

**U.S. Hours and Productivity Behavior
using CPS Hours Worked Data: 1959-I to 2003-II**

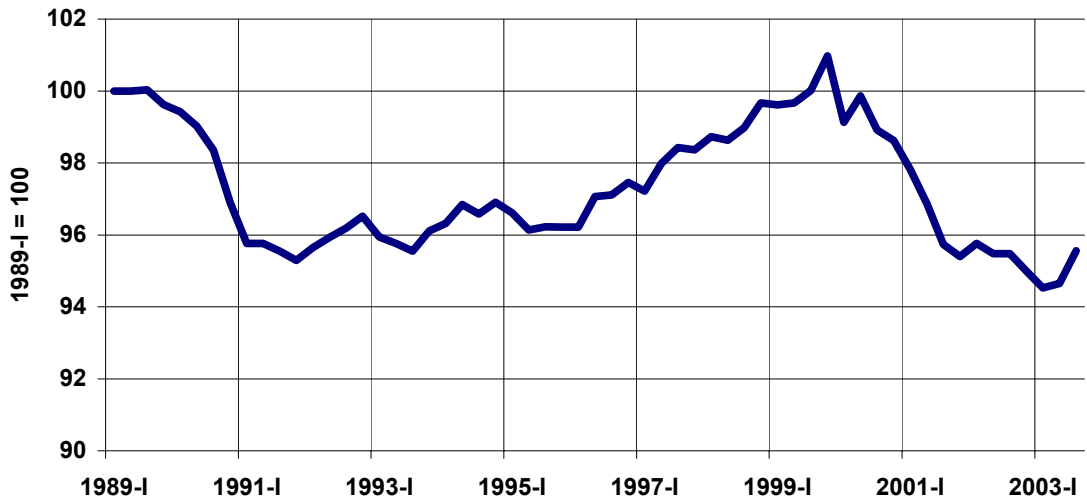
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and
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December 15, 2003

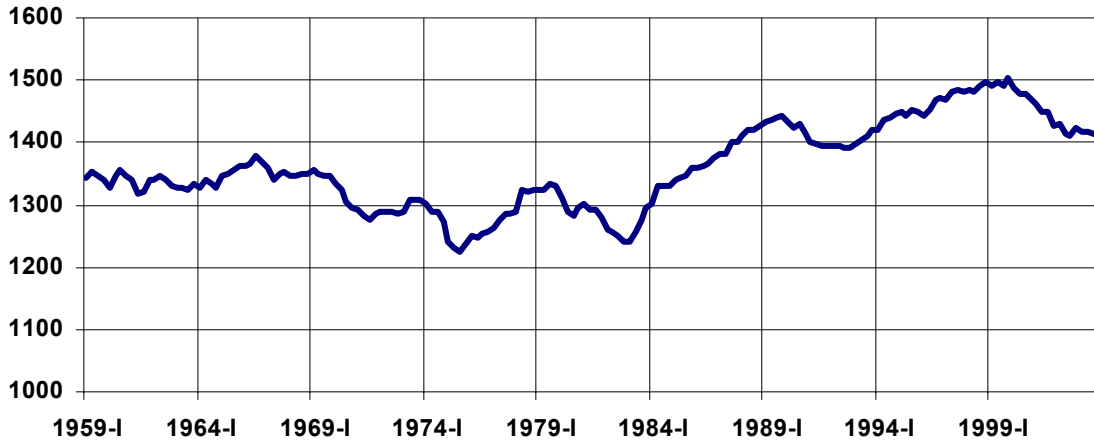
U.S. Detrended (2%) GDP per Non-Institutional Pop. Age 16-64
1959-I to 2003-III



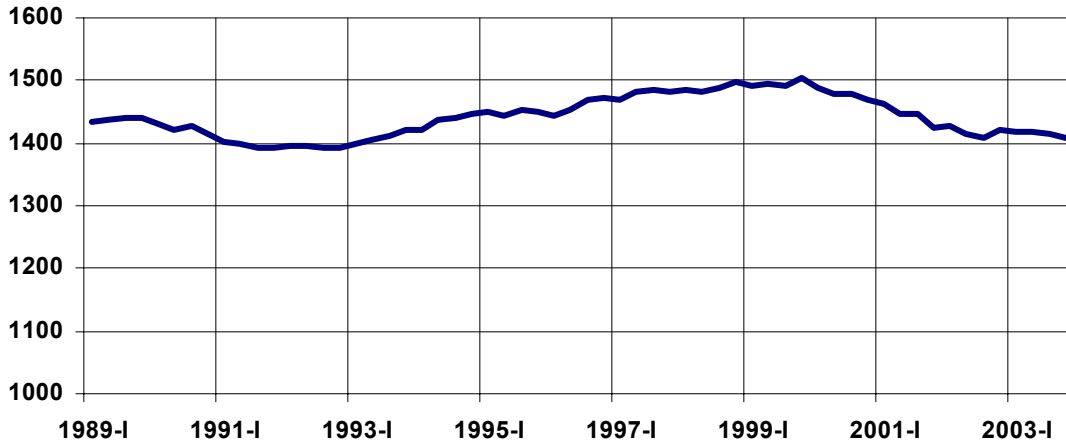
U.S. Detrended (2%) GDP per Non-Institutional Pop. Age 16-64
1989-I to 2003-III



**U.S. CPS hours worked at annual rate
per non-institutional pop. Age 16-64
1959-I to 2003-IV**

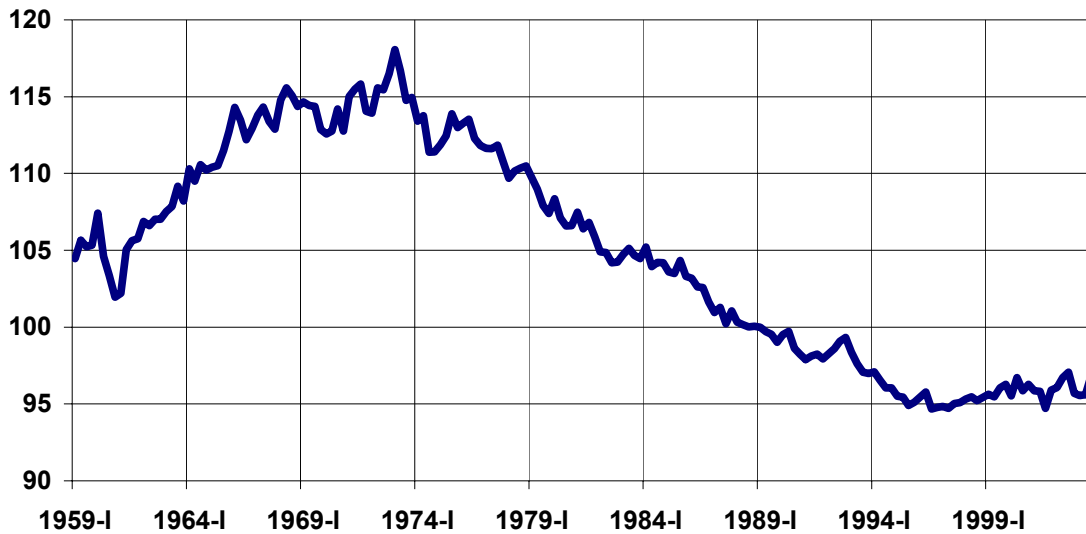


**U.S. CPS hours worked at annual rate
per non-institutional pop. Age 16-64
1959-I to 2003-IV**



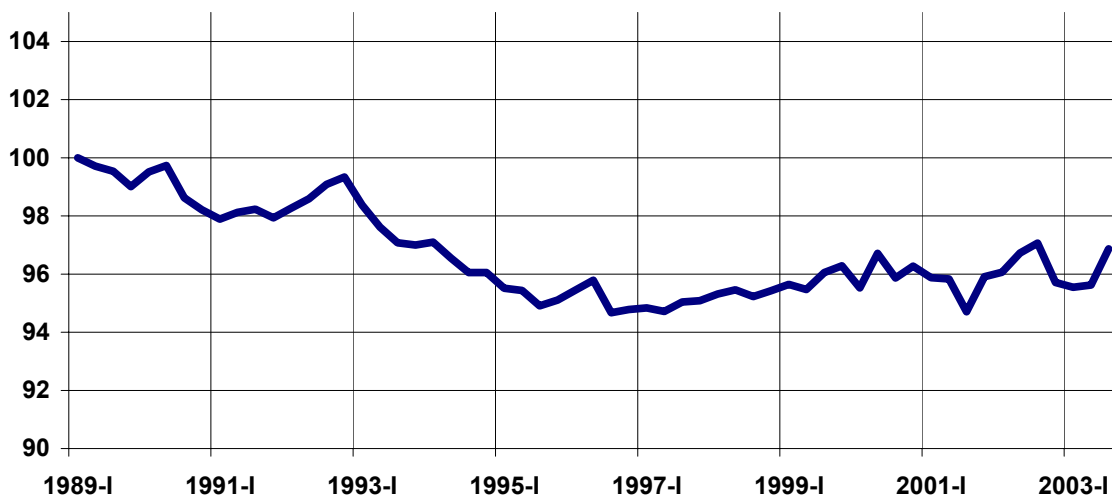
U.S. Detrended (2% trend) GDP per Hour CPS

1959-I to 2003-III

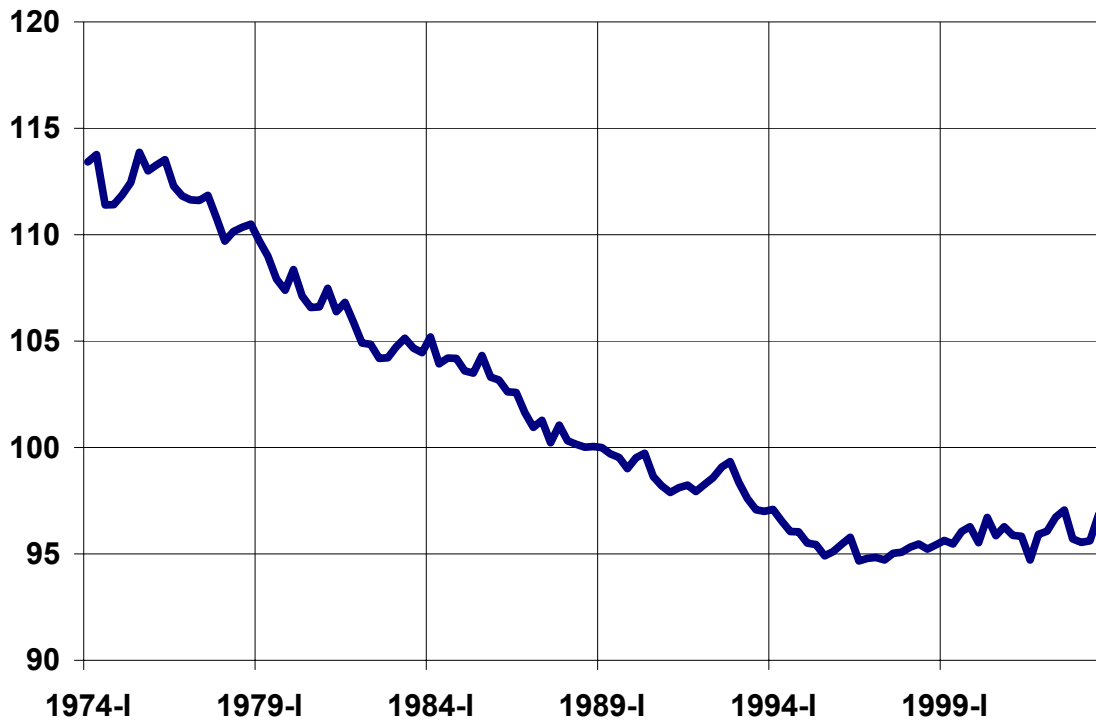


US Detrended (2% trend) GDP per Hour CPS

1989-I to 2003-III



U.S. Detrended (2 % trend) GDP per Hour CPS
1974-I to 2003-III



**Documentation of “Hours.DataUpdate12_15_03.xls” and
“ProductivityUpdate12_15_03.xls”**

Remark: *Compared to the previous versions, the latest revised GDP numbers were used and the CPS series were updated till November 2003. The real GDP numbers for the fourth quarter of 2003 are preliminary and were published by the BEA in November, 2003.*

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Hours.DataUpdate12_15_03.xls – The worksheets and their content

Worksheet Data1 — CPS

Source of the data

U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earning*, Publications 1959.1-2003.11, Table A23.

The statistics are based on the CPS household survey. The corresponding definitions apply.

Definitions

Covered set: Civilian no institutional population - All persons age 16 or older, that currently reside in one of the 50 states or the District Columbia and who do not reside in institutions (e.g. penal and mental facilities, homes for the aged) and who are not on active duty for the Armed Forces.

Definition: Employed person - If a person did work at all as a paid employee during the reference week, worked for an own business, profession or farm, or without pay for more than 15 hours in a family business or farm. A person is also employed, if it is temporary absent from work due to illness, bad weather, vacation, labor-management disputes or for personal reasons.

Of particular interest for economists is the following subgroup of the employees:
Persons at work.

Definition: Persons at work - All those employed persons, which are during the sample week not absent from work.

Content by columns

The columns contain the following data series:

A: Year

B: Month

C: Persons at work in 1000

D: Average hours worked by a person at work

F: Quarterly time index

G: Average hours worked per week on a quarterly basis

H: Average number of persons at work on a quarterly basis

I: Total hours worked per quarter

M-O: Same as F-H just deleted the blanks

Some calculations

On the worksheet the given monthly data are converted into quarterly data using the following formula:

```
IF(MIN(DataQuarter)/AVERAGE(DataQuarter)<0.9  
THEN Cell=AVERAGE(DataQuarter)  
ELSE Cell=(3*AVERAGE(D13:D15)-MIN(D13:D15))/2)
```

In words: If no particular value for the average hours worked or the persons at work deviates to much, the value for the respective quarter is the average over all values, else the average is only taken over the two highest values.

The aim is to sort out outliers on the lower side.

Consider the following example of the year 1998 quarter III: hours worked=(39.9, 39.9, 36.8). Observe that in the next month hours worked were 39.5. With the given procedure we filter out this deviation. Observe that captured deviations usually occur in the third quarter and are due to a holiday in November falling in the sampling week.

The Total hours worked per quarter are calculated using the formula:

$$Total\text{-}hours\text{-}worked = Hours\text{-}per\text{-}week * \frac{52}{4} * Persons\text{-}at\text{-}work \quad (0.1)$$

Worksheet Data2 — Population

Source of the data

U.S. Department of Labor, Bureau of Labor Statistics, Not Seasonally Adjusted Civilian non-institutional population, age 16 and over.

Download: 23/15/03, from www.bls.gov.

For civilian non-institutional population age ≥ 65 the Employment and Earnings Publications of the Department of Labor, Bureau of Labor Statistics, January edition from 1982-2003 were used.

Content by columns

A-N: Monthly data of the civilian non-institutional population.

P-S: Quarterly data of the civilian non-institutional population, where quarterly numbers are calculated as averages over monthly data.

W: Same as P-S, just reorganized.

X: Civilian non-institutional population age ≥ 65 . The quarterly data from 1982-2003 were generated using linear interpolation with the formula

$$n_{i,t} = \frac{4-i}{4} n_{4,t-1} + \frac{i}{4} n_{4,t}; i = 1, 2, 3; \text{ the years prior to 1982 were estimated using the}$$

following formula: $X=0.9577*W$.

Y: For the observed data points we calculated the relation between the population age ≥ 16 and the civilian non-institutional pop age ≥ 65 , $Y=X/Z$.

Z: Population age ≥ 65 .

AA: Civilian non-institutional population age 16-64; AA=W-X.

Worksheet Data3 — Military Personnel

Source of the data

Department of Defense; <http://web1.whs.osd.mil/mm/military/miltop.htm>

Download: 12/15/03.

The annual personnel data from 1956 onward were collected on the 30th of September of each year, before that the data were collected in June of the respective year.

Content by columns

A: Annual time index.

B: Military personnel in U.S. Territories, annual.

C: Military personnel worldwide, annual.

D: Total hours worked by military personnel, assuming a 40 hours workweek.

G-I: The quarterly numbers on the basis of the annual data. The formula used is given

$$\text{by: } m_{i,t} = \frac{4-i}{4} m_{4,t-1} + \frac{i}{4} m_{4,t}; i = 1, 2, 3; \text{ here } i \text{ is the quarter index.}$$

Worksheet Calculation

Source of data

Data1-3.

All time series are quarterly.

Content by columns

A: Quarterly time index.

B: Military personnel worldwide; from Data3.

C: Civilian non-institutional population age ≥ 16 in 1000; from Data2.

D: Non-institutional population age ≥ 16 ; $D=C*1000+B$.

I: average weekly hours worked; from Data1.

J: Persons at work in 1000; from Data1.

K: Total hours worked by civilian non-institutional population; $K=I*13*J*1000$.

M: Total hours worked; $M = \left\{ \begin{array}{l} K + B*40 \\ K \end{array} \right\} \text{ for } t = \left(\begin{array}{l} 1959.1 - 1981.4 \\ 1982.1 - \text{current time} \end{array} \right)$.

O: Hours worked per non-institutional population age ≥ 16 at annual rate;

$$O=M/D.$$

Chart1

CPS hours worked at annual rate per non-institutional population age 16-64.
Column N of Calculation for the period: 1959-I to 2003-IV.

Chart2

CPS hours worked at annual rate per non-institutional population age 16-64.
Column O of Calculation for the period: 1989-I to 2003-IV.

ProductivityUpdate12_15_03.xls – The worksheets and their content

Worksheet DataCalc

Source of Data

1. Bureau of Economic Analysis, Download of the table 1.2. Real Gross Domestic Product (Billions of Chained (2000) dollars) on 12/15/03 from <http://www.bea.doc.gov/>.
2. Hours.DataV3.xls.

Content of Columns

B: quarterly time index.

C: GDP in billion of chained 2000 US dollars.

E: U.S. CPS total hours worked by the non-institutional population ≥ 16 .

H: GDP per hours worked; $H=C*1,000,000,000/E$.

J: Productivity with base 1989-I = 100; $J(t)=H(t)/H(1989-I)$.

L: $\log(\text{Productivity})$ with base 1959-I = 0.

N: Detrended productivity and trend per quarter 1.005, $N(t)=H(t)/1.005^{(t-(1959-I))}$.

P: Detrended productivity with base 1989-I = 100; $P(t)=N(t)/N(1989-I)$.

Q-R: Non-institutional population age 16-64 (Q in 1000).

T: GDP per non-institutional population age 16-64.

V: Detrended (0.5% per quarter) GDP per non-institutional population age 16-64,
 $V(t)=T(t)/1.005^{(t-(1959-I))}$.

X: Detrended (0.5% per quarter) GDP per non-institutional population age 16-64, with base 1989-I = 100.

Chart Y_N_59

U.S. detrended real GDP per non-institutional population age 16-64, base 1989-I = 100.
Period 1959-I to 2003-III.

Plot of Worksheet Data Calc Column X.

Chart Y_N_89

U.S. detrended real GDP per non-institutional population age 16-64, base 1989-I = 100.
Period 1989-I to 2003-III.
Plot of Worksheet Data Calc Column X.

Chart Y_H_59

U.S. detrended real GDP per CPS hour worked, base 1989-I = 100.
Period 1959-I to 2003-III.
Plot of Worksheet Data Calc Column P.

Chart Y_N_74

U.S. detrended real GDP per CPS hour worked, base 1989-I = 100.
Period 1974-I to 2003-III.
Plot of Worksheet Data Calc Column P.

Chart Y_N_89

U.S. detrended real GDP per CPS hour worked, base 1989-I = 100.
Period 1989-I to 2003-III.
Plot of Worksheet Data Calc Column P.

Chart Y_N_59

Logarithm with base two of U.S. real GDP per CPS hour worked,
normalized 1959-I = 100.
Period 1959-I to 2003-III.
Plot of Worksheet Data Calc Column L.

NOTES

1. Aim is to estimate: (a) hours worked, (b) population N (the non-institutionalized population of age greater equal 16).
Our estimates are:
For hours worked: The CPS hours worked augmented for the period prior to 1982 with hours worked (estimated using number of military personnel each working 40 hours per week).
For population: From the CPS, civilian non-institutional persons age 16 and older plus military personnel worldwide.
The reason for an inclusion of the military personnel worldwide: The GDP measure provided by the BEA does include on the cost side the salaries to military personnel worldwide and not only in U.S. territories.
2. GDP does include compensation for military personnel abroad as service payments, thus military personnel abroad is included in the non-institutional persons age ≥ 16 and persons at work.
3. The military personnel was included in the CPS starting with the year 1982. They are however not included in the CES statistics. This adjustment is reasonable since after the Vietnam war military personnel became more like paid employees

due to the abandonment of the draft. Adding military personnel can explain the different movements of CES and CPS hours worked. In particular the convergence of the different measures during the period 1986-2001, can be explained.

4. The CPS average hours worked and number of persons at work were deseasonalized using E-Views 4, the census deseasonalizer X13, multiplicative deseasonalizing.
5. Prior to 1982 we could not find a statistic for the civilian non-institutional population age ≥ 65 . The numbers prior to 1982 were estimated based on the observations available for the years after 1981. The assumption utilized was a relative constant relation between population age ≥ 65 and civilian non-institutional population age ≥ 65 .

The relation is fairly constant for the time from 1982-1994. Over that period we take the average over civilian non-institutional population age ≥ 65 divided by population age ≥ 65 .