The historical trends of technology and distribution in the U.S. economy since 1869. Data and figures

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This note introduces and illustrates with figures the new set of long-term historical data that we substituted for our previous set "USLT" :

http://www.jourdan.ens.fr/levy/uslt4x.txt

The new tables can be found at the following address:

http://www.cepremap.fr/membres/dlevy/uslt.txt

The field of analysis is the **U.S. private nonresidential economy** and the period covered, **1869-2015**.

Main changes:

(1) New estimates, based on historical studies, have been made for the early decades. Prior to 1889, only ten-year averages are known for some among the variables. It is, therefore, more appropriate to use ten-year averages for the two first decades in some of the figures.

(2) No series are given for investment, and no distinction is made between Equipment, Structures, and Intellectual property products within the total capital stock.

Basic variables:

(1)	GDP	Gross Domestic Product in current dollars.
(2)	NDP	Net Domestic Product in current dollars.
(3)	NDP^R	NDP in constant 2009 dollars.
(4)	L	Number of employees and self-employed persons, to which we refer as "Workers" for brevity.
(5)	W	Total compensation of workers in current dollars.
(6)	H	Total number of hours worked in one year.
(7)	K	Net stock of fixed capital in current dollars.
(8)	K^R	Net stock of fixed capital in constant 2009 dollars.

Variables used in the figures:

(1)	p	NDP deflator: $p = NDP/\ NDP^R$.
(2)	GDP^R	GDP in constant 2009 dollars: $GDP^R = GDP/p$.
(3)	NDP^R	NDP in constant 2009 dollars.
(4)	K^R	Net stock of fixed capital in constant 2009 dollars.
(5)	L	Number of workers.
(6)	H	Annual number of hours worked.
(7)	w^R	Annual wage of a worker in constant 2009 dollars. The annual wage in current dollars, $w = W/L$, is deflated by the NDP deflator: $w^R = w/p$.
(8)	w_H^R	Hourly wage of a worker in constant 2009 dollars. The hourly wage in current dollars, $w_H = W/H$, is deflated by the NDP deflator: $w_H^R = w_H/p$.
(9)	Π	Profit: $\Pi = NDP$ - W.
(10)	r	Profit rate = Profit / Capital: $r = \Pi/K$.
(11)	P_K	Productivity of capital, ratio of variables in current dollars: $P_K = NDP/K$.
(12)	P_K^R	Productivity of capital, ratio of variables in constant 2009 dollars: $P_K^R = NDP^R/K^R$.
(13)	P_L	Labor productivty per worker: $P_L = NDP^R/L$.
(14)	P_H	Labor productivity per hour: $P_H = NDP^R/H$.
(15)	π	Share of profits: $\pi = \Pi/NDP$.
(16)	γ	Capital-Output ratio: $\gamma = 1/P_K = K/NDP$.
(17)	δ	Capital per hour: Ratio of the stock of fixed capital to the number of hours worked: $\delta = K^R/H$.
(18)	h	Annual hours per person: $h = H/L$.

Sources:

(1) NIPA (BEA).
   (a) Table 1.3.5. Gross Value Added by Sector
   1, Gross domestic product
   8, General government
   (b) Table 1.7.4. Price Indexes for GDP, GNP, NNP, National Income, and Personal Income
   11, Net domestic product
   (c) Table 1.7.5. Relation of GDP, GNP, NNP, National Income, and Personal Income
   6, Consumption of fixed capital, Private
   (d) Table 6.2 Compensation of Employees by Industry
   3, Private industries
   (e) Table 6.5 Full-Time Equivalent Employees by Industry
   3, Private industries
   (f) Table 6.7 Self-Employed Persons by Industry
   1, Self-employed persons
   (g) Table 7.4.5. Housing Sector Output, GVA and NVA
   13, Net housing value added
   14, Compensation of employees

(2) Fixed assets (BEA).
   (a) Table 1.1. Current-Cost Net Stock
   4, Fixed assets, Private, Nonresidential
   (b) Table 1.2. Chain-Type Quantity Indexes for Net Stock
   4, Fixed assets, Private, Nonresidential

(3) Balke, N. and Gordon, R. (1989). The estimation of prewar gross national product: Methodology and new evidence. *Journal of Political Economy*, 97(1):38–92: GNP (dollars) and GNP (dollars 1982).

(4) Kendrick, J. (1961). *Productivity Trends in the United States*. Princeton University Press, Princeton:
   (a) Table A-VI. National Economy: Persons Engaged.
   (b) Table A-X. National Economy: Manhours.
   (c) Table A-XVI. Real capital stock (Private nonresidential fixed capital + Private Inventories).

(5) Lebergott, S. (1964). *Manpower in Economic Growth: The American Record Since 1800*. McGraw-Hill, New York: Nonfarm Employees Annual Earnings.

Introductory comments

The original motivation in the preparation of the data was the estimate of the long-term trend of the profit rate in the U.S. economy (Figure 13). The field of investigation is, however, broader, including notably technical change, labor costs, growth, accumulation, employment, and the general level of prices.

(1) We denote as "trajectory à la Marx" a pattern of technical change whose main feature is the increased use of fixed capital. This additional amount of fixed capital must be assessed in relation to output. The most straightforward approach to such trajectories is, therefore, the downward trend of the productivity of capital as in Figure 15 (or the upward trend of its inverse, the capital-output ratio), not the composition of capital as in Figure 25 (or the ratio of fixed capital and wages in Figure 27). The reason is that the variables involved (in the numerator and denominator) in the determination of the composition of capital may both rise or diminish in tandem without impacting the ratio, while such variations will have consequences on the profit rate. [1]

(2) The profit rate (à la Marx) in Figure 13 is not the profit rate directly impacting firms' behavior. Firms pay taxes to be subtracted from profits; inventories and sufficient liquidities must be financed; profits are paid out as interest and dividends. The potential impacts of the options taken in these respects are very large. The definition of the profit rate must be adjusted to the object of investigation. [2]

(3) The two sequences à la Marx of declines and low values of the profit rate (Figure 13) during the late 19th century and during the 1960s-1970s were so strong that they finally manifested themselves in firms' accounts and behaviors. The structural crises during those years can be imputed to these declines. [3] Neither the Great Depression [4] nor the

1. Duménil, G. and Lévy, D. (2016). Thomas Piketty's Historical Macroeconomics: A Critical Analysis. *Review of Political Economy*, 28(2):220–232.

2. Duménil, G. and Lévy, D. (1993). *The Economics of the Profit Rate: Competition, Crises, and Historical Tendencies in Capitalism*. Edward Elgar, Aldershot, England, Section 2.4; Duménil, G. and Lévy, D. (1996). *La dynamique du capital. Un siècle d'économie américaine*. Presses Universitaires de France, Paris (Chapter 19); Duménil, G. and Lévy, D. (2011b). *The Crisis of Neoliberalism*. Harvard University Press, Cambridge, Massachusetts, pp. 57-60.

3. Duménil, G. and Lévy, D. (1993). *The Economics of the Profit Rate: Competition, Crises, and Historical Tendencies in Capitalism*. Edward Elgar, Aldershot, England, Section 19.3; Duménil, G. and Lévy, D. (2004). *Capital Resurgent. Roots of the Neoliberal Revolution*. Harvard University Press, Cambridge, Massachusetts, Chapters 3 and 16.

4. Duménil, G. and Lévy, D. (2004). *Capital Resurgent. Roots of the Neoliberal Revo-*

crisis of 2008 [5] were caused by falling profit rates; symmetrically, the rise of the profit rate during the 1920s was not the cause of the Great Depression as contended by the French "Regulation school" and others. [6] Since 2005, a new trajectory of technical change à la Marx is underway [7] with a diminishing productivity of capital (Figure 15), but the profit rate is stagnating due to the rise of the share of profits (Figure 14).

(4) The most striking feature in the historical trend of the profit rate à la Marx is the long phase of restoration from the early 20th century to the 1960s. During those years, the course of technical change was exceptionally favorable [8], with the fast growth of labor productivity and the growth of capital productivity (Figure 23).

A number of figures show the growth rates of trend lines. They are usefull tools in the investigation of historical trends, supplementing the original display of the variables and their trends. Thus, the sharp rise of labor productivity between the 1920s and 1960s is dramatically reflected in the growth rate of the trend of the variables in Figure 24 to which Robert Gordon recently drew the attention of the economic community in the debate around the "long stagnation". (In the footnote 9 of his 2000 paper [9], Gordon was fair enough to acknowledge: "My attention to the big wave was drawn by Duménil and Lévy (1990) [10]".)

The "big wave" can, however, only be interpreted in relation to the no less spectacular trend of the productivity of capital during the same period (Figures 15 and 17). Concerning capital productivity using constant dollars variables, the notion would be "one big leap". [11] We interpret

lution. Harvard University Press, Cambridge, Massachusetts, Chapter 19.

5. Duménil, G. and Lévy, D. (2011b). *The Crisis of Neoliberalism*. Harvard University Press, Cambridge, Massachusetts.

6. Duménil, G. and Lévy, D. (1989). The Regulation school in light of one century of the U.S. economy. Paris.

7. Duménil, G. and Lévy, D. (2016). Thomas Piketty's Historical Macroeconomics: A Critical Analysis. *Review of Political Economy*, 28(2):220–232.

8. Duménil, G. and Lévy, D. (1993). *The Economics of the Profit Rate: Competition, Crises, and Historical Tendencies in Capitalism*. Edward Elgar, Aldershot, England, Part V.

9. Gordon, R. (2000). Interpreting the "One big wave" in U.S. long-term productivity growth. In van Ark, B., Kuipers, S., and Kuper, G., editors, *Productivity, Technology, and Economic Growth*, pages 19–66. Kluwer Publishers, Norwell, MA.

10. Duménil, G. and Lévy, D. (1990). Continuity and rupture in the process of techological change. Working Paper, CEPREMAP, Paris.

11. A comprehensive analytical framework can be found in Duménil, G. and Lévy, D. (2011a). The classical Marxian evolutionary model of technical change. In Setterfield, M., editor, *Handbook of Alternative Theories of Economic Growth*, pages 243–274. Edward Elgar, Aldershot, England.

these favorable trends from the early 20th century to the 1960s as the gradual extension and intensification of the effects of the managerial revolution throught out various sectors of the economy. [12]

One can also notice that the parallel in the fluctuations of the growth rates of labor productivity and the hourly wage rate in Figure 29 is striking and explains the comparative horizontal trend of the share of profits in Figure 14.

(5) Still resorting to the figures illustrating the growth rates of variables, further insight can be gained from Figures 32 and 33. The figures contrast the distinct dynamics of the productivities of capital and labor regarding the above pattern of technical change. The growth rate of the productivity of labor remained positive (with the bulge already observed in Figure 24 during the central period) while, depending on the period, the growth rate of capital productivity was alternatively negative or positive (as in Figure 15). Figures 32 and 33 allow for a closer analysis of the sequence of events. Although capital productivity was still declining, one can notice that the favorable trends that ushered in the phase of growth in capital productivity a few years prior to 1900 were underway since the 1870s: the productivity of capital was still diminishing but at an increasingly slower rate, up to a point where the sign of the variation changed (from negative to positive).

In a similar manner, the figures illustrate the ensuing pattern of transformation: from the 1920s onward, the continuing increase in the growth rate of labor productivity was obtained at the cost of a diminishing growth rate of capital productivity (still growing, however). The gradual erosion of the favorable features of technical change became more obvious from about the mid-1930s onward, when the two growth rates diminished in tandem, up to the fall in capital productivity during the 1960s and the stagnation at levels which would have been negative had not the boom of new technologies during the 1990s temporarily inverted this new trend. Simultaneously, the growth of labor productivity returned to its early rate between 1 and 1.5 percent.

12. Duménil, G. and Lévy, D. (1996). *La dynamique du capital. Un siècle d'économie américaine*. Presses Universitaires de France, Paris, Chapter 21.

The figures below use ten-year averages for the two first decades. A number of figures show a trend line. This trend is determined using a Hodrick-Prescott filter with $\lambda = 1000$ (excluding the period 1929-1944).

List of Figures

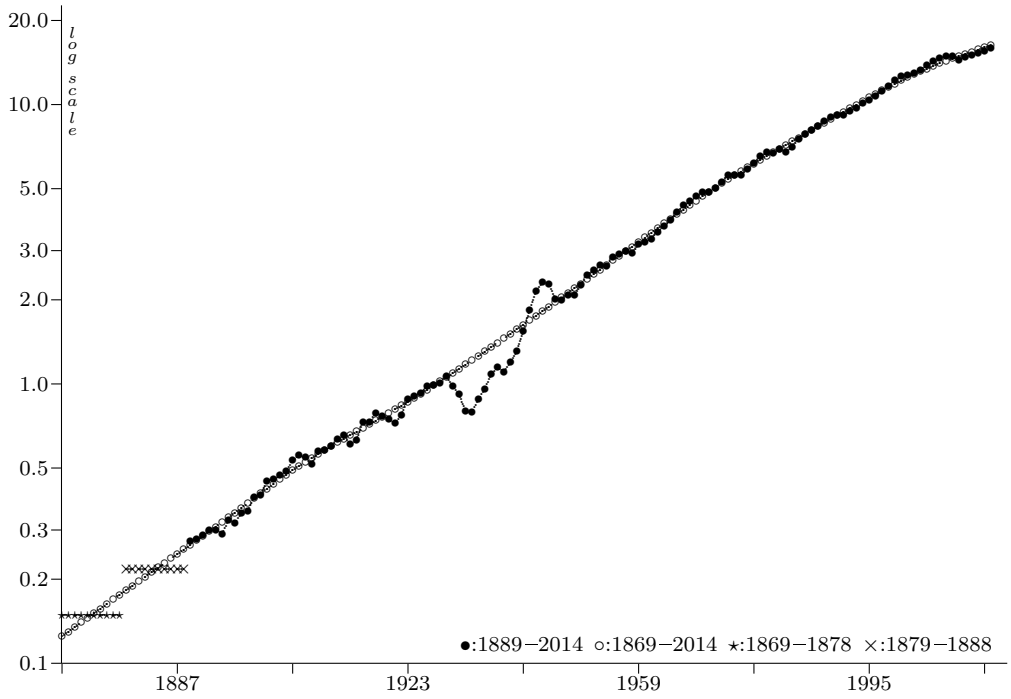


Figure 1: Gross domestic product (trillions of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

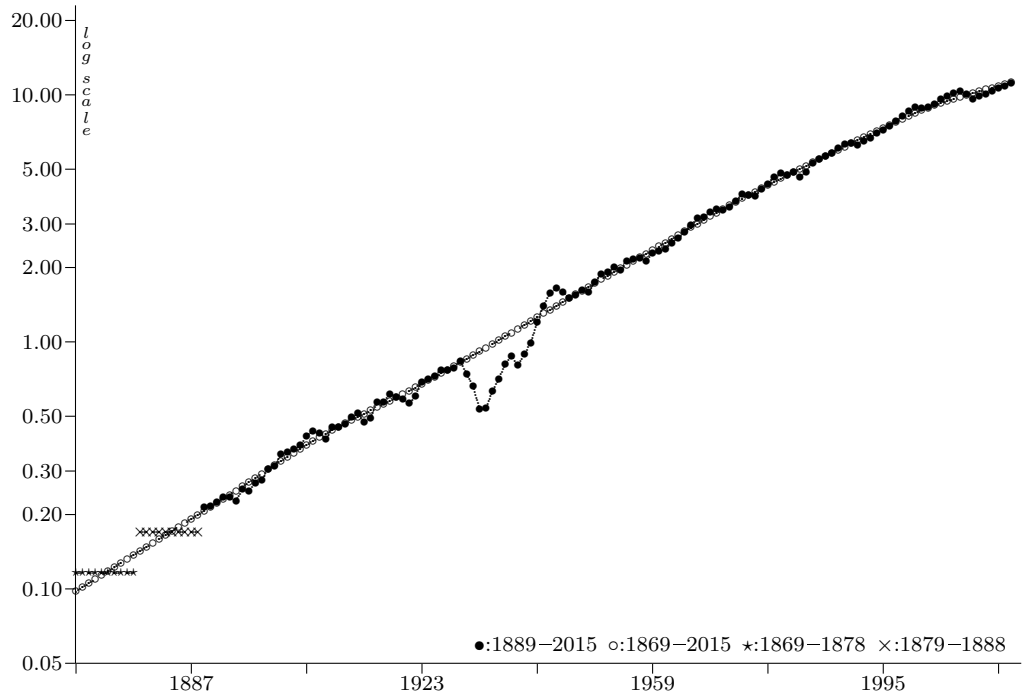


Figure 2: Net domestic product (trillions of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

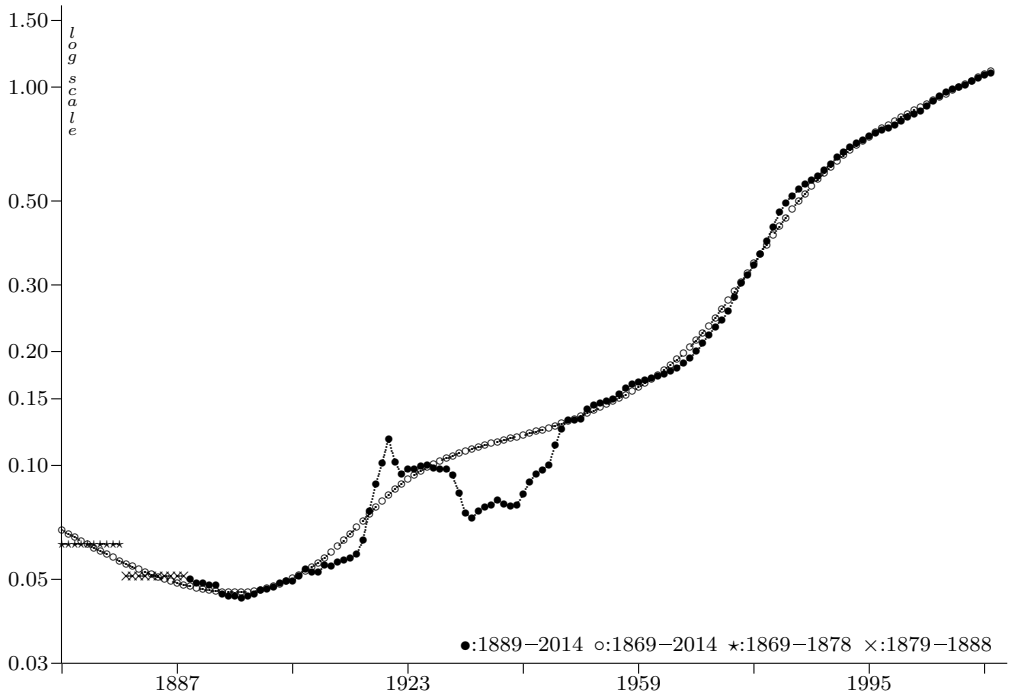


Figure 3: NDP deflator (2009=1)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

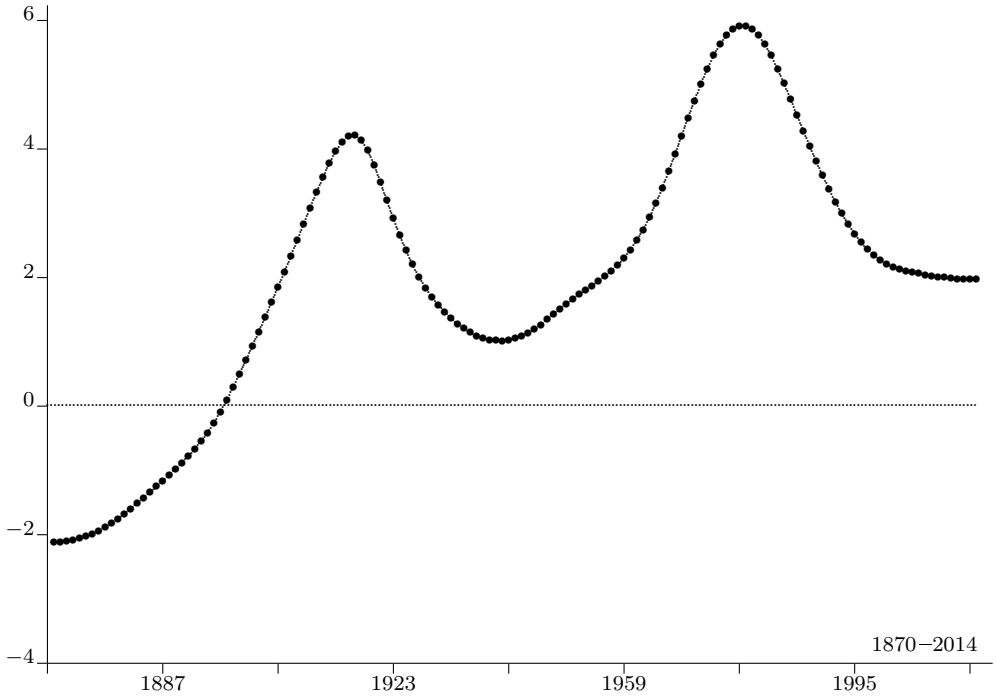
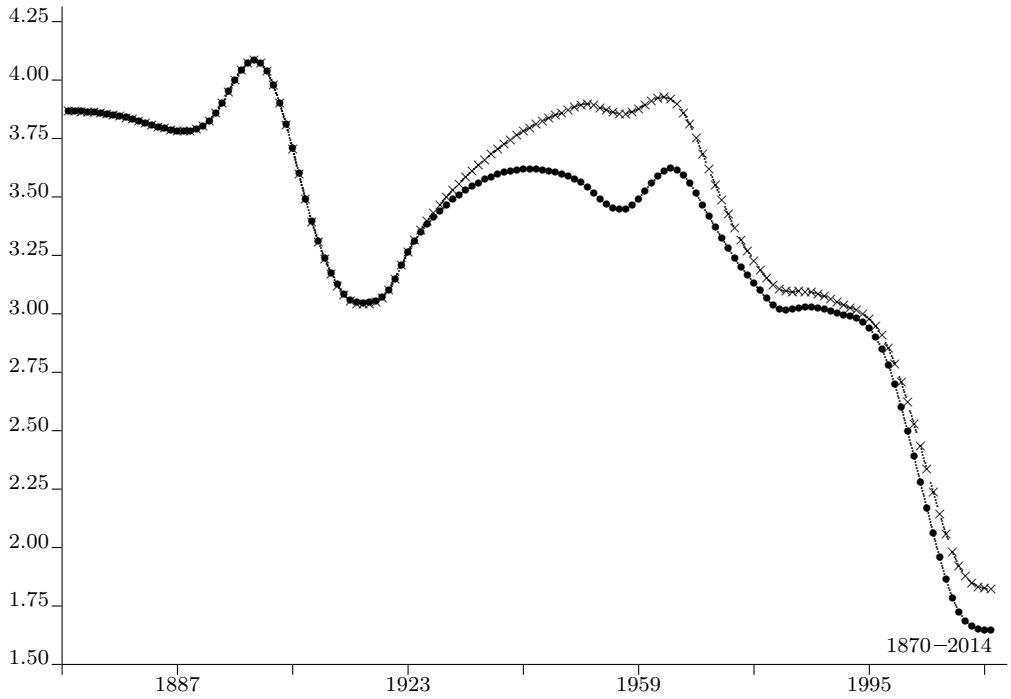


Figure 4: NDP deflator: Growth rate of trend (inflation rate in percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



• NDP
× GDP

Figure 5: GDP and NDP: Growth rates of trends (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

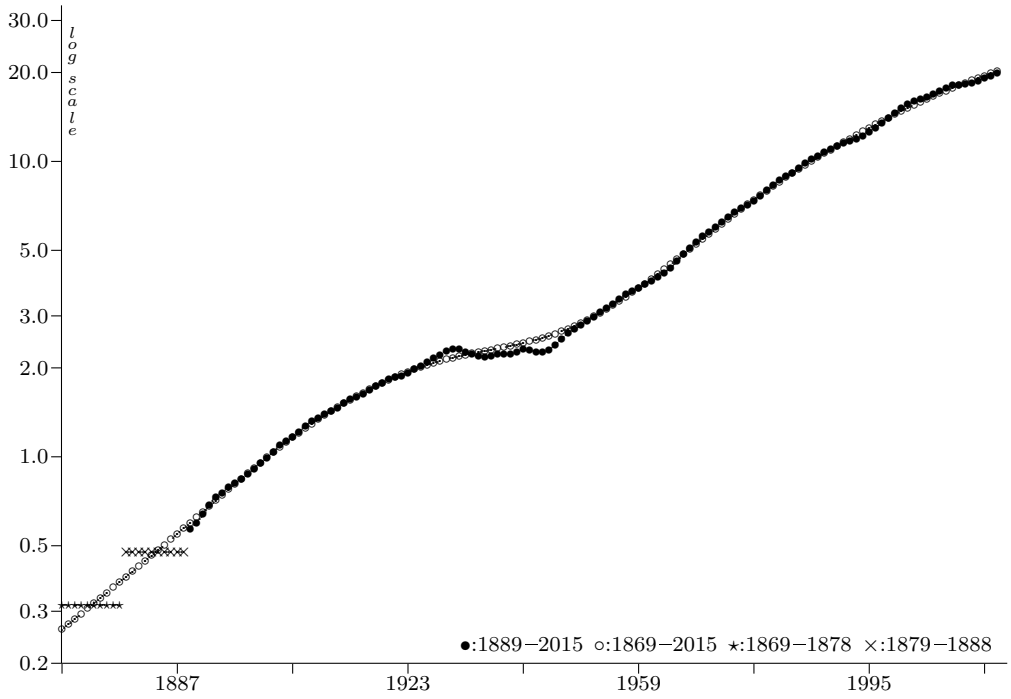
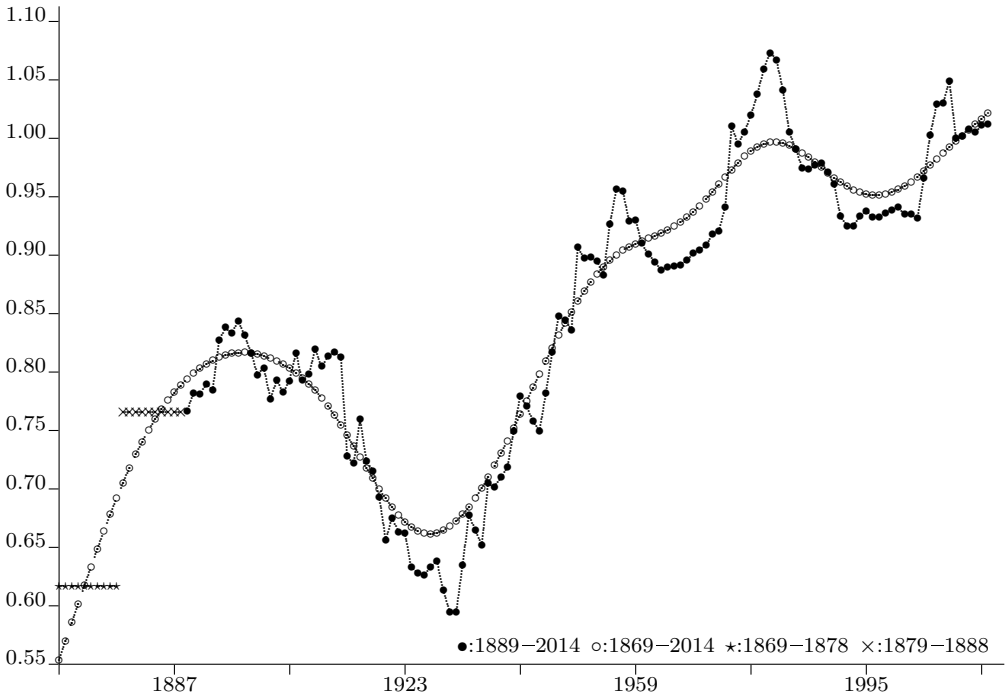


Figure 6: Net stock of fixed capital (trillions of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



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Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

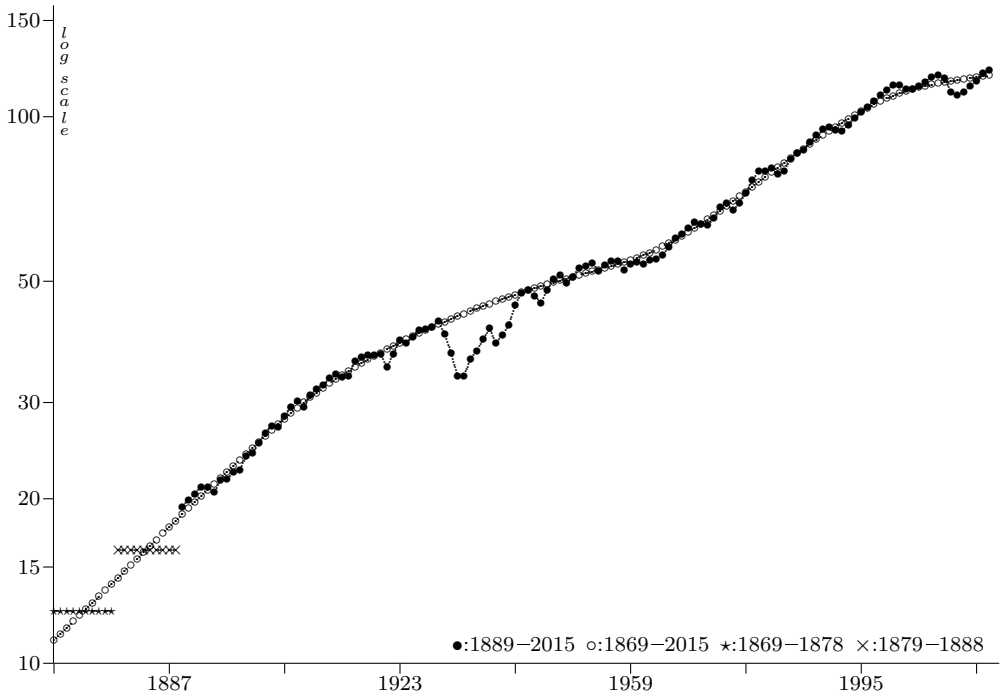


Figure 8: Number of workers (millions)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

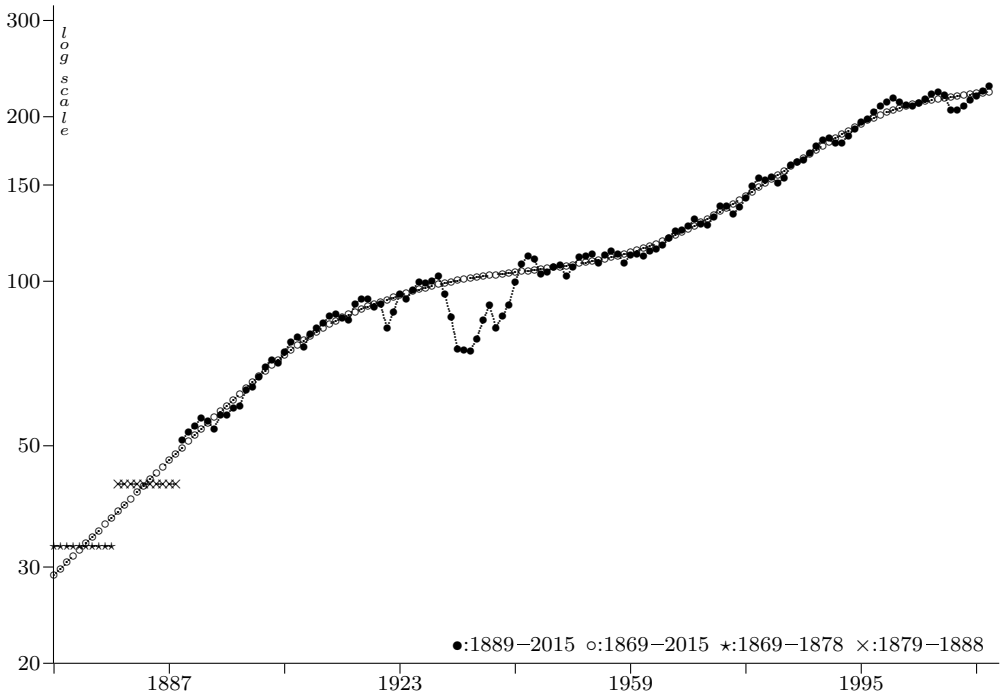
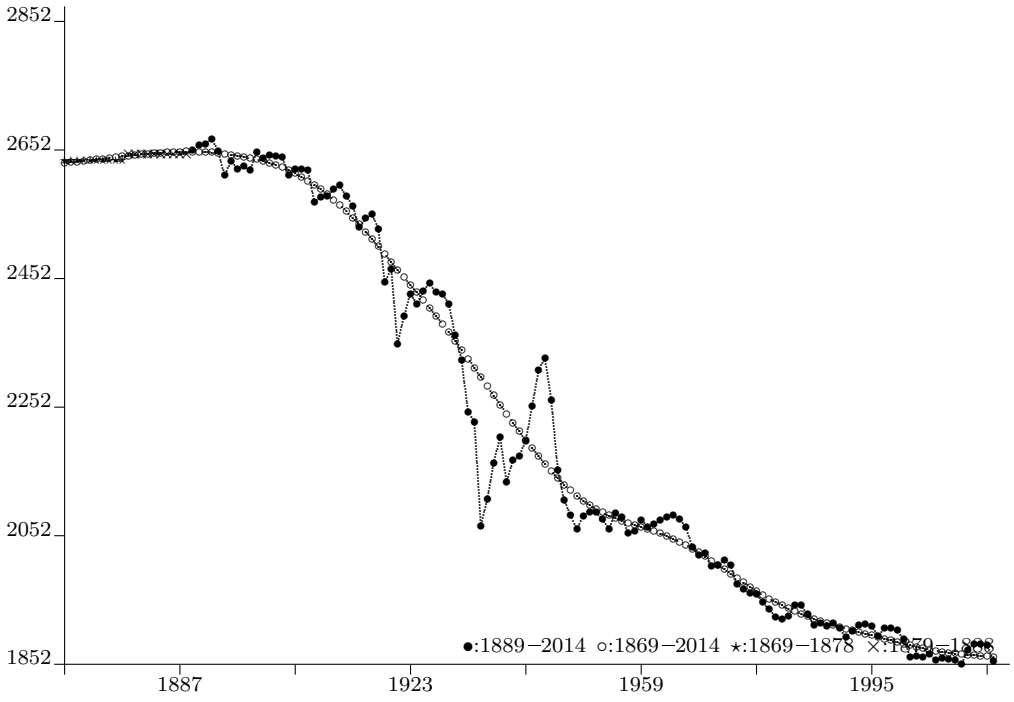


Figure 9: Number of hours worked (trillions)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



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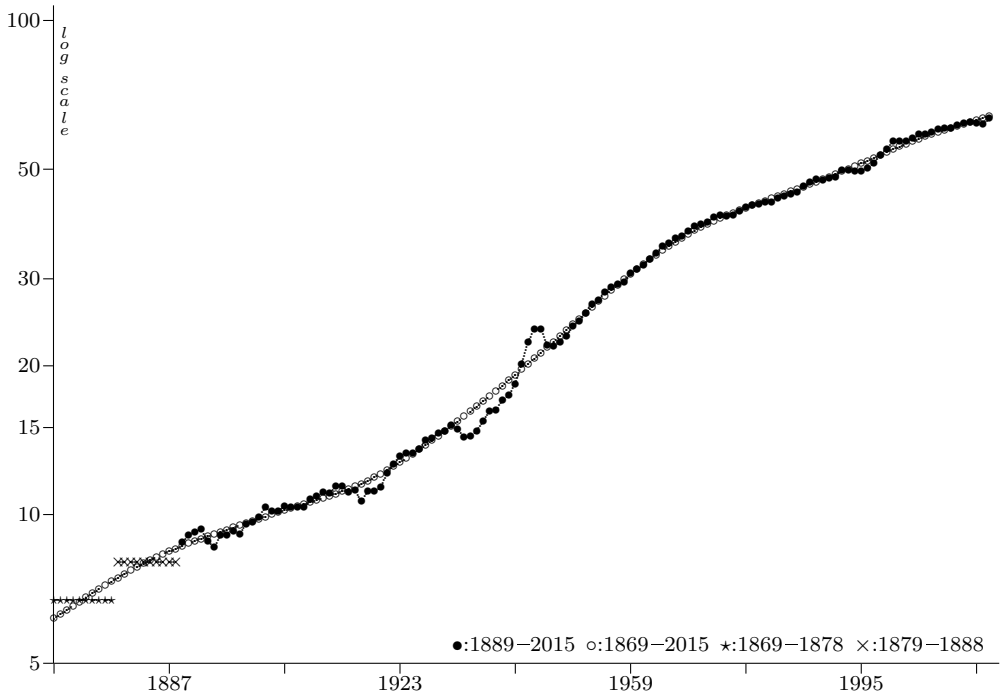
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



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Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

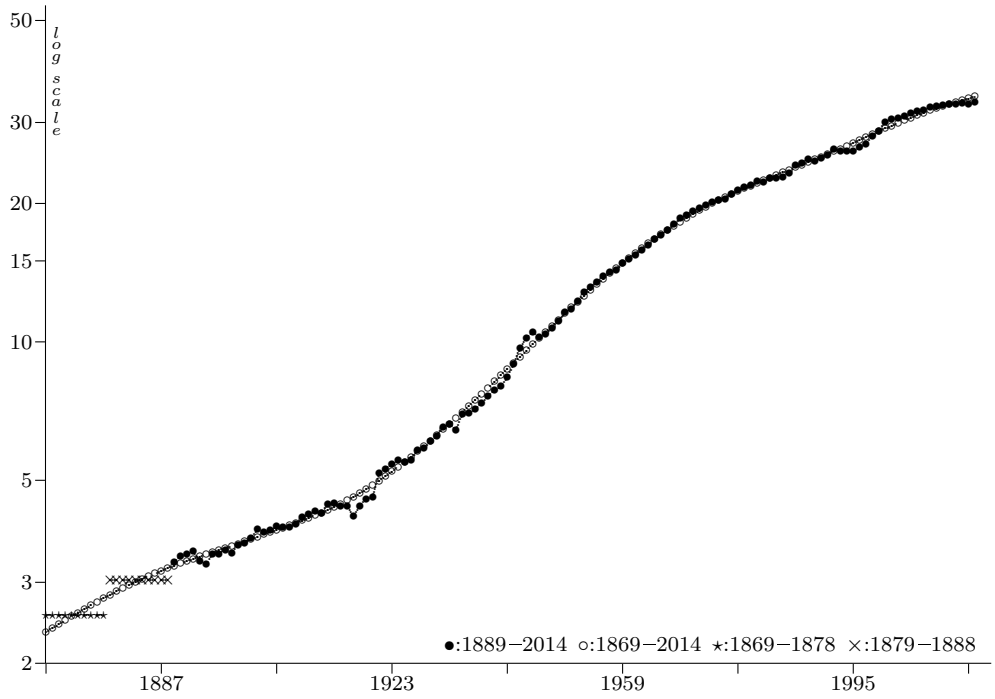


Figure 12: Hourly wage rate (consant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

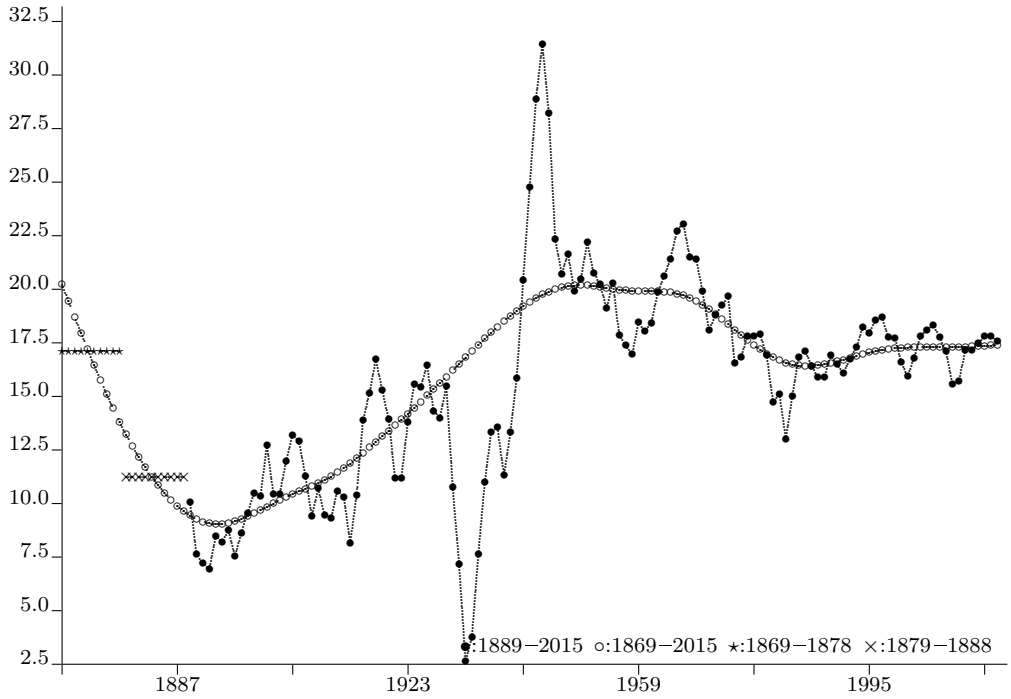


Figure 13: Profit rate

Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

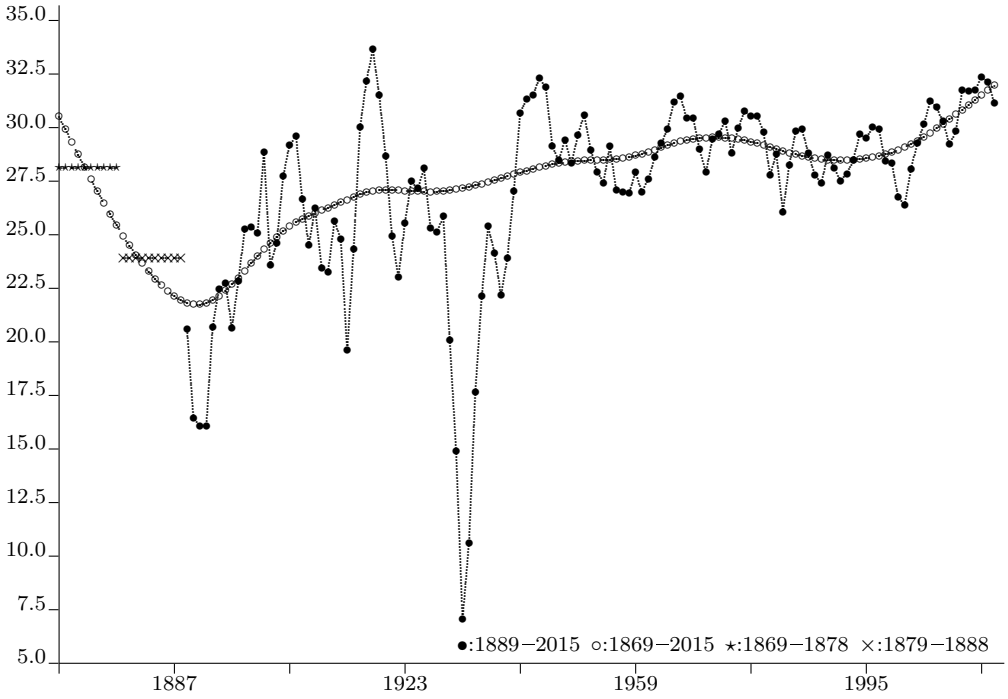


Figure 14: Share of profits (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

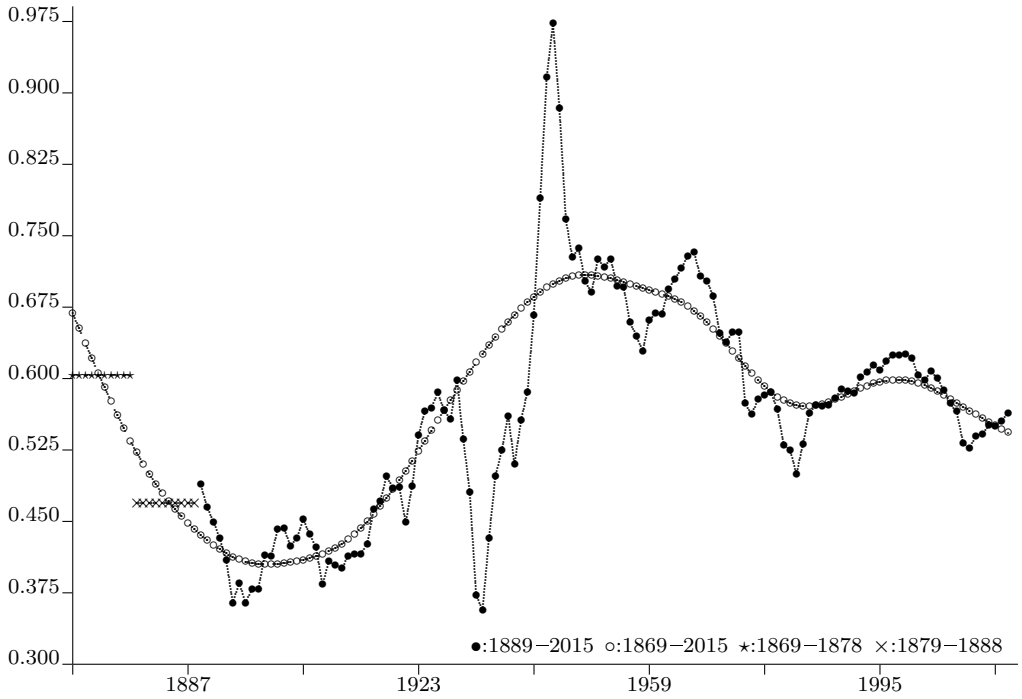
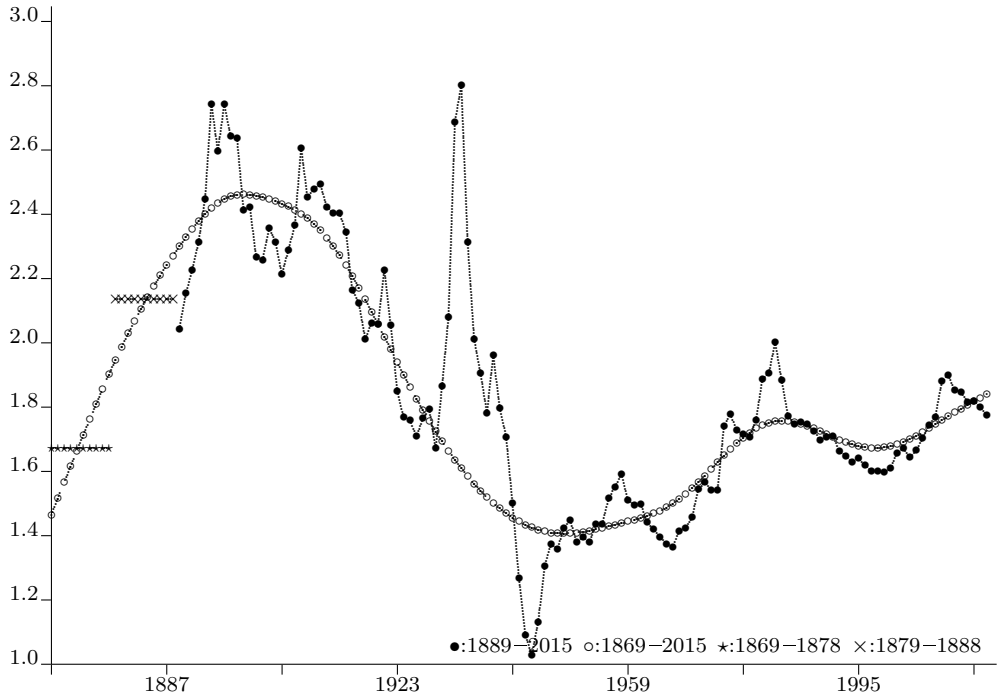


Figure 15: Productivity of capital, ratio of variables in current dollars
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



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Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

Figure 17: Productivity of capital, ratio of variables in constant dollars
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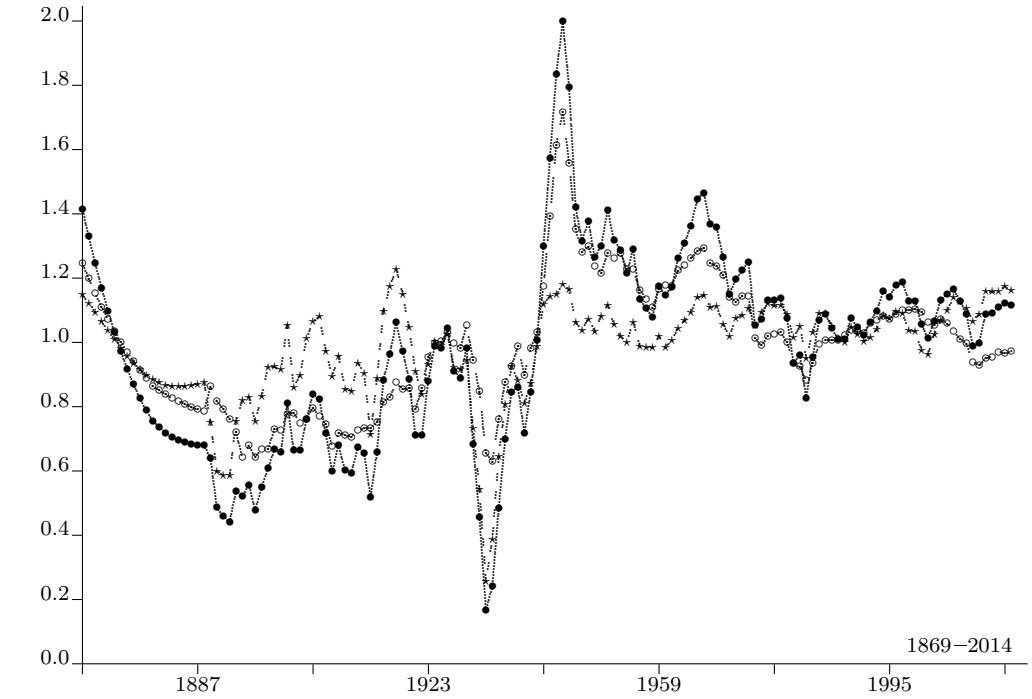
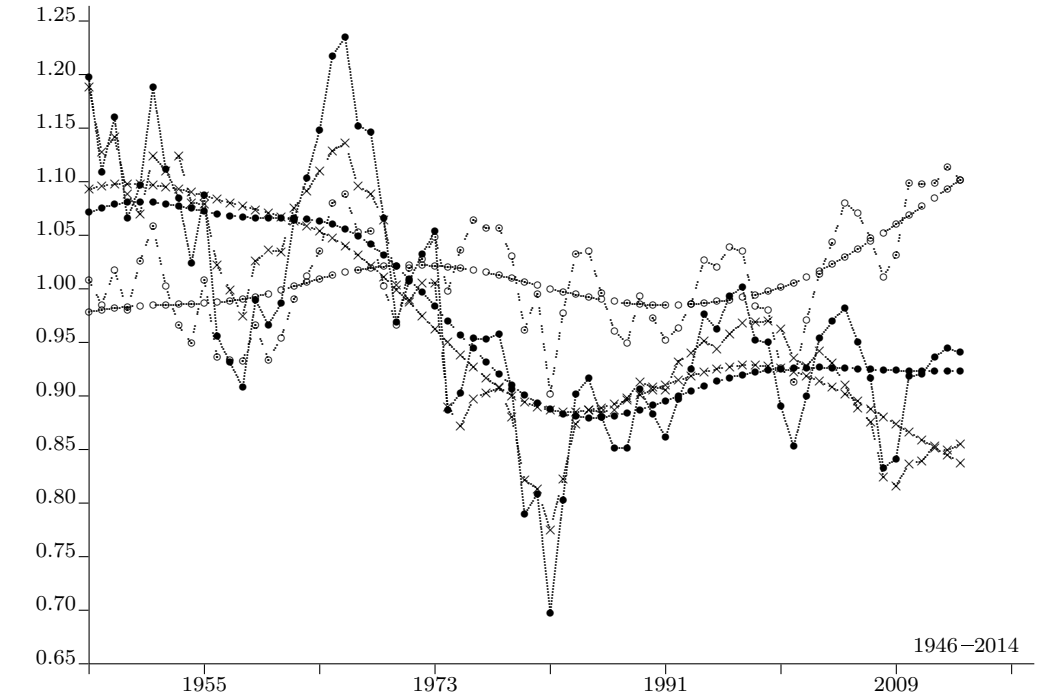


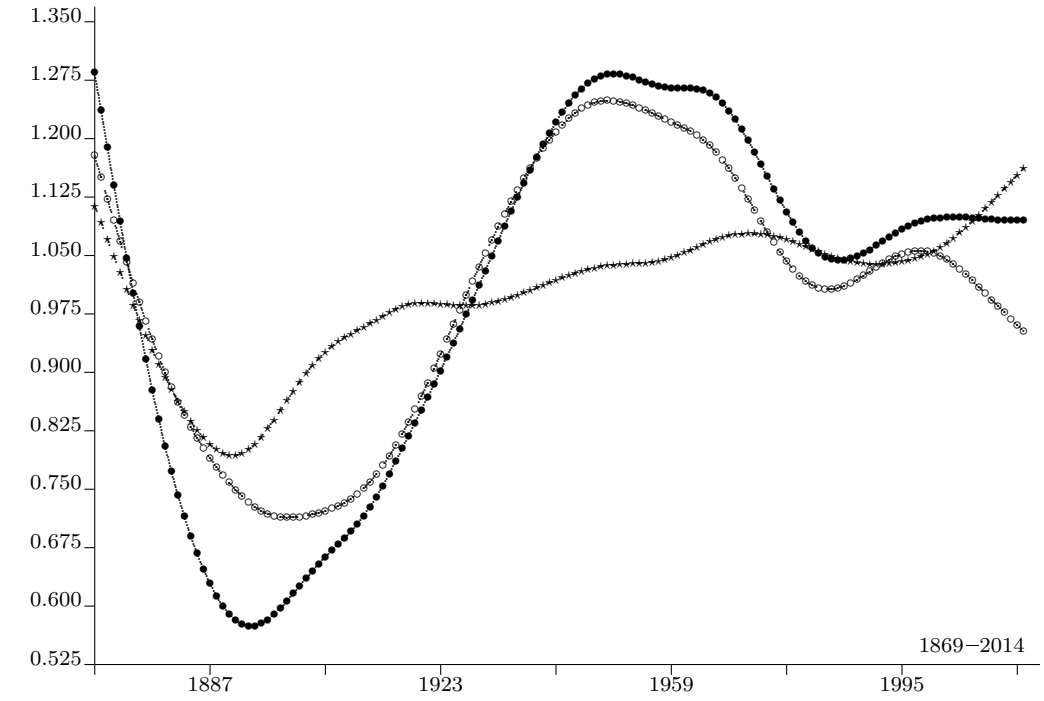
● r
○ P_K
⋆ π

Figure 18: Profit rate, capital productivity (ratio of variables in current dollars), and share of profits (Average 1869-2014=1)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



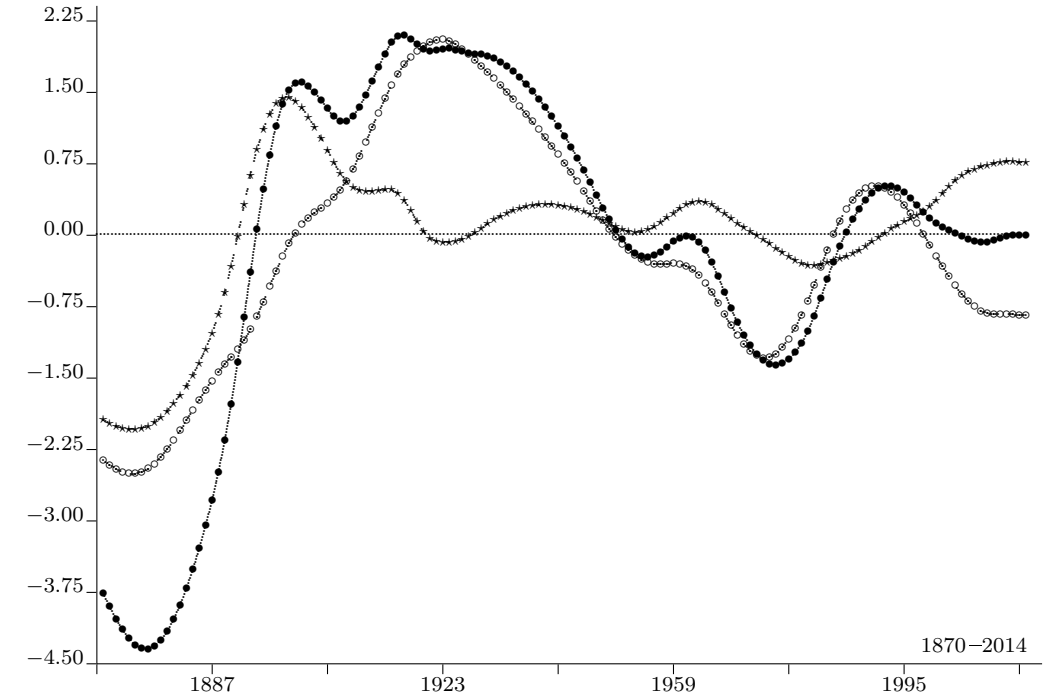
• r
× P_K
○ π

Figure 19: Profit rate, capital productivity (ratio of variables in current dollars), and share of profits (1946-2014=1)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



● r
○ P_K
⋆ π

Figure 20: Profit rate, capital productivity (ratio of variables in current dollars), and share of profits: Trend lines (Average 1869-2014=1)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



• r
◦ P_K
⋆ π

Figure 21: Profit rate, capital productivity (ratio of variables in current dollars), and share of profits: Growth rates of trends (percent) *Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).*

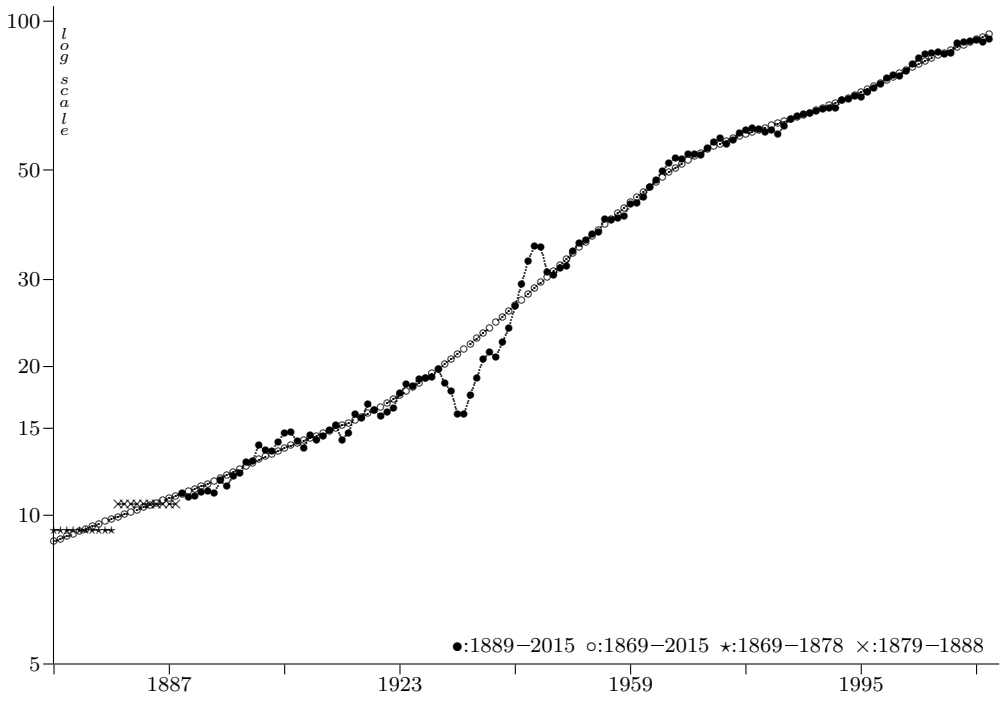


Figure 22: Labor productivity per worker (Thousands of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

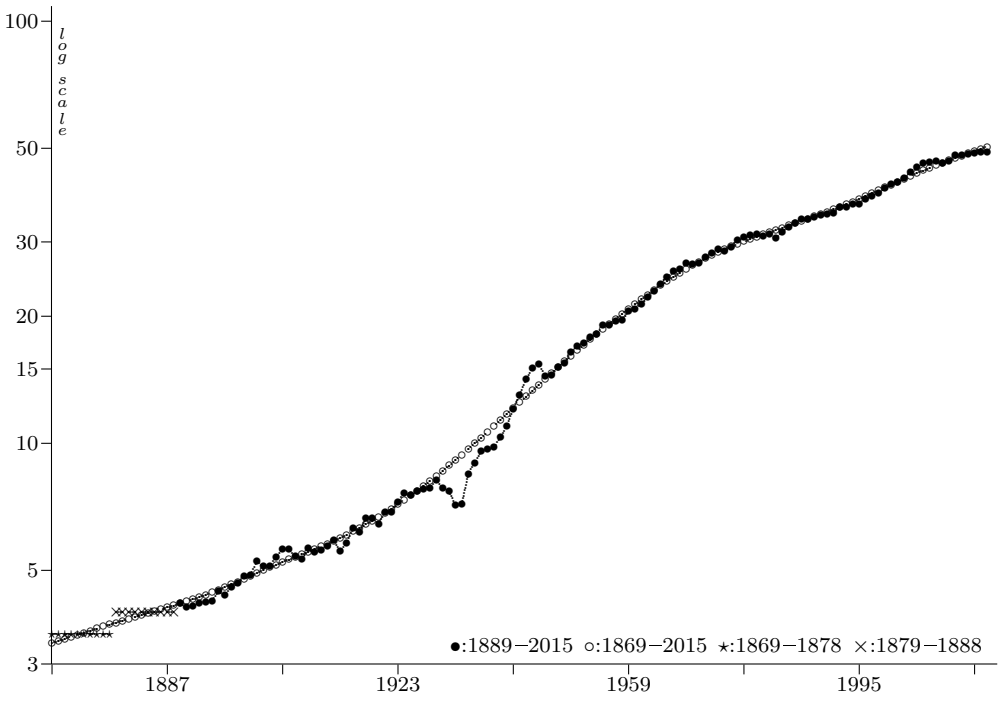
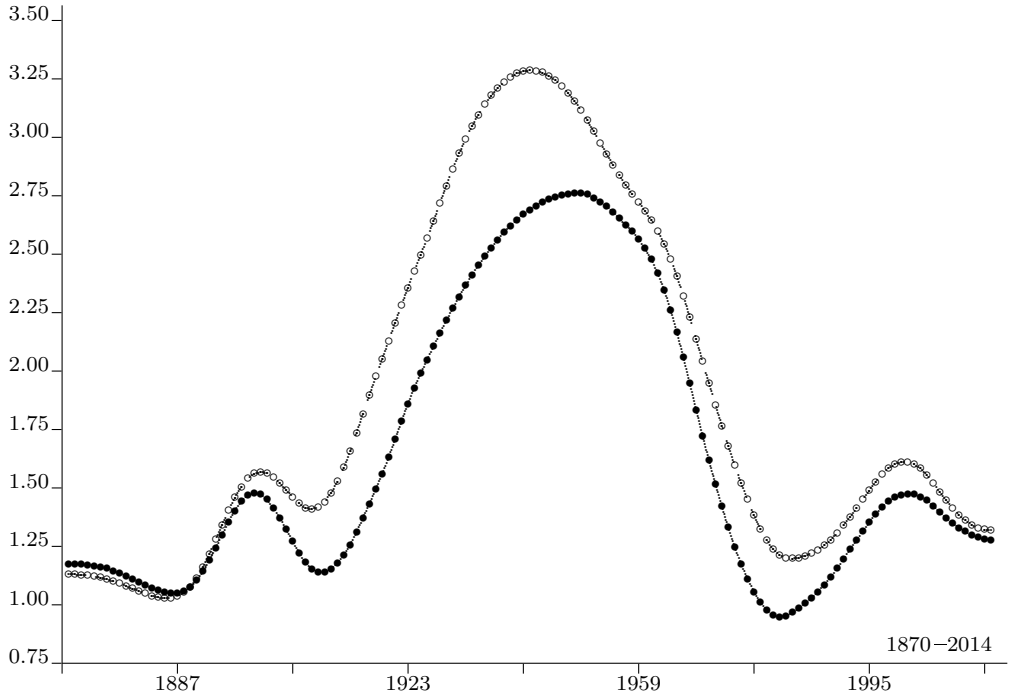


Figure 23: Labor productivity per hour (Thousands of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



• P_L
◦ P_H

Figure 24: Labor productivity per worker and labor productivity per hour: Growth rates of trends (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

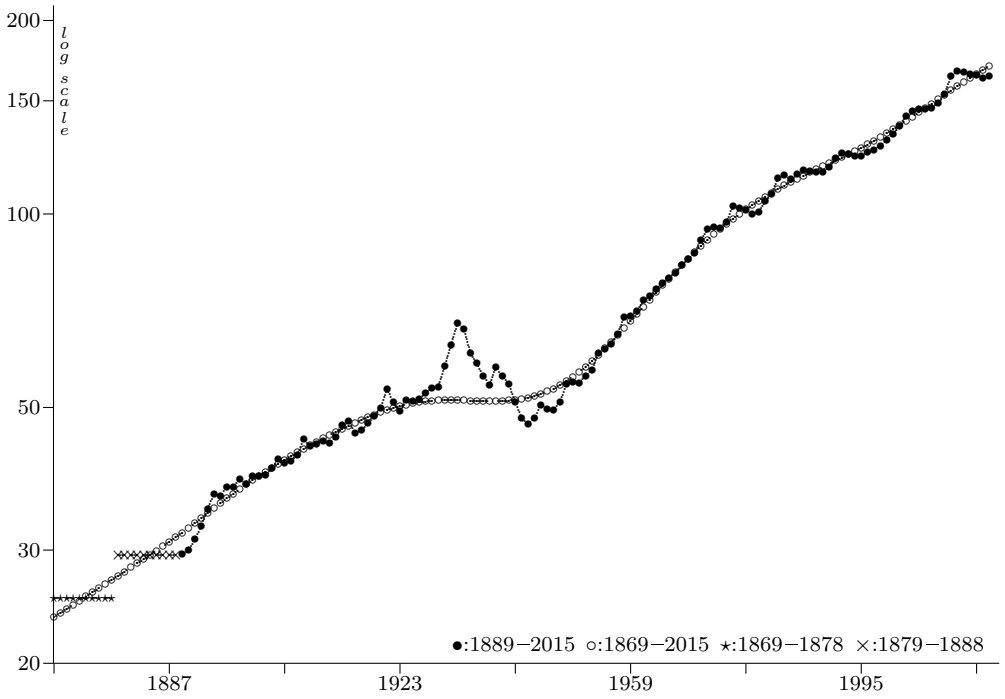


Figure 25: Fixed capital per worker (Thousands of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

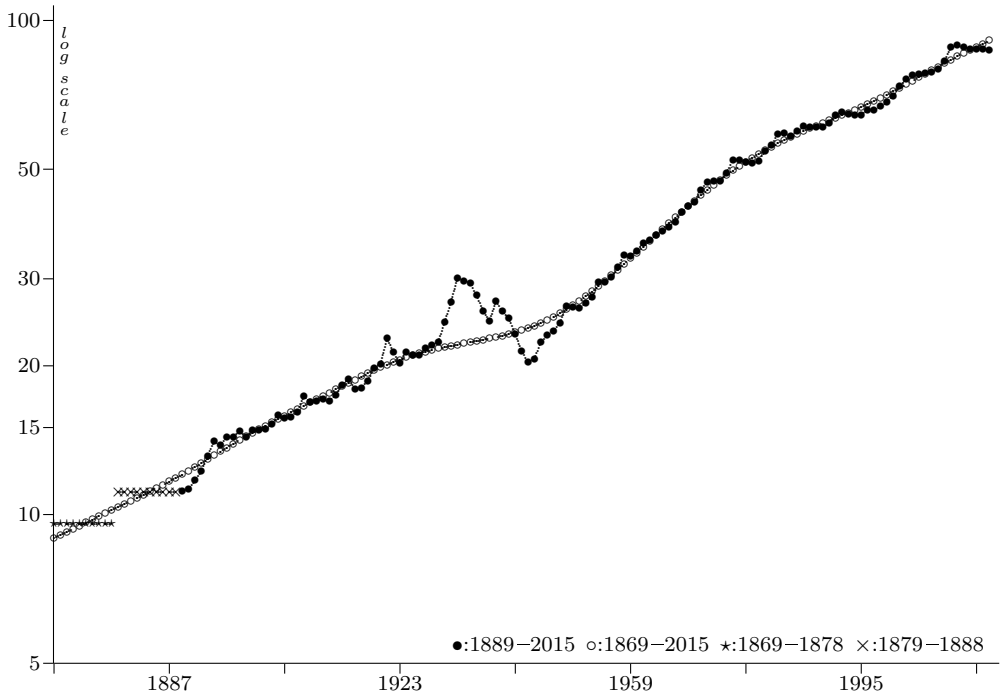


Figure 26: Fixed capital per hour worked (Constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

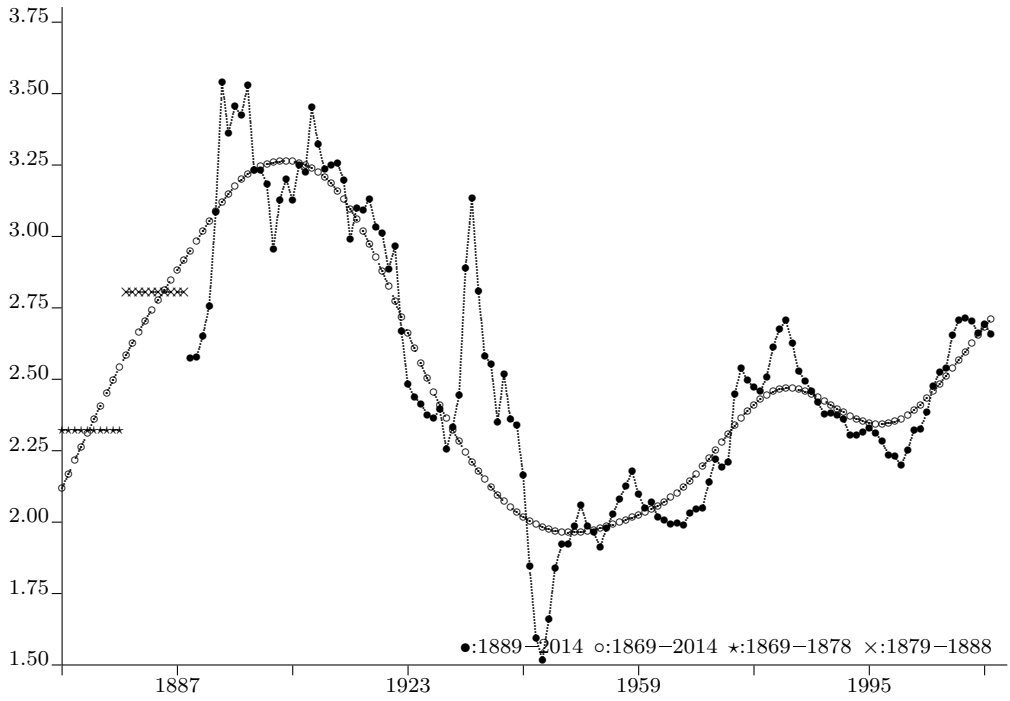


Figure 27: Composition of capital: Ratio of the stock of fixed capital and yearly wages (both variables in current dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

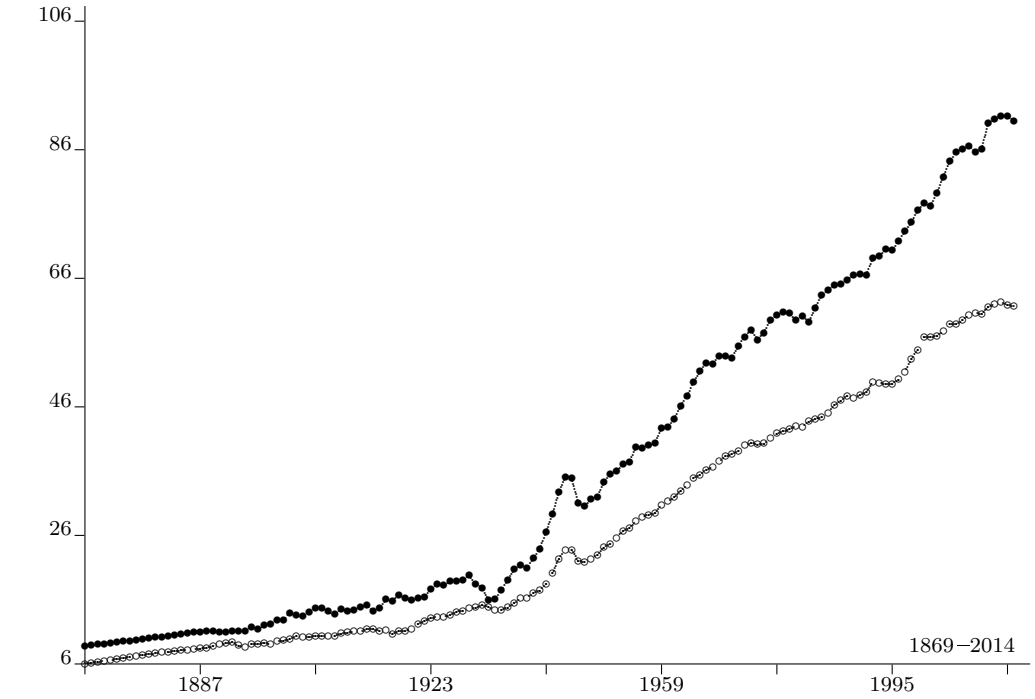


Figure 28: Labor productivity per worker and annual wage (Thousands of constant 2009 dollars)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

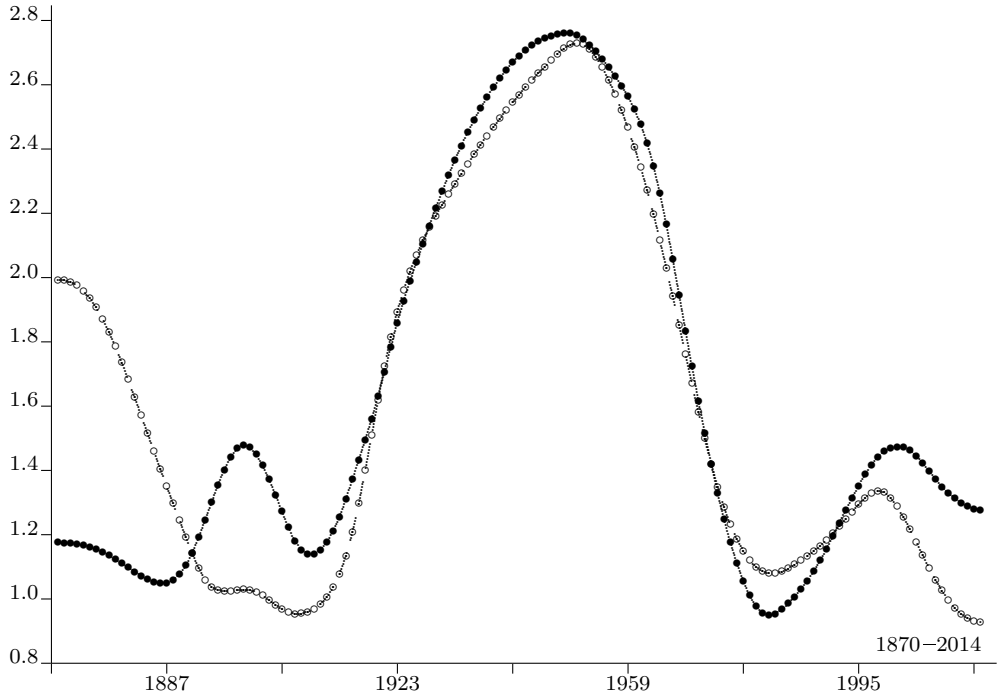


Figure 29: Labor productivity per worker and annual wage: Growth rates of trends (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

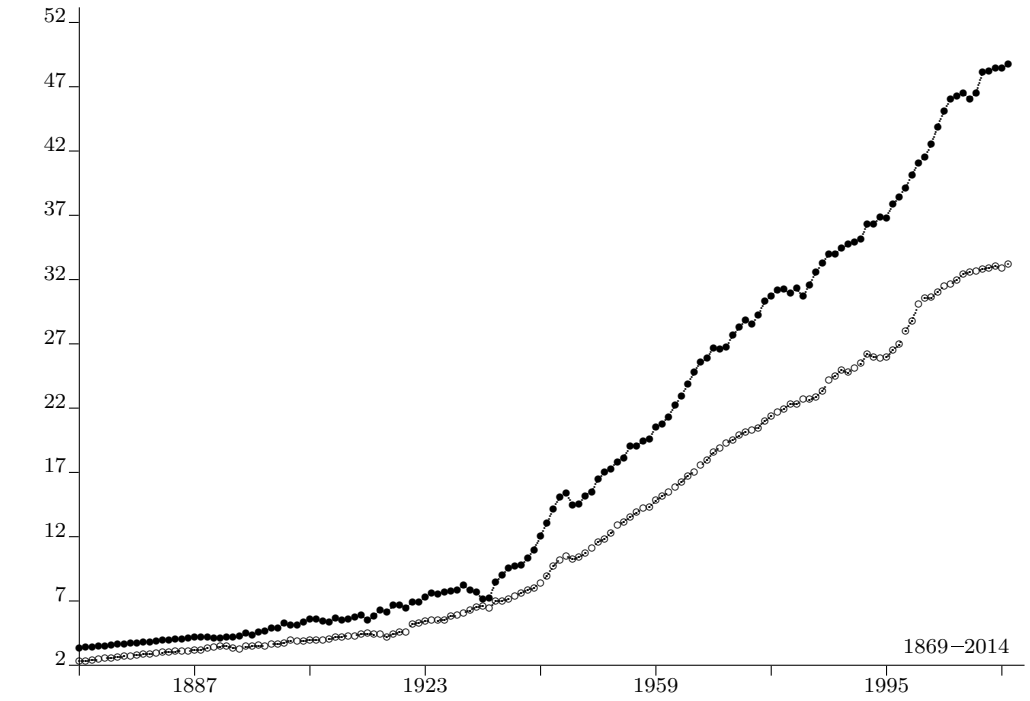


Figure 30: Labor productivity per hour and hourly wage, constant 2009 dollars
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).

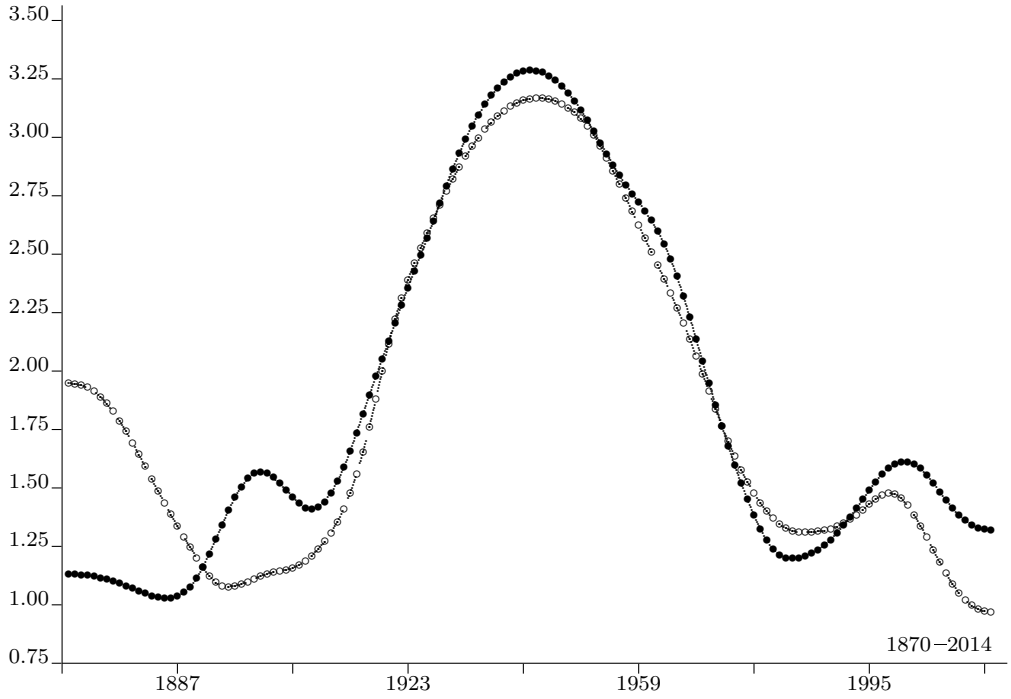
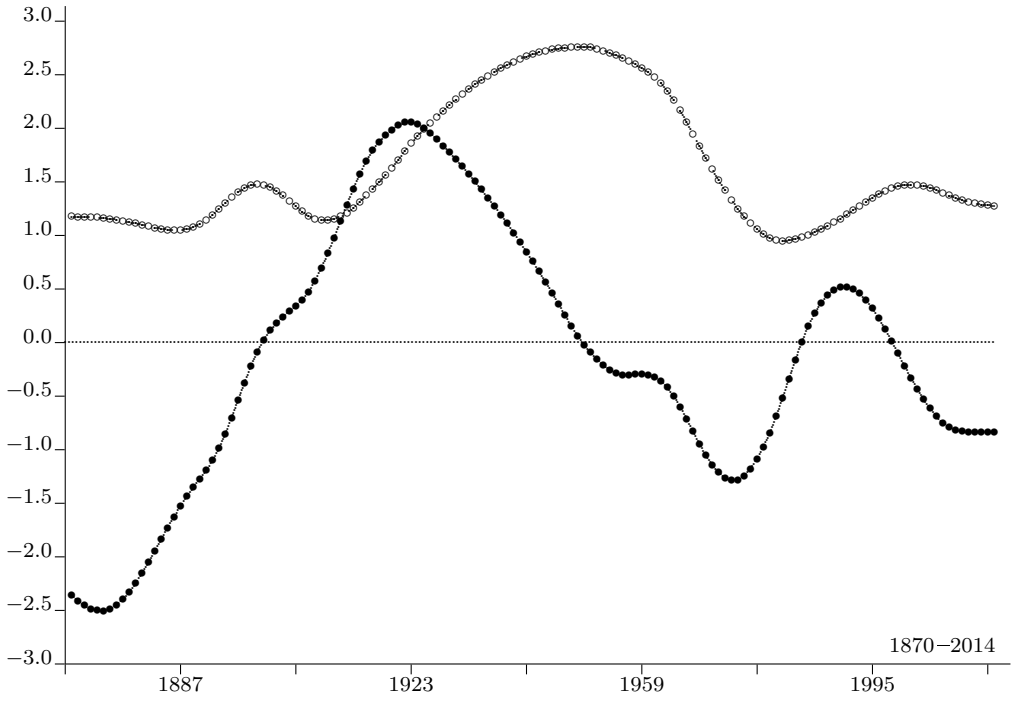
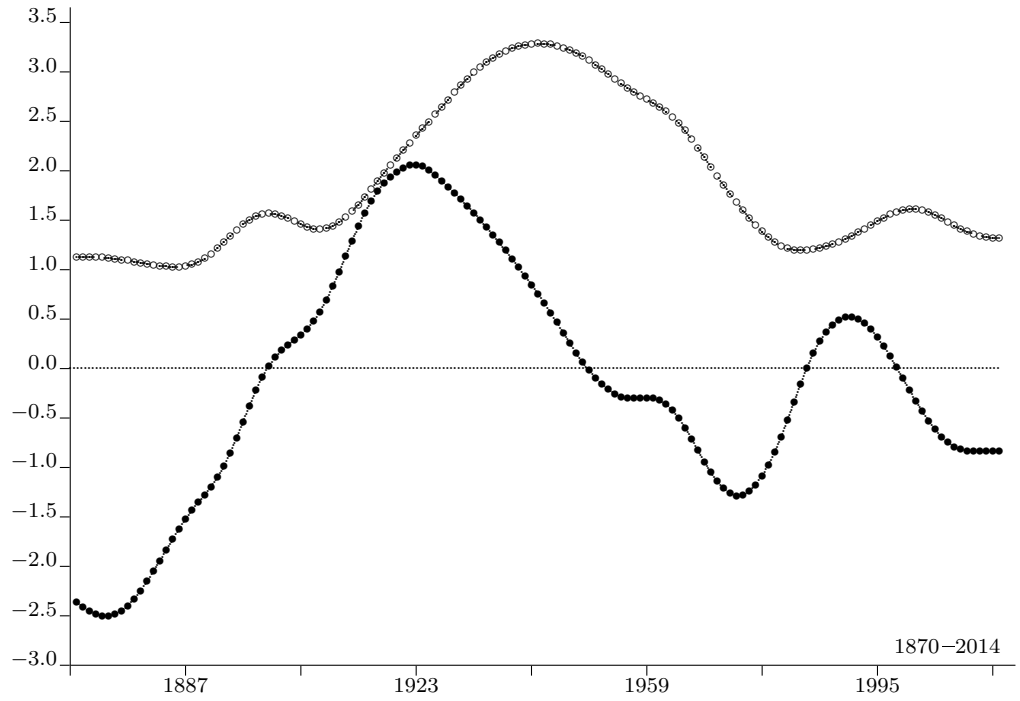


Figure 31: Labor productivity per hour and hourly wage rate: Growth rates of trends (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



• P_K
◦ P_L

Figure 32: Capital productivity (ratio of variables in current dollars) and labor productivity per worker: Growth rates of trends (percent)
Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).



• P_K
◦ P_H

Figure 33: Capital productivity (ratio of variables in current dollars) and labor productivity per hour: Growth rates of trends (percent) *Source: G. Duménil and D. Lévy, 2016, The historical trends of technology and distribution in the U.S. economy, Data and figures (1869-2015).*

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