A similar point can be made about unpaid hours in family business outside agriculture, although less relevant quantitatively.

hours worked on the family farm feature in the time budget constraint; hence:

$$\sum_{i=r,m,s} p_i c_i \leq w_m \left(L_m - l_{mh} - l_{mn} - l_{ml}\right) + w_f \left(L_f - l_{fh} - l_{fn} - l_{fl}\right) + p_n y_n \qquad (66)$$

The outputs of family and modern farms are close substitutes in utility, i.e.

$$c_a \equiv \left(\psi_n Y_n^{\frac{\sigma_a - 1}{\sigma_a}} + (1-\psi_n)\, Y_r^{\frac{\sigma_a - 1}{\sigma_a}}\right)^{\frac{\sigma_a}{\sigma_a - 1}}, \qquad \sigma_a > 1 \qquad (67)$$

where we have additionally imposed $c_r = Y_r$ and $c_n = Y_n$ for market clearing.

Given $\sigma_a > 1$, faster productivity growth in the modern farm sector drives labor reallocation from family to modern farms, a process that we define as *modernization* of agriculture. This is conceptually equivalent to marketization of home production, and its derivation follows equivalent steps. In particular, the optimal hours allocation implies that condition (10) holds for family as well as modern farms, and condition (13) can be used to to describe the relationship between the hours' allocation and relative expenditures:

$$\frac{l_{fn}}{l_{fr}} = \frac{I_n}{I_r} E_{nr}, \qquad (68)$$

where

$$E_{nr} \equiv \frac{p_n Y_n}{p_r Y_r} = \hat{A}_{nr}^{\sigma_a - 1} \left(\left[\frac{\xi_r}{\xi_n}\right]^{\frac{\eta}{\eta-1}} \left(\frac{I_r}{I_n}\right)^{\frac{1}{\eta-1}} \right]^{\sigma_a - 1} ; \quad \hat{A}_{nr} \equiv \frac{A_n}{A_r} \left(\frac{\psi_n}{1-\psi_n}\right)^{\frac{\sigma_a}{\sigma_a - 1}}.$$

By reallocating labor from family into modern farm, modernization implies an increase in the productivity growth of the overall agricultural sector over time. This contributes to the decline of agricultural hours and the dynamics of overall market hours. This enriched model cannot be directly calibrated because we lack separate information on value added for family and modern farms. However, we can consider the extension of Section 5.3 with lower agricultural productivity growth pre-1950 as a reduced-form approach that would capture the role of modernization in shaping agricultural productivity growth.