THE U.S. ECONOMY SINCE THE CIVIL WAR: SOURCES AND CONSTRUCTION OF THE SERIES

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RÉSUMÉ

L'ÉCONOMIE DES ÉTATS-UNIS DEPUIS LA GUERRE DE SÉCESSION :
SOURCES ET CONSTRUCTION DES SÉRIES

Ce papier présente les sources et la construction des séries utilisées dans diverses études portant sur l'évolution de la technique et de la répartition aux États-Unis depuis la guerre de Sécession (1869-1992), en particulier dans DUMÉNIL G., LÉVY D. 1991 et 1992(b) et, avec quelques modifications mineures, dans DUMÉNIL G., LÉVY D. 1992(a), 1993 et 1994, ainsi que dans DUMÉNIL G., GLICK M., LÉVY D. 1992 et 1993. Les séries se trouvent sur le site Internet du Cepremap (//www.cepremap.cnrs.fr/~levy/uslt4.txt). Elles peuvent aussi être obtenues sur une disquette.

ABSTRACT

THE U.S. ECONOMY SINCE THE CIVIL WAR :
SOURCES AND CONSTRUCTION OF THE SERIES

This paper presents the sources and construction of the series used in various studies devoted to the evolution of technology and distribution in the U.S. economy since the Civil War (1869-1992), in particular in DUMÉNIL G., LÉVY D. 1991 and 1992(b) and, with a few minor alterations, in DUMÉNIL G., LÉVY D. 1992(a), 1993, and 1994, as well as in DUMÉNIL G., GLICK M., LÉVY D. 1992 and 1993. The series can be found on the Web site of Cepremap (//www.cepremap.cnrs.fr/~levy/uslt4.txt), or can be obtained from the authors on a diskette.

MOTS CLEFS : Investissement, Stock de Capital, Salaires, Emploi, Taux de profit, Taux d'utilisation du capital.
KEYWORDS : Investment, Capital Stock, Wages, Employment, Profit Rate, Capacity Utilization Rate.
J.E.L. Nomenclature : 040,620.

INTRODUCTION

This paper presents the sources and construction of the series used in various studies devoted to the evolution of technology and distribution in the U.S. economy since the Civil War (1869-1992), in particular in DUMÉNIL G., LÉVY D. 1991 and 1992(b) and, with a few minor alterations, in DUMÉNIL G., LÉVY D. 1992(a), 1993, and 1994, as well as in DUMÉNIL G., GLICK M., LÉVY D. 1992 and 1993. We will determine 11 basic series which can be obtained from the authors. A number of plots of the series or variables (productivities, labor cost, profit rate, etc.) are displayed in an appendix.

• Gross Fixed Capital Stocks in Current and \$87	**KG,KG7**
• Net Fixed Capital Stocks in Current and \$87	**KN,KN7**
• Total Hours Worked	**L**
• Hourly Wages	**W**
• Private Gross National Products in Current and \$87	**GNP,GNP7**
• Private Net National Products in Current and \$87	**NNP,NNP7**
• Gross Investment in \$87	**I7**

The period covered is 1869-1992 for all variables with the exception of KN7, KG7, and I7 which are estimated since 1805. The unit of analysis is the total private economy.

The following should be noted:

1. For capital stock and investment, equipment and structures are constructed separately and then added. For example:

$$\mathrm{KN} = \mathrm{KNEQ} + \mathrm{KNST} \quad \textit{or} \quad \mathrm{I7} = \mathrm{IEQ7} + \mathrm{IST7}$$

2. Government Owned Privately Operated (GOPO) capital is included in the capital stock of the private sector, as well as in the investment series.

In addition to these basic variables, one can also find in the data base: (1) r, the profit rate, (2) u, a proxy for the capacity utilization rate, and (3) the breakdowns between equipment and structures for investment and capital stocks (gross and net of depreciation, in current or constant dollars).

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Prior to 1929 (or 1925), it is important to examine the construction of the series before using them in any econometric exercise. Basically, the series in this study have been constructed *in order to analyze their historical trends*, and not their fluctuations.

The early trend of investment has been derived to be consistent with the capital stock, which itself is the result of an interpolation and does not reflect any business fluctuations. The capital stock in current dollars reveals a certain degree of fluctuations, but they only reflect those of the deflator of investment. Concerning employment, prior to 1889, the fluctuations observed have been derived from those of GNP. The same is true of the number of hours worked which is used to derive the hourly wages from yearly wages.

1 - SOURCES

1.1 VARIABLES FROM GOLDSMITH R.W., 1952

The prefixes G1 and G2 below correspond to two different series. The first series covers the years 1805, 1850, 1880, 1890, and 1900, and the second series 1900, 1912, 1922, 1929, 1939, and 1948. For Non-Agricultural Business in 1805 and 1850, only the total (equipment plus structures) is known.

The figure in parentheses in the table below indicates the line read.

Composition of Reproducible Tangible Wealth.

A. Absolute figures in current prices ($ Billion), p. 306

Agric, Struct.	Sel. Years	*(5)*	**G1KAST,G2KAST**
Agric, Equip.	Sel. Years	*(6)*	**G1KAEQ,G2KAEQ**
Non-Agric. Bus., Struct.	Sel. Years	*(10)*	**G1KNAST,G2KNAST**
Non-Agric. Bus., Equip.	Sel. Years	*(11)*	**G1KNAEQ,G2KNAEQ**

B. Absolute figures in 1929 prices ($ Billion), p. 307

Agric, Struct.	Sel. Years	*(5)*	**G1KAST7,G2KAST7**
Agric, Equip.	Sel. Years	*(6)*	**G1KAEQ7,G2KAEQ7**
Non-Agric. Bus., Struct.	Sel. Years	*(10)*	**G1KNAST7,G2KNAST7**
Non-Agric. Bus., Equip.	Sel. Years	*(11)*	**G1KNAEQ7,G2KNAEQ7**

1.2 VARIABLES FROM THE BEA CAPITAL STOCK TABLES, 1994

The stocks of capital are available for the period 1925-1992. Investment is apparently available since 1832, but the early figures cannot be used (*cf.* section 3.1). In the table below we give in parentheses the numbers of the section and of the series :

Investments :

Private, Equip.	1832-1992	Hist. Cost	*(3.6.98)*	**KIE**
Private, Struct.	1832-1992	Hist. Cost	*(3.6.99)*	**KIS**
Private, Equip.	1832-1992	$87	*(3.6.182)*	**KIE7**
Private, Struct.	1832-1992	$87	*(3.6.183)*	**KIS7**

Net Stocks of Capital :

Net Private, Equip.	1925-1992	Cur. Cost	*(1.3.322)*	**KKNPRIEQ**
Net Private, Struct.	1925-1992	Cur. Cost	*(1.3.323)*	**KKNPRIST**
Net Private, Equip.	1925-1992	$87	*(1.3.262)*	**KKNPRIEQ7**
Net Private, Struct.	1925-1992	$87	*(1.3.263)*	**KKNPRIST7**
Net GOPO, Equip.	1925-1992	Cur. Cost	*(1.3.658)*	**KKNGOPOEQ**
Net GOPO, Struct.	1925-1992	Cur. Cost	*(1.3.659)*	**KKNGOPOST**
Net GOPO, Equip.	1925-1992	$87	*(1.3.627)*	**KKNGOPOEQ7**
Net GOPO, Struct.	1925-1992	$87	*(1.3.628)*	**KKNGOPOST7**

Gross Stocks of Capital:

Gross Private, Equip.	1925-1992	Cur. Cost	*(1.1.322)*	**KKGPRIEQ**
Gross Private, Struct.	1925-1992	Cur. Cost	*(1.1.323)*	**KKGPRIST**
Gross Private, Equip.	1925-1992	\$87	*(1.1.262)*	**KKGPRIEQ7**
Gross Private, Struct.	1925-1992	\$87	*(1.1.263)*	**KKGPRIST7**
Gross GOPO, Equip.	1925-1992	Cur. Cost	*(1.1.658)*	**KKGGOPOEQ**
Gross GOPO, Struct.	1925-1992	Cur. Cost	*(1.1.659)*	**KKGGOPOST**
Gross GOPO, Equip.	1925-1992	\$87	*(1.1.627)*	**KKGGOPOEQ7**
Gross GOPO, Struct.	1925-1992	\$87	*(1.1.628)*	**KKGGOPOST7**

We define the following aggregates for private (including GOPO) capital:

Net Cap., Equip.	Cur. Cost	KKNPRIEQ + KKNGOPOEQ	**KKNEQ**
Net Cap., Struct.	Cur. Cost	KKNPRIST + KKNGOPOST	**KKNST**
Net Cap., Equip.	\$87	KKNPRIEQ7 + KKNGOPOEQ7	**KKNEQ7**
Net Cap., Struct.	\$87	KKNPRIST7 + KKNGOPOST7	**KKNST7**
Gross Cap., Equip.	Cur. Cost	KKGPRIEQ + KKGGOPOEQ	**KKGEQ**
Gross Cap., Struct.	Cur. Cost	KKGPRIST + KKGGOPOST	**KKGST**
Gross Cap., Equip.	\$87	KKGPRIEQ7 + KKGGOPOEQ7	**KKGEQ7**
Gross Cap., Struct.	\$87	KKGPRIST7 + KKGGOPOST7	**KKGST7**

1.3 VARIABLES FROM NIPA, 1994

In the third column below, the first figure refers to the table, and the figure in parentheses indicates the line read.

Gross National Product by Sector (Current \$):

Total Economy	1929-1992	*1.7(1)*	**NGNP**
Government	1929-1992	*1.7(12)*	**NGNPGVT**

Gross National Product by Sector (\$87):

Total Economy	1929-1992	*1.8(1)*	**NGNP7**
Government	1929-1992	*1.8(12)*	**NGNPGVT7**

Compensation of Employees by Industry:

Private Industries	1929-1992	*6.4(3)*	**NTOTW**

Full-Time Equivalent Employees by Industry:

Private Industries	1929-1992	*6.7(3)*	**NWEMPL**

Self-Employed Persons by Industry:

Self-Employed Persons	1929-1992	*6.9(1)*	**NSELF**

Hours Worked by Full-Time and Part-Time Employees by Industry:

Private Industries	1948-1992	*6.11(3)*	**NWHOURS**

We define: NSELF + NWEMPL = **NEMPL**

1.4 VARIABLES FROM MISCELLANEOUS SOURCES

Series from BALKE N.S., GORDON R.G. 1989 *:*

GNP (Current $)	1869-1928	**MGNP**
GNP ($87)	1869-1928	**MGNP7**

Series from KENDRICK J.W. 1961 *:*

Table A-VI National Economy : Persons Engaged, by Major Sector, pp. 305-307

Private Total	1869-1957	**MEMPL**

In the above table, only averages are provided for 1869-1878 and 1879-1888. Figures for 1869 and 1879 are available in Table A-V Private Economy : Persons Engaged, by Class of Worker, Key Years, p. 304.

Table A-X National Economy : Man Hours, by Major Sector, pp. 311-313

Private Total	1869-1957	**MHOURS**

In the above table, only averages are provided for 1869-1878 and 1879-1888. Figures for 1869 and 1879 are available in Table A-XI National Economy : Man Hours, by Sector and by Industrial Division, Key Years, p. 314.

Table A-II National Product, Commerce Concept by Sector, 1869-1957 (Millions of $29), pp. 298-300

Government Product	1869-1957	**MGNPGVT9**

Series from LEBERGOTT S. 1964 *:*

A-16 All employees, Annual Earnings, 1900-1970, p. 523

Money Earnings (when Employed)	1900-1960	**M2WAGE**

A-19 Earnings of Non-Farm Employees, 1860-1900, p. 528

Annual Earnings, Money (when Employed)	1860-1900	**M1WAGE**

2 - CAPITAL STOCK

We build separately the series for equipment and structures, including both gross and net measures of the capital stock. These series are available from the BEA, since 1925. Prior to this date, for the sake of simplicity, we rely on a single source GOLDSMITH R.W. 1952.

Goldsmith's data are limited in several respects :

1. Figures are only available for a limited number of years.
2. The distinction between equipment and structures, for the Non-Agricultural sector of the economy, is only made since 1880.
3. Two different series are presented prior to and after 1900.
4. Only net capital is considered.

The reconstruction requires 9 different stages :

1. The series G1..., introduced in section 1.1, are rescaled to the levels of the series G2.., using the values for the common year 1900.

2. The logarithm of rescaled Goldsmith's series for the net stocks of equipment and structures in constant dollars for the entire economy (the sum Agricultural + Non-Agricultural), are interpolated, since 1880 (when the breakdown between equipment and structures is available), using the procedure EXPAND of SAS-ETS (cubic-spline method).

3. We determine the deflator of capital implicit in Goldsmith's series for the years for which the data are available (for example, by comparing G2KAEQ + G2KNAEQ with G2KAEQ7 + G2KNAEQ7).

4. This deflator is interpolated using KI / KI7, the deflator of total investment (equipment + structures) from the BEA.

5. On this basis, we derive the series of capital in current dollars from the series in constant dollars and the capital deflator.

6. These series are spliced to those of the BEA, KKNEQ, KKNST, KKNEQ7, and KKNST7, using the values for 1925. Thus, the series KNEQ, KNST, KNEQ7, and KNST7 have been reconstructed for the period 1880-1992.

7. Prior to 1880, *i.e.*, for 1805 and 1850, the breakdown between equipment and structures is not available for the Non-Agricultural sector of the economy. Since after 1880 the ratios *Structures / Equipment* diminished steadily, we estimate models for the logarithm of these ratios (for the period 1880-1992 in current and constant dollars), and use these models to extrapolate the breakdown between the two components (with $t = Year - 1900$) :

$$ln\,\frac{\text{KNST}}{\text{KNEQ}} = \underset{(t=79.7)}{1.148} - \underset{(t=42.8)}{0.01270}\,t \qquad R^2 = 0.96$$

$$ln\,\frac{\text{KNST7}}{\text{KNEQ7}} = \underset{(t=74.7)}{1.437} - \underset{(t=39.3)}{0.01556}\,t \qquad R^2 = 0.94$$

8. Stages 2 to 7 can now be repeated beginning in 1805 for the net stocks in constant dollars. For the stocks in current dollars, the deflator derived from the BEA series for investment is not reliable for the early years, for the reasons explained below in section 3.3, and in any case, the series only begin in 1832. Consequently, the stocks of capital in current dollars are only estimated since 1869.

The series obtained are :

Net Fixed Cap. in Cur. $, Equip. and Struct., since 1869	**KNEQ,KNST**
Net Fixed Cap. in Const. $, Equip. and Struct., since 1805	**KNEQ7,KNST7**

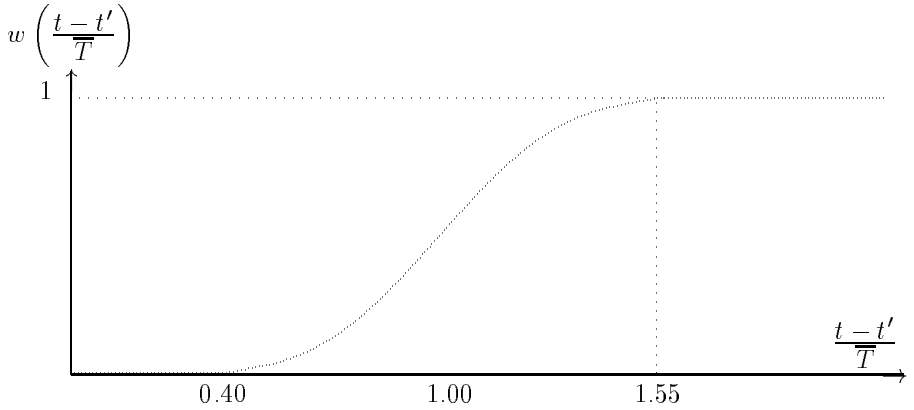
9. In order to provide an estimate of the gross stocks of capital, we extrapolate the BEA series KKGEQ, KKGST, KKGEQ7, and KKGST7, which begin in 1925, with the assumption that the ratios *Gross Stocks / Net Stocks* remained constant prior to 1925, and equal to their value in 1925 in the BEA series. Thus, we obtain :

Gross Fixed Cap. in Cur. $, Equip. and Struct., since 1869	**KGEQ,KGST**
Gross Fixed Cap. in Const. $, Equip. and Struct., since 1805	**KGEQ7,KGST7**

3 - INVESTMENT

This section is devoted to the reconstruction of the series of investments for equipment and structures in constant dollars, IEQ7 and IST7, as well as the series of discards and depreciation allowances.

Figure 1 Winfrey's Schedule, $w\left(\frac{t-t'}{\overline{T}}\right)$



The schedule is the same for equipment and structures. It is different for residential capital, which is not considered here. An analytical form of the function between 0.40 and 1.55 is:

$$w(x) = -1.17822 + 8.55939x - 23.82384x^2 + 30.88613x^3 - 17.49325x^4 + 3.58836x^5$$

3.1 DISCUSSION OF THE BEA INVESTMENT SERIES

The BEA determined series for investment only in order to allow for the construction of the stocks of capital since 1925, using the perpetual inventory method. The following model is used by the BEA for the various (several tens) components of the capital stock:

$$K(t) = \sum_{t' \leq t} I(t') \left(1 - w\left(\frac{t-t'}{\overline{T}}\right)\right) \tag{1}$$

with the following notation:

$K(t)$ *Gross Stock of capital in constant dollars in year t*
$I(t)$ *Gross investment in constant dollars in year t*
$w(x)$ *Winfrey coefficient, an increasing function, as displayed in figure 1, which measures the rate at which capital is discarded*
$\overline{T}$ *Average service life (specific to each type of capital)*

Using equation 1, the stocks of capital can be derived from investment series. Obviously, the determination of the capital stocks since 1925 requires investment series for previous years. The sum on t' in equation 1 is bounded since Winfrey's schedule is such that a *maximum* service life equal to $1.55\overline{T}$ is associated with an average service life $\overline{T}$. Therefore the summation is limited to values of t' such that $t - 1.55\overline{T} \leq t' \leq t$. For example, if $\overline{T}$ is equal to 15 years, the investment series must be known since $1925 - 1.55 \times 15 = 1902$. Since various types of capital goods have different service lives, the initial year differs in each case. The investment series in the BEA data begin in the years required for the estimation of the capital stocks in 1925. Therefore, the investment series in the early years only correspond to a selection of capital goods, and cannot be used as a measure of total investment.

3.2 THE AVERAGE SERVICE LIVES OF EQUIPMENT AND STRUCTURES

Most of the average service lives vary between 10 and 20 years for the various components of equipment, and between 30 and 40 years for those of structures. The purpose of this section is to determine average service lives, $\overline{T}_E$ and $\overline{T}_S$, for total equipment and total structures. This is done using equation 1, with the BEA series for both investment and capital. This equation for $\overline{T}$ is nonlinear. The SAS procedure NLIN was used (for the logarithm of equation 1). For the period 1925-1992, this estimation yields:

$$\overline{T}_E = 15.8 \ Years$$
$$\overline{T}_S = 38.0 \ Years$$

With these service lives, the oldest vintage of investment still in use in 1869 is 1844 for equipment and 1811 for structures.

3.3 A MODEL FOR INVESTMENT SERIES

For the earlier years, we build investment series coherent with the measures of the gross stocks of capital in constant dollars as determined in section 2. Obviously, this procedure only accounts for the trend value of investment, and not its fluctuations.

Rather than modeling investment $I(t)$, or the investment rate $I(t)/K(t)$, it is easier and more appropriate to model the rate of discard $DIS(t)/K(t)$, which is *a priori* steadier, and then to reconstruct investment using: $I(t) = DIS(t) + K(t) - K(t-1)$. The assumption of constant service lives suggests the use of constant discard rates, denoted a_E and a_S for equipment and structures respectively. With this model, investment is determined by:

$$I(t) = (1+a)K(t) - K(t-1) \tag{2}$$

A straightforward estimation of a_E and a_S is to compute their average in BEA data over the period 1925-1992. One obtains: $a_E = 0.0500$ and $a_S = 0.0230$. Another method is to use equations 1 and 2. With this method, the consistency between investment and the capital stock series as expressed in equation 1 is improved for the earlier years. We replace $I(t)$ in equation 1, by its value as in equation 2, and obtain an equation with parameter a as unique unknown:

$$K(t) = b(t) + ac(t) \quad with:$$

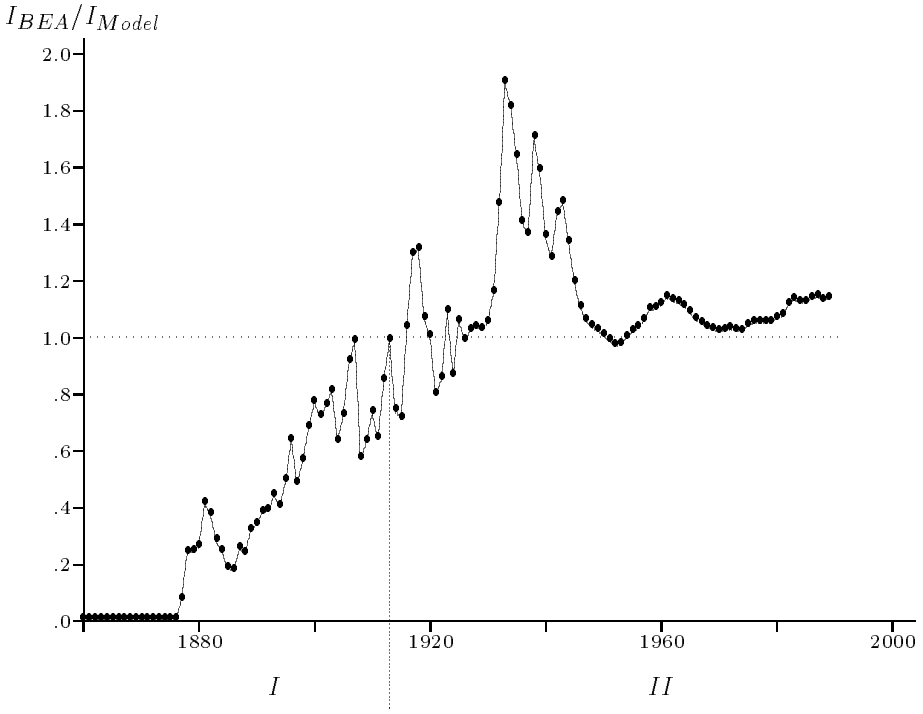
$$b(t) = \sum_{t' \leq t} \left(K(t') - K(t'-1)\right) \left(1 - w\left(\frac{t-t'}{\overline{T}}\right)\right)$$

$$c(t) = \sum_{t' \leq t} K(t') \left(1 - w\left(\frac{t-t'}{\overline{T}}\right)\right)$$

Then a_E and a_S are estimated as the average of $(K(t) - b(t))/c(t)$ over the period 1869-1992. One obtains: $a_E = 0.0428$ and $a_S = 0.0166$. These estimates are different from the above, but the orders of magnitude are consistent. The second method has been preferred to the first one.

Since the capital series are known since 1805, these two estimates allow for the determination of the two investment series (in constant \$) since this same date.

Figure 2 Investment in Equipment : I_{BEA}/I_{Model}



3.4 THE SPLICING OF THE INVESTMENT SERIES

This section is devoted to the determination of the year in which the series accounting for the trend of investment, as derived from the model above, can be spliced to the BEA series, which are not reliable for the early years.

Figure 2 displays the ratio between the two series for equipment. During the later years (period II in the figure), the ratio oscillates in the vicinity of 1, and the series derived from the model actually corresponds to the trend of the BEA series. For the earlier years (period I), the ratio is equal to 0 at the beginning, and then increases to 1. This rise mirrors the fact that BEA investment series only correspond to the subset of goods which are required for the construction of capital stocks in 1925 and after. We choose 1913 as the transition year. Prior to this date, we select the model series over the BEA data. The same investigation for structures assigns 1897 as the transition year.

These results are quite consistent with the estimates of the average service lives as in section 3.2 for equipment and structures :

$$1913 \simeq 1925 - \overline{T}_E$$
$$1897 \simeq 1925 - \overline{T}_S$$

Thus, we define the two following variables :

Model (equation 2 with $a_E = 0.0428$) prior to 1913
BEA series since 1913 **IEQ7**

Model (equation 2 with $a_S = 0.0166$) prior to 1897
BEA series since 1897 **IST7**

3.5 ADDITIONAL VARIABLES

We further define discards and depreciation for equipment and structures in constant dollars:

$\mathrm{IEQ7}(t) + \mathrm{KGEQ7}(t-1) - \mathrm{KGEQ7}(t)$	**DISEQ7**(t)
$\mathrm{IST7}(t) + \mathrm{KGST7}(t-1) - \mathrm{KGST7}(t)$	**DISST7**(t)
$\mathrm{IEQ7}(t) + \mathrm{KNEQ7}(t-1) - \mathrm{KNEQ7}(t)$	**DEPEQ7**(t)
$\mathrm{IST7}(t) + \mathrm{KNST7}(t-1) - \mathrm{KNST7}(t)$	**DEPST7**(t)

4 - PRIVATE NET NATIONAL PRODUCT AND CAPACITY UTILIZATION RATE

4.1 PRIVATE NET NATIONAL PRODUCT

Gross National Product for the total economy is derived from NIPA since 1929, and from BALKE N.S., GORDON R.G. 1989 prior to 1929, in both current and constant dollars:

MGNP prior to 1929
NGNP since 1929 **TGNP**

MGNP7 prior to 1929
NGNP7 since 1929 **TGNP7**

The Government GNP is available from NIPA since 1929. Prior to this date, we use Kendrick's series MGNPGVT9. A first difficulty with this latter series is that it is available annually only since 1889. We make a linear interpolation of the logarithm of the series for the early years. Second, the series is expressed in \$29. The series is first multiplied by GNP7(1929) / GNP(1929) to convert \$29 into \$87, and then reflated utilizing the deflator for total GNP. Private GNP is obtained by subtracting Government GNP from total GNP: **GNP**,**GNP7**

The two depreciation series, DEPEQ7 and DEPST7, determined in the previous section, are also reflated using the GNP deflator. They are subtracted from private GNP to yield Private Net National Product in current dollars or \$87: **NNP**,**NNP7**

4.2 CAPACITY UTILIZATION RATE

As is well known, the capacity utilization rate is only avalable for the industrial sector of the economy, and since World War II. In order to construct a proxy for this variable for the period covered in this study, we will determine a trend GNP (corresponding to the average or "normal" utilization of capacity) and compute the difference between the logarithm of the actual GNP and of this trend.

A method to determine the trend GNP is to use the Hodrick-Prescott filter (HODRICK R.J., PRESCOTT E.C. 1980). For a given time interval (namely, 1869-1992 in this study),

this method decomposes a variable x_t into two components $\overline{x}_t$ and $\widehat{x}_t$, respectively its trend and fluctuation, by minimizing the following expression :

$$\sum_{t=1869}^{1992} \widehat{x}_t^2 + \lambda \sum_{t=1871}^{1992} (\overline{x}_{t+2} - 2\overline{x}_{t+1} + \overline{x}_t)^2 \tag{3}$$

This allows for the construction of a more or less rigid trend, depending on the value of parameter λ.

The method implicitly assumes that there is no asymmetry between the fluctuations above and below the trend. Considering business-cycle fluctuations, this assumption implies that an overheating and a recession involve equal deviations above and below the trend. "Routine" business-cycle fluctuations are compatible with this assumption, but it cannot be maintained for two quite specific events : the Great Depression and World War II. If no correction is made, a significant bias is introduced in the separation between the trend and fluctuations of GNP. In particular, the trend is too low during the 1920s, due to the severity of the Great Depression.

In order to correct for the specific features of the depression and war, we modify equation 3, deleting the years 1930 to 1945 from the first sum, *i.e.*, we minimize:

$$\sum_{t=1869}^{1929} \widehat{x}_t^2 + \sum_{t=1946}^{1992} \widehat{x}_t^2 + \lambda \sum_{t=1871}^{1992} (\overline{x}_{t+2} - 2\overline{x}_{t+1} + \overline{x}_t)^2$$

The difficulty with this method is to choose the appropriate value of λ, the parameter which commands the flexibility or rigidity of the trend. Since we want to provide an estimation of the capacity utilization rate, we select the value which maximizes the correlation coefficient between the capacity utilization rate of Manufacturing industries and our proxy, since 1948. The maximum correlation coefficient, 0.842, is obtained for a parameter equal to 650. (This value is smaller than the standard figure $\lambda = 1600$, but we work on annual instead of quarterly series.) With $x_t =$ LGNP7, the logarithm of GNP in \$87, one obtains $\overline{x}_t =$ **LGNP7TR**, the trend GNP. Thus, we define **U** :

$$\text{U} = \text{LGNP7} - \text{LGNP7TR}$$

(U is approximately equal to the ratio of the fluctuation of GNP to its trend.)

5 - EMPLOYMENT AND WAGES

5.1 EMPLOYMENT

To construct a series of employment, we draw on MEMPL prior to 1929 and NEMPL since 1929. A difficulty exists for the early years since Kendrick only provides the average employment for the periods 1869-1878 and 1879-1888, and figures for 1869 and 1879. In the determination of employment between 1869 and 1888, we use these two figures. A mere linear interpolation is not sufficient. It is necessary to build a yearly series which follows the short-term fluctuations of the economy.

We determine the elasticity of employment to the capacity utilization rate over the period 1889-1929 :

$$ln\,\mathrm{MEMPL} = \underset{(t=1476.)}{10.20} + \underset{(t=41.0)}{1.91}\ t + \underset{(t=4.1)}{0.467}\ \mathrm{U} \quad R^2 = 0.979$$

Then, we use this elasticity to interpolate employment for each subperiod, 1869-1879 and 1879-1889 :

$$ln\,\mathrm{EMPL} = A + Bt + 0.467\ \mathrm{U}$$

in which A and B are determined by the data for the initial and final years of each subperiod.

Finally, the interpolated Kendrick's series is spliced to that of NIPA. Actually there is little difference in the two series for the overlapping period.

The Number of Hours Worked per Year (by all Employees and Self-Employed Persons), L, is determined as follows :

1869-1947 MHOURS
1948-1992 NWHOURS $\times$ NEMPL / NWEMPL **L**

Kendrick's series MHOURS is interpolated with the same model as employment :

$$ln\,\mathrm{MHOURS} = \underset{(t=1264.)}{11.22} + \underset{(t=27.2)}{1.63}\ t + \underset{(t=4.4)}{0.649}\ \mathrm{U} \quad R^2 = 0.956$$

5.2 WAGES

The annual wage per employee, WY, is formed from the splicing of the three following series :

1869-1899 M1WAGE
1900-1928 M2WAGE **WY**
1929-1992 NTOTW / NWEMPL

The hourly wage, **W**, can be determined as :

$$\mathrm{W} = \mathrm{WY}\frac{\mathrm{EMPL}}{\mathrm{L}}$$

APPENDIX

This appendix displays the plots of some of the series presented above or other derived variables. With the exception of the capacity utilization rate, the share of profits, and the profit rate, we always display the logarithm of the series. The period covered is 1869-1992, unless otherwise specified. The trend lines have been constructed with the Hodrick-Prescott filter.

3 The real Gross National Product (GNP7).

4 The capacity utilization rate (u).

5 Number of hours worked (L).

6 The net stock of real capital (KN7).

7 The real gross investment (I7).

8 The technical composition of capital (KN7 / L).

9 The productivity of labor (NNP7 / L).

10 The productivity of capital (NNP / KN).

11 The productivity of structures (NNP / KNST).

12 The productivity of equipment (NNP / KNEQ).

13 The ratio *Structures / Equipment* (KNST / KNEQ).

14 The scatter *Labor productivity* $\leftrightarrow$ *Capital productivity.*

15 The scatter *Labor productivity* $\leftrightarrow$ *Technical composition of capital.*

16 GNP deflator (GNP / GNP7).

17 The relative price of fixed capital ((KN / KN7) / (GNP / GNP7)).

18 The ratio *Nominal hourly wage / GNP deflator* or labor cost (W / (GNP / GNP7)).

19 The share of profits ((NNP $-$ L $\times$ W) / NNP).

20 The profit rate (r).

21 The scatter *Labor productivity* $\leftrightarrow$ *Labor cost.*

Figure 3 Gross National Product, (1869-1992)

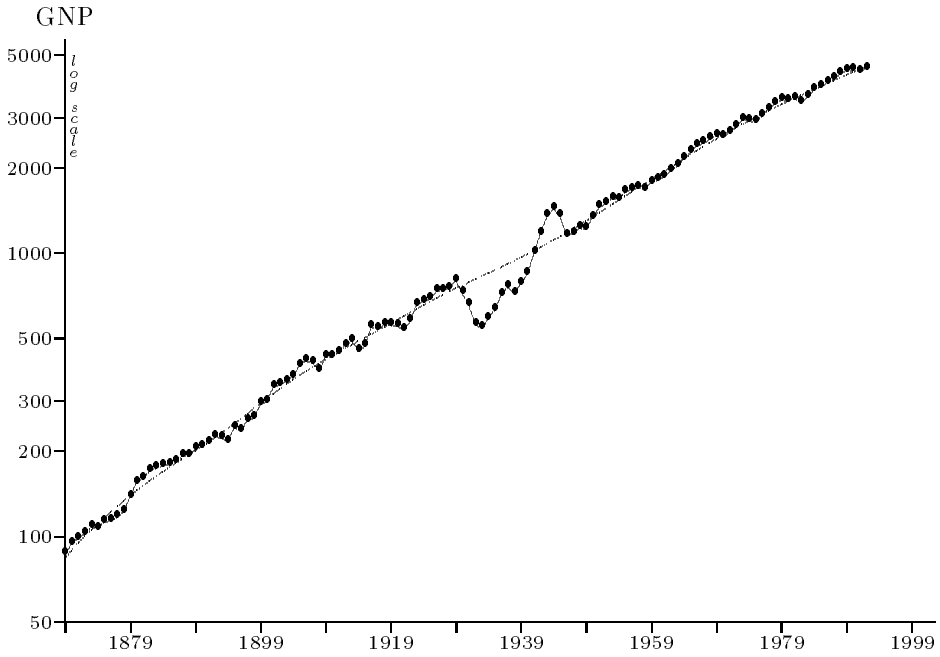


Figure 4 Capacity Utilization Rate, (1869-1992)

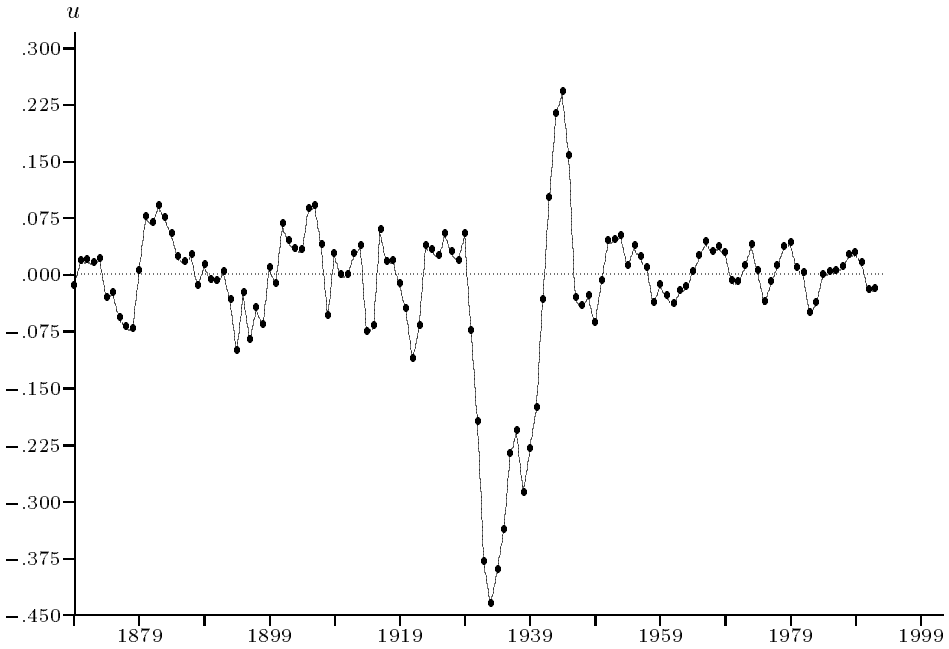


Figure 5 Number of Hours Worked, (1869-1992)

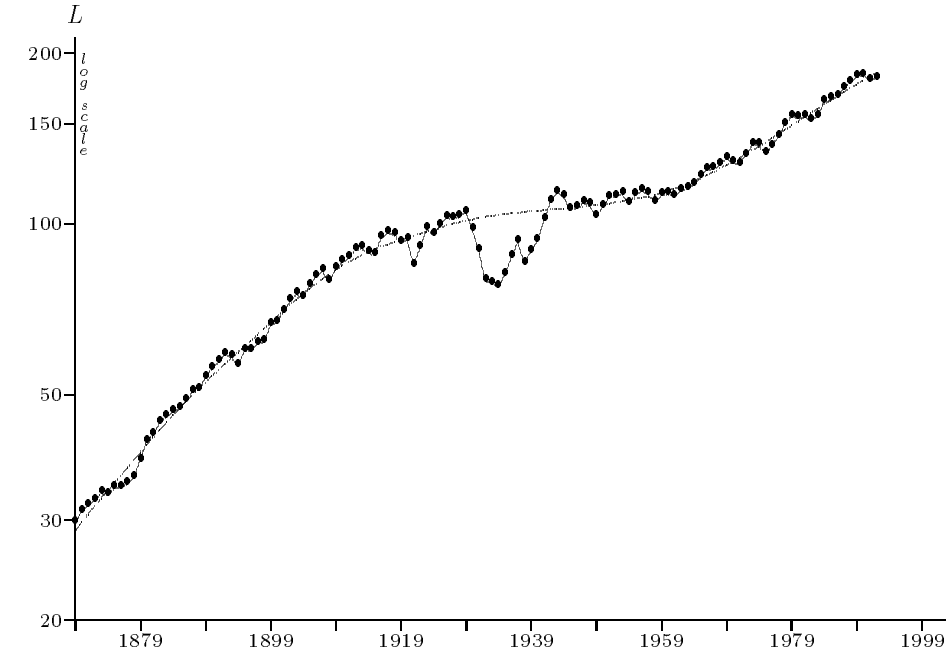


Figure 6 The Net Stock of Real Capital, (1869-1992)

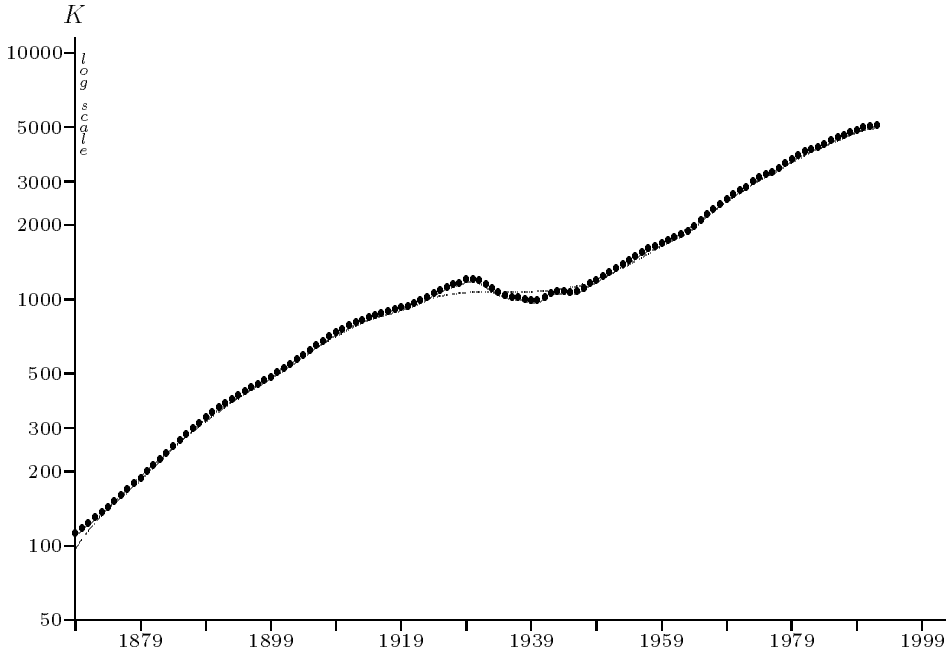


Figure 7 The Real Gross Investment, (1869-1992)

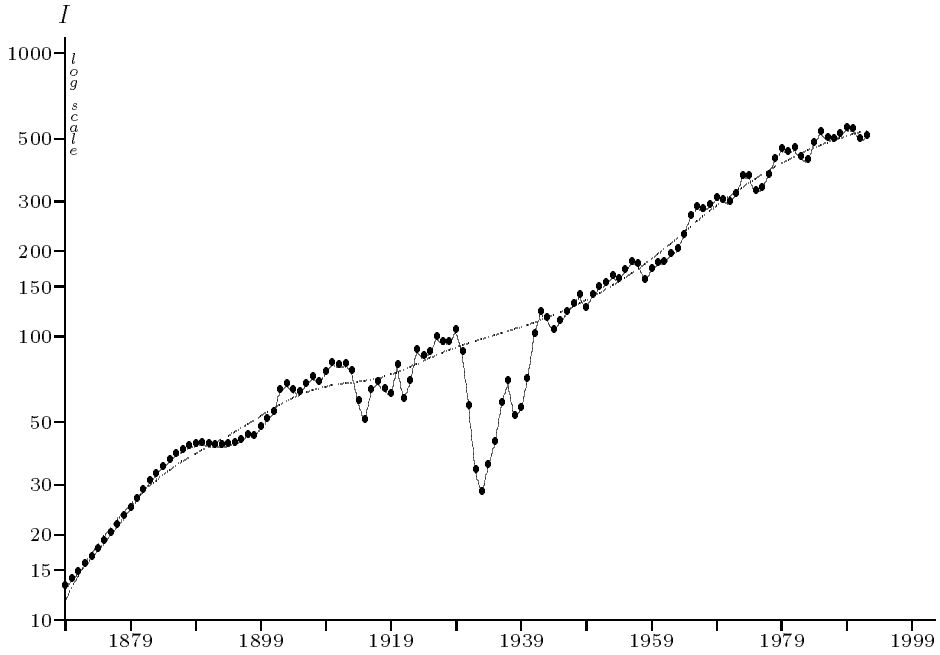


Figure 8 The Technical Composition of Capital, (1869-1992)

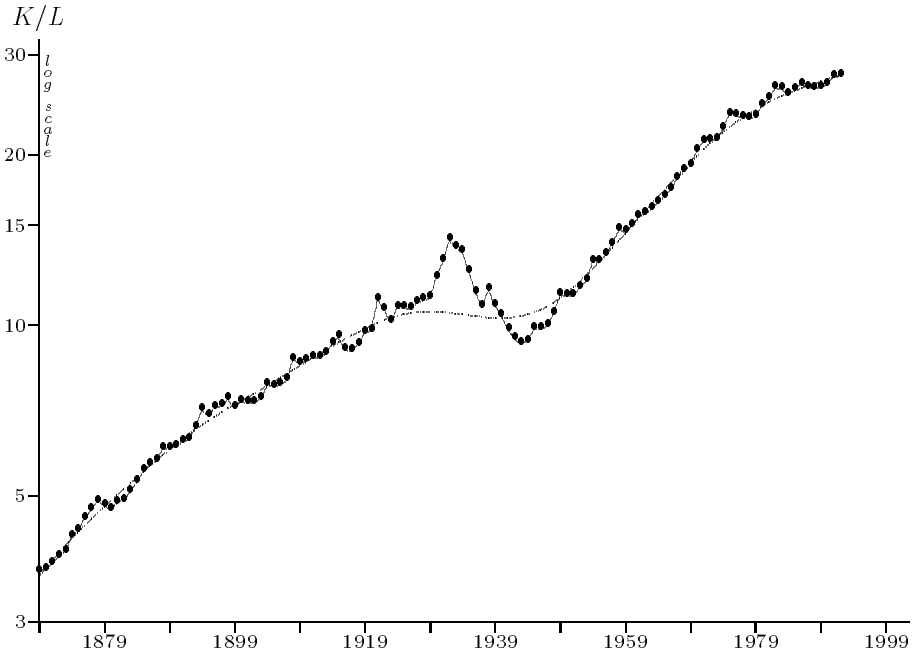


Figure 9 The Productivity of Labor, (1869-1992)

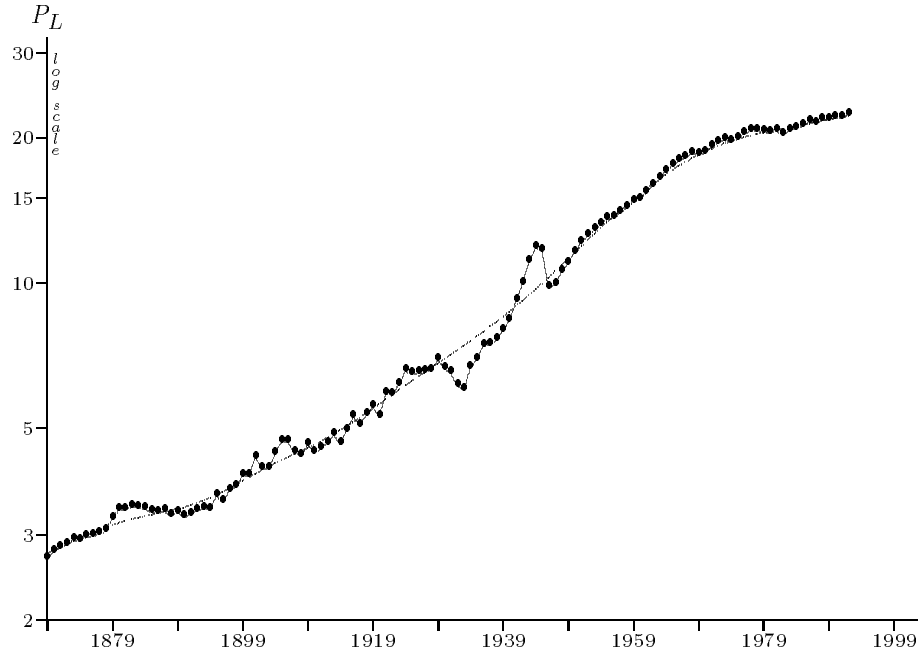


Figure 10 The Productivity of Capital, (1869-1992)

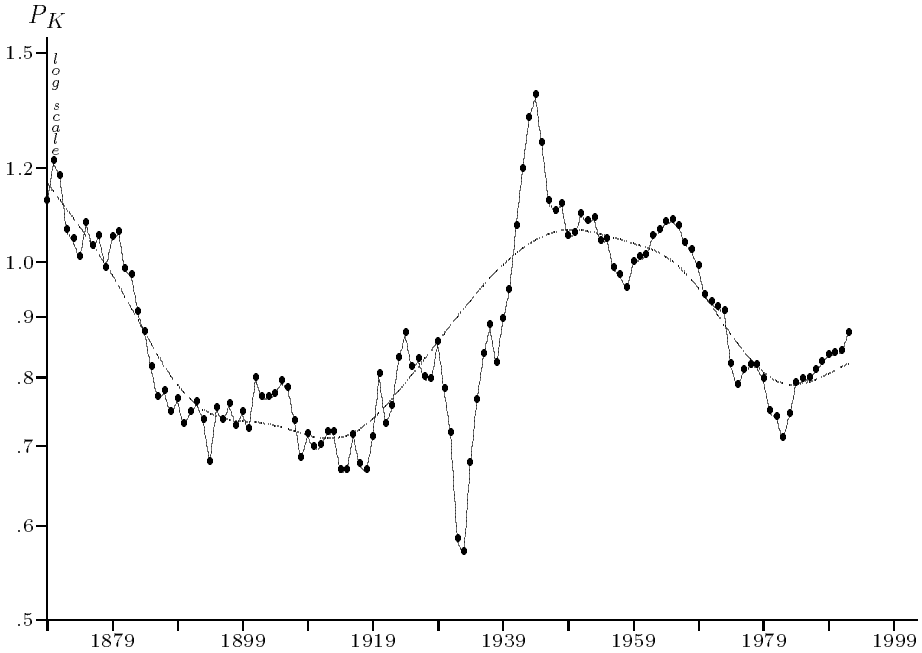


Figure 11 The Productivity of Structures, (1869-1992)

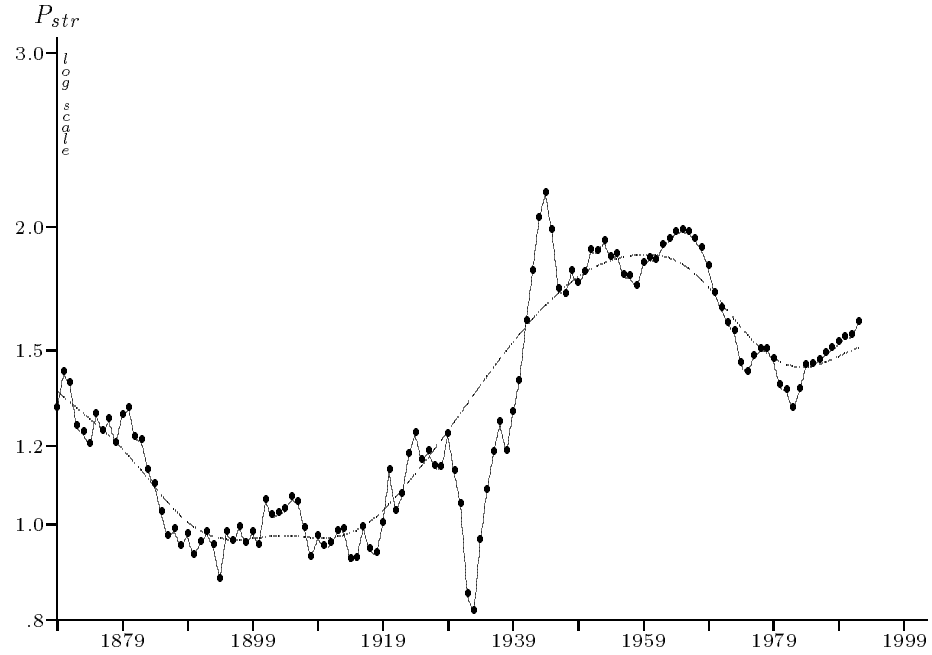


Figure 12 The Productivity of Equipment, (1869-1992)

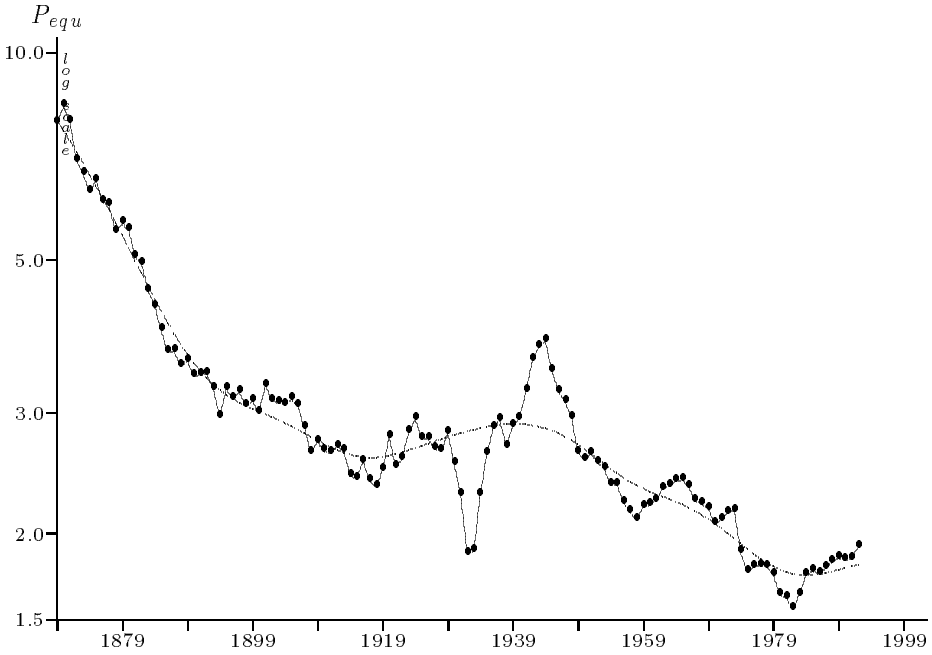


Figure 13 The Ratio *Structures / Equipment*, (1869-1992)

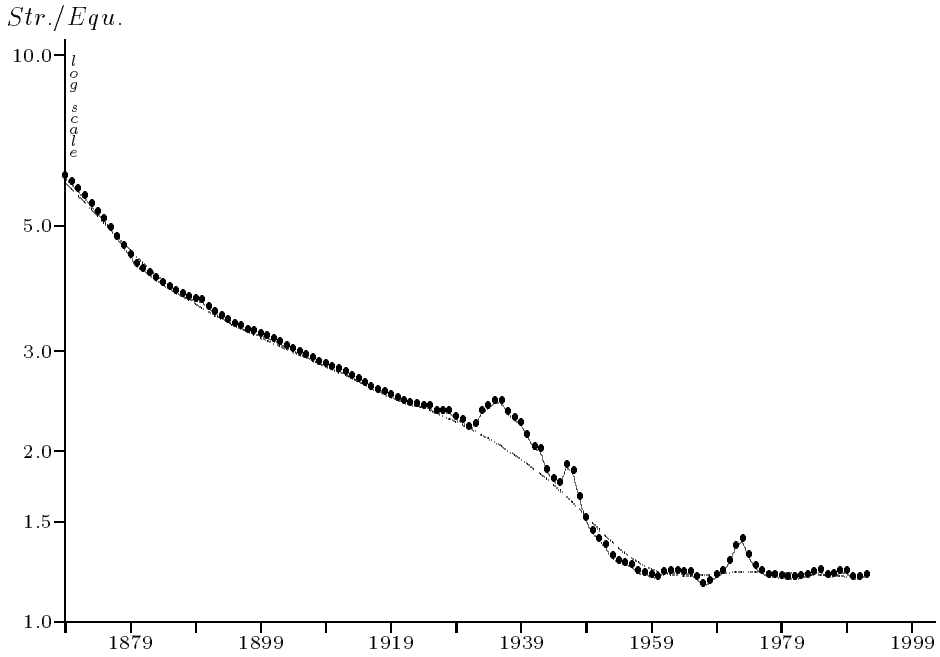


Figure 14 Scatter Diagram of Labour Productivity against Capital Productivity, (1869-1992)

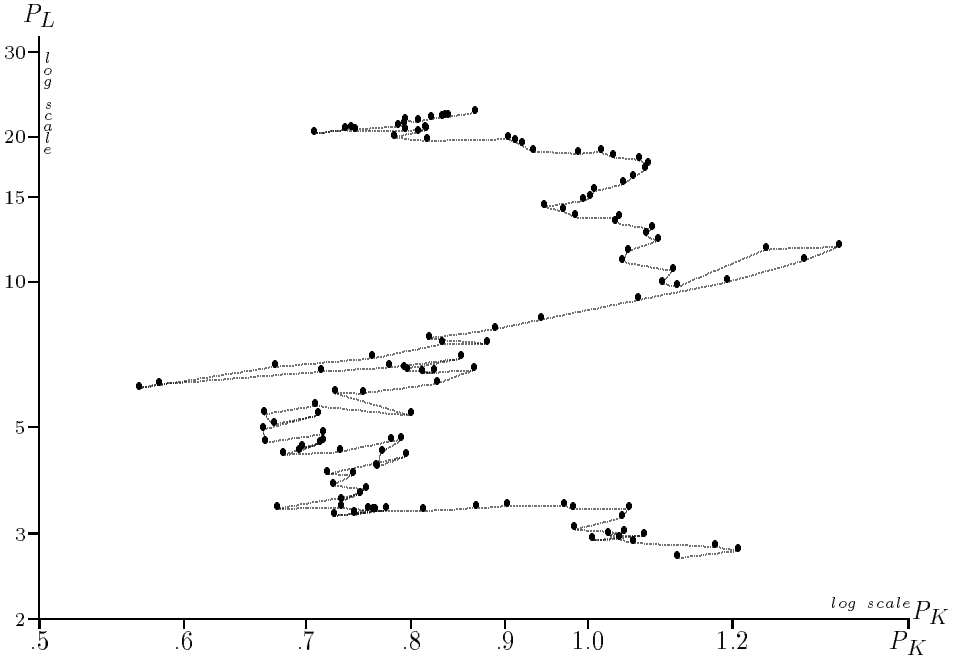


Figure 15 Scatter Diagram of Labor Productivity against the Technical Composition of Capital, (1869-1992)

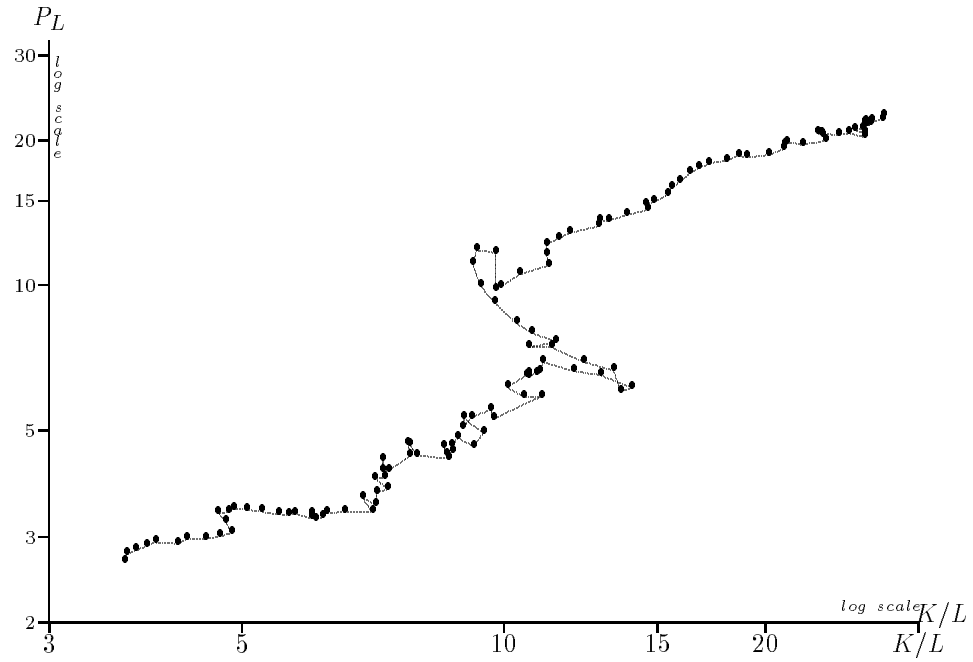


Figure 16 GNP Deflator (1987=1), (1869-1992)

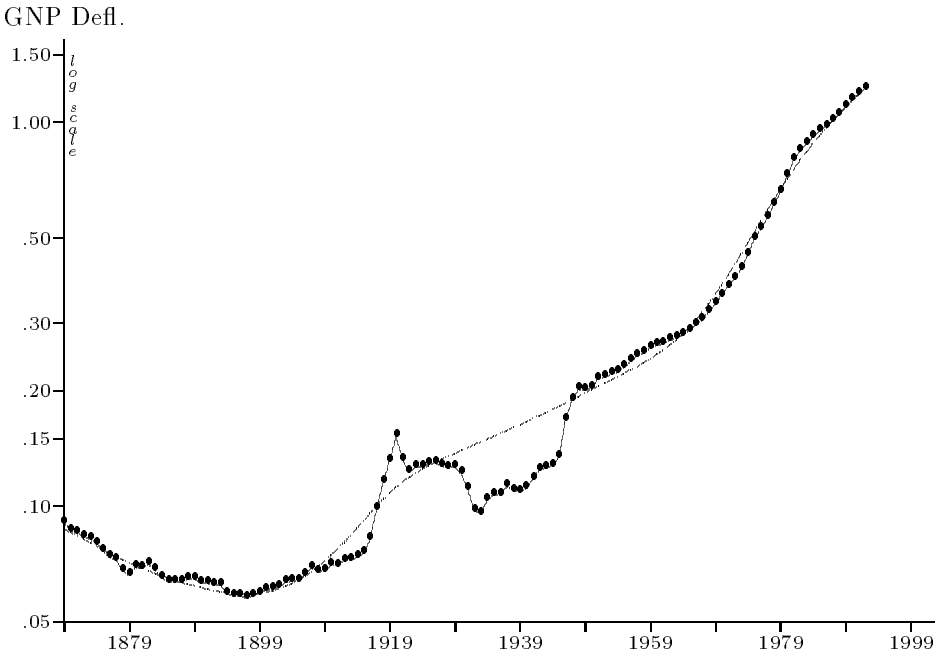


Figure 17 The Relative Price of Fixed Capital (1987=1), (1869-1992)

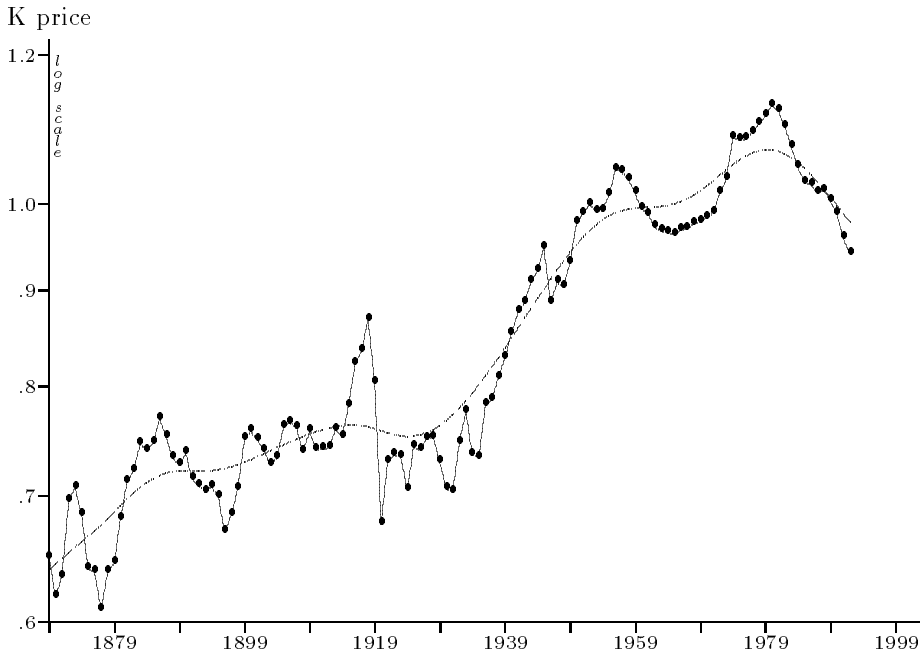


Figure 18 Labor Cost, (1869-1992)

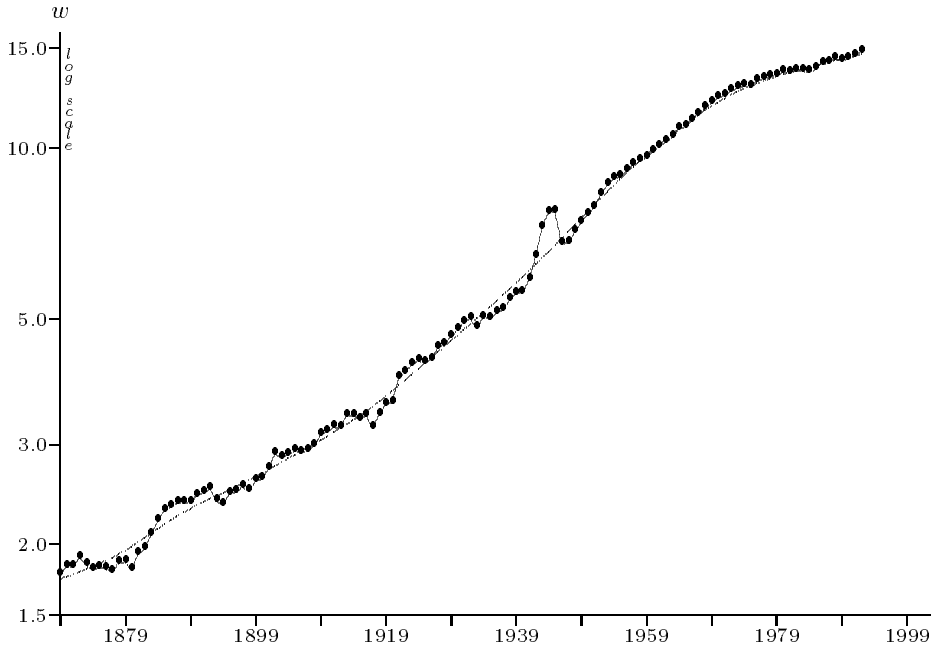


Figure 19 The Share of Profits, (1869-1992)

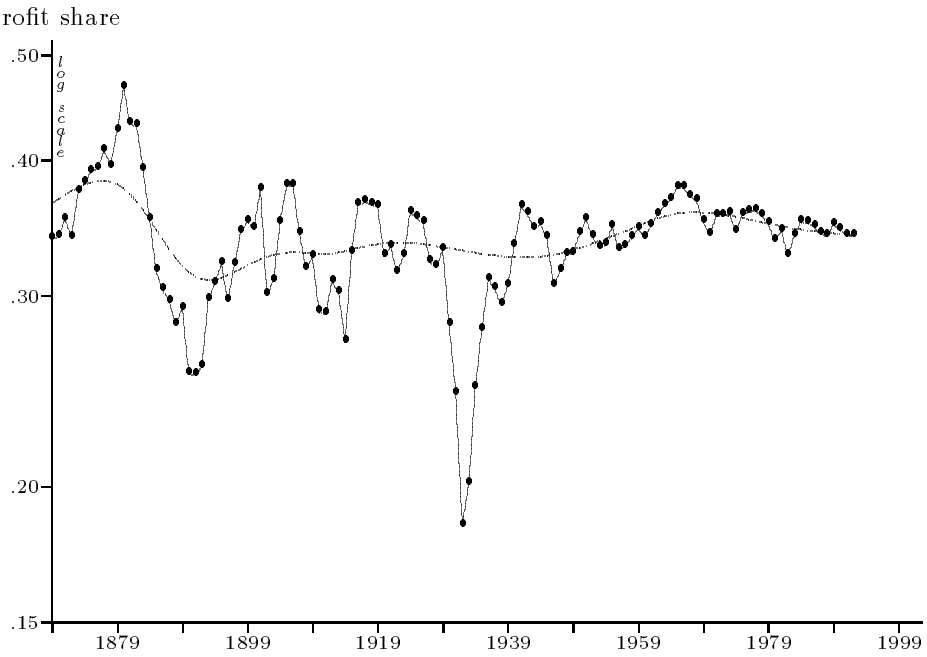


Figure 20 The Profit Rate, (1869-1992)

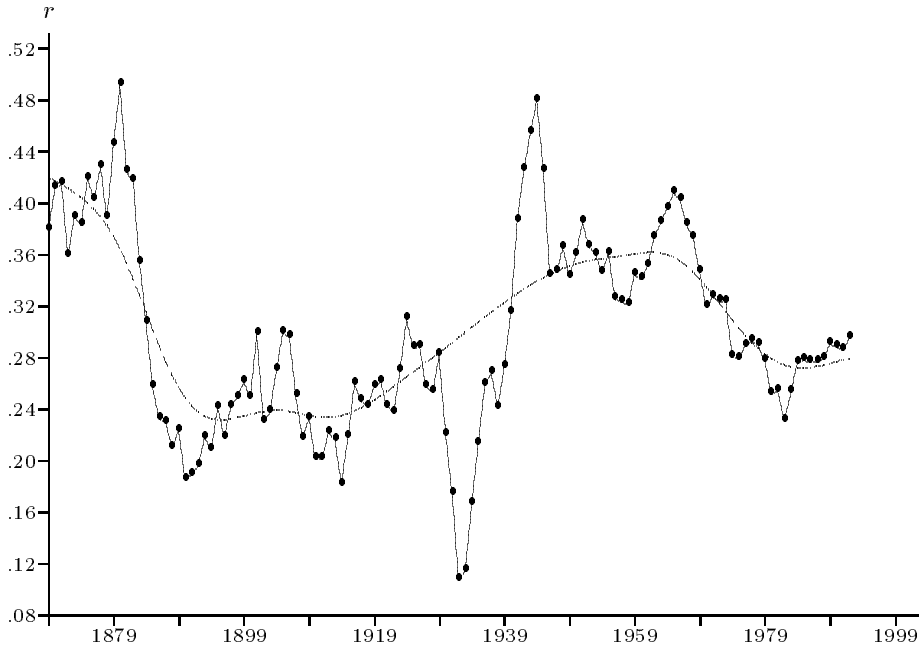
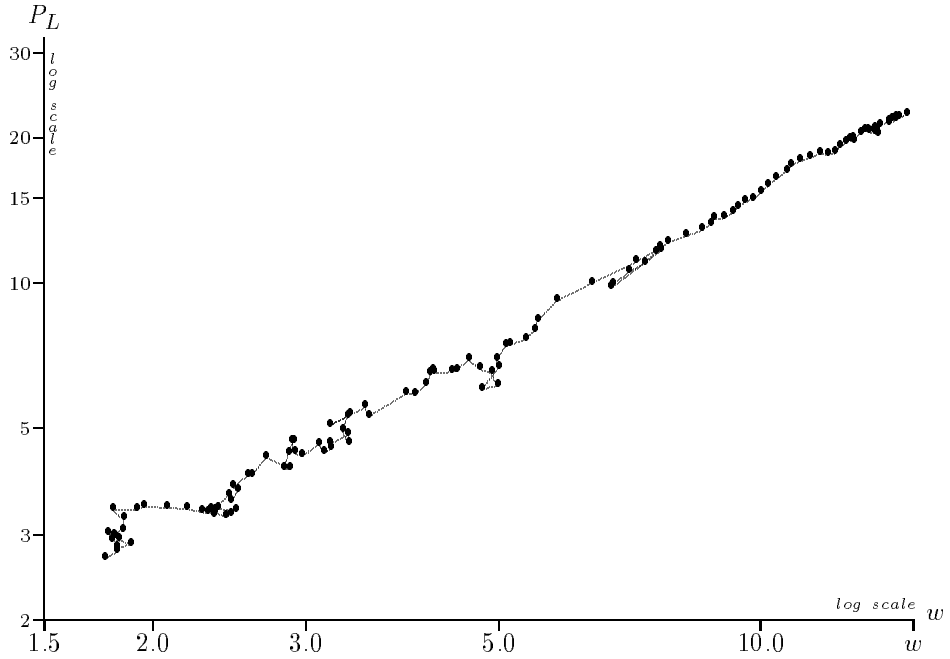


Figure 21 Scatter Diagram of Labor Productivity against Labor Cost, (1869-1992)



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