Less Labor or Post-Labor? Hours, Productivity, and Lifetimes of Work, 1870–2100*

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Abstract

Keynes expected that by 2030 a fifteen-hour week might be enough, and artificial intelligence has revived the idea that paid work is coming to an end. This paper asks what 150 years of data on hours, productivity and lifespans can say about that idea. Since 1890, US output per hour has grown about 2 percent a year, but working time has fallen much more slowly. After 1950, shorter hours took up only 9 percent of US productivity growth and 16 percent across 19 rich countries, and Americans did slightly more paid work per person in 2019 than in 1950. Apart from a wave of shorter hours between 1913 and 1950, driven by laws, unions and the Depression, hours per worker have fallen by 0.1 to 0.2 percent for each 1 percent rise in productivity. Over the life cycle, the reductions came at the start and end of adult life: counting unpaid work, Americans aged 25–54 worked about as many hours a week in 2005 as in 1900. On these patterns, Americans would still work about 28 hours a week in 2100; a fifteen-hour week would need faster growth than the United States has ever had and a new movement for shorter hours. A household model separates cuts in work that households choose and can afford from displacement, which needs no financing and would show up elsewhere. Through mid-2026, US hours, employment, productivity and pay remain within their postwar range. Two things stand out: the nonfarm business labor share is at its lowest since 1947, and young adults' employment lags the business cycle.

JEL codes: E24, J22, J26, N30, O33, O40. *Keywords:* hours of work, labor supply, productivity, automation, artificial intelligence, retirement, life expectancy, long-run forecasting.

*Disclosures: The code, the analyses and the drafts of this paper were prepared with AI assistants (Google's Antigravity, Anthropic's Claude Opus 5.5 and OpenAI's Codex), working under the author's direction. The work was done in a personal capacity, outside the author's employment. All data are public; the replication package rebuilds every number, table and figure from the raw files.

1. Introduction

In 1930 John Maynard Keynes predicted that by 2030 living standards in progressive countries would be four to eight times higher, and suggested that "three-hour shifts or a fifteen-hour week" might then be enough to satisfy "the old Adam in most of us" (Keynes 1931). The income half of the forecast was close: US GDP per head had risen 6.4-fold by 2016. The hours half was not. Employees on US private payrolls still average about 34 hours a week (BLS 2026). Half a century later, Wassily Leontief (1983) restated the fear in starker form: the role of humans as the most important factor of production would diminish, as the role of horses in agriculture had been "first diminished and then eliminated" by the tractor. The precedent is vivid. American farms held 21.2 million horses in 1918 and 3.1 million in 1960 (Carter et al. 2006, series Da983–987; Olmstead and Rhode 2001). Recent advances in artificial intelligence have revived the argument. In models in which AI can perform nearly all tasks, wages are pinned to the cost of the computation that replicates human work and the labor share of income tends to zero (Korinek and Suh 2024; Restrepo 2025). Popular accounts describe the result as a world without work, or a "post-labor" economy (Susskind 2020).

Forecasts of the end of work run together three different events. A machine can reduce the labor needed to produce a given output. Higher incomes can finance shorter hours, longer schooling and earlier retirement. And a machine can eliminate a job without making the displaced worker better off. The first need not lead to the second, and the third can happen while the economy as a whole grows richer. Keynes's fifteen-hour week is a claim about the second; the horse analogy is a claim about the third. This paper asks what the long-run record of hours, productivity and lifespans can say about each, and what it cannot.

The paper combines hours and productivity series for the United States since 1870 and 19 rich countries since 1950 with US age-specific market work, home production, schooling, leisure and survival data, and adds US data through mid-2026. Its contribution is a joint accounting of four margins that are usually discussed separately: labor per unit of output, hours per employed worker, employment per person and work over a synthetic lifetime. Robustness exercises assess how the historical associations depend on estimator, sample, income measure and the attribution of trends. A simple household model then separates reductions in work that households choose and can finance from reductions imposed by a fall in labor demand, and turns that distinction into indicators, which the paper reads against each series' own postwar distribution. The exercise does not identify the causal effect of productivity on labor supply or estimate a probability that AI will end work. It establishes a benchmark against which claims of a break can be judged.

Four findings organize the evidence. First, labor saving per unit of output has been much faster than the decline in working time. US productivity grew about 2.1 percent a year from 1890 to 2019. On consistent PWT data for 1950–2019, US output per person grew 1.99 percent

a year: productivity contributed 1.91 points, hours per worker -0.17 and employment per person $+0.25$. Across all 19 rich countries in the panel, output per person grew 2.36 percent a year $(2.61 - 0.41 + 0.15)$. Shorter hours per worker offset 9 percent of productivity growth in the United States and 16 percent across the 19 countries. Employment per person rose in 16 of the 19 countries, so paid hours per person fell only 0.25 percent a year on average, and rose slightly in the United States. This is an accounting result. It does not establish that households freely chose the resulting allocation between consumption and leisure.

Second, no single historical coefficient can safely be carried into an AI future. The post-1950 ratio of cumulative changes across 19 countries is -0.16, and country fixed-effects slopes are about -0.09. Replacing output per hour with GDP per capita brings those slopes close to zero; the two regressors are biased in opposite directions, the first by measurement error in hours and the second by shocks to hours that raise or lower output. With hours per person as the outcome, the ratio is -0.10, because rising employment offset part of the fall in hours per worker. The much larger pre-1930 ratio, -0.37, is concentrated in the shorter-hours movement of 1913–29; before 1929, cuts in the standard workweek accounted for nearly nine-tenths of the fall in annual hours. After 1950 the United States and Europe diverged. US full-time weekly hours and paid leave barely moved, while Western Europe cut annual full-time hours by more than a quarter, mostly through a shorter standard week and partly through longer paid vacations and more holidays. Taxes, bargaining, participation, measurement error and the direction of causation all complicate a labor supply interpretation. Conditional scenarios therefore vary both productivity growth and the association between growth and hours, and an additional exercise allows part of the hours trend to continue independently of productivity.

Third, the life cycle is where work has receded. In period calculations from age 14, American men's lifetime paid work fell from 54 full-time-equivalent (FTE) years in 1900 to 40 in 2005; a two-factor Shapley decomposition attributes $+12$ years to better survival and -26 to lower paid hours at each age. Women's lifetime paid work rose from 11 to 30 FTE years while their unpaid home production fell, and men's home production rose from 5 to 27 FTE years: over the century, work moved from the home to the market and partly from women to men. Adding paid and unpaid work shows where the reduction in work happened. At ages 25–54, total work per person was 53 hours a week for men and 58 for women in 1900, and 54 and 57 in 2005. Nearly all of the age-specific decline in total work came before 25 and after 55, the ages of schooling and retirement. Because lives lengthened, lifetime total work rose in FTE years, but its share of adult life fell by about 4 percentage points for both sexes, and lifetime leisure rose by 26 FTE years. These period findings complement Hazan's (2009) cohort evidence.

Fourth, the first years of generative AI have not left the historical envelope. Compared with every six-year period since 1948, the 2019–25 changes in US productivity, hours per worker, real compensation and prime-age employment are unremarkable, between the 30th and 65th

percentiles of their postwar distributions. Productivity growth picked up to about 2.5 percent a year after late 2022. Hours per worker fell 0.1 to 0.15 percent for each 1 percent of productivity growth, as after 1950, not the 0.37 percent that the AI scenarios assume, and population aging accounts for the entire fall in the adult employment rate. Two levels are unusual. The nonfarm business labor share reached its lowest value since 1947 in 2026, and its fall accounts for the entire gap between productivity and real compensation since 2019; before 2019, much of that gap reflected consumer prices rising faster than output prices. Its pace has precedents, however, about half of the fall came by early 2023, during the inflation surge, and the economy-wide compensation share is at, not below, its 2013 low. The employment rate of 20- to 24-year-olds fell 1.2 to 2.8 points more than its historical relationship with prime-age employment predicts: a larger shortfall than in any six-year period since 1990, but not unusual before then. Teenagers, a placebo group with little AI exposure, show no unusual shortfall over 2019–25, but their employment fell even more than young adults' after 2023.

Extrapolating the post-1950 cross-country association at the US historical rate of productivity growth yields about 28 weekly hours in 2100. This is a reference path, not a probabilistic forecast. A fifteen-hour week by 2100 needs growth of 3.1 percent a year combined with the pre-1930 association, which includes a new movement for shorter hours, or growth of 7 to 11 percent at post-1950 associations; the best 75-year US record is 2.6 percent. How much of the historical hours trend is attributed to productivity matters as much as the growth assumption. None of these paths tests whether AI will destroy the demand for human labor: they extrapolate relationships observed while that demand persisted.

The household model makes the boundary explicit. Rising wages and rising nonlabor income can finance voluntary reductions in hours, and the model measures how large those resources must be: halving chosen hours at an unchanged wage requires nonlabor income to rise roughly three- to eight-fold. Calibrated to the post-1950 associations, the model also implies that most of the historical decline in hours came from nonlabor income growing alongside wages: with nonlabor income held fixed, a higher wage leaves desired hours roughly unchanged. Who receives the gains from productivity therefore matters for working time as well as for living standards. Involuntary displacement needs no financing at all. It requires only that jobs disappear, and a labor supply model cannot predict it. A fall in the labor share is therefore neither necessary for a household to lose its job nor sufficient for broadly shared leisure. The paper's practical conclusion is that a post-labor transition would show up first in hours per working-age person, in the composition and distribution of household income and in the pay of typical workers, not in average hours per worker, and that tracking these together, each against its own history, is more informative than tallying failed predictions. The first years of generative AI fit that ordering: so far what is unusual is the division of income and the hiring of entrants, not working time.

Related literature. The paper builds on three literatures. The first studies the long-run decline of hours. Huberman and Minns (2007) assemble the benchmark series used here and show that hours stopped converging after 1970. Whaples (1990, 2001) and Costa (2000) document the early twentieth-century fall in the working day. Vandenbroucke (2009) and Restuccia and Vandenbroucke (2013) model the decline as a response to rising wages, cheaper leisure and human capital. Ramey and Francis (2009) and Aguiar and Hurst (2007) measure leisure over a century and over five decades, and Kuhn and Lozano (2008) and Aguiar et al. (2021) document diverging hours across groups within the United States. Prescott (2004), Rogerson (2006), Ohanian, Raffo, and Rogerson (2008) and Bick, Brüggemann, and Fuchs-Schündeln (2019) relate the gap in hours between Europe and the United States to taxes, and Alesina, Glaeser, and Sacerdote (2005) to regulated hours, unions and vacations. Bick, Fuchs-Schündeln, and Lagakos (2018) show that hours fall with income across countries. Closest to this paper, Boppart and Krusell (2020) document that hours worked have fallen by a little under 0.5 percent a year in rich countries since 1870. They propose preferences under which hours fall at a constant rate proportional to productivity growth along a balanced growth path, and calibrate the proportionality factor at about 0.2 to match a decline in hours of 0.4 percent a year with productivity growth of 2 percent. The descriptive coefficients here can be compared with that calibration in magnitude, but they do not estimate its preference parameter. The whole-period average includes the concentrated reduction of 1913–50; benchmark ratios outside that episode tend to be smaller.

The second literature studies retirement and lifetime work. Costa (1998), Lee (2001) and Kopecky (2011) explain the rise of retirement by rising income and cheaper leisure. Ausubel and Grübler (1995) and Fogel (2000) estimate lifetime hours of work. Hazan (2009) shows that expected lifetime hours fell for American men born between 1840 and 1970 even as their life expectancy rose, contradicting the assumption that longer lives raise lifetime labor supply. Ramey (2009) reconstructs time spent in home production over the century, and Greenwood, Seshadri, and Yorukoglu (2005) link its decline to household appliances. This paper adds a period decomposition of the change in lifetime paid and unpaid work into survival and hours components by stage of life, a comparison of simple rules linking careers to lifespans, and projections.

The third literature asks whether automation and AI will displace labor. Keynes's essay and the gap between its hours projection and the subsequent record are reassessed in Freeman (2008) and Zilibotti (2008), who stress rising consumption aspirations and inequality. Mokyr, Vickers, and Ziebarth (2015) survey two centuries of technological anxiety, and Autor (2015) explains why so many jobs remain. Acemoglu and Restrepo (2018, 2019) and Autor et al. (2024) show how new tasks reinstate labor, and Frey and Osborne (2017) estimate occupations' exposure to computerization. A theoretical literature considers growth

and wages when AI can perform most tasks (Aghion, Jones, and Jones 2019; Nordhaus 2021; Trammell and Korinek 2023; Korinek and Suh 2024; Restrepo 2025), and Acemoglu (2025) estimates AI's macroeconomic effects from the task side. Early evidence on employment effects is limited and mixed (Brynjolfsson, Chandar, and Chen 2025, revised 2026; Humlum and Vestergaard 2025, revised 2026). A related literature documents the fall in the labor share, across countries since the 1980s and in the United States especially since 2000, and attributes it to cheaper capital goods (Karabarbounis and Neiman 2014), offshoring (Elsby, Hobijn, and Şahin 2013), the rise of superstar firms (Autor et al. 2020) and the growth of intellectual property capital (Koh, Santaeulàlia-Llopis, and Zheng 2020). This paper does not forecast AI's capabilities. It measures the historical relationship between productivity, wages and work, examines conditional paths for working time and the resources that could finance voluntary reductions, and reads the first years of generative AI against that record.

2. A Framework: Wages, Nonlabor Income and Hours

Consider a household that chooses consumption c and annual hours h to maximize

$$u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} - \psi \frac{h^{1+1/\eta}}{1+1/\eta} \qquad \text{subject to} \qquad c = wh + y, \tag{1}$$

where w is the real hourly wage, y is nonlabor income (capital income and transfers), $\sigma > 0$ governs the curvature of utility in consumption and $\eta > 0$ is the Frisch elasticity of labor supply. Let $s \equiv wh/(wh+y)$ denote the labor share of household income. The first-order condition $c^{-\sigma} w = \psi h^{1/\eta}$, with $c = wh/s$, gives

$$\ln h = \frac{1-\sigma}{\sigma + 1/\eta} \ln w + \frac{\sigma}{\sigma + 1/\eta} \ln s - \frac{\ln \psi}{\sigma + 1/\eta}. \tag{2}$$

Because s itself depends on h, equation (2) is an equilibrium relation between hours, the wage and the composition of household income, not a reduced form in the primitives w and y. It is nonetheless the natural way to organize long-run data, because income composition is measurable. Constancy of the production labor share alone does not ensure constancy of household s: transfers, taxes, ownership and participation can change it.

The wage channel. Along a path on which s is constant, that is, on which nonlabor income grows in proportion to labor income, hours respond to the wage with elasticity $\varepsilon_w = (1-\sigma)/(\sigma + 1/\eta)$. When $\sigma > 1$ the income effect of a higher wage outweighs its substitution effect and hours fall as wages rise. If wages also grow with labor productivity A, hours fall at a constant rate εg, where g is productivity growth and $\varepsilon \equiv d \ln h / d \ln A = \varepsilon_w$. This constant-rate decline resembles the balanced-growth outcome in Boppart and Krusell (2020), but the static utility function here is an organizing device, not their dynamic model. The log-

consumption limit of this static example, $\sigma = 1$, has no constant-share hours trend, echoing the balanced-growth restriction on hours in King, Plosser, and Rebelo (1988). Under the wage channel, halving hours within T years requires productivity growth of

$$g^* = \frac{\ln 2}{|\varepsilon|\, T}. \tag{3}$$

Nonlabor income and the boundary of the model. Equation (2) assigns the coefficient $\beta_s = \sigma/(\sigma+1/\eta)$ to $\ln s$. This coefficient describes equilibrium combinations of hours and income composition. A lower s is not an exogenous intervention: at a fixed wage, an increase in nonlabor income induces both lower hours and a lower labor share. Treating the coefficient as a causal effect of an observed aggregate share would reverse part of that relationship.

For changes in the primitive variables, total differentiation of the first-order condition gives

$$d\ln h = \frac{1-\sigma s}{1/\eta + \sigma s}\, d\ln w - \frac{\sigma(1-s)}{1/\eta + \sigma s}\, d\ln y.$$

The second term is negative: additional nonlabor resources finance less work. Its size scales with $1 - s = y/c$. When nonlabor income is a small part of the budget, a given percentage increase in it buys little, so a large voluntary reduction in hours requires nonlabor income to grow by a large multiple (Section 9.1).

The wage term has the sign of $1 - \sigma s$. Nonlabor income dilutes the income effect of a wage change, because the wage applies only to the share s of the household's resources. At $\sigma = 1.57$, $\eta = 0.5$ and $s = 0.62$, $\sigma s = 0.97$, so the income and substitution effects nearly cancel and the elasticity at fixed y is about $+0.01$. The calibration has a sharp implication: most of the constant-share elasticity of -0.16 comes from y growing with w. Across the post-1950 calibrations in Appendix Table A8, the fixed-y elasticity lies between $+0.01$ and $+0.19$ at $s = 0.62$, and between -0.06 and $+0.09$ at $s = 0.75$, the labor share of personal income excluding transfers. On this reading, rising wages shortened hours historically largely because households also acquired pensions, transfers and capital income in step with wages. Unlike the calibrated household, one living entirely on wages ($s = 1$) with $\sigma > 1$ has a negative wage elasticity at fixed y: a wage *reduction* raises its desired hours, because the income effect dominates.

To see the missing margin, impose a job-availability constraint $h \leq \bar{h}$. When it binds, realized hours fall with $\bar{h}$ even if desired hours rise, and income falls unless wages, transfers or capital income compensate. A post-labor transition through involuntary displacement therefore requires no prior increase in nonlabor income: it requires only that jobs disappear. An *affluent* transition, by contrast, requires that households command the resulting output. This

distinction prevents the model from treating a necessary financing condition for voluntary leisure as a necessary condition for job loss.

Illustrative calibration. If the observed association is interpreted as the constant-share wage elasticity, then, given η, a measured elasticity ε implies $\sigma = (1-\varepsilon/\eta)/(1+\varepsilon)$. With a Frisch elasticity of 0.5, the post-1950 cross-country estimate $\varepsilon = -0.16$ implies $\sigma = 1.57$, the pre-1930 US estimate of -0.26 implies $\sigma = 2.05$, and the 1913–29 estimate of -0.53 implies $\sigma = 4.38$. With $\eta = 1$ the corresponding values are 1.38, 1.70 and 3.26. At $\sigma = 1.57$ and $\eta = 0.5$, the elasticity of hours with respect to s is 0.44, so halving hours through this channel alone requires s to fall by a factor of $2^{1/0.44} \approx 4.8$.

The calibration is not a structural estimate: the historical coefficient combines preferences, institutions, participation and measurement. Nor does a representative household describe the distribution of gains from AI. The model abstracts from home production, taxes, saving and institutions, all of which have shaped hours historically (Prescott 2004; Ramey and Francis 2009; Huberman and Minns 2007). Subsequent sections use "elasticity" for a descriptive ratio or regression slope and state explicitly when interpreting it as a behavioral parameter.

3. Data

The analysis uses the public series in Table 1. Most were retrieved from the dataset archive of Our World in Data, which redistributes the original authors' files. The US earnings, price and personal income series come from FRED, and working-age population from the World Bank.

Hours. For the United States, the hours series joins Huberman and Minns's benchmark estimates for 1870–1929 to PWT's annual hours per worker from 1950. The 1938 benchmark is dropped as a Depression work-sharing outlier. The two series measure different things: Huberman and Minns cover full-time nonfarm production workers, while PWT covers all workers, including part-timers. Every result on the US trend is therefore also reported on Huberman and Minns's full-time series alone, which runs on a consistent basis to 2000. PWT's hours before about 1975 are interpolated between benchmarks for seven countries (Australia, Austria, Belgium, Ireland, the Netherlands, New Zealand and Switzerland), identified by having eight or fewer distinct annual growth rates over 1951–75; Section 5 reports estimates without these observations.

Productivity and wages. US output per hour is Bergeaud, Cette, and Lecat's series in 2010 PPP dollars to 2016, extended to 2019 with PWT. For the 19-country panel, output per hour is PWT's real GDP at constant national prices (*rgdpna*) divided by employment times hours per worker. Feenstra, Inklaar, and Timmer (2015, 3157) recommend *rgdpna* "if the sole object is to compare the growth performance of economies." The chained-PPP series in the Our World in Data extract is reported as a robustness check. Because output per hour divides by

Table 1
Data Sources

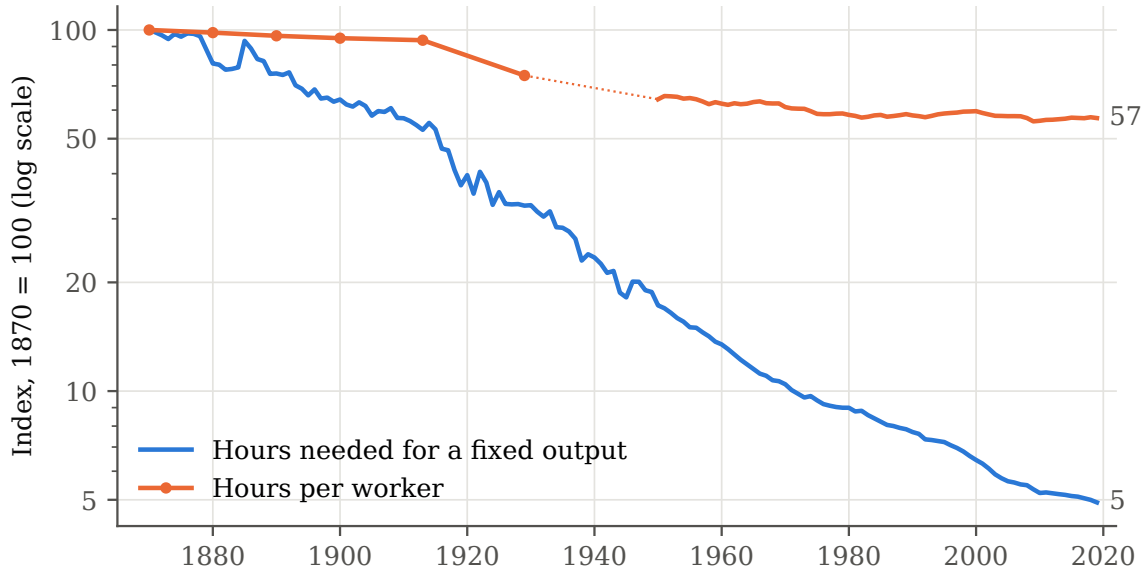
Series	Coverage	Source
Annual and weekly hours, weeks worked and vacation/holiday days per full-time production worker	14 countries, benchmark years 1870–2000	Huberman and Minns (2007)
Hours per worker, employment, population, real GDP, labor share	19 countries, 1950–2019	Penn World Table 10.0 (Feenstra, Inklaar, and Timmer 2015)
GDP per hour and GDP per capita	US 1850–2016; other countries from 1890	Bergeaud, Cette, and Lecat (2016)
Weekly hours of market work, schooling, home production and leisure per person, by age band and sex	US, decennial 1900–2000 and 2005	Ramey and Francis (2009)
Expected age at death at 15 and 45, by sex	US, 1790–2014 (1900–2005 used)	US Social Security Administration (in OWID compilation with Hacker 2010)
Life expectancy at 15 and 45, by sex	US, 2023	Arias, Xu, and Kochanek (2025)
Average hourly earnings and weekly hours of production and nonsupervisory employees; CPI	US, 1964–2026	BLS, via FRED
Nonfarm business output per hour, hours, compensation, labor share and output price deflator; employment, population and unemployment by age	US, 1948–2026	BLS, via FRED and the BLS Public Data API
Personal income, compensation of employees, transfer receipts; real disposable income; compensation as a share of gross domestic income	US, 1929–2025	BEA, via FRED
Population aged 15–64	19 countries, 1960–2019	World Bank (2026)

Source: Our World in Data dataset archive (github.com/owid/owid-datasets), NCHS, FRED, the BLS Public Data API (employment and population aged 55–64 and 65 and over, which FRED does not carry) and the World Bank, retrieved October 2026. The BLS and BEA series are used through 2019 in Sections 5 and 9.1 and through mid-2026 in Section 9.2. *Note:* The 19 countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. New Zealand's PWT hours begin in 1970.

hours, measurement error in hours enters both sides of a regression of hours on productivity. Section 5 therefore also uses real GDP per capita, which does not contain measured hours. Labor compensation per hour (PWT's labor share times real GDP divided by total hours) is a further regressor, but shares the hours denominator and is measured in output prices rather than household purchasing power. Real GDP can miss gains from new and improved goods (Nordhaus 1997); that limitation does not turn inverse productivity into a bound on the work required for a fixed standard of living.

Hours by age and survival. Ramey and Francis (2009) report weekly hours per person, not per worker, in five age bands from 14–17 to 65 and over, for men and women (market work

Figure 1
Hours Needed for a Fixed Output and Hours Worked, United States, 1870–2019



Source: Huberman and Minns (2007) to 1929, PWT 10.0 from 1950 (hours); Bergeaud, Cette, and Lecat (2016), extended to 2019 with PWT (output per hour). *Note:* Both series are indexed to 1870 = 100 and plotted on a log scale. Hours needed for a fixed output is the inverse of GDP per hour. The dotted segment joins the full-time production-worker series (to 1929) to the all-worker series (from 1950).

and unpaid home production by sex and total; schooling and leisure for the total population). The lifetime model in Section 7 combines these profiles with survival curves fitted to US life tables. The Our World in Data life-expectancy compilation combines Hacker's (2010) decennial white-population tables for 1790–1890 with US Social Security Administration (Bell and Miller) period life tables from 1900 to 2014. Because the lifetime calculations begin in 1900, they use the Social Security Administration tables throughout; before 1933, however, the underlying official tables were constructed from the Death Registration Area (originally 10 states and the District of Columbia), which overrepresented urban and white populations and may slightly misstate national survival in the earliest decades. The 2023 values come from the National Center for Health Statistics (Arias, Xu, and Kochanek 2025).

4. The Labor Requirement and Hours Worked

Figure 1 compares two series for the United States since 1870, both indexed to 100 in 1870. The first is the labor required to produce a fixed quantity of measured real output, the inverse of GDP per hour. The second is hours per worker. By 2019 the labor requirement had fallen to 5 percent of its 1870 level, while hours per worker had fallen to 57 percent.

Output per hour grew 2.1 percent a year from 1890 to 2019, so the labor needed for a fixed output halved every 33 years. The pace varied less than one might expect. Over ten-year

windows it ranged from 0.7 percent a year (1898–1908) to 5.2 percent (1914–24). Over 20-year windows it stayed between 1.1 percent (1895–1915) and 3.4 percent (1933–53), and over 75-year windows between 1.8 and 2.6 percent, the maximum running from 1908 to 1983. From 2005 to 2019 it was 1.0 percent a year.

At 2019 average productivity, a quantity of measured real output equal to a full 1929 working year's output corresponds to about 350 hours, or seven hours a week for 50 weeks. This comparison uses an aggregate volume index. It does not price the 1929 consumption basket at current technology, determine a subsistence workweek, or hold capital, trade and sector composition fixed. GDP includes investment and public services as well as household consumption. It illustrates the scale of measured labor saving, rather than establishing that seven hours would reproduce an earlier standard of living.

Hours per worker declined in two phases. A hinge regression of log hours on time, with a single break chosen by least squares, places the break in 1975. Before it, hours fell 0.56 percent a year; after it, 0.06 percent a year. Because the errors are autocorrelated and the model has a continuous kink, standard threshold inference (Hansen 2000, 2017) does not apply directly; a moving-block bootstrap of the residuals (blocks of five observations) gives a 90 percent interval for the break year of 1970 to 1979. On PWT alone (1950–2019) the break falls in 1980, with a bootstrap interval of 1973 to 1988, and declines of 0.39 and 0.07 percent a year before and after. On Huberman and Minns's consistent full-time series (1870–2000) the break falls in 1978, with a decline of 0.53 percent a year before it and a slight rise after; with only 12 benchmark observations, precise inference is not credible. The spliced series also mixes sparse historical benchmarks with annual postwar observations; the PWT-only result is the more defensible timing check. The benchmark intervals locate the earlier decline precisely (Appendix Table A1). Full-time hours fell 0.1 to 0.2 percent a year from 1870 to 1913, 1.4 percent a year from 1913 to 1929 and 0.7 percent a year from 1929 to 1950. They fell about 0.5 percent a year in the 1960s and 1970s and were flat or rising after 1980.

The two halves of the record have different average hours declines despite similar productivity growth. From 1870 to 1929, output per hour grew 1.9 percent a year and hours per worker fell 0.49 percent a year. From 1950 to 2019, output per hour grew 1.8 percent a year and hours per worker fell 0.17 percent a year. The difference is concentrated in a single episode, however. From 1870 to 1913, full-time hours fell only 0.15 percent a year while output per hour grew 1.5 percent, a ratio close to the post-1950 one. Most of the reduction in working time in the century to 1950 came between 1913 and 1950, through the shorter-hours movement of 1913–29 and the Depression.

Workweeks versus workyears. Huberman and Minns (2007) report full-time weekly hours alongside annual hours, so the log change in annual hours splits into the change in the standard week and the change in implied weeks worked (annual divided by weekly hours). The

two eras differed in *how* working time fell. Between 1870 and 1929, the shorter standard week accounted for 88 percent of the log decline in annual hours, both in the United States (weekly hours fell from 62.0 to 48.0 and annual hours from 3,096 to 2,316) and across the 11 European countries in the data (65.9 to 47.8 weekly hours on average; 3,191 to 2,223 annual hours). Between 1950 and 2000, US full-time weekly hours (42.4 to 40.3) and paid vacations and holidays (18 to 20 days) barely moved, and annual full-time hours fell only 6.7 log points (2,008 to 1,878). Across the eight European countries with complete 1950 and 2000 data, annual full-time hours fell 33.0 log points (2,144 to 1,541). Shorter weekly schedules (46.7 to 38.0 hours) account for 63 percent of that fall. Implied weeks worked fell from 46.0 to 40.6, but paid vacations and holidays, which rose from 25.6 to 36.9 days a year, explain less than half of that: counted as five-day weeks off a 52-week year, they account for 15 percent of the fall in annual hours. The remaining 22 percent is a residual that includes sickness and other leave and differences between the sources of the weekly and annual series. Postwar Europe shortened working time mainly by shortening the standard week, as before 1929, but it also took weeks off the working year, which the United States did not.

Accounting for output and employment. Let Q be real output, N population, E employment, h hours per worker and $A = Q/(Eh)$ measured output per hour. The identity

$$\Delta \ln(Q/N) = \Delta \ln A + \Delta \ln h + \Delta \ln(E/N)$$

separates productivity, working schedules and the employment margin. On PWT data, US annual growth over 1950–2019 is $1.99 = 1.91 - 0.17 + 0.25$ percent, up to rounding (Appendix Table A6). Shorter hours per worker offset 9 percent of the productivity contribution, while increased employment per person more than offset that reduction; from 1975 to 2019, the hours-per-worker offset was only 4 percent. Across all 19 rich countries in the panel over 1950–2019 (1970–2019 for New Zealand), average annual growth is $2.36 = 2.61 - 0.41 + 0.15$ percent. Shorter hours per worker offset 16 percent of productivity growth on average (17 percent across the 14 European countries and 13 percent across the five non-European economies). Employment per person rose in 16 of the 19 countries (all but Finland, France and Italy; 18 of 19 since 1970), offsetting more than a third of the fall in hours per worker, so total paid hours per person fell only 0.25 percent a year (-0.35 percent in Europe and $+0.02$ percent outside Europe), less than a tenth of productivity growth. These are log-growth contributions, not welfare shares or evidence that each worker chose to spend the remainder on goods. They also show why hours per worker alone cannot measure the disappearance of work.

5. Historical Associations between Hours and Productivity

5.1 Estimates

Table 2 reports estimates of ε, the elasticity of hours per worker with respect to productivity, for both eras. Panel B leads with estimators that use variation within countries. The ratio of cumulative changes is a separate descriptive statistic. It is not the slope of a regression through the origin: it weights country ratios by their cumulative productivity changes. Reading it as a behavioral elasticity attributes the whole hours trend to productivity and imposes a zero autonomous trend.

Before 1930. In the United States, hours per worker fell 0.26 percent for each 1 percent gain in output per hour between 1870 and 1929. From 1870 to 1913, however, the US response was only -0.10, and across 13 countries with benchmark data it was -0.19 for 1890–1913, with -0.18 to -0.24 in each interval. It jumped to -0.53 in 1913–29 (-0.46 in the United States), the years in which the eight-hour day spread through legislation, collective agreements and, after 1919, the International Labour Organization's first convention. This episode is better read as an institutional change than as a labor supply parameter. Productivity growth was slow in several countries during the war years, so the ratio in individual countries can be very large. The pooled estimate for 1890–1929, -0.37, is dominated by it, and the US response remained elevated in 1929–50 (-0.22), a period that includes the Depression and the Fair Labor Standards Act of 1938. Panel A also pairs full-time manufacturing hours with economy-wide productivity, a mismatch the data do not allow us to avoid before 1950. On Huberman and Minns's consistent full-time series, the US elasticity is -0.07 for 1950–2000, close to the -0.10 of 1870–1913. The ratios outside the 1913–50 institutional wave are of a similar order, roughly -0.1 in the United States and -0.2 across rich countries. This comparison is not a formal test of parameter stability, given changing coverage and institutions.

Since 1950. Within countries, a 1 percent rise in output per hour has gone with a fall in hours per worker of 0.08 to 0.09 percent, with or without decade effects. Long differences, which compare countries over 50 to 70 years and are least affected by cycles, give -0.08 from 1950 and -0.16 from 1970. Figure 2 plots the 1950–2019 long-difference points for all 19 countries alongside the unconstrained cross-country OLS line (slope -0.08), the ratio line through the origin (-0.16), and the much steeper pre-1930 slopes (-0.37 and -0.53). The unconstrained long-difference intercepts are negative (-0.21 percent a year with a standard error of 0.15 from 1950; -0.08 with 0.12 from 1970): countries with slower productivity growth, such as Switzerland, Canada and the United Kingdom, still experienced hours declines of 0.3 to 0.4 percent a year, while fast-growing Japan and Ireland lie well above the origin-constrained line. With 18 or 19 countries, the regressions do not precisely distinguish an autonomous trend in hours from co-movement with productivity. The ratio of cumulative changes, -0.16, cannot resolve that ambiguity. Its interpretation as an upper bound on the

Table 2
Elasticity of Hours per Worker with Respect to Productivity, Income and Wages

Sample and estimator	Output per hour	GDP per capita	Compensation per hour
Panel A. Before 1950: ratio of cumulative changes			
US, 1870–1913	−0.10		
US, 1913–1929	−0.46		
US, 1929–1950	−0.22		
US, 1870–1929	−0.26		
13 countries, 1890–1913, pooled	−0.19		
13 countries, 1913–1929	−0.53		
13 countries, 1890–1929, pooled	−0.37		
Panel B. 19 countries, 1950–2019, 131 country-decades			
Decade differences, country fixed effects	−0.09 (0.03)	−0.02 (0.04)	−0.09 (0.03)
Decade differences, country and decade fixed effects	−0.08 (0.05)	0.06 (0.05)	−0.09 (0.04)
Long difference, 1950–2019 (18 countries)	−0.08 (0.06)	−0.02 (0.06)	−0.10 (0.08)
Long difference, 1970–2019 (19 countries)	−0.16 (0.06)	−0.09 (0.04)	−0.23 (0.06)
Ratio of cumulative changes	−0.16	−0.17	−0.17
	[−0.18, −0.14]	[−0.20, −0.15]	[−0.19, −0.15]
Panel C. Output per hour: alternative measures and samples	Fixed effects	Ratio	
Chained-PPP output per hour (OWID extract)	−0.08 (0.03)	−0.14	
Without interpolated hours before 1975 (112 obs.)	−0.08 (0.04)	−0.16	
Decades from 1970 (95 obs.)	−0.19 (0.05)	−0.20	
European countries (98 obs.)	−0.11 (0.03)	−0.17	
Non-European countries (33 obs.)	0.03 (0.07)	−0.12	
US, ratio, 1950–2019 (Bergeaud, Cette, and Lecat)		−0.095	

Source: Author's calculations from Huberman and Minns (2007), Bergeaud, Cette, and Lecat (2016) and PWT 10.0. *Note:* Each entry estimates the elasticity of hours per worker with respect to the variable in the column heading. Panel A pairs full-time production-worker hours with economy-wide GDP per hour; with 12 or 13 countries per interval its ratios are descriptive and have no standard errors. US 1929–1950 uses Huberman and Minns's 1950 benchmark. Decade differences are non-overlapping log changes (the last decade is 2010–19); standard errors in parentheses are clustered by country. Long differences are cross-country regressions of annualized log changes with a constant; heteroskedasticity-robust standard errors. A ratio is the sum of log changes in hours divided by the sum of log changes in the regressor; brackets give 90 percent intervals from 5,000 bootstrap draws of countries (seed 0). Output per hour is PWT real GDP at constant national prices divided by total hours, except in the first row of Panel C. Compensation per hour is the labor share times real GDP divided by total hours. Non-European countries: Australia, Canada, Japan, New Zealand and the United States. Appendix Table A2 reports the ratio by country.

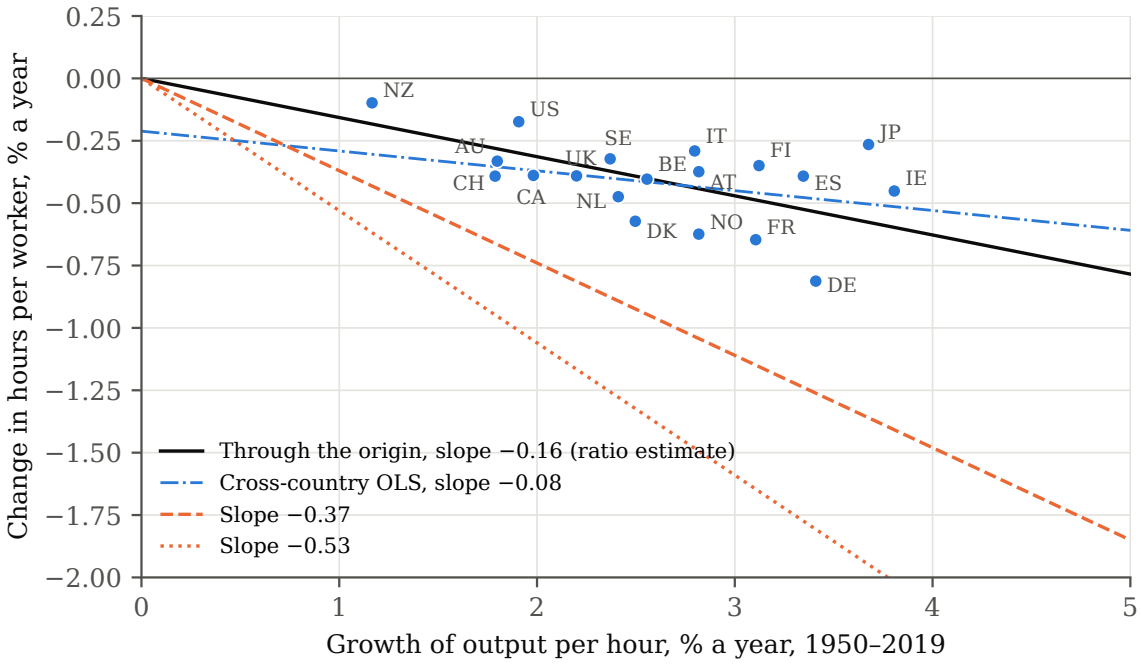
magnitude of a causal response would require additional sign and exclusion assumptions that are not established here.

Three considerations limit causal interpretation; none supplies a general bound on the true response. First, the two main regressors in Table 2—output per hour ($\ln A = \ln(Q/E) - \ln h$) and GDP per capita ($\ln(Q/N) = \ln A + \ln h + \ln(E/N)$)—suffer from opposing biases. Classical measurement error in $\ln h$ enters output per hour with a negative sign, creating division bias toward -1. Conversely, non-productivity shocks to working time—such as tax increases, statutory hours reductions or part-time entry—enter GDP per capita with a positive sign for a given level of hourly productivity, creating simultaneity bias toward $+1$. The within-country slopes fit this pattern: -0.09 on output per hour, -0.02 on GDP per capita with country fixed effects, and $+0.06$ on GDP per capita when decade fixed effects absorb the common secular trend. Neither regressor is free of bias, and the data do not say where between them the true response lies. Second, causality may run from hours to productivity: shorter hours raise output per hour when long hours cause fatigue (Pencavel 2015), which again makes the measured response on output per hour more negative. Third, the within-country relationship is concentrated in Europe. There it is -0.11, while outside Europe it is zero; in Europe the decline in hours coincided with rising taxes on labor and collective reductions in the workyear (Prescott 2004; Ohanian, Raffo, and Rogerson 2008). Against this, the estimates for the decades since 1970 are larger, about -0.19 to -0.20, and the long difference on compensation per hour since 1970 is -0.23. The results are robust to dropping interpolated hours and to the choice of productivity measure. Across countries, the ratio ranges from -0.07 in Japan and -0.08 in New Zealand to -0.24 in Germany (Figure 2 and Appendix Table A2).

Hours per person. Appendix Table A10 replaces hours per worker with total hours per person, the margin on which a post-labor transition would appear. The ratio of cumulative changes falls to -0.10 per person and -0.11 per person aged 15–64, because employment rates rose in most countries while hours per worker fell. The within-country slopes on output per hour are steeper, -0.20 and -0.28. Decades of rising unemployment, as in Spain after 1974 or Finland in the early 1990s, were also decades of rising measured productivity as less productive workers left employment; and because employment enters output per hour with a negative sign and hours per person with a positive one, any independent movement in employment pushes the slope toward -1. On GDP per capita, which contains hours per person directly, the slopes are close to zero or positive. Over the whole period, each 1 percent of productivity growth went with roughly 0.1 percent less paid work per person, and the within-country episodes in which work per person fell fastest were mostly episodes of job loss rather than of shorter schedules (Section 6).

In sum, the post-1950 estimates lie between 0 and about -0.2, with a central value near -0.1. They are similar to the pre-1913 values and somewhat smaller than the factor of about 0.2

Figure 2
Productivity Growth and the Change in Hours per Worker, 19 Countries, 1950–2019



Source: Author's calculations from PWT 10.0. *Note:* Each point is a country's average annual log change over 1950–2019 (New Zealand: 1970–2019). Output per hour is real GDP at constant national prices divided by total hours. The solid line has the slope of the ratio estimator in Table 2 (-0.16); the dash-dotted line is the unconstrained cross-country OLS fit (slope -0.08, intercept -0.21 percent a year); the dashed and dotted lines show the slopes of the pooled 1890–1929 estimate (-0.37) and of 1913–29 (-0.53), both dominated by the institutional shorter-hours movement of 1913–29.

that Boppart and Krusell (2020) calibrate to the whole period since 1870, which includes the 1913–50 wave. The projections in Section 8 use the US ratio, -0.095, and the 19-country ratio, -0.16. These reference values preserve historical co-movement. They do not establish how much an externally induced acceleration of productivity would change hours. Equal weighting of country ratios gives -0.158, and dropping one country at a time gives -0.164 to -0.151; the ratio is not driven by a single country. This stability concerns the descriptive summary, not causal identification. The AI scenarios use -0.37, the pooled 1890–1929 estimate. Because that estimate is dominated by the 1913–29 shorter-hours movement, the AI scenarios in effect assume that rapid productivity growth will be accompanied by a new institutional wave of shorter hours.

5.2 Wages, Productivity and the Post-1975 Stall

The model in Section 2 says that hours respond to wages, and the projections assume that wages grow with productivity. Table 3 examines this link for the United States. From 1964 to 1975, output per hour, average labor compensation per hour and the real hourly earnings of production and nonsupervisory workers all rose, and hours per worker fell 0.6 percent

Table 3
Productivity, Pay and Hours, United States (Percent a Year)

	1964–1975	1975–2019
Output per hour	2.07	1.48
Labor compensation per hour, all workers (PWT)	2.22	1.45
Real hourly earnings, production and nonsupervisory employees (CPI)	0.68	0.10
Real hourly earnings, production and nonsupervisory employees (PCE deflator)	1.15	0.57
Real hourly compensation, nonfarm business, including benefits (PCE deflator)	2.17	1.25
Hours per worker (PWT)	−0.59	−0.06
Weekly hours, production and nonsupervisory employees	−0.62	−0.15
Elasticity of hours per worker with respect to compensation per hour	−0.27	−0.04

Source: Author's calculations from Bergeaud, Cette, and Lecat (2016), PWT 10.0, BLS Current Employment Statistics (series AHETPI and AWHNONAG) and Productivity and Costs (COMPNFB), and BEA (PCE price index). *Note:* Annualized log changes. PWT compensation per hour is deflated by the GDP deflator (a product wage); the other pay series by the consumer price indexes shown. Average hourly earnings exclude employer-paid benefits.

a year. From 1975 to 2019, output per hour and average compensation per hour grew by nearly the same amount, about 1.5 percent a year, while production workers' real hourly earnings grew only 0.1 percent a year and hours per worker were nearly flat. Switching from CPI to PCE raises measured earnings growth by about 0.5 percentage points after 1975. The remaining gaps involve benefits, sector coverage, worker composition and the difference between output and consumer prices. Table 3 does not identify their separate contributions. Production and nonsupervisory earnings are a broad group average, not a median wage or the pay of a fixed worker; the benefits-inclusive series covers a different sector.

The two periods support two readings. On the first, the response of hours to the average wage weakened after 1975, as the ratio estimates suggest. On the second, hours respond to the pay of typical workers, which grew slowly after 1975 while average compensation kept pace with productivity. The second reading is consistent with evidence that long hours rose among high earners after 1979 (Kuhn and Lozano 2008), and it motivates a distributional question for AI. If productivity gains fail to raise broadly shared purchasing power, the mechanism that finances voluntary reductions in work is weaker. The coincidence in timing does not identify why hours stopped falling, and composition, taxes, bargaining and participation remain competing explanations. The aggregate data cannot separate these readings, and the projections below use productivity, as the historical estimates do.

Table 4
Ten-Year Changes in Work, 19 Countries (Percent a Year)

	Hours per worker	Hours per person	Hours per person aged 15–64
Overlapping windows			
Windows	1,118	1,118	939
Median	−0.39	−0.27	−0.24
5th percentile	−1.17	−1.59	−1.64
Minimum	−2.01	−3.60	−3.93
Window with the minimum	Denmark, 1967–77	Spain, 1974–84	Spain, 1975–85
Share of windows below −1 percent a year	0.10	0.19	0.21
Non-overlapping decades			
Decades	112	112	94
Median	−0.40	−0.32	−0.33
Minimum	−1.57	−2.41	−2.08
Share below −1 percent a year	0.12	0.20	0.22
United States, whole period	−0.17	0.08	0.03

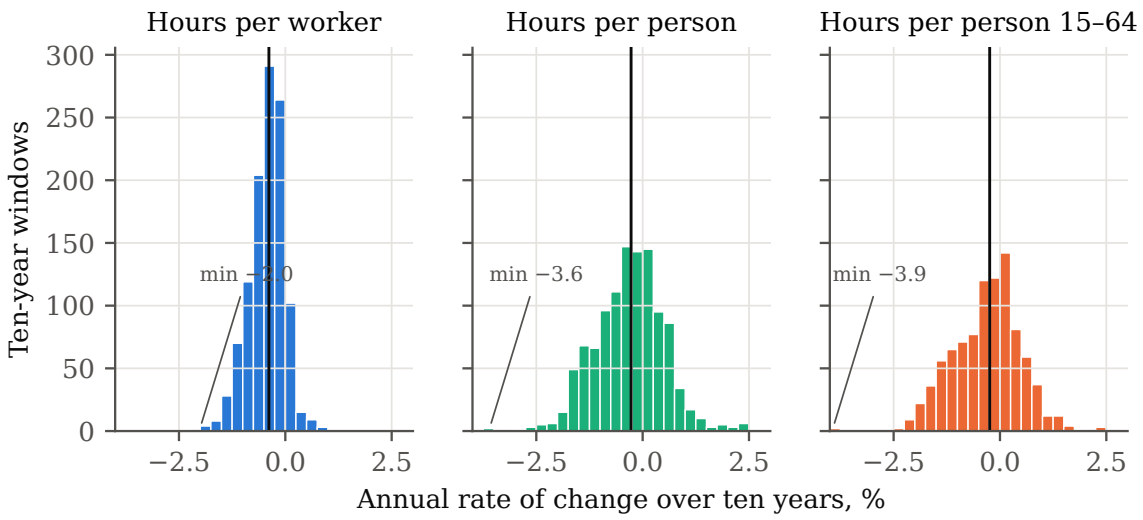
Source: Author's calculations from PWT 10.0 and World Bank (2026). *Note:* Annualized log changes. Overlapping windows start in every year from 1950 (1960 for the last column) to 2009; countries contribute 40 to 60 windows depending on data availability. Non-overlapping decades start in each country's first year. Hours per person is total hours divided by total population. The US row covers 1950–2019 (1960–2019 for the last column).

6. The Historical Envelope: How Fast Has Work Ever Fallen?

A sufficiently rapid transition would place hours outside their historical range, whatever its mechanism. Since a transition of that kind would be a change of regime, the historical distribution cannot rule it out. What it can do is describe the envelope within which past declines have occurred, and so define what an unprecedented decline would look like. Table 4 and Figure 3 report the distribution of ten-year changes on three margins across the 19 countries. Hours per worker and hours per person are available from 1950, and hours per person aged 15–64 from 1960.

Hours per worker never fell faster than 2.01 percent a year over a decade, and the fastest non-overlapping decade fell 1.6 percent a year. The fastest declines came in Scandinavia and continental Europe in the late 1960s and 1970s, when collective agreements and legislation shortened the standard week and lengthened paid holidays. Before 1938, the fastest declines between Huberman and Minns's benchmarks were the United States in 1929–38 (3.1 percent a year) and France in 1929–38 (2.5 percent), both dominated by the Depression and, in France, by the 40-hour law of 1936. The 1913–29 shorter-hours wave produced declines of 1.4 percent a year in the United States and 2.0 percent in Italy.

Figure 3
Distribution of Ten-Year Changes in Work, 19 Countries



Source: Author's calculations from PWT 10.0 and World Bank (2026). *Note:* Each histogram counts overlapping ten-year windows, from 1950 for the first two panels and from 1960 for the third; vertical lines mark the medians.

Hours per person fell faster, and the episodes are telling. Among the large declines are Spain in 1974–84, Finland in 1984–94 and Ireland in 2001–11, which include major unemployment crises. Canada in 1951–61 and Italy in 1961–71 also appear in the list of country-specific minima (Appendix Table A3). Measured per person aged 15–64, which reduces the effect of changes in broad age structure but does not age-standardize employment, the list is Spain, the Netherlands in 1973–83, Finland, France in 1976–86 and Ireland. Appendix Table A3 decomposes these episodes. In Spain and Finland, and in Canada in 1951–61 when the baby boom swelled the population, falling employment rates account for 70 to 92 percent of the decline. In France and the Netherlands, shorter hours per worker account for 59 to 66 percent: the French decade includes the 39-hour week and fifth week of paid leave of 1982, and the Dutch figures before 1975 are interpolated. Ireland and Italy in 1961–71 split about evenly. These episodes combine recessions, demographic shifts, participation changes and reductions in standard hours. The accounting decomposition cannot establish that each was caused by unemployment or legislation, or exclude changing preferences. What the record lacks is a documented economy-wide transition to abundant consumption with little paid work. The 1,118 overlapping windows are strongly dependent, and the selected countries are not a random sample; their frequencies are descriptive, not probabilities of future transitions. Ten-year changes can also conceal abrupt declines followed by recoveries, so this exercise is not a test for every kind of sudden stop.

The United States lies at the other extreme. Hours per person were 803 a year in 1950 and 849 in 2019, and hours per person aged 15–64 were essentially unchanged between 1960 and

2019. Seventy years of productivity growth that multiplied output per hour by 3.5 left the amount of paid work per American nearly unchanged: shorter hours per worker were offset by more people, mostly women, in paid work.

The growth required for a fast decline. Equation (3) gives the productivity growth needed to halve hours per worker within 25 years. At the post-1950 cross-country elasticity of -0.16 it is 17 percent a year. At the pooled pre-1930 elasticity of -0.37 it is 7.5 percent, and at the 1913–29 elasticity of -0.53 it is 5.2 percent (Table 9, last row). The highest US productivity growth over any 20-year window since 1890 was 3.4 percent a year (1933–53), and the highest over any decade was 5.2 percent (1914–24). Through the wage channel alone, a post-labor transition would therefore require a productivity acceleration without precedent, combined with a response of hours as strong as during the 1913–29 shorter-hours movement, sustained for a generation.

7. Lifetimes of Paid Work and Survival

Hours per worker measure working time within a year. A post-labor transition could also come through the life cycle: later entry, earlier exit and longer retirements. This section measures how much of adult life Americans have spent in paid work since 1900, and how the change divides between longer survival and changing hours by age.

7.1 A Lifetime Model

For each year and sex, I fit a Gompertz (1825) mortality hazard from age 15, $\mu(x) = a\, e^{b(x-15)}$, choosing a and b so that the implied expected ages at death at 15 and at 45 match the life tables exactly. Survival from 15 is then $S(x) = \exp\{-(a/b)(e^{b(x-15)} - 1)\}$, and the expected years lived in age band $[x_0, x_1)$ by a person alive at 14 is $\int_{x_0}^{x_1} S(x)\, dx$, with survival from 14 to 15 set to one. Lifetime paid hours are the sum over Ramey and Francis's five age bands of weekly paid hours per person, times 52.18, times expected years in the band. Because the hours are per person, not per worker, they include the extensive margin: schooling, nonparticipation and retirement. Two summary measures follow. *Full-time-equivalent (FTE) years* are lifetime paid hours divided by 2,000. The *share of life worked* is lifetime paid hours divided by all hours alive after 14 (8,766 a year). Figures for "all Americans" average men and women.

The model is a period measure: it combines one year's survival with the same year's hours by age, as a synthetic cohort would experience them. It is therefore complementary to Hazan's (2009) cohort measures. Two checks support it. The fitted Gompertz slopes for 2005, 0.074 for men and 0.085 for women, imply that adult mortality doubles every 8 to 10 years, in line with standard estimates. Applied to Ramey and Francis's leisure hours, the same machinery gives lifetime leisure shares of 0.222 (1900), 0.248 (1950) and 0.256 (2005), against their published cohort estimates of 0.235 (born 1890), 0.251 (born 1950) and 0.256 (born 2000).

7.2 Lifetime Work since 1900

Table 5 and Figure 4 report the results. Men's lifetime paid work fell from 54 FTE years in 1900 to 40 in 2005, and their share of life after 14 spent in paid work fell from 26.5 percent to 14.9 percent. Women's paid work rose from 11 FTE years to 30, and their paid share from 5.1 percent to 10.1 percent. For all Americans, lifetime paid work stayed between about 30 and 35 FTE years throughout the century, while expected age at death at 15 rose from 61 to 78 and expected years lived after 65 rose from 6.5 to 15.4. Appendix Table A4 compares these lifetime totals with earlier estimates, which use different definitions of work.

Because Ramey and Francis (2009) also measure unpaid home production, schooling and leisure in the same five age bands, the lifetime model can follow work outside the labor market (Table 5, Panel B). Their home production estimates for the early decades are reconstructed from early time-use studies of homemakers and related evidence (Ramey 2009), so the 1900 levels are less certain than the later ones. Between 1900 and 2005, women's lifetime home production fell from 54.2 to 48.1 FTE years (from 25.9 to 16.5 percent of adult life after 14), even though adult women lived nearly 19 years longer, while men's rose more than fivefold, from 5.1 to 27.0 FTE years. Work moved from the home to the market and, within the home, partly from women to men. Adding paid and unpaid work, lifetime total work rose in FTE years because lives were longer (from 59.3 to 67.1 for men and from 65.0 to 77.6 for women), but fell as a share of adult life after 14 by 4.1 percentage points for men (from 29.0 to 24.9 percent) and 4.4 points for women (from 31.0 to 26.6 percent). Formal schooling after age 14 rose from 0.8 to 4.0 FTE years, and lifetime leisure by 26.0 FTE years, from 22.2 to 25.6 percent of adult life.

7.3 Where the Extra Years Went

Table 6 decomposes the change in lifetime paid work, unpaid home production and total work into the effect of survival and the effect of hours by age. Each effect is the average of the two counterfactuals that change one factor at a time (a two-factor Shapley decomposition), so the effects sum to the total change. The decomposition is an accounting exercise: it shows how the change arose, not why.

The decomposition overturns a natural reading of the decline in men's share of life worked, namely that it fell mainly because lives grew longer. Longer survival contributes less than one percentage point. Better survival raised the number of years lived at working ages as well as in old age, so it raised lifetime work nearly in proportion to lifetime. At 1900's hours by age, men in 2005 would have worked 70 FTE years in the market instead of 54. They worked 40 because paid hours per person fell across the age profile. Of the 25.7 FTE-year hours-profile effect, ages below 25 contribute -6.5 years, ages 25–54 contribute -8.7, and ages 55 and over contribute -10.5 (Appendix Table A9). The endpoints together account for about two thirds, but the prime-age reduction is substantial. The age-band accounting

Table 5
Lifetime Work, Home Production, Leisure and Survival, United States, 1900–2005

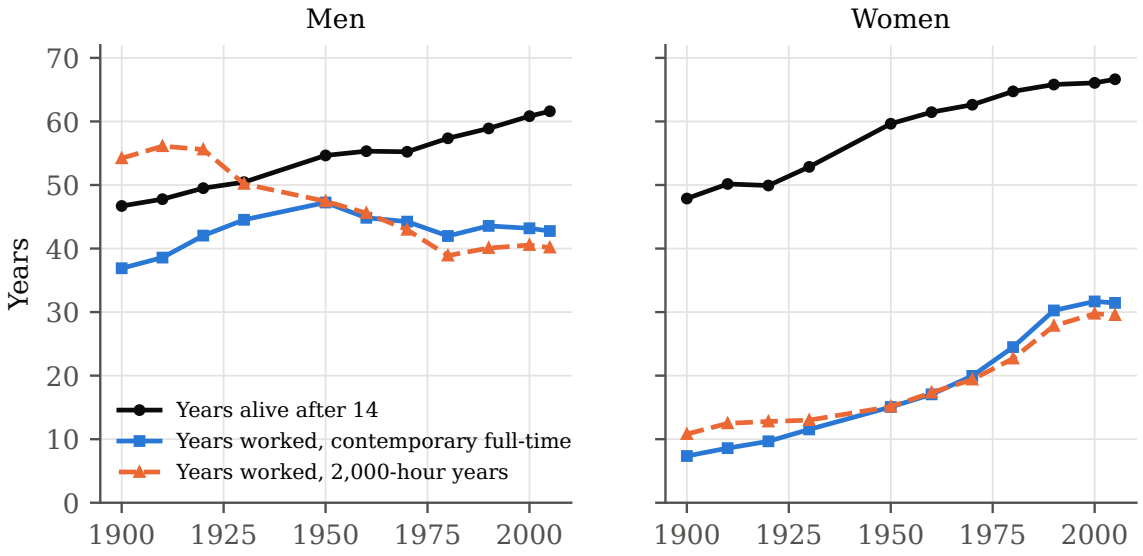
Year	FTE years: men	FTE years: women	FTE years: all	Share of life: men (%)	Share: women (%)	Share: all (%)	Age at death at 15	Years lived after 65
Panel A. Paid market work and survival								
1900	54.2	10.8	32.5	26.5	5.1	15.7	61.3	6.5
1930	50.2	13.0	31.6	22.7	5.6	14.0	65.6	7.7
1950	47.4	15.1	31.3	19.8	5.8	12.5	71.1	10.0
1970	43.0	19.4	31.2	17.7	7.1	12.1	72.9	11.4
1990	40.1	27.8	34.0	15.5	9.6	12.4	76.4	14.1
2005	40.1	29.5	34.8	14.9	10.1	12.4	78.1	15.4
Panel B. Unpaid home production and total work							*Schooling, all*	*Leisure, all*
Home production, 1900	5.1	54.2	29.7	2.5	25.9	14.3	0.8 (0.4)	46.0 (22.2)
Home production, 1950	13.2	60.2	36.7	5.5	23.0	14.6	2.4 (1.0)	62.1 (24.8)
Home production, 2005	27.0	48.1	37.5	10.0	16.5	13.4	4.0 (1.4)	72.0 (25.6)
Total work, 1900	59.3	65.0	62.2	29.0	31.0	30.0		
Total work, 1950	60.6	75.3	68.0	25.3	28.8	27.1		
Total work, 2005	67.1	77.6	72.4	24.9	26.6	25.7		

Source: Author's calculations from Ramey and Francis (2009) and US Social Security Administration life tables.
Note: FTE years are lifetime hours from age 14 divided by 2,000. Shares are lifetime hours divided by all hours alive from 14 (8,766 a year). Total work is paid market work plus unpaid home production. In Panel A, the last two columns report expected age at death at 15 and expected years lived after 65 (averaged across men and women, over everyone alive at 14). In Panel B, the last two columns report lifetime formal schooling and leisure for all Americans in FTE years, with their percentage shares of adult life after 14 in parentheses; they are placed in the home-production rows only to save space.

does not separately identify schooling, retirement, participation and changes in schedules among employed people. The labor force participation of men 65 and older fell from 78 percent in 1880 to 18 percent in 1990 (Short 2002; Costa 1998), and the expected length of male retirement rose accordingly (Lee 2001). Between 1950 and 2005, survival added 3 FTE years to men's paid careers and changes in hours by age removed 10.

Panel C of Table 6 decomposes home production and total work. Had women kept their 1900 housework hours at each age while gaining 19 years of adult life, they would have done 75.0 FTE years of housework in 2005, against 54.2 in 1900; they did 48.1. Averaging over both orders, survival contributes $+17.4$. Lower housework at each age, mostly at ages 25–54 (-13.6), removed 23.6 FTE years, more than the $+14.3$ that women's paid work gained at given ages. Men's age-specific increases in home production added 17.3 FTE years, two-

Figure 4
Years Alive after 14 and Years Worked, by Sex, United States, 1900–2005



Source: Author's calculations. *Note:* Years worked at contemporary full-time schedules divide lifetime paid hours by the full-time annual hours of the period (Huberman and Minns 2007, interpolated between benchmarks; 2005 uses the 2000 value). 2,000-hour years divide by 2,000. 1940 is omitted because the full-time benchmark is interpolated from the 1938 Depression low.

thirds of their −25.7 in paid work. For paid and unpaid work combined, changes in hours by age removed 8.4 FTE years of total work for men and 9.3 for women, and better survival added 16.3 and 21.8.

Panel D shows where in the life cycle the age-specific change in total work occurred. At ages 25–54 it is close to zero for both sexes: +0.7 FTE years for men and −0.8 for women. Total work per person at those ages was 53.1 hours a week for men and 58.3 for women in 1900, and 54.1 and 57.2 in 2005. Nearly all of the decline came at the two ends of adult life, −4.8 (men) and −4.3 (women) FTE years before age 25 and −4.3 for both from age 55. In prime age, the century reallocated work between the market and the home and between men and women; it did not reduce it. The reduction came through less work at the start and end of adult life, in schooling and retirement, not through less work in the middle. The period evidence is consistent with Hazan's (2009) cohort evidence that lifetime labor supply did not rise alongside longevity. Neither comparison identifies the causal effect of longer life: income, health, household technology, pensions and schooling changed together with survival.

7.4 Rules Linking Careers to Lifespans

How should careers be projected as lifespans grow? Table 7 compares six simple rules for the number of years worked at contemporary full-time schedules, W_t, given years lived after

Table 6
Decomposition of the Change in Lifetime Work and Home Production

	Men, 1900–2005	Women, 1900–2005	Men, 1950–2005	Women, 1950–2005
Panel A. Paid market work (FTE years)				
Start	54.2	10.8	47.4	15.1
End	40.1	29.5	40.1	29.5
Effect of survival	+11.6	+4.4	+3.0	+1.1
Effect of hours by age	−25.7	+14.3	−10.3	+13.3
Panel B. Paid market work (share of life after 14, percentage points)				
Start	26.5	5.1	19.8	5.8
End	14.9	10.1	14.9	10.1
Effect of survival	−0.8	−0.8	−0.9	−0.5
Effect of hours by age	−10.8	+5.8	−4.0	+4.8
Panel C. Unpaid home production and total work, 1900–2005 (FTE years)	*Men: home*	*Women: home*	*Men: total work*	*Women: total work*
Start (1900)	5.1	54.2	59.3	65.0
End (2005)	27.0	48.1	67.1	77.6
Effect of survival	+4.6	+17.4	+16.3	+21.8
Effect of hours by age	+17.3	−23.6	−8.4	−9.3
Panel D. Effect of hours by age, by stage of life, 1900–2005 (FTE years)	*Men: paid*	*Women: paid*	*Men: total work*	*Women: total work*
Ages 14–24	−6.5	−0.4	−4.8	−4.3
Ages 25–54	−8.7	+12.8	+0.7	−0.8
Ages 55 and over	−10.5	+1.9	−4.3	−4.3

Source: Author's calculations. *Note:* The effect of survival averages (i) the change from replacing the start year's survival curve with the end year's, holding the start year's hours by age, and (ii) the same change holding the end year's hours by age; the effect of hours by age is defined symmetrically. In Panel C, columns 1–2 decompose unpaid home production over 1900–2005 and columns 3–4 decompose total work (paid market work plus unpaid home production) over 1900–2005. Panel D groups the age-band contributions to the effect of hours by age (Appendix Table A9 reports them for paid work); each column sums to the corresponding row above.

14, L_t: a constant career ($W_t = c$), proportionality ($W_t = kL_t$), a linear relation in L_t or in time, a fixed number of years not worked ($W_t = L_t - c$), and a log relation. Each is estimated on the decennial observations for 1900–2005 (1940 omitted) and evaluated in two out-of-sample tests: fitting through 1960 and predicting 1970–2005, and fitting 1950–80 and predicting 1990–2005.

The results should be read with care, because the sample is small and the measure depends on a normalization (Figure 4). On years at contemporary full-time schedules, men's careers lengthened from 37 years in 1900 to 47 in 1950, as full-time schedules shortened faster than hours per person, and then stayed between 42 and 47 years through 2005 while years alive after 14 rose by 7. In sample, rules linear in lifespan or in time fit slightly better than a constant career, because they capture the pre-1950 rise. Out of sample, the constant career

Table 7
Out-of-Sample Errors of Rules Linking Years Worked to Years Lived (Root Mean Squared Error, Years)

Rule	Men: predict 1970–2005	Men: predict 1990–2005	All: predict 1970–2005	All: predict 1990–2005
Constant career	1.1	1.4	8.7	5.3
Proportional to lifespan	6.4	5.3	3.5	2.9
Linear in lifespan	7.8	6.9	1.2	2.7
Linear in time	8.9	4.1	1.5	2.9
Fixed years not worked	7.7	6.4	1.6	1.1
Log of lifespan	7.4	6.6	1.5	2.8

Source: Author's calculations. *Note:* Years worked are lifetime paid hours from 14 divided by contemporary full-time annual hours. "Predict 1970–2005" fits 1900–60; "predict 1990–2005" fits 1950–80. 1940 is excluded throughout.

predicts men's careers after 1960 with errors of 1.1 to 1.4 years, against 4.1 to 8.9 for every rule that ties careers to lifespan or time, but this partly reflects the coincidence that the 1900–60 average equals the later plateau. Measured in 2,000-hour years instead, men's careers shortened from 54 to 40 (Figure 4, left panel). What is robust across measures is the negative finding: since 1950, men's careers have not lengthened as their lives have. For all Americans no rule dominates, because women's entry into paid work raised years worked alongside lifespan until about 1990 (Figure 4, right panel); years worked by all Americans rose from 31 to 37 between 1950 and 1990 and then stopped rising. The projections below hold the age profile of hours fixed at its 2005 shape and report a variant in which retirement moves with longevity. Neither FTE years nor years at contemporary full-time schedules directly count years between first employment and retirement. A fixed age profile also changes lifetime hours when survival improves, so it is not literally a fixed-career rule.

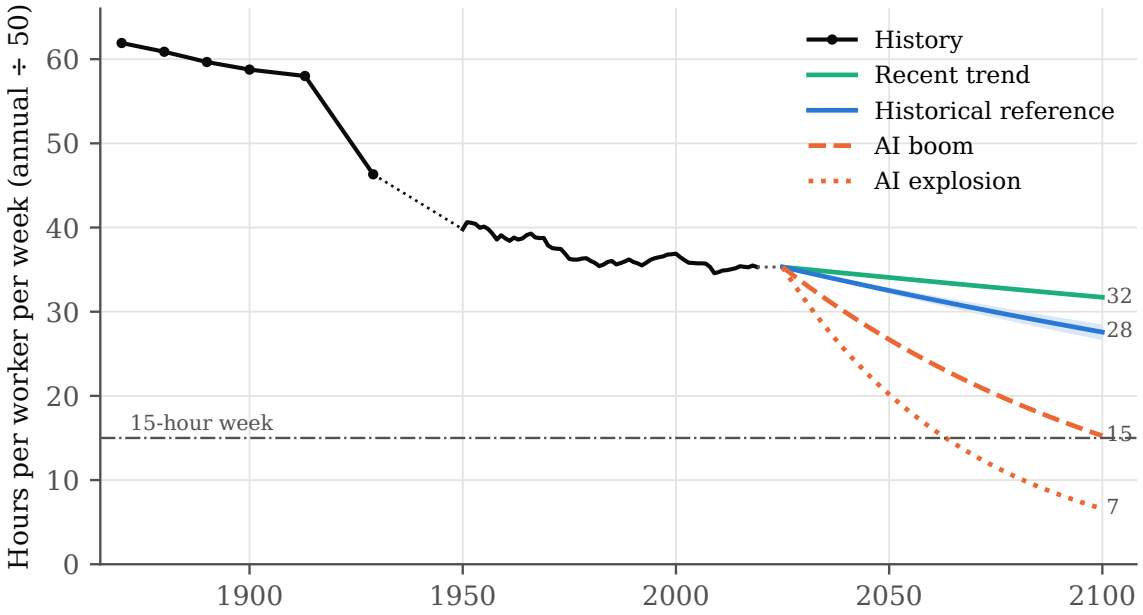
8. Conditional Scenarios to 2100

8.1 Hours per Worker

Each scenario pairs productivity growth g with an elasticity ε, and sets hours per worker to $h_t = h_{2025}\, e^{\varepsilon g (t-2025)}$. Here h_{2025} is 1,765 hours, the 2019 PWT level, as a normalization rather than an estimate from 2025 data. Weekly hours are annual hours divided by 50 weeks as a presentation convention, which gives 35.3 hours in 2025; on a 52-week basis the figure is 33.9, numerically close to the BLS payroll-survey average. The concepts differ: PWT annual hours include a different worker population and annual absences, so this numerical agreement is not a validation of the conversion. The 15-hour week corresponds to 750 hours a year on the 50-week convention. The scenarios are:

- *Recent trend*: $g = 1.5$ percent, $\varepsilon = -0.095$ (United States since 1950).

Figure 5
Weekly Hours per Worker: History and Scenarios, United States



Source: History as in Figure 1; scenarios from the model in Section 8. *Note:* Hours are assumed flat from 2019 to 2025. The shaded band around the historical reference scenario is the 90 percent country-bootstrap interval for the descriptive ratio in Table 2. Numbers at the right are weekly hours in 2100.

- *Historical reference*: $g = 2.1$ percent (US average since 1890), paired with the 19-country elasticity since 1950, $\varepsilon = -0.16$, which is larger than the US estimate.
- *AI boom*: $g = 3$ percent, above any 75-year US precedent, with $\varepsilon = -0.37$ (the pooled 1890–1929 estimate, which includes the 1913–29 shorter-hours movement).
- *AI explosion*: $g = 6$ percent, with the same elasticity.

All four keep the wage channel: wages grow with productivity and the labor share of household income is stable. They describe less-labor outcomes of differing speed, not a post-labor transition.

On the post-1950 US trend, hours per worker are 34 a week in 2050 and 32 in 2100 (Figure 5 and Table 8). On the historical reference path, they are 32.5 and 28. The 90 percent bootstrap interval for ε translates into 26.7 to 28.5 hours in 2100 (shaded band in Figure 5). This interval describes variation from resampling the selected countries, not uncertainty about whether the elasticity will remain stable, which Section 5 shows to be the larger uncertainty. A purely statistical forecast, which extrapolates the post-1975 trend with autoregressive errors and parameter uncertainty, gives 32.5 to 34.7 hours in 2100 (10th to 90th percentiles). The 15-hour week arrives around 2100 in the AI boom and around 2065 in the AI explosion.

Table 8
Scenarios for the United States, 2050 and 2100

	Recent trend	Historical reference	AI boom	AI explosion
Productivity growth g (percent a year)	1.5	2.1	3.0	6.0
Elasticity ε	−0.095	−0.16	−0.37	−0.37
Hours a week, 2050	34.1	32.5	26.7	20.2
Hours a week, 2100	31.7	27.6	15.3	6.6
FTE years of lifetime work, 2050	33.8	32.3	26.5	20.1
FTE years of lifetime work, 2100	32.6	28.3	15.7	6.8
Share of life worked, 2050 (%)	11.3	10.8	8.8	6.7
Share of life worked, 2100 (%)	9.9	8.6	4.8	2.1
15-hour week arrives	after 2500	about 2285	about 2100	about 2065

Source: Author's calculations. *Note:* In 2025 weekly hours are 35.3, FTE years 34.4 and the share of life worked 12.0 percent. All scenarios share one lifespan path: expected age at death at 15 rises from 79.4 in 2025 to 82.5 in 2050 and 88.9 in 2100, and expected years lived after 65 from 16.8 to 19.5 and 25.0. Lifetime measures apply the 2005 age-and-sex profile of hours per person, scaled by hours per worker relative to 2005, to the projected survival curves. The year of the 15-hour week extrapolates each path; dates beyond 2100 indicate orders of magnitude only.

Table 9
Weekly Hours per Worker in 2100 under Alternative Growth Rates and Elasticities

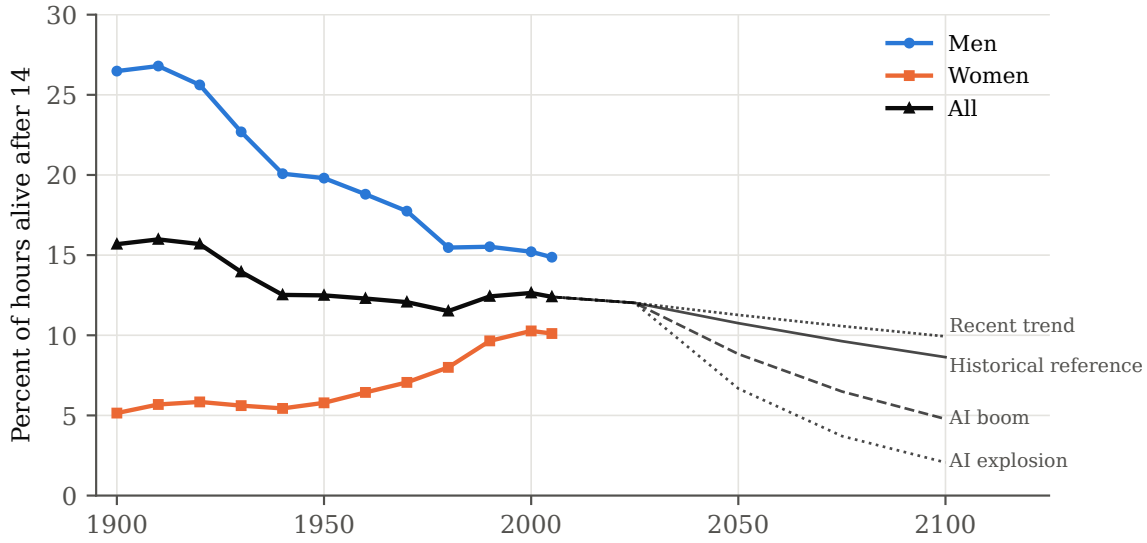
Productivity growth	$\varepsilon = -0.05$	-0.10	-0.16	-0.26	-0.37	-0.53
1.5 percent	33.4	31.6	29.5	26.4	23.3	19.4
2.1 percent	32.6	30.2	27.4	23.4	19.7	15.3
3.0 percent	31.6	28.2	24.6	19.7	15.4	10.7
6.0 percent	28.2	22.5	17.2	11.0	6.7	3.3
Productivity growth needed to halve hours in 25 years	55.5	27.7	17.3	10.7	7.5	5.2

Source: Author's calculations. *Note:* Weekly hours are annual hours divided by 50, starting from 35.3 in 2025. The last row applies equation (3) with $T = 25$. Column elasticities are rounded, so entries differ slightly from Table 8.

Table 9 makes the requirements explicit. A 15-hour week in 2100 needs growth of 2.2 percent with the 1913–29 elasticity, or 3.1 percent with the pooled pre-1930 elasticity. At the post-1950 elasticities of -0.10 to -0.16, it would require productivity growth of 7 to 11 percent a year for 75 years, and at an illustrative coefficient of -0.05, more than 20 percent.

How much of the hours trend belongs to productivity? Table 9 varies the coefficient but assumes every projected change is proportional to productivity. A different exercise preserves the same reference decline at 2.1 percent growth and writes $\Delta \ln h = \alpha + \beta g$, choosing $\alpha = (\varepsilon_{ratio} - \beta) \times 0.021$. For $\beta = -0.157$, -0.09 or zero, all paths reach 27.6 hours in 2100

Figure 6
Share of Life after 14 Spent in Paid Work, United States, 1900–2100



Source: Author's calculations. *Note:* History from Table 5. Scenarios from 2005 use the 2005 age profile of hours per person, scaled by hours per worker, with projected survival.

at reference growth. With 6 percent growth, they instead reach 17.4, 21.2 and 27.6 hours (Appendix Table A7). These are calibrated alternatives, not three fitted structural models, but the middle one is close to what the within-country regressions say: across the panel, the fixed-effects slope of −0.09 leaves an average decline of 0.19 percent a year unexplained by productivity, close to half the average decline of 0.41 percent. Agreement about the historical trend therefore need not imply agreement about the effect of faster growth, and the data lean toward the smaller effect. The 6.6-hour AI-explosion path additionally assumes the stronger pre-1930 coefficient. Its large decline therefore combines faster growth with a change in the relationship between growth and working time.

8.2 Lifetimes

The lifetime projections start from the 2023 life tables and assume that expected ages at death at 15 and 45 improve at the average of the men's and women's linear trends for 1980–2014: 0.13 years a year at 15 and 0.11 at 45. Using a common pace avoids projecting that men overtake women. The trends are applied from 2023, so the stall in US longevity after 2014 lowers the starting level but not the pace.

Under the historical reference path, lifetime paid work falls from 34 FTE years in 2025 to 28 in 2100, and the share of life after 14 spent in paid work falls from 12.0 to 8.6 percent (Figure 6 and Table 8). Of the 3.4-point fall, 2.5 points come from shorter hours and 0.9 from longer lives, by the same two-factor decomposition as in Table 6. Three sensitivity checks explore the result. If longevity stalls at its 2023 level, the 2100 share is 9.4 percent. If longevity improves

50 percent faster than assumed, it is 8.3 percent. If retirement ages rise one for one with adult lifespan, shifting the 55–64 and 65+ bands of the hours profile by the gain in life expectancy at 45 (10 years by 2100), lifetime paid work falls only to 33 FTE years and the share only to 10.1 percent. These values are sensitivity checks within one age-profile model, not an uncertainty interval. They omit changes in participation, health at older ages, sex differences and the age pattern of AI displacement. The denominator also includes sleep and all other time alive: an 8.6 percent paid-work share does not mean that 91.4 percent of waking time is leisure.

8.3 What Past Forecasts Can Establish

Appendix Table A5 illustrates why prominent claims about shorter working time need different evaluations. Predictions about technical feasibility, policy proposals, scenarios, dated forecasts and statements without deadlines should not be assigned a common success score. Nor can a selected list of famous misses estimate forecasters' accuracy: memorable predictions are not a sampling frame, and the relevant denominators and definitions of a working week differ.

The observed workweek remains far from Keynes's fifteen-hour benchmark. That cautions against moving directly from technical capability to aggregate working time. It does not refute a new mechanism of displacement. Frey and Osborne's (2017; working paper 2013) estimate of occupations susceptible to computerization, for example, is not a prediction that the same share of aggregate employment would disappear: adoption, new tasks, demand and occupational change intervene. Likewise, a conditional extrapolation built to preserve the historical relationship cannot adjudicate a forecast whose premise is that the relationship breaks.

9. Affluent Leisure or Displacement?

9.1 Two Kinds of Transition

A transition away from paid work should be judged by work and living standards together. Fewer hours with rising consumption, secure income and wider ownership describe affluent leisure. Fewer hours with lower earnings, unmet demand for work and falling consumption describe displacement. The two can look alike in hours per worker, and average productivity or the aggregate labor share alone cannot tell them apart: capital income can become more concentrated, and a stable aggregate labor share can coexist with severe losses for particular workers.

The model of Section 2 puts numbers on the first kind. **Income composition.** BEA compensation of employees fell from 72 percent of personal income in 1970 to 62 percent in 2019, while transfer receipts rose from 8 to 17 percent (BEA 2026). Feeding that change into equation (2), with $\sigma = 1.57$ and $\eta = 0.5$, gives hours about 6 percent lower than otherwise. Excluding

transfers from the denominator gives about 2 percent; adding proprietors' income to labor income changes little. These are illustrations, not estimates: most of the rise in transfers went to retirees through Social Security and Medicare, so it changed the composition of income across households more than within working households, and excluding transfers does not construct a working-age sample. The order of magnitude is the point. Half a century of change in income composition is consistent with hours a few percent lower, not with a transformation of working life.

The scale of a financed hours reduction. At the same calibration, halving voluntarily chosen hours with the wage unchanged requires s to fall from 0.62 to about 0.13. The identity $c = wh/s$ then implies consumption about 2.4 times as high and nonlabor income about 5.5 times as high. The share change is the outcome of that increase in resources, not a lever that can be moved on its own. With a Frisch elasticity of 1, calibrated to the same -0.16 wage association, the required share is 0.19 and nonlabor income rises about 3.5-fold. Across the full parameter grid, the share needed ranges from 0.09 to 0.23 and the rise in nonlabor income from 2.8- to 7.9-fold (Appendix Table A8). A voluntary post-labor transition, in other words, is a transition in which households come to own, or be granted, claims on output several times larger than all their current nonlabor income.

Displacement needs no financing. The second kind of transition requires no such resources. If the job-availability constraint $h \leq \bar{h}$ binds and $\bar{h}$ falls, realized hours fall whatever households want, and income falls with them unless transfers or capital income compensate. For a household living on wages with $\sigma > 1$, a lower wage *raises* desired hours. That is the model's sharpest warning about the horse analogy: if AI lowered the value of human labor without anyone receiving the income labor used to earn, households that live on wages would not drift into leisure. They would want to work more, find less work, and consume less.

These two cases leave different signatures on four margins, each measured in published data:

1. *Schedules or jobs.* Affluent leisure shortens the hours of people who work, through shorter standard weeks and longer holidays, while jobs remain available. Displacement leaves the schedules of the employed roughly unchanged and lowers the share of people with jobs, with rising unemployment and involuntary part-time work.
2. *The ages at which work falls.* Rich countries have taken most of their additional nonwork at the ends of life, in schooling and retirement (Section 7). Displacement would reach the prime working ages, and it would appear first among labor market entrants, because firms can cut hiring before they cut incumbent employment.
3. *Pay and factor shares.* Affluent leisure requires that productivity gains reach the pay of typical workers or their nonlabor income. Displacement shows up as a falling labor share and stagnant typical pay while output per hour rises.

4. *Household resources.* Affluent leisure appears as rising real disposable income and consumption alongside a falling share of income from work. Displacement lowers the incomes and consumption of the households that lose work.

A sustained fall in hours per working-age person across many countries at once, faster than the 1 percent a year that only a fifth of national decades have seen (Table 4), would be the aggregate sign that something has changed; the four margins say which kind of change it is. For comparison, the per-person ratio in Appendix Table A10 implies a decline of about 0.2 percent a year at 2 percent productivity growth, and even the steepest within-country slope about 0.6 percent. The 1-percent threshold is a monitoring convention, not a statistical test, and it should be applied after removing changes in age composition: an aging population lowers work per adult without any change in the availability of jobs. For one country over a few years, a sharper benchmark is each indicator's own history: how often a change as large as the one observed occurred over comparable windows before.

9.2 The Record since 2019

The historical panel ends in 2019. The US statistical agencies publish most of the indicators above quarterly or monthly, so the first years of generative AI can be read against the benchmark directly. Table 10 compares 2019–25 with the decade of the late-1990s productivity boom and with 2005–19, using BLS productivity and labor force data and BEA income data. Table 12 compares each 2019–25 change with every six-year change in the same series since 1948, and splits the period since 2019 at the release of ChatGPT in November 2022. Productivity and hours here cover the nonfarm business sector, not the whole economy as in PWT, so the comparison with the historical estimates concerns growth rates and ratios, not levels.

Read against the signatures of Section 9.1, the record since 2019 shows continuity in working time, employment and pay, and unusual levels in the division of income and the hiring of young adults.

Productivity and hours per worker are within their historical range. Output per hour grew 2.16 percent a year over 2019–25, above 2005–19 but below 1995–2005 and close to the median six-year change since 1948 (Table 12). The path was uneven: a jump in 2020, as less productive jobs disappeared, a fall in 2022, and growth of 2.48 percent a year from the fourth quarter of 2022 to the second quarter of 2026, against 1.53 percent in the three years before. Annual comparisons that start in 2022 begin from a trough and overstate the acceleration. Hours per worker fell 0.31 percent a year over 2019–25, a ratio of -0.14; on quarterly data the ratio is -0.11 before and -0.09 after the fourth quarter of 2022. Applied to the realized 2019–25 productivity growth, the US post-1950 coefficient would have predicted a decline of 0.21 percent a year, the cross-country coefficient 0.34 percent, and the pooled pre-1930 coefficient used in the AI scenarios 0.80 percent. Nearly a third of six-year windows since 1948 saw hours per worker fall faster. Weekly hours of private-sector employees in the payroll survey

Table 10
The US Record since 2019 and Two Earlier Periods

	1995–2005	2005–2019	2019–2025	
Panel A. Annual log change (percent)				
Output per hour, nonfarm business	2.95	1.45	2.16	
Hours per worker, nonfarm business	−0.23	−0.09	−0.31	
Ratio of hours to productivity growth	−0.08	−0.06	−0.14	
Real compensation per hour, nonfarm business (PCE deflator)	2.31	0.98	1.61	
Real hourly earnings, production and nonsupervisory employees (CPI)	0.77	0.77	0.95	
Real hourly earnings, production and nonsupervisory employees (PCE deflator)	1.32	1.04	1.40	
Labor share, nonfarm business	−0.27	−0.31	−0.58	
Hours per person aged 16 and over	−0.42	−0.27	−0.48	
Employment per person aged 16 and over	−0.03	−0.22	−0.28	
Real disposable income per person	2.26	1.48	1.91	
Panel B. Levels	*2019*	*2023*	*2025*	*2026*
Employment rate, ages 25–54 (%)	80.0	80.7	80.6	80.6
Employment rate, ages 20–24 (%)	67.3	66.6	65.4	65.7
Unemployment rate, all (%)	3.7	3.6	4.3	4.2
Unemployment rate, ages 20–24 (%)	6.7	6.6	8.3	7.2
Part time for economic reasons (% of employed)	2.8	2.5	2.9	2.9
Compensation of employees (% of personal income)	62.3	60.2	59.6	
Transfer receipts (% of personal income)	16.8	17.5	18.3	
Labor share, nonfarm business (index, 2017 = 100)	100.0	96.4	96.6	94.1

Source: Author's calculations from BLS Productivity and Costs (series OPHNFB, PRS85006023, HOANBS, PRS85006173, COMPNFB), Current Employment Statistics (AHETPI) and Current Population Survey (CNP16OV, CE16OV, LNS12300060, LNS11300036, LNS14000036, LNS12032194, UNRATE), and BEA (personal income, PCE price index, real disposable income per capita), via FRED (BEA 2026; BLS 2026). *Note:* Annual averages of monthly or quarterly data. The 2026 column averages January–September for monthly series and the first two quarters for quarterly ones (in the October 2026 FRED vintage, October 2025 is missing in the CPS monthly series and CPI). Average hourly earnings exclude employer-paid benefits; both CPI and PCE deflators are shown for production workers, as in Table 3. In Panel B the columns are years, not periods. The employment rate of 20- to 24-year-olds is the participation rate times one minus the unemployment rate (both seasonally adjusted). Hours per person aged 16 and over divides nonfarm business hours (HOANBS) by the civilian noninstitutional population (CNP16OV); it differs slightly from the sum of nonfarm business hours per worker and CPS household employment per person aged 16 and over because nonfarm business establishment jobs per adult (-0.17 percent a year over 2019–25) grew 0.11 percentage points a year faster than CPS household employment (-0.28 percent a year).

Table 11
Accounting for the Gap between Productivity and Pay and for the Fall in Employment, United States

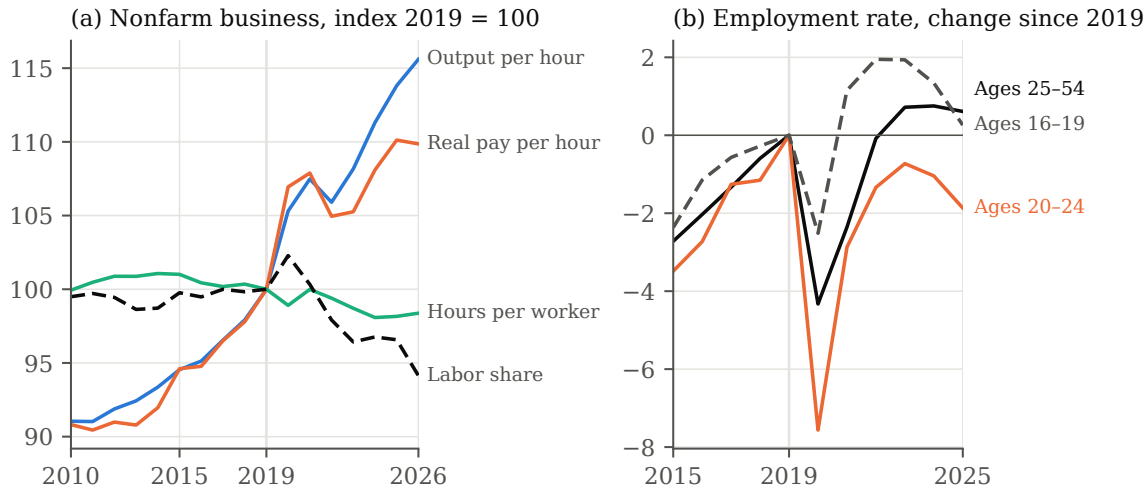
	1995–2005	2005–2019	2019–2025
Panel A. Productivity minus real pay (*percentage points a year*)			
Output per hour minus real compensation per hour	0.64	0.47	0.55
From the fall in the labor share	0.27	0.31	0.58
From consumer prices relative to output prices	0.37	0.16	−0.03
Output per hour minus real hourly earnings of production workers	1.63	0.41	0.75
Of which, compensation relative to hourly earnings	0.99	−0.06	0.20
Panel B. Change in the employment rate, ages 16 and over (*percentage points*)			
Total	−0.21	−1.91	−1.04
Within age groups	0.18	1.20	0.08
Age composition	−0.39	−3.11	−1.12

Source: Author's calculations from BLS Productivity and Costs (OPHNFB, COMPNFB, PRS85006173, IPDNBS), Current Employment Statistics (AHETPI), the Current Population Survey (employment and population by age; BLS 2026) and the PCE price index (BEA 2026). *Note:* Panel A: annual log changes; real pay uses the PCE deflator. Because the labor share is nominal compensation divided by nominal output, output per hour minus real compensation per hour equals the fall in the labor share plus the rise of the PCE price index relative to the nonfarm business output deflator; the two rows sum to the first up to rounding. The production-worker gap adds the growth of compensation per hour relative to average hourly earnings, which reflects benefits, sector coverage and composition. Panel B: shift-share over five age groups (16–19, 20–24, 25–54, 55–64, 65 and over), from annual averages of employment and population levels not seasonally adjusted. The within term weights each group's change in employment rate by its average population share; the composition term weights each group's change in population share by its average employment rate.

were 34.4 in 2019, 34.4 in 2023 and 34.2 in 2025. Part of the measured decline in hours per worker reflects the changing composition of employment after the pandemic.

Work per adult fell because the population aged. Hours per person aged 16 and over fell 0.48 percent a year, and the employment rate of that population fell 1.0 point between 2019 and 2025. Panel B of Table 11 splits the change across five age groups. Had each group kept its 2019 share of the population, the employment rate would have risen by 0.1 point; the shift of the population toward ages 65 and over lowered it by 1.1 points (a drag of 0.31 percent a year). Removing that demographic drag leaves age-adjusted hours per adult falling only 0.16 percent a year on the nonfarm business margin and 0.28 percent a year on the CPS margin, well inside the 1-percent-a-year monitoring threshold of Section 9.1. Employment rates rose at ages 25–54 (from 80.0 to 80.6 percent, within a point of the 2000 peak) and 55–64, and fell at 20–24 and 65 and over. Involuntary part-time work is roughly unchanged (2.8 percent of employment in 2019, 2.9 percent in 2025). The decline in work per adult is the life-cycle margin of Section 7 at work, not a sign that jobs became scarce. The CPS population controls are revised each January without revising earlier months, which adds noise to the population shares.

Figure 7
The US Record since 2019



Source: BLS Productivity and Costs and Current Population Survey, via FRED; BEA PCE price index. *Note:* Panel (a): annual averages through 2026 H1, nonfarm business sector, 2019 = 100; real pay is hourly compensation deflated by the PCE price index (using first-half PCE prices for 2026 to match the two available quarters of nominal compensation). Panel (b): change in the employment rate since 2019, percentage points, from annual averages of CPS employment and population levels not seasonally adjusted (full years only).

Pay rose, and labor's share fell to a record low. Real compensation per hour grew 1.61 percent a year over 2019–25, and real hourly earnings of production workers 1.40 percent (0.95 percent with the CPI), faster than in 2005–19; compensation grew faster than in most six-year windows since 1959. Both grew more slowly than output per hour, and Panel A of Table 11 shows why. Before 2019 a large part of the gap between productivity and pay reflected prices (Feldstein 2008): consumer prices rose faster than the prices of business output, accounting for 0.37 of the 0.64-point gap in 1995–2005 and 0.16 of the 0.47-point gap in 2005–19. Since 2019 that wedge has vanished, and the fall in the labor share accounts for the whole gap. The labor share fell 0.58 percent a year over 2019–25, roughly twice its pace in the two earlier periods.

Three facts put that fall in proportion. First, the pace has precedents but the level does not. A fifth of six-year windows since 1948 saw a decline at least as fast, and the share fell 1.13 percent a year in 2000–06 (Table 12). But in the second quarter of 2026 the index stood at 93.4 (2017 = 100), its lowest since the series began in 1947, and 15 of the 17 quarters since the second quarter of 2022 have been below the lowest pre-2019 value. Second, the timing. The annual index fell from 100.3 in 2021 to 96.4 in 2023, during the inflation surge; on quarterly data, about half of the fall from the fourth quarter of 2019 to the second quarter of 2026 had occurred by early 2023. The share then stayed between 96 and 98 for two and a half years after ChatGPT's release, and has fallen in every quarter since the first quarter of 2025, to 93.4. Only this last leg coincides with widespread adoption of generative AI, and its quarters will

be revised. Third, the broader BEA measure of compensation as a share of gross domestic income, which covers the whole economy, was 42.0 percent in 2025: equal to its 2013 low, not below it. The post-2019 data extend the decline that began around 2000, and that the literature attributes to cheaper capital goods, offshoring, concentration and intangible capital, rather than start a new one. Compensation fell from 62.3 to 59.6 percent of personal income. Through equation (2), that shift corresponds to hours about 2 percent lower, small next to the factor of five a financed halving of hours requires.

Young adults are doing worse than the business cycle explains. The employment rate of 20- to 24-year-olds fell from 67.3 to 65.4 percent between 2019 and 2025, while the prime-age rate rose 0.65 points. Before 2019, annual changes in the young-adult rate were 1.35 to 1.49 times those in the prime-age rate. Applied to the 2019–25 prime-age change, that relationship predicts a change of between -0.7 and $+1.0$ points, depending on the estimation period (from 1949, 1976 or 1990) and on whether a pre-2019 trend is allowed. The actual fall was 1.2 to 2.8 points larger. Applying each fitted relationship to every six-year window in its own sample shows how unusual that is. The shortfall is larger than any since 1990, a period in which six-year deviations had a standard deviation of 0.7 points, but shortfalls at least as large occurred in about a fifth of the windows in the samples from 1949 and 1976 (Table 12). Young adults' unemployment rose 1.6 points over 2019–25, against 0.8 to 0.9 points predicted from the 0.6-point rise in overall unemployment. Data for January–September 2026 show partial improvement, with employment at 65.7 percent and unemployment at 7.2 percent.

Teenagers provide a placebo. They are also labor market entrants, but mostly in jobs, such as retail and food service, that generative AI does little to automate. Over 2019–25 as a whole their employment rate rose 0.3 points, inside the range predicted by the same cyclical benchmark, so the six-year shortfall is specific to the 20–24 group, which includes new college graduates entering white-collar occupations (Figure 7, panel b). From 2023 to 2025, however, teenagers' employment fell 1.7 points, more than the 1.1-point fall for 20- to 24-year-olds, while the prime-age rate was flat. Part of the recent weakness is therefore a general slowdown in hiring newcomers, not a pattern confined to AI-exposed work. The firm-level evidence is also mixed. Brynjolfsson, Chandar, and Chen (2025, revised 2026) report that employment of 22- to 25-year-olds in AI-exposed occupations is 19 percent below a comparison path based on less-exposed peers, mainly through weaker hiring; they describe the patterns as early descriptive indicators. Humlum and Vestergaard (2025, revised 2026) find effects on Danish earnings and recorded hours close to zero over the early adoption period, alongside task reorganization. Aggregate data cannot attribute the shortfall to AI: school enrollment, immigration and the population controls also move this age group.

Both exceptions admit two readings. On the first, they are the early signature of task substitution (Acemoglu and Restrepo 2018, 2019): generative AI takes over tasks done by entrants, which slows their hiring, while it complements experienced workers and raises the share of

Table 12
The US Record since 2019 against Its Own History

	2019–2025	Windows as low or lower (%)	Median window
Panel A. 2019–25 against all six-year windows, 1948–2019			
Output per hour, nonfarm business (% a year)	2.16	58	2.08
Hours per worker, nonfarm business (% a year)	−0.31	32	−0.15
Real compensation per hour, PCE deflator (% a year)	1.61	62	1.22
Labor share, nonfarm business (% a year)	−0.58	20	−0.17
Employment rate, ages 25–54 (points)	0.65	35	1.69
Employment rate, ages 20–24, relative to the cycle (points)	−1.2 to −2.8	0 to 23	
Employment rate, ages 16–19, relative to the cycle (points)	−0.7 to 3.3	83 to 96	
Panel B. Before and after ChatGPT, quarterly data (% a year)	*2019 Q4–2022 Q4*	*2022 Q4–2026 Q2*	*2019 Q4–2026 Q2*
Output per hour, nonfarm business	1.53	2.48	2.04
Hours per worker, nonfarm business	−0.17	−0.21	−0.19
Ratio of hours to productivity growth	−0.11	−0.09	−0.09
Real compensation per hour, PCE deflator	1.09	1.46	1.29
Real hourly earnings, production workers, PCE deflator	1.30	1.03	1.16
Labor share, nonfarm business	−0.91	−1.04	−0.98

Source: Author's calculations from BLS Productivity and Costs, Current Employment Statistics and Current Population Survey, and the BEA PCE price index, via FRED (BEA 2026; BLS 2026). *Note:* Panel A: the second column is the percentage of overlapping six-year windows (start years 1948–2013; 1959–2013 for compensation, which needs the PCE price index) in which the change was no larger than in 2019–25; the third column is their median. Rows relative to the cycle report the deviation of the 2019–25 change from the six cyclical benchmarks described in the text (negative values are shortfalls) and the percentage of six-year windows in each benchmark's estimation sample with a deviation at least as low: 0 for the benchmarks fitted from 1990, 20 to 23 for those fitted from 1949 and 1976. Teenagers are compared with the prime-age rate computed on the same basis, from CPS levels not seasonally adjusted. Panel B: changes between quarterly values, with monthly series averaged by quarter; ChatGPT was released on November 30, 2022.

income paid to capital, including software. On the second, they reflect forces unrelated to AI: the inflation of 2021–23, during which prices outran wages; the tightening of monetary policy after 2022, which falls hardest on hiring; and the decline in the labor share since 2000, which preceded generative AI. The timing gives each reading something. About half of the fall in the labor share came before chatbots were in wide use, the share then held steady for two years, and teenagers' hiring weakened alongside young adults'; but the newest fall in the labor share, since early 2025, is not yet explained, and young adults have lagged teenagers since 2019. The accounting narrows the field, because it rules out a price-index explanation for the recent gap between productivity and pay, but it cannot choose between these read-

ings. What it does show is where the change is happening. On the four margins of Section 9.1, schedules and age-adjusted employment are inside the historical envelope, involuntary part-time work is flat, and real disposable income per person has grown 1.9 percent a year. What is unusual is the division of output between labor and capital and the hiring of entrants. In the model of Section 2, the first of these is the margin that decides whether a future reduction in work would be affluent or impoverishing.

9.3 The Horse Analogy

Leontief's analogy correctly emphasizes derived demand: firms employ labor when it helps produce what someone wants to buy, and being human does not guarantee that one's labor remains competitive. Where the analogy fails is on the other side of the market. A draft animal is a pure input: it owns no capital, receives no transfers, buys nothing and has no vote. In the notation of equation (2), its nonlabor income is zero and its consumption is chosen by its owner. When the tractor made horse labor uneconomic, nothing obliged anyone to maintain horses. Human consumption need not be financed by labor income alone. Ownership, pensions, transfers and public services can sustain access to output as employment declines, and the United States built Social Security and Medicare within living memory.

That is a possibility, not a guarantee. Being a consumer or a voter does not ensure an adequate claim on output. Owners could receive most of the gains while displaced workers lose purchasing power, and aggregate demand could be sustained by owners' consumption, investment and public spending without restoring every former worker's income. The relevant precedent for the affluent case is retirement, which rising incomes, saving and public institutions turned from a rarity into a normal stage of life: 78 percent of American men aged 65 and over were in the labor force in 1880, and 18 percent in 1990 (Short 2002; Costa 1998; Lee 2001). Retirement shows that sustained nonwork with income is feasible for one stage of life. Extending it to much of working-age life would change the tax base, the ownership of productive assets and the financing of transfers. Labor demand determines whether paid work ends; these distributional arrangements determine whether its end would be prosperous or impoverishing.

10. Conclusion

The data of the past 150 years describe an economy in which the labor required per unit of output falls steadily, about 2 percent a year, while working time falls far more slowly. Shorter hours per worker absorbed less than a tenth of US productivity growth after 1950, and rising employment left paid hours per American slightly higher in 2019 than in 1950. The large reductions in working time came in one institutional wave, between 1913 and 1950. Outside it, hours per worker have fallen with productivity at a ratio of roughly -0.1 in the United States and -0.2 across rich countries, and the largest declines in work per person since 1950 came

in unemployment crises, demographic shifts and legislated cuts in standard hours. Over the life cycle, longer survival raised lifetime paid work less than lower work at each age reduced it, so American men's synthetic careers shortened while their lives lengthened. Counting unpaid work as well, Americans aged 25–54 worked about as many hours a week in 2005 as in 1900; the reductions in work came at the start and end of adult life.

These regularities make gradual reduction the benchmark. Carried forward, the post-1950 association gives about 28 weekly hours in 2100 and paid work in 9 percent of life after 14, against 35 hours and 12 percent today. A fifteen-hour week by 2100 would need growth above any US precedent and a new institutional movement for shorter hours. The benchmark is not a causal elasticity, and it cannot rule out a change in the demand for human labor: it was measured while that demand persisted.

The paper's framework identifies what a break would look like. A voluntary post-labor transition requires households to command nonlabor resources several times larger than today's. An involuntary one requires only that work disappear, and would show up as falling hours per working-age person, falling pay for typical workers and a collapsing labor share with output still rising. Through mid-2026, US productivity, hours per worker, age-adjusted employment and real pay are unremarkable against their own postwar history. Two levels are unusual. The nonfarm business labor share is at a record low, and its fall accounts for the entire gap between productivity and pay since 2019, although its pace has precedents and about half of the fall came during the inflation of 2021–23. Young adults' employment has fallen further than the business cycle explains, by more than in any six-year period since 1990, although teenagers' hiring has also weakened since 2023. Neither establishes displacement, but both lie on the margins where displacement would appear first. In the model, rising wages shortened hours in the past largely because households' nonlabor income rose alongside them; productivity gains that accrue to capital most households do not own would finance neither shorter hours nor higher consumption for those households. Whether AI brings more leisure or more insecurity will depend less on what it can produce than on who receives what it produces. That is a question about institutions, and the data to answer it arrive every quarter.

Data availability. All data are public. The replication package contains the raw series, the code that produces every number, table and figure, a script that rebuilds them and a script that checks the accounting identities and model solutions independently. The BLS and BEA series for 2019–26 are recent vintages and subject to revision. The statements in Appendix Table A5 are cited to their primary sources.

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Appendix

A. Data Construction and Additional Results

US hours per worker. Huberman and Minns (2007) report US benchmark estimates for 1870, 1880, 1890, 1900, 1913, 1929, 1938 and decennially from 1950 to 2000. The main series uses their values through 1929 and PWT 10.0 annual values from 1950 to 2019. Table A1 reports the annualized change between Huberman and Minns's US benchmarks, which define the consistent full-time series used in Sections 4 and 5.

Table A1

US Full-Time Hours: Annualized Change between Benchmarks (Percent a Year)

Interval	1870–80	1880–90	1890–1900	1900–13	1913–29	1929–50	1950–60	1960–70	1970–80	1980–90	1990–2000
Change	−0.17	−0.20	−0.15	−0.10	−1.41	−0.68	0.12	−0.46	−0.47	−0.07	0.20

Source: Huberman and Minns (2007). *Note:* 1938 is omitted; the 1929–50 change spans it.

Productivity. Bergeaud, Cette, and Lecat (2016) report GDP per hour in 2010 PPP dollars through 2016. For 2017–19 the US series is extended with the growth of PWT output per hour. The pre-1930 cross-country estimates in Table 2 pair Huberman and Minns's benchmark hours with Bergeaud, Cette, and Lecat's GDP per hour for the countries in both data sets (12 countries for 1870–90, 13 thereafter).

Panel variables. From PWT 10.0: hours per worker (*avh*), employment (*emp*), population (*pop*), real GDP at constant national prices (*rgdpna*) and the share of labor compensation in GDP (*labsh*). Output per hour is *rgdpna* divided by *emp* times *avh*; the robustness row in Table 2 uses the chained-PPP output per hour in the Our World in Data extract. GDP per capita is *rgdpna* divided by *pop*. Compensation per hour is *labsh* times *rgdpna* divided by *emp* times *avh*. Hours per person aged 15–64 divide *emp* times *avh* by the World Bank's population aged 15–64. Interpolated PWT hours are identified as country series with eight or fewer distinct annual log changes over 1951–75.

Table A2

Elasticity of Hours per Worker with Respect to Output per Hour, by Country, 1950–2019

Country	Ratio	Country	Ratio
Australia	−0.18	Japan	−0.07
Austria	−0.13	Netherlands	−0.20
Belgium	−0.16	New Zealand (1970–2019)	−0.08
Canada	−0.20	Norway	−0.22
Denmark	−0.23	Spain	−0.12
Finland	−0.11	Sweden	−0.14
France	−0.21	Switzerland	−0.22
Germany	−0.24	United Kingdom	−0.18
Ireland	−0.12	United States	−0.09
Italy	−0.10	All 19 countries	−0.16

Source: Author's calculations from PWT 10.0. *Note:* Sum of decade log changes in hours per worker divided by the sum of decade log changes in output per hour (real GDP at constant national prices divided by total hours).

Life tables. The Our World in Data compilation combines Hacker's (2010) decennial white-population life tables for 1790–1890 with US Social Security Administration life tables for 1900–2014, reporting expected ages at death at 15 and 45 by sex. Duplicated years in the source file are dropped. Because Ramey and Francis's series starts in 1900, the lifetime calculations use the Social Security Administration tables throughout (for each Ramey and Francis year, the nearest life-table year is used). The 2023 anchor uses NCHS life expectancy at 15 (61.5 for men, 66.7 for women) and at 45 (34.3 and 38.0) from Arias, Xu, and Kochanek (2025, Tables 2 and 3). The Gompertz parameters are found by solving the two moment conditions numerically; survival is integrated to age 130.

Lifespan projection. Linear trends in expected age at death at 15 and at 45, fitted for 1980–2014, give slopes of 0.174 (men) and 0.081 (women) years a year at 15, and 0.153 and 0.076 at 45. The projection applies their averages, 0.127 and 0.114, to both sexes from the 2023 anchor. A linear fit to expected age at death at 15 for both sexes over 1950–2023 gives a similar slope, 0.129 years a year ($R^2 = 0.98$).

Hours scenarios and trend forecast. The 2025 starting value, 1,765 hours, is PWT's 2019 value. The statistical trend forecast in Section 8 fits log hours on time for 1975–2019 with Newey–West standard errors and simulates 20,000 paths that combine parameter draws with AR(1) residuals (seed 0). The break-year intervals in Section 4 come from a moving-block bootstrap: residuals of the fitted kink model are resampled in blocks of five observations, the series is rebuilt and the break re-estimated, 999 times (seed 0).

Wages and household income. Real hourly earnings are BLS average hourly earnings of production and nonsupervisory employees divided by the CPI for all urban consumers or the PCE price index, annual averages of monthly data. Benefits-inclusive pay is BLS hourly compensation in the nonfarm business sector divided by the PCE price index. The labor share of household income in Section 9 is BEA compensation of employees received divided by personal income; the alternatives exclude transfer receipts from the denominator and add proprietors' income to the numerator.

Table A3

Decomposition of the Largest Ten-Year Declines in Work per Person (Percent a Year)

Episode	Denominator	Hours per person	From hours per worker	From employment rate
Spain, 1974–84	All persons	−3.60	−1.06	−2.54
Canada, 1951–61	All persons	−2.66	−0.60	−2.06
Finland, 1984–94	All persons	−2.41	−0.20	−2.21
Ireland, 2001–11	All persons	−2.20	−1.02	−1.17
Italy, 1961–71	All persons	−2.02	−0.80	−1.21
Spain, 1975–85	Persons 15–64	−3.93	−1.17	−2.76
Netherlands, 1973–83	Persons 15–64	−2.30	−1.36	−0.94
Finland, 1984–94	Persons 15–64	−2.22	−0.20	−2.02
France, 1976–86	Persons 15–64	−2.06	−1.36	−0.69
Ireland, 2001–11	Persons 15–64	−2.04	−1.02	−1.01

Source: Author's calculations from PWT 10.0 and World Bank (2026). *Note:* Annualized log changes; the two components sum to the total. The five largest declines for each denominator, one window per country. Netherlands hours before 1975 are interpolated in PWT.

B. Comparison with Other Estimates of Lifetime Work

Table A4

Lifetime Hours of Work: Estimates in the Literature and in This Paper

Estimate	Group	Year	Lifetime hours
Fogel (2000), including chores and commuting	US	1880	182,100
Fogel (2000)	US	1995	122,400
Fogel (2000), projection	US	2040	75,900
Ausubel and Grübler (1995)	UK men	1856	149,700
Ausubel and Grübler (1995)	UK men	1981	88,000
Ausubel and Grübler (1995)	UK women	1856	62,800
Ausubel and Grübler (1995)	UK women	1981	39,800
This paper, paid work from age 14	US men	1900	108,400
This paper, paid work from age 14	US men	2005	80,300
This paper, paid work from age 14	US women	1900	21,600
This paper, paid work from age 14	US women	2005	59,100
This paper, paid + unpaid home work from age 14	US men	1900	118,600
This paper, paid + unpaid home work from age 14	US men	2005	134,300
This paper, paid + unpaid home work from age 14	US women	1900	130,100
This paper, paid + unpaid home work from age 14	US women	2005	155,200

Source: Fogel (2000) as reported in Whaples (2001); Ausubel and Grübler (1995); author's calculations. *Note:* Definitions differ: Fogel includes chores and commuting, Ausubel and Grübler count working time of the employed population, and this paper counts market work (or market plus unpaid household work) per person from age 14 as measured by Ramey and Francis (2009). Lifetime market plus household hours rose between 1900 and 2005 because adult life lengthened by about 17 years; as a share of life after 14 they fell, from 29.0 to 24.9 percent for men and from 31.0 to 26.6 percent for women.

C. Different Kinds of Claims about the End of Work

Table A5

Selected Primary-Source Claims and the Appropriate Comparison

Source	Claim	Type and target	What the comparison can establish
Franklin, letter to Benjamin Vaughan, 1784	Four hours a day could provide material necessities and comforts if work and its proceeds were organized differently	Feasibility and distributional argument; no deadline	Not a dated forecast to be scored against a modern average workday
Keynes, 1930	Living standards four to eight times higher within a century, with a fifteen-hour week sufficient to meet remaining work needs	Long-run forecast and discussion of social adjustment; 2030	GDP per head rose 6.4-fold by 2016; hours remain much longer than fifteen. Deadline still pending in October 2026
Frey and Osborne, working paper 2013	About 47 percent of US employment in occupations classified as highly susceptible to computerization	Technical susceptibility; uncertain adoption horizon	Exposure is not a prediction of a 47 percent net fall in employment; aggregate employment alone cannot validate or reject the occupation-level classification

Source: Franklin to Vaughan, July 26–approximately August 15, 1784, Founders Online, National Archives (https://founders.archives.gov/documents/Franklin/01-42-02-0280); Keynes (1931; original 1930); Frey and Osborne (2017; working paper September 17, 2013, https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf). *Note:* The entries illustrate distinct propositions, not a sample from which a forecasting success rate can be estimated. Output, consumption possibilities, labor demand and realized working time are different outcomes.

D. Additional Accounting and Sensitivity Exercises

Table A6

Growth Accounting in Consistent PWT Data (Percent a Year)

Sample and interval	Output per person	Output per hour	Hours per worker	Employment per person	Hours per person	Hours-per-worker offset (% of productivity growth)
United States, 1950–2019	1.99	1.91	−0.17	0.25	0.08	9.1
United States, 1970–2019	1.83	1.62	−0.14	0.35	0.21	8.8
United States, 1975–2019	1.84	1.55	−0.06	0.35	0.29	3.9
All 19 countries (mean), 1950–2019	2.36	2.61	−0.41	0.15	−0.25	15.8
14 European countries (mean), 1950–2019	2.44	2.79	−0.46	0.11	−0.35	16.9
5 non-European countries (mean), 1950–2019	2.13	2.11	−0.25	0.27	0.02	12.6

Source: Author's calculations from PWT 10.0. *Note:* Annualized log changes (New Zealand starts in 1970). Output per person equals the sum of output per hour, hours per worker and employment per person, and hours per person equals hours per worker plus employment per person, up to rounding. The final column is the mean across countries of minus the hours-per-worker contribution divided by the productivity contribution (for the 19-country, European and non-European rows, the ratios of mean growth rates are 15.6, 16.6 and 11.9 percent; the corresponding offsets for total paid hours per person are 8.4, 12.5 and −3.1 percent). Productivity differs from the BCL-based series used for the long historical comparison.

Table A7

Weekly Hours in 2100 with Alternative Attributions of the Reference Hours Trend

Productivity coefficient β	Autonomous trend α (% a year)	Growth 2.1%	Growth 3%	Growth 6%
−0.157	0.00	27.6	24.8	17.4
−0.090	−0.14	27.6	26.0	21.2
0.000	−0.33	27.6	27.6	27.6

Source: Author's calculations. *Note:* All paths begin at 35.3 weekly hours in 2025. The autonomous trend α is calibrated so that each path matches the reference rate at 2.1 percent productivity growth. The alternatives are accounting scenarios, not separately estimated causal models.

Table A8

Resources Required to Halve Voluntarily Chosen Hours, and the Wage Response at Fixed Nonlabor Income

Wage elasticity ε	Frisch elasticity η	Required labor share	Consumption multiple	Nonlabor income multiple	Wage elasticity at fixed nonlabor income
−0.05	0.5	0.09	3.31	7.90	0.10
−0.05	1.0	0.17	1.87	4.11	0.19
−0.10	0.5	0.11	2.83	6.63	0.06
−0.10	1.0	0.18	1.76	3.82	0.14
−0.16	0.5	0.13	2.42	5.54	0.01
−0.16	1.0	0.19	1.65	3.53	0.08
−0.26	0.5	0.16	1.96	4.35	−0.08
−0.26	1.0	0.21	1.50	3.14	−0.03
−0.37	0.5	0.19	1.65	3.53	−0.19
−0.37	1.0	0.23	1.38	2.80	−0.15

Source: Author's calculations from the illustrative household model. *Note:* Initial labor share is 0.62, the wage is unchanged, and σ is calibrated from ε and η. The required share is 0.62 times 0.5 raised to the inverse of the share coefficient. Consumption and nonlabor income follow from the budget identity. The last column is $(1 - \sigma s)/(1/\eta + \sigma s)$ at $s = 0.62$, the response of desired hours to the wage when nonlabor income does not grow. At $s = 0.75$ (compensation over personal income excluding transfers, 2019) the corresponding values are 0.05, 0.09, 0.00, 0.04, −0.06, −0.02, −0.15, −0.12, −0.26 and −0.24. Assumes an unconstrained interior hours choice; these are neither estimates of an AI effect nor requirements for involuntary displacement.

Table A9

Age Contributions to the Change in Lifetime Paid Work from 1900 to 2005 (FTE Years)

Age band	Men: hours profile	Men: survival	Women: hours profile	Women: survival
14–17	−2.73	+0.01	−0.97	+0.00
18–24	−3.73	+0.16	+0.61	+0.08
25–54	−8.74	+4.80	+12.83	+2.08
55–64	−3.37	+2.84	+2.46	+1.17
65+	−7.13	+3.84	−0.60	+1.04

Source: Author's calculations using the same two-factor decomposition as Table 6. *Note:* Each age band's hours contribution is its change in weekly hours per person times the mean of initial and final expected years in that band, times 52.18, divided by 2,000. Survival contributions use the corresponding change in years times mean weekly hours. Columns sum to the aggregate components before rounding. Age bands do not identify particular institutions or individual transitions into schooling or retirement.

Table A10

Elasticity of Hours per Person with Respect to Productivity and Income, 19 Countries

Outcome and estimator	Output per hour	GDP per capita
Hours per person, 1950–2019 (131 country-decades)		
Decade differences, country fixed effects	−0.20 (0.06)	0.04 (0.08)
Decade differences, country and decade fixed effects	−0.19 (0.13)	0.35 (0.06)
Ratio of cumulative changes	−0.10 [−0.13, −0.07]	−0.11 [−0.15, −0.08]
Hours per person aged 15–64, 1960–2019 (113 country-decades)		
Decade differences, country fixed effects	−0.28 (0.04)	−0.10 (0.09)
Decade differences, country and decade fixed effects	−0.32 (0.09)	0.16 (0.10)
Ratio of cumulative changes	−0.11 [−0.13, −0.08]	−0.12 [−0.15, −0.09]
For comparison: hours per worker, 1950–2019 (Table 2)		
Decade differences, country fixed effects	−0.09 (0.03)	−0.02 (0.04)
Ratio of cumulative changes	−0.16 [−0.18, −0.14]	−0.17 [−0.20, −0.15]

Source: Author's calculations from PWT 10.0 and World Bank (2026). *Note:* Hours per person is total hours worked (employment times hours per worker) divided by population; hours per person aged 15–64 divides by the World Bank population aged 15–64. Estimators as in Table 2: non-overlapping decade log changes with standard errors clustered by country in parentheses; brackets give 90 percent intervals from 5,000 bootstrap draws of countries. Employment enters output per hour with a negative sign and hours per person with a positive one, so independent movements in employment bias the slope on output per hour toward -1; hours per person enters GDP per capita directly, which biases that slope toward $+1$.