Productivity, Taxes, and Hours Worked in Spain 1975-2000

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June 2003

Questions:

What has driven economic growth and fluctuations in Spain since 1975? Changes in productivity or changes in factor inputs?

What has been the impact of changes in taxes on aggregate hours worked and on output?

Framework:

Cole-Ohanian (1999) and Kehoe-Prescott (2002): growth accounting + general equilibrium growth model

Other researchers have stressed the role of labor market institutions: Blanchard and Jimeno (1999), Blanchard and Summers (1986), Sargent and Ljungqvist (1995, 1999, 2000).

Growth accounting

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

$$\frac{Y_t}{N_t} = A_t^{\frac{1}{1-\alpha}} \left(\frac{K_t}{Y_t} \right)^{\frac{\alpha}{1-\alpha}} \left(\frac{L_t}{N_t} \right)$$

Note: On a balanced growth path, the capital-output ratio, K_t / Y_t, and hours per working-age person, L_t / N_t, are constant.

Great Depressions methodology

Cole and Ohanian (1999), Kehoe and Prescott (2002)

Aggregate production function:

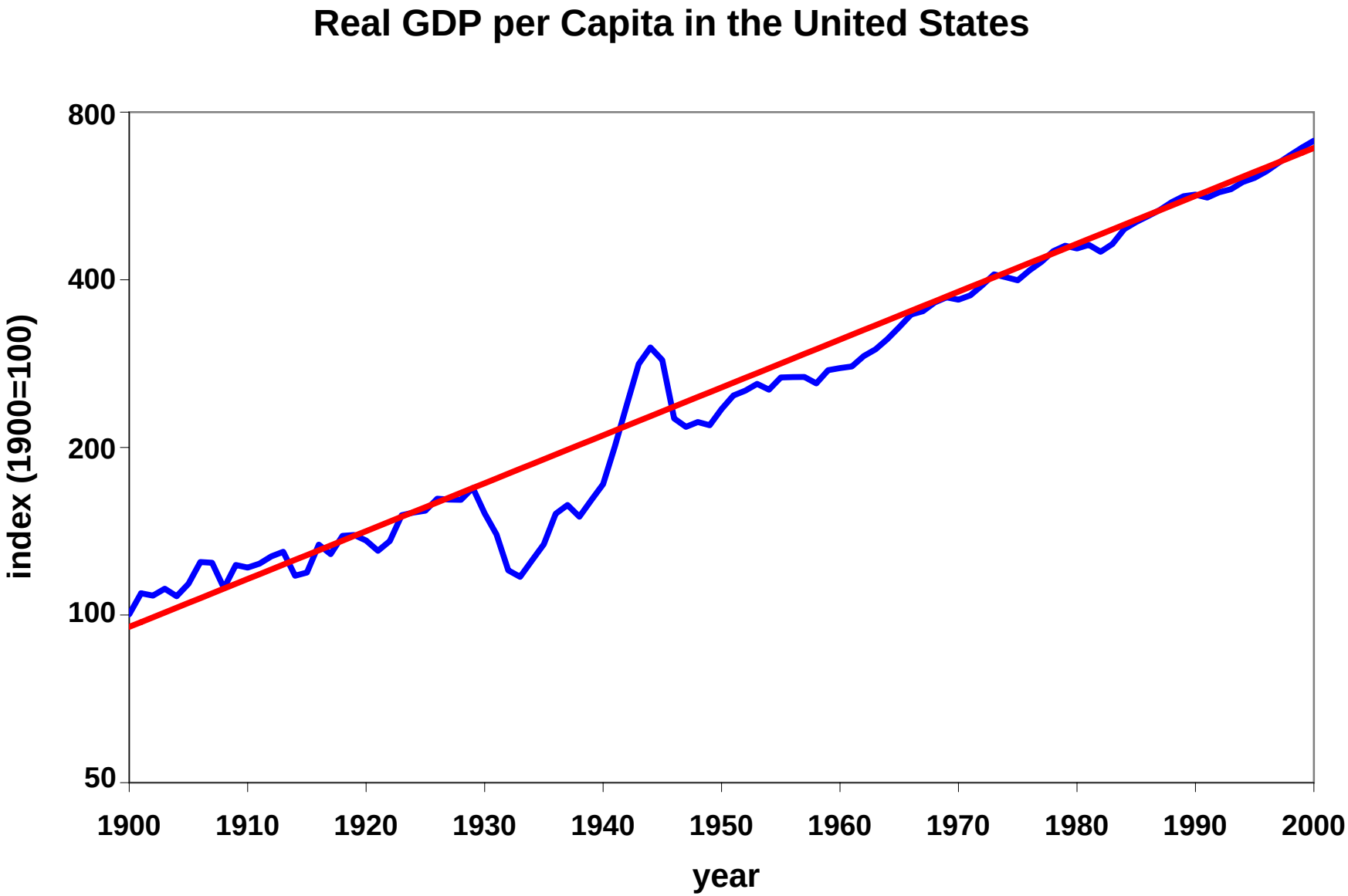
$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}.$$

Balanced growth path:

Suppose that $A_t = A_0 g^{(1-\alpha)t}$. When the capital-output ratio, K_t / Y_t, and hours per working-age person, L_t / N_t, are constant, output per working-age person, Y_t / N_t, grows at constant rate $g - 1$.

Measure output growth with respect to the balanced growth path.

- Trend growth represents the stock of useable production knowledge growing smoothly over time.
- This knowledge is not country specific.
- Countries grow at the same rate, $g-1$, on different balanced growth paths.
- Levels differ across countries because institutions (such as taxes) are different.
- Changing institutions moves the country to a different balanced growth path.
- Take $g-1$ to be growth rate of the industrial leader – United States: $g=1.02$


Real GDP per Capita in the United States
800
400
200
100
50
index (1900=100)
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
year

Growth accounting

Y_t : real GDP (national income accounts – SNA93, 1954-2000)

X_t: real investment (national income accounts)

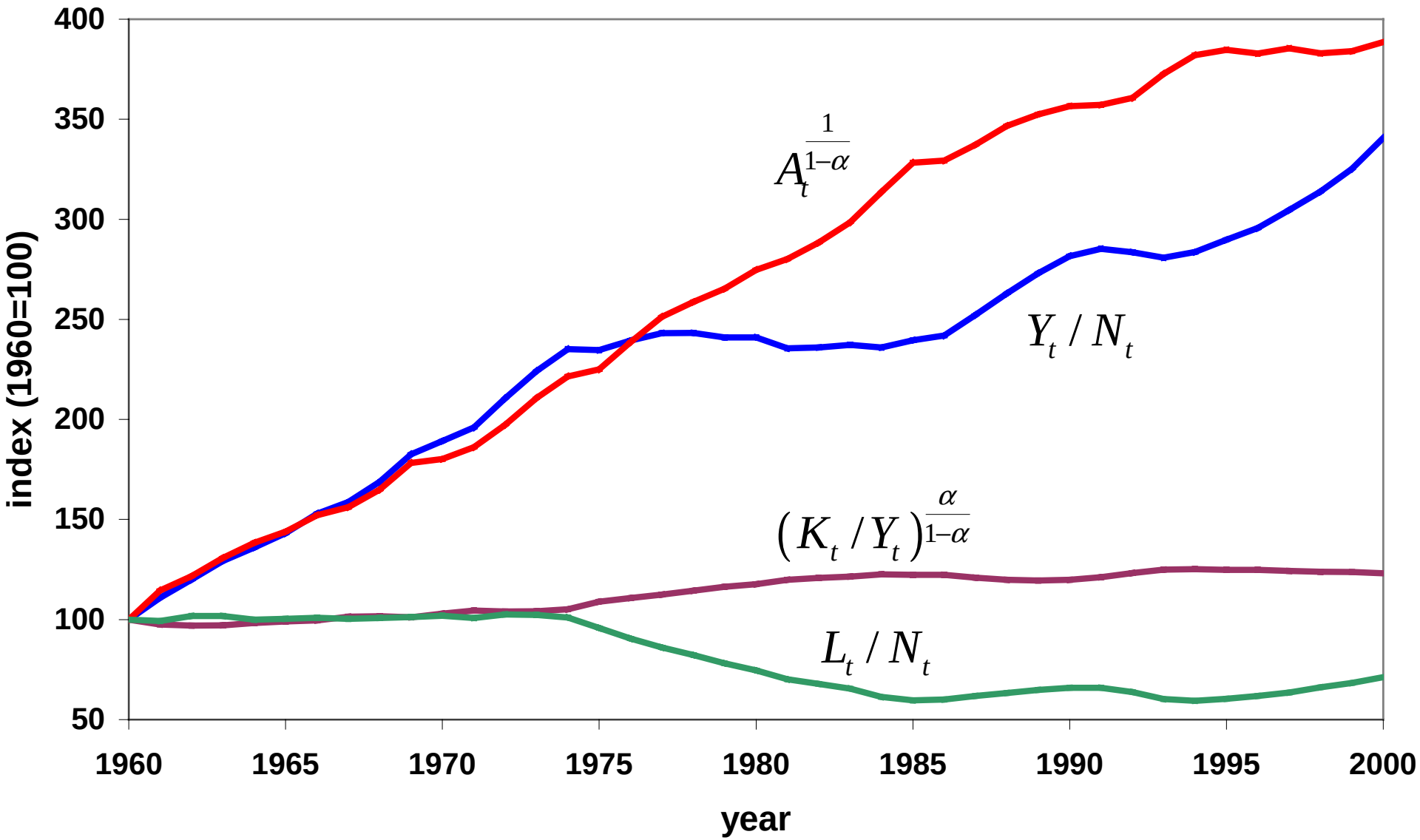
L_t : hours worked (labor surveys, 1959-1980, 1977-2000)

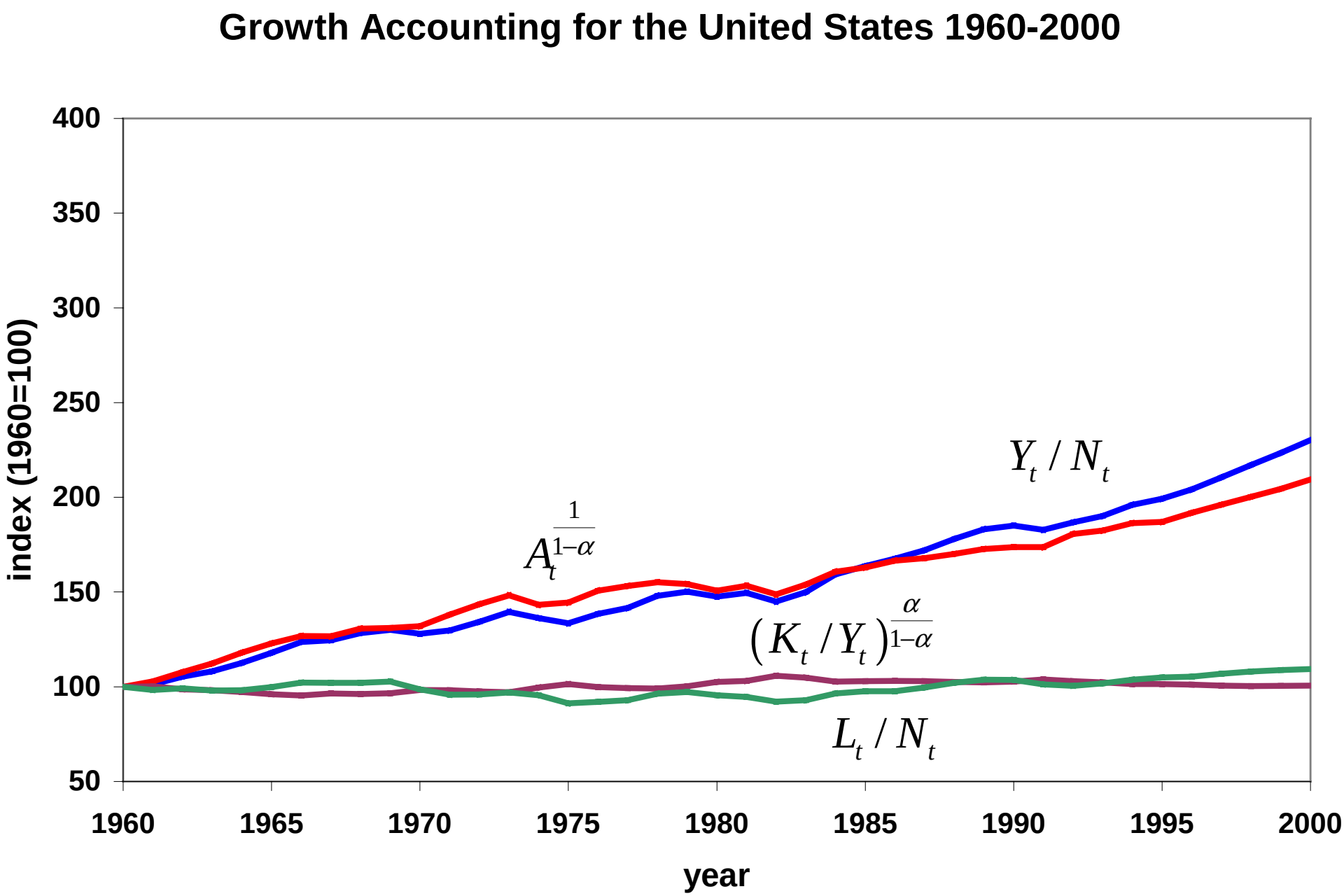
Construct capital stocks:

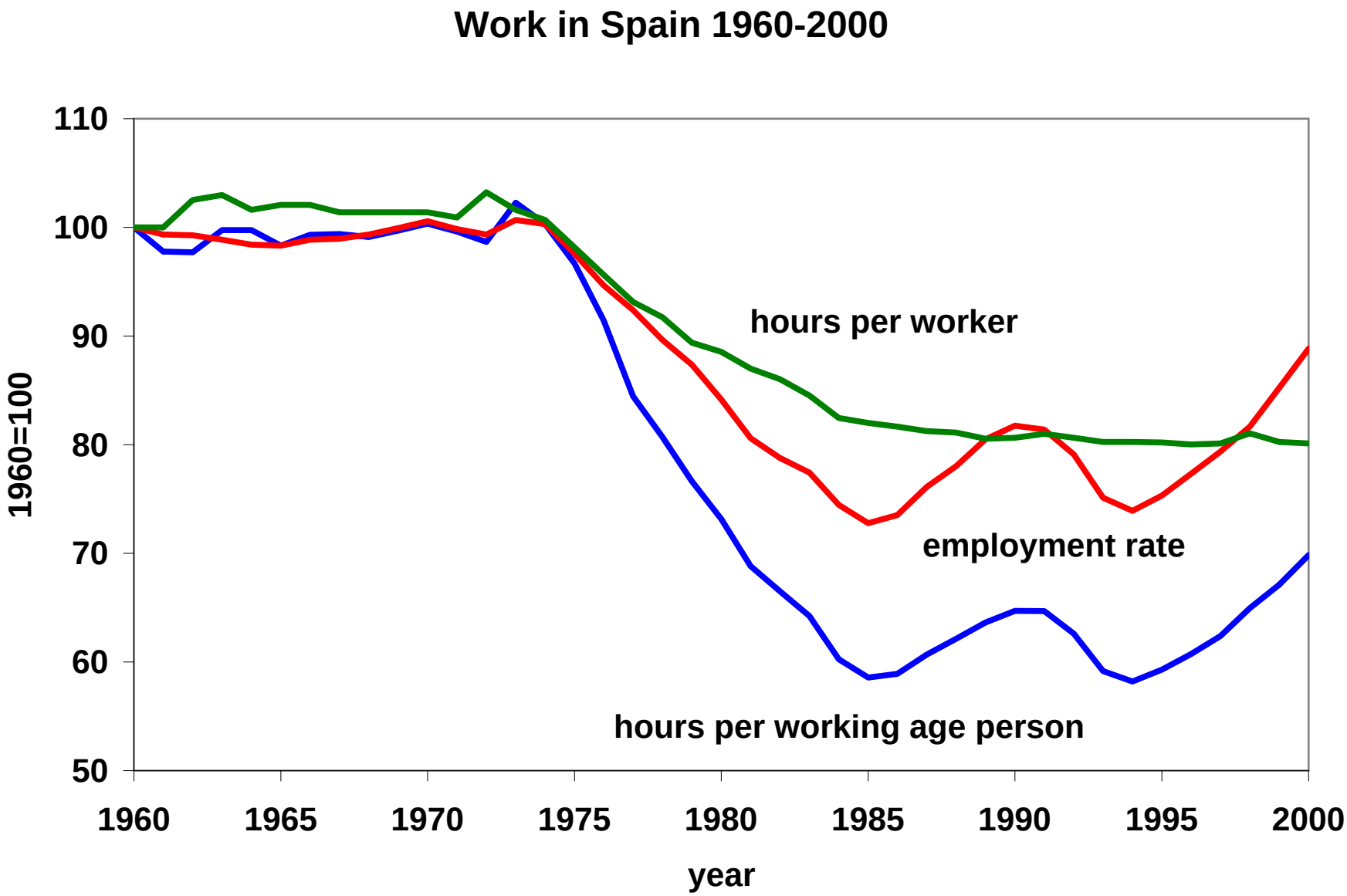
$$K_{t+1} = (1-\delta)K_t + X_t$$

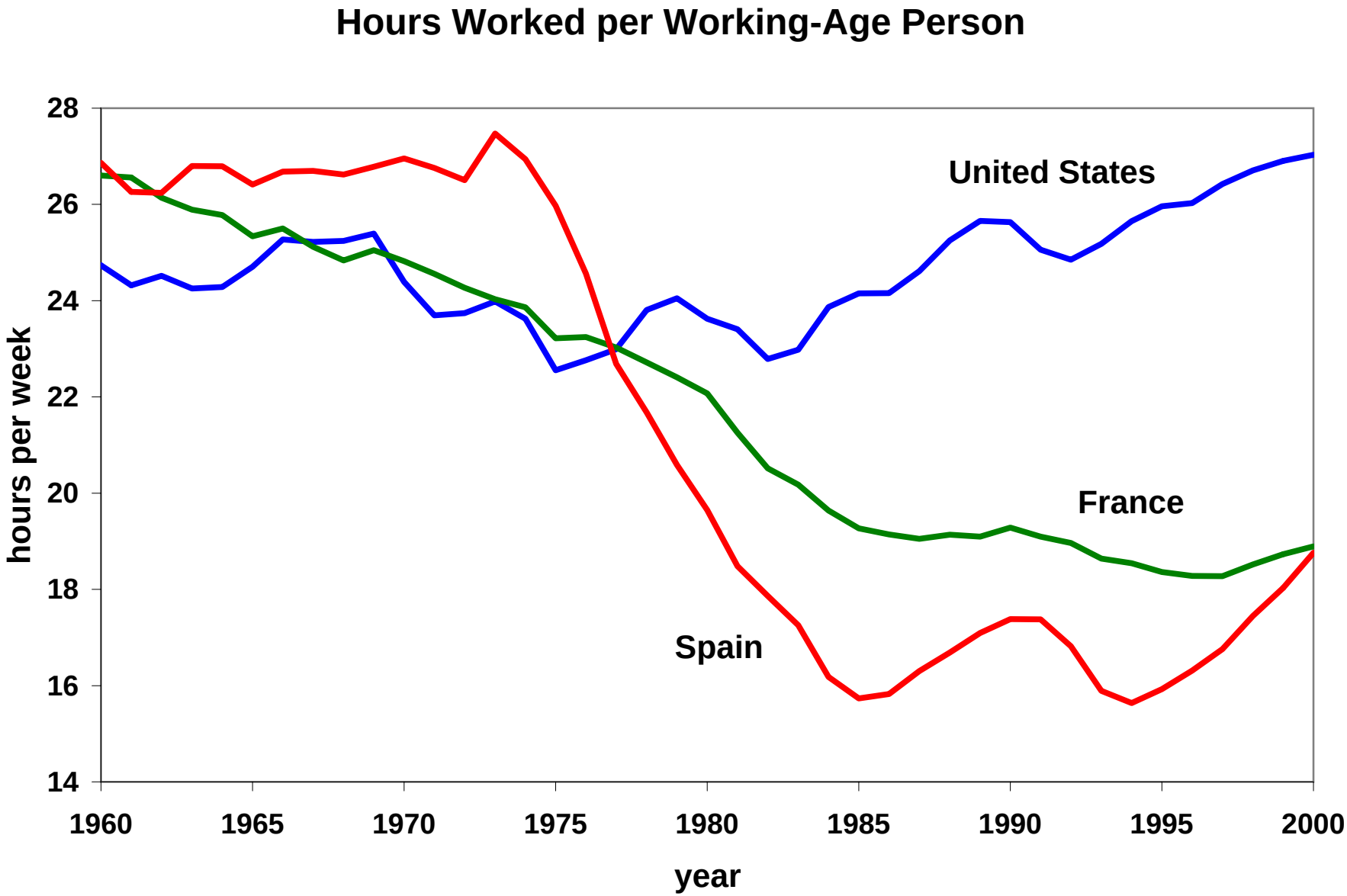
Total factor productivity is the residual:

$$A_t = Y_t \big/ K_t^{\alpha} L_t^{1-\alpha}$$


Growth Accounting for Spain 1960-2000
400
350
300
250
200
150
100
50
index (1960=100)
1960
1965
1970
1975
1980
1985
1990
1995
2000
year
$A_t^{\frac{1}{1-\alpha}}$
Y_t / N_t
$(K_t / Y_t)^{\frac{\alpha}{1-\alpha}}$
L_t / N_t


Growth Accounting for the United States 1960-2000
index (1960=100)
400
350
300
250
200
150
100
50
1960
1965
1970
1975
1980
1985
1990
1995
2000
year
Y_t / N_t
$A_t^{\frac{1}{1-\alpha}}$
$(K_t / Y_t)^{\frac{\alpha}{1-\alpha}}$
L_t / N_t


Work in Spain 1960-2000
110
100
90
80
70
60
50
1960=100
1960
1965
1970
1975
1980
1985
1990
1995
2000
year
hours per worker
employment rate
hours per working age person

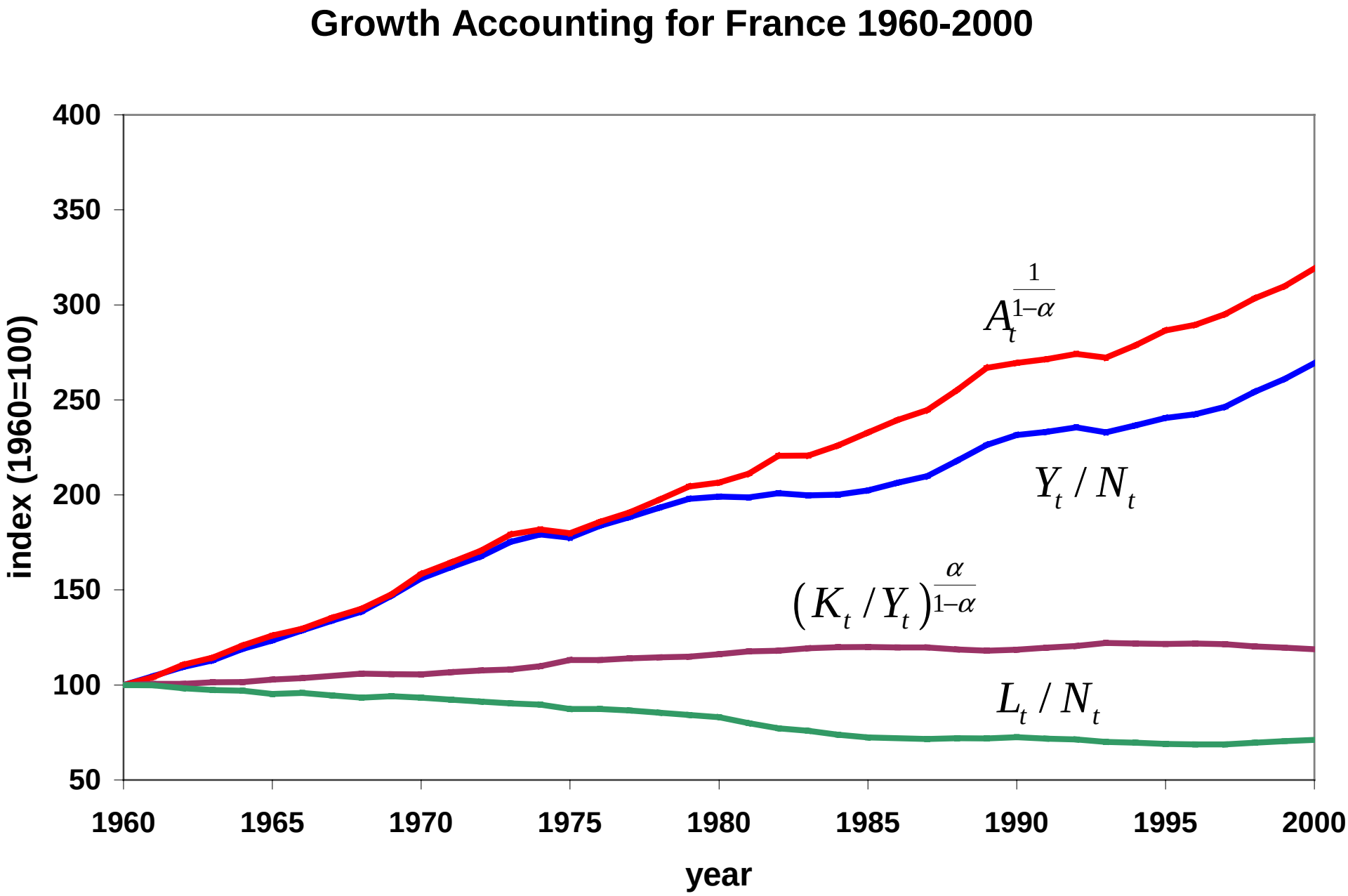

Hours Worked per Working-Age Person
hours per week
28
26
24
22
20
18
16
14
1960
1965
1970
1975
1980
1985
1990
1995
2000
year
United States
France
Spain

Something happened in Spain starting in 1975!

End of the dictatorship

Acuerdos de Moncloa

Instead of focusing on lots of institutional changes, we are going to see how far we can go in accounting for Spain's growth experience after 1975 by incorporating tax changes in a simple, one sector general equilibrium growth model.


Growth Accounting for France 1960-2000
400
350
300
250
200
150
100
50
index (1960=100)
1960
1965
1970
1975
1980
1985
1990
1995
2000
year
$A_t^{\frac{1}{1-\alpha}}$
Y_t / N_t
$(K_t / Y_t)^{\frac{\alpha}{1-\alpha}}$
L_t / N_t

Model

Stand-in consumer:

$$\max \sum_{t=1970}^{\infty} \beta^t [\gamma \log C_t + (1-\gamma) \log(N_t \bar{h} - L_t)]$$

$$\text{s.t. } (1+\tau_t^c) C_t + K_{t+1} - K_t$$
$$= (1-\tau_t^\ell) w_t L_t + (1-\tau_t^k)(r_t - \delta) K_t + T_t.$$
$$K_{1970} = \bar{K}_{1970}.$$

Feasibility:

$$C_t + K_{t+1} - (1-\delta) K_t = A_t K_t^\alpha L_t^{1-\alpha}.$$

Government budget constraint:

$$\tau_t^c C_t + \tau_t^\ell w_t L_t + \tau_t^k (r_t - \delta) K_t = T_t.$$

Calibration

$\delta = 0.044 \;\; (\delta K_{1970} / Y_{1970} = 0.091)$

$\alpha = 0.300$ (Gollin (2002), *European Economy* (1994))

Tax data: Boscá, Fernández, and Taguas (1999), 1965-1996, and ours, 1996-2000, using methodology of Mendoza, Razin, and Tesar (1994).

Income tax rates: marginal > average (by a factor of 1.8) (Calonge and Conesa (2003)).

Parameters of stand-in consumer's utility function β and γ: estimated using 1965-1974 data.

First order conditions:

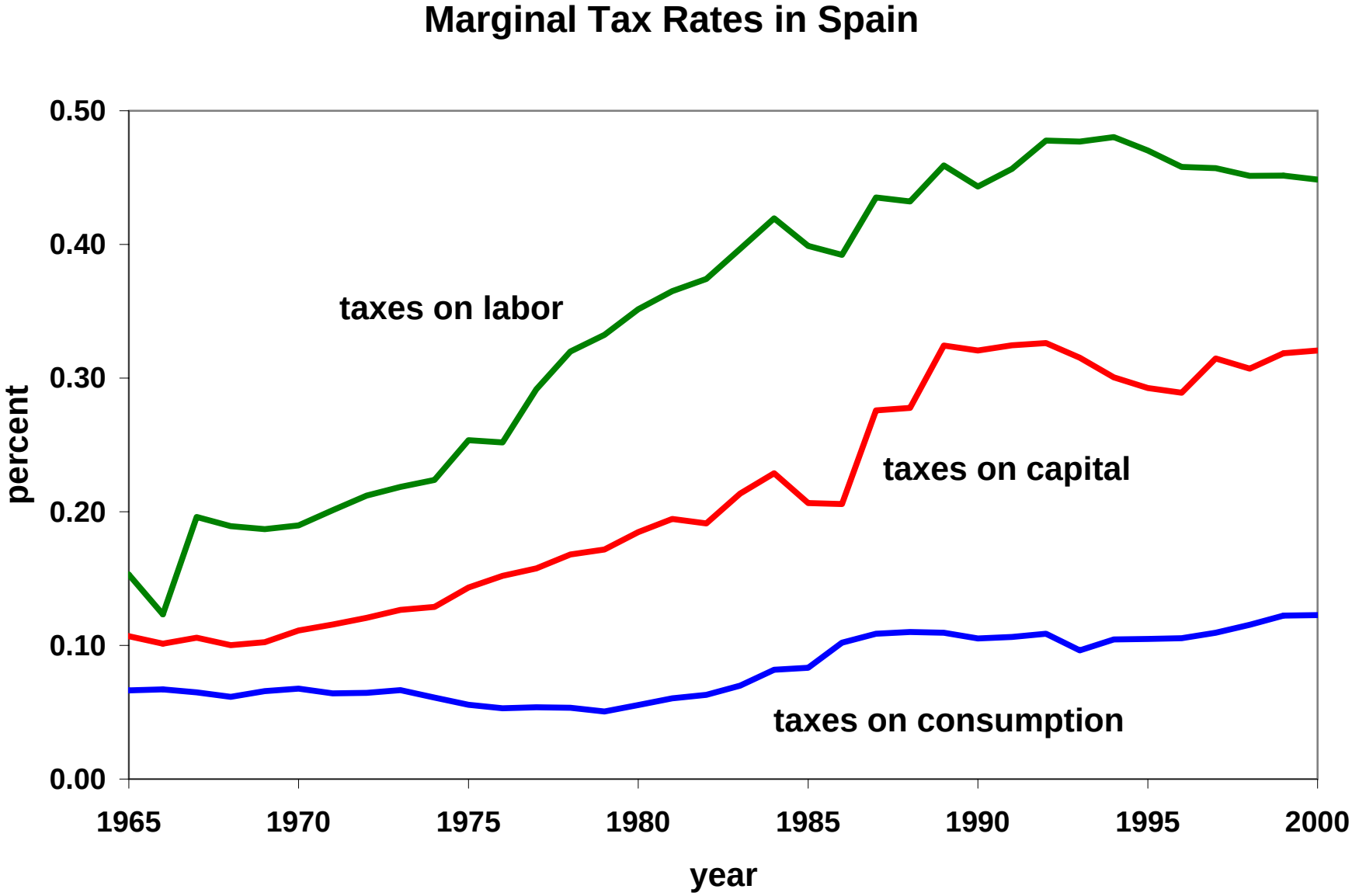
$$\beta = \frac{(1+\tau_{t+1}^{c})C_{t+1}}{(1+\tau_{t}^{c})C_{t}} \frac{1}{1+(1-\tau_{t}^{k})(r_{t}-\delta)}$$

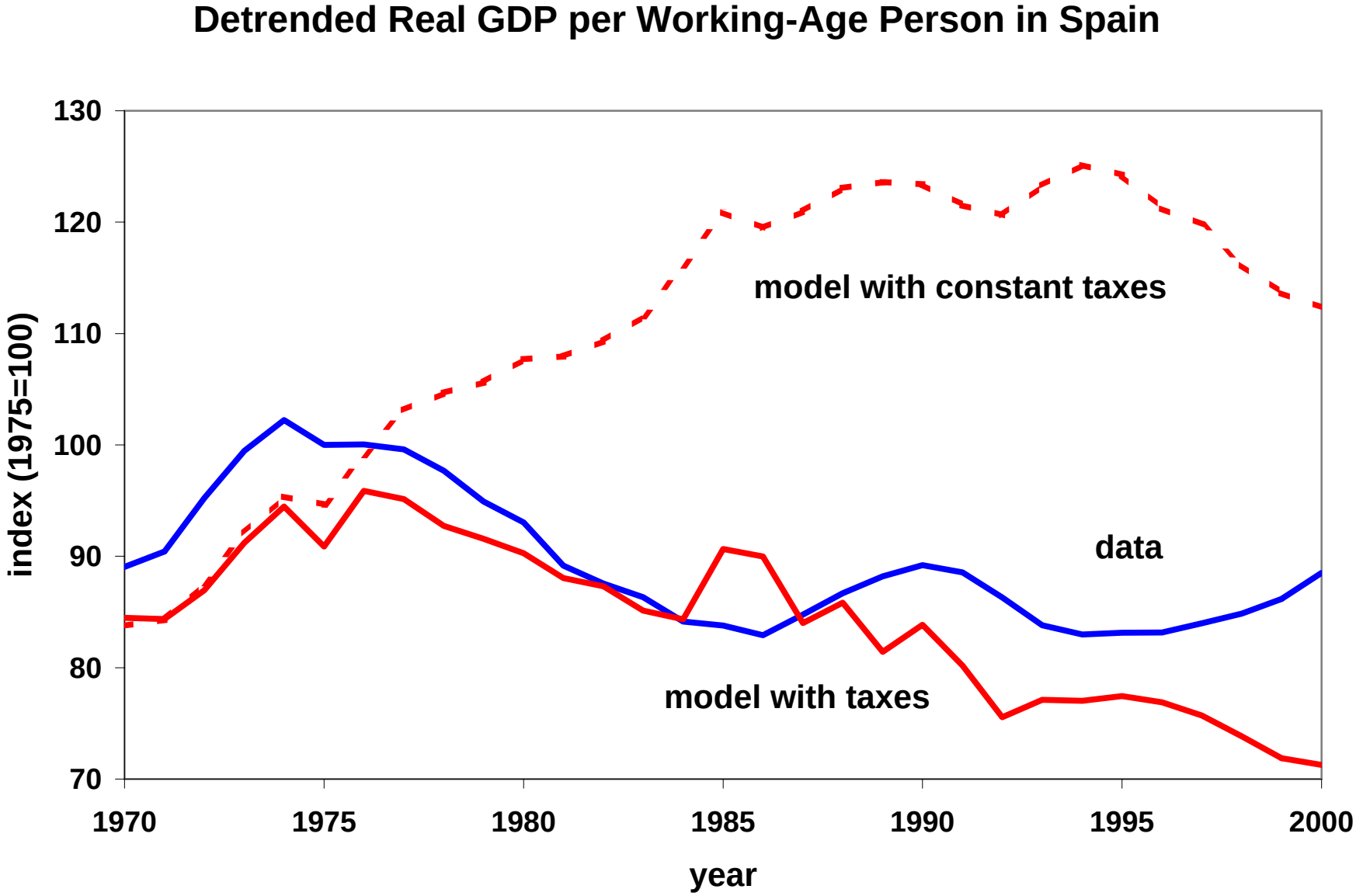
$$\gamma = \frac{(1+\tau_{t}^{c})C_{t}}{(1+\tau_{t}^{c})C_{t}+(1-\tau_{t}^{\ell})w_{t}(N_{t}\bar{h}-L_{t})}$$

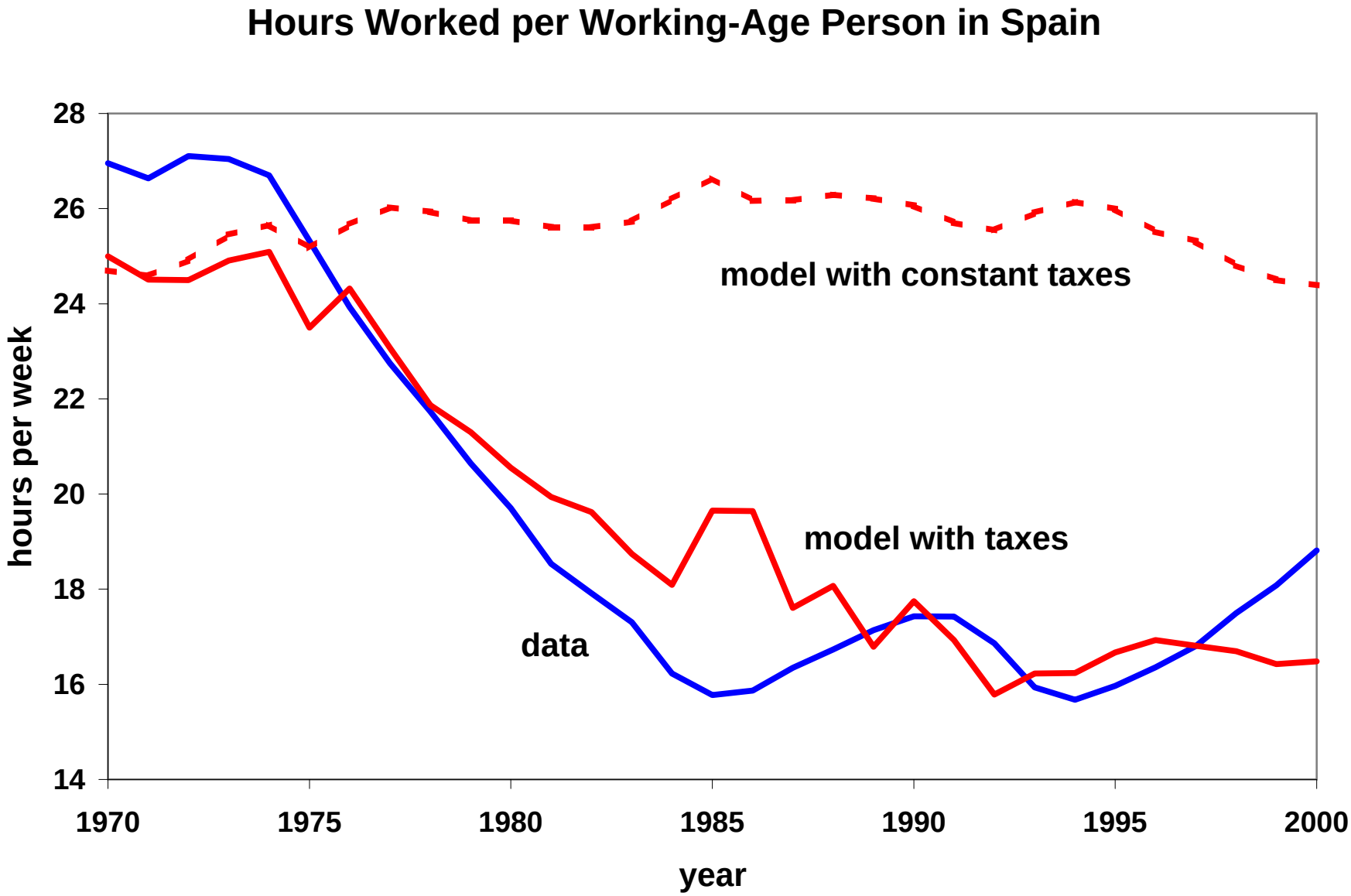
Numerical experiments

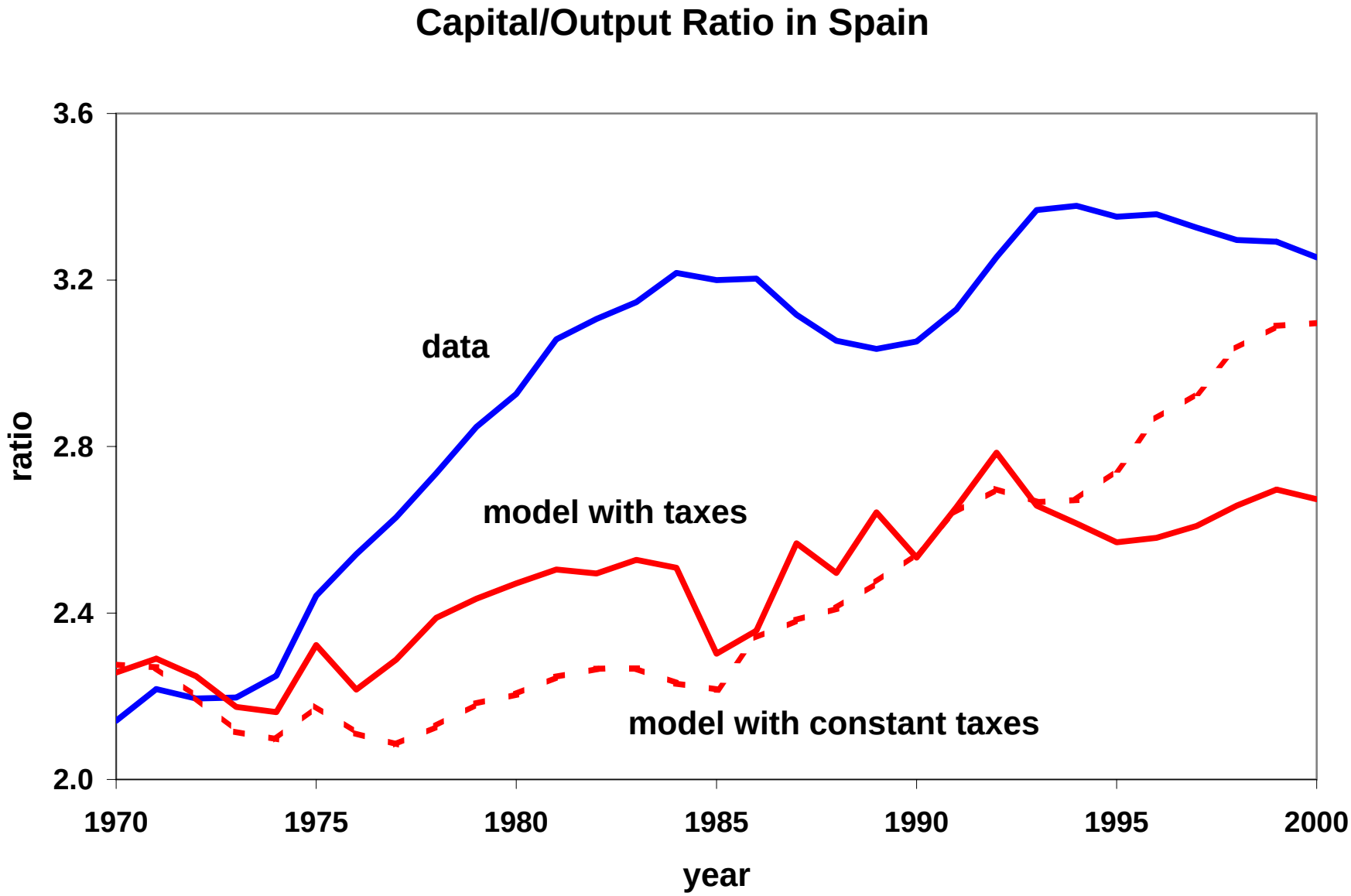
Set $K_{1970} = \bar{K}_{1970}$. Set $A_t = Y_t / K_t^{\alpha} L_t^{1-\alpha}$, $t = 1970,...,2000$.

1. Constant taxes – set taxes τ_t^c, τ_t^{ℓ}, τ_t^k equal to values in 1975.
   Estimate $\beta = 0.973$, $\gamma = 0.351$ for 1965-1974 data.
2. Taxes – set taxes equal to their actual values 1970-2000.
   Estimate $\beta = 0.970$, $\gamma = 0.333$ for 1965-1974 data.


Marginal Tax Rates in Spain
0.50
0.40
0.30
0.20
0.10
0.00
percent
taxes on labor
taxes on capital
taxes on consumption
1965
1970
1975
1980
1985
1990
1995
2000
year


Detrended Real GDP per Working-Age Person in Spain
index (1975=100)
130
120
110
100
90
80
70
1970
1975
1980
1985
1990
1995
2000
year
model with constant taxes
data
model with taxes


Hours Worked per Working-Age Person in Spain
hours per week
28
26
24
22
20
18
16
14
1970
1975
1980
1985
1990
1995
2000
year
model with constant taxes
model with taxes
data


Capital/Output Ratio in Spain
3.6
3.2
2.8
2.4
2.0
ratio
data
model with taxes
model with constant taxes
1970
1975
1980
1985
1990
1995
2000
year

Results

The model with constant taxes fails to account for the sharp fall in hours worked per working-age person after 1975.

The model with taxes accounts for more than 80 percent of the fall in hours worked between 1974 and 1994. (Hours worked per working-age person falls 41 percent in the data and 35 percent in the model.)

The model fails to account for the rapidness of the fall in hours worked between 1974 and 1985.

The model fails to account for the partial recovery in hours worked after 1994.

Comments

High elasticity of labor supply implicit in logarithmic utility function: and Hansen (1985) and Rogerson (1987).

Calibrated values of β and γ implicitly take into account different institutions. The assumption is that these stay constant over time.

There is a lot left out of the model!

This macro analysis points to the directions in which we need to do more micro analysis.

An instructive comparison: France

Calibrate:

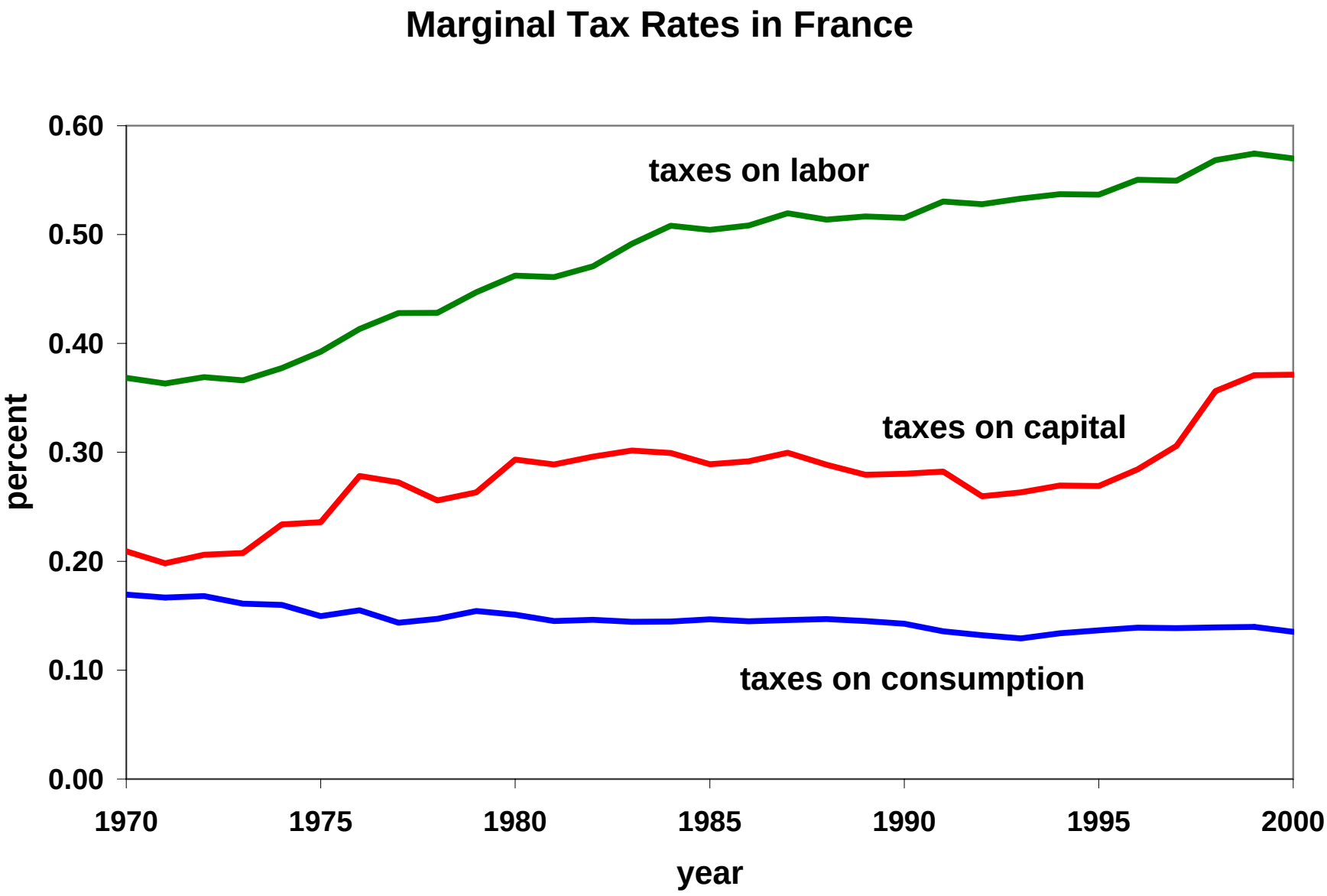
$\beta = 0.993,\ \gamma = 0.394$ in model with constant taxes.

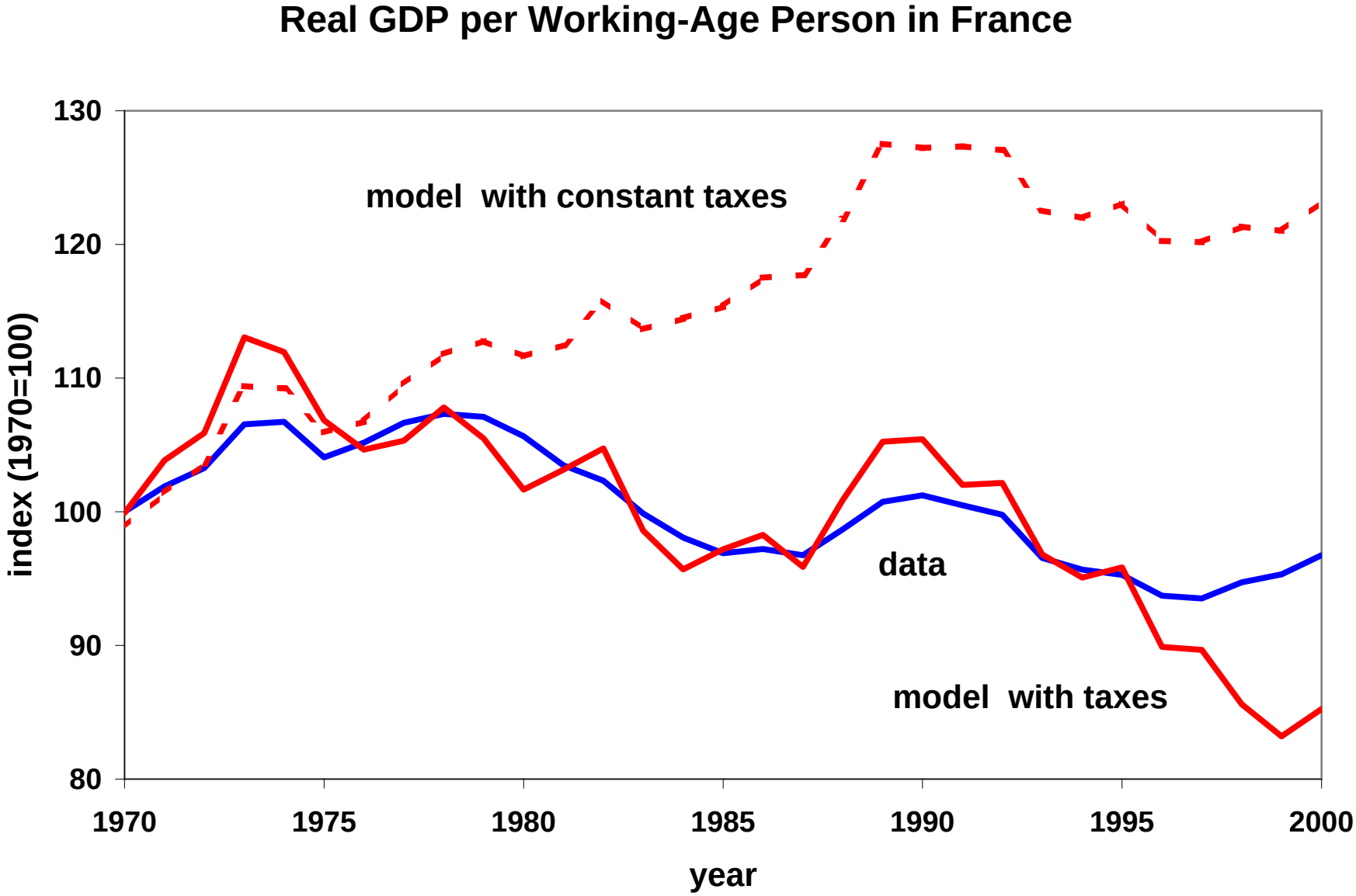
$\beta = 0.991,\ \gamma = 0.386$ in model with actual taxes.

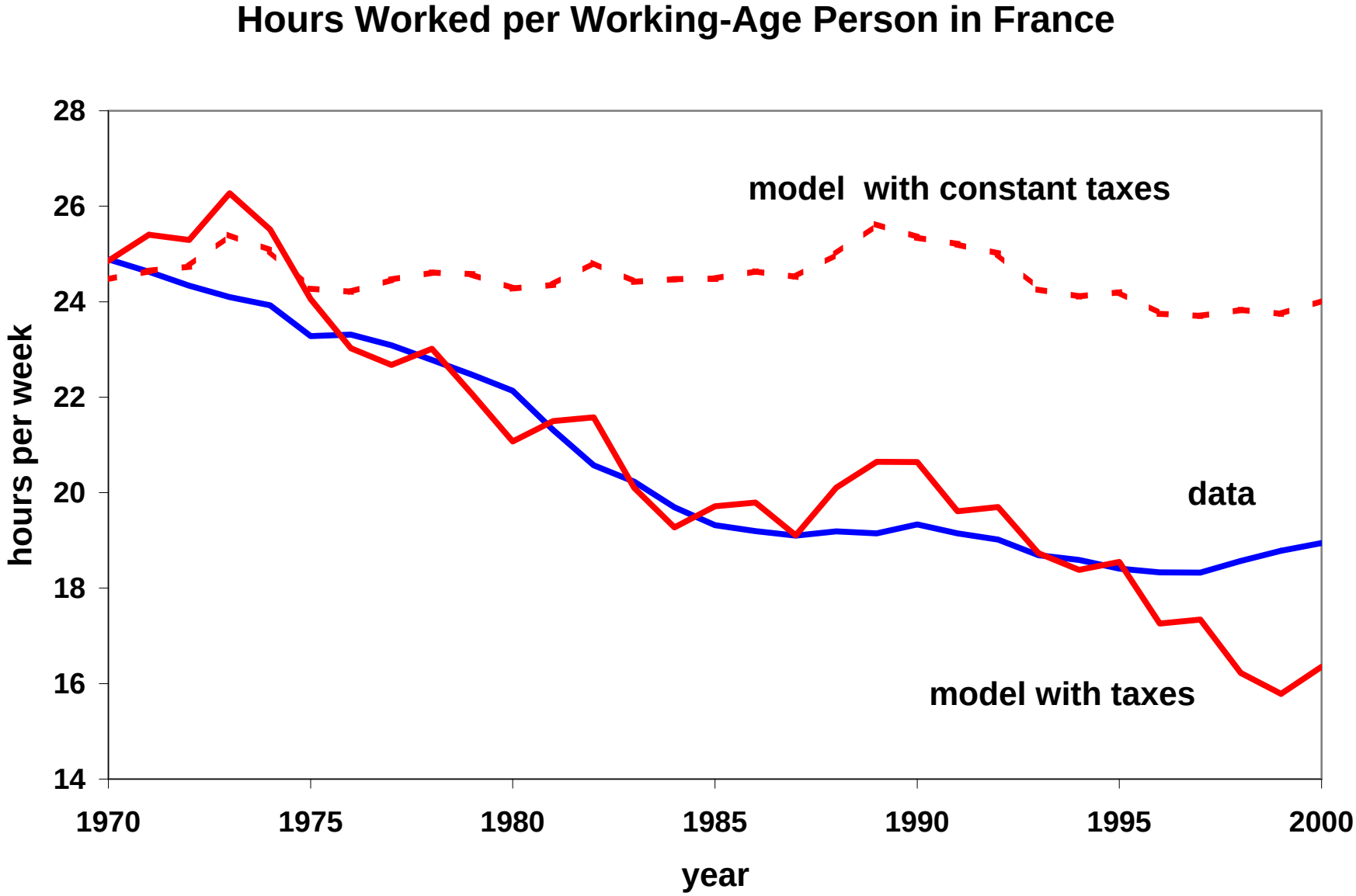
$\alpha = 0.300,\ \delta = 0.046.$

The model does an impressive job in accounting for the evolution of GDP, hours worked, and the capital stock.

Prescott (2002)


Marginal Tax Rates in France
0.60
0.50
0.40
0.30
0.20
0.10
0.00
percent
taxes on labor
taxes on capital
taxes on consumption
1970
1975
1980
1985
1990
1995
2000
year


Real GDP per Working-Age Person in France
130
120
110
100
90
80
index (1970=100)
model with constant taxes
data
model with taxes
1970
1975
1980
1985
1990
1995
2000
year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28
26
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1975
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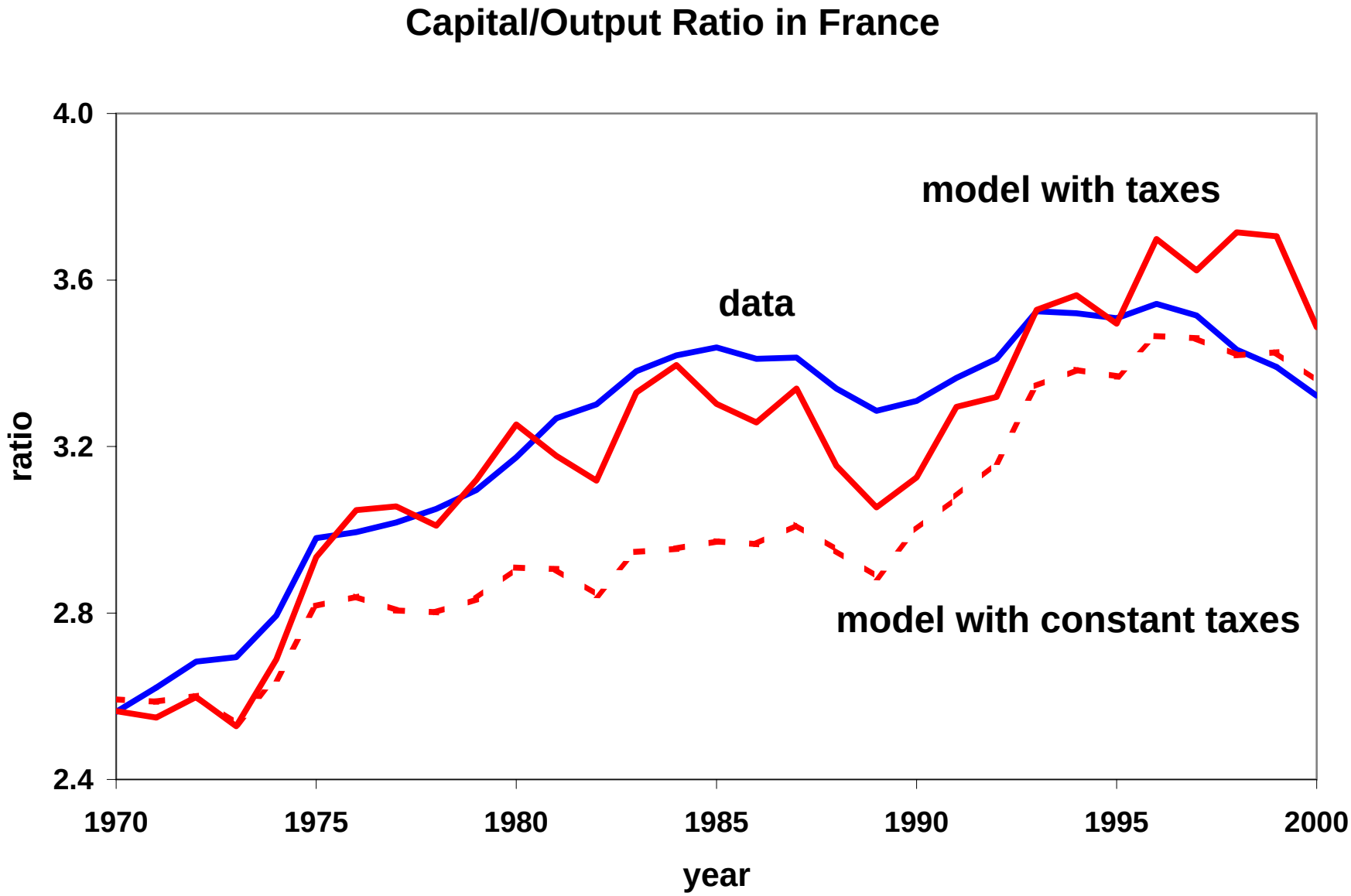
1995
2000
year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2.4
ratio
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1990
1995
2000
year
model with taxes
data
model with constant taxes

Sensitivity Analysis

$$\sum_{t=1970}^{\infty} \beta^t \left(\left[\left(\frac{C_t}{\tilde{N}_t} \right)^{\gamma} \left(\frac{N_t \bar{h} - L_t}{N_t} \right)^{1-\gamma} \right]^{\phi} - 1 \right) / \phi$$

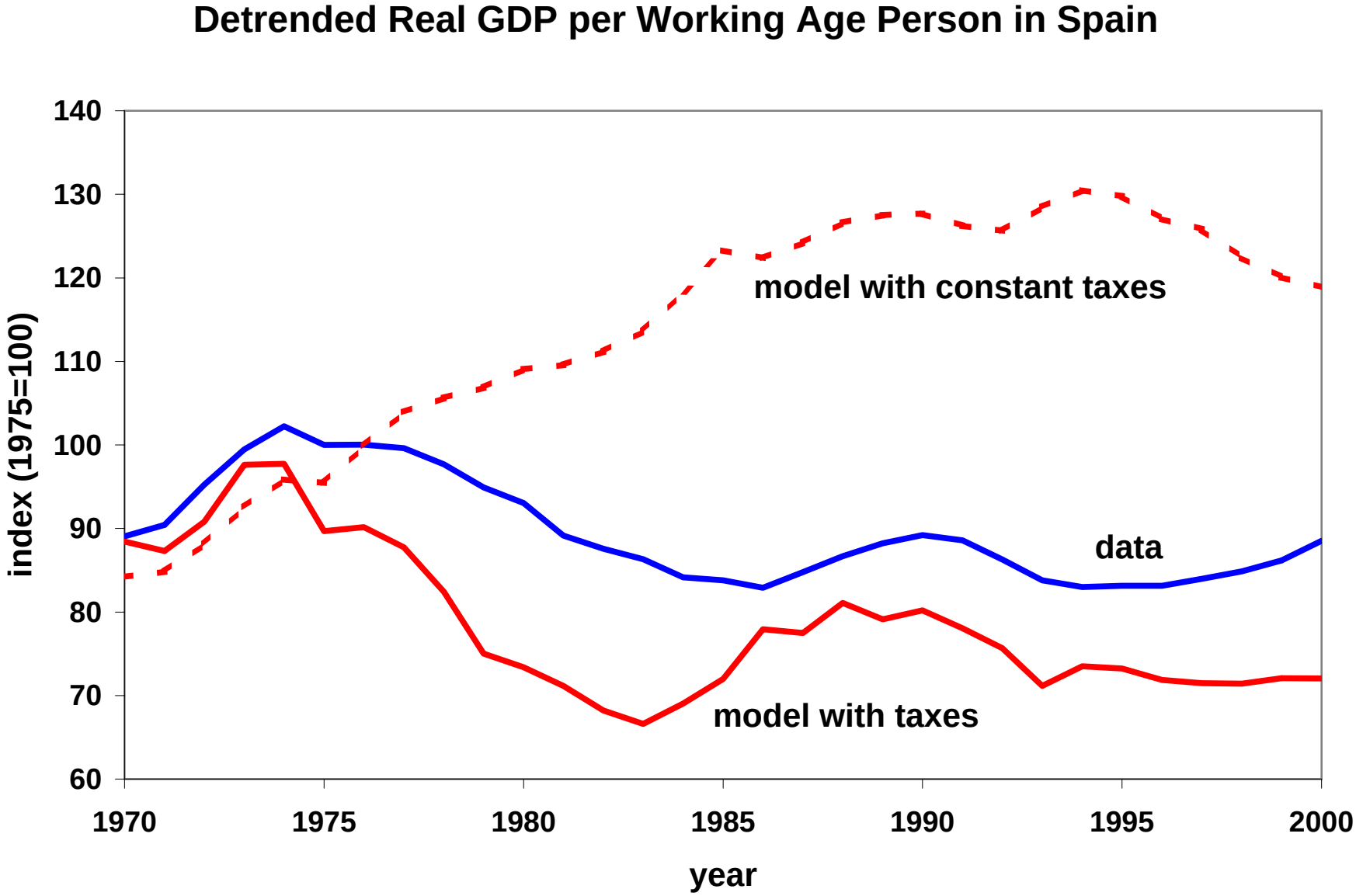
where $\tilde{N}_t$ is adult-equivalent population and $\phi = -1$.

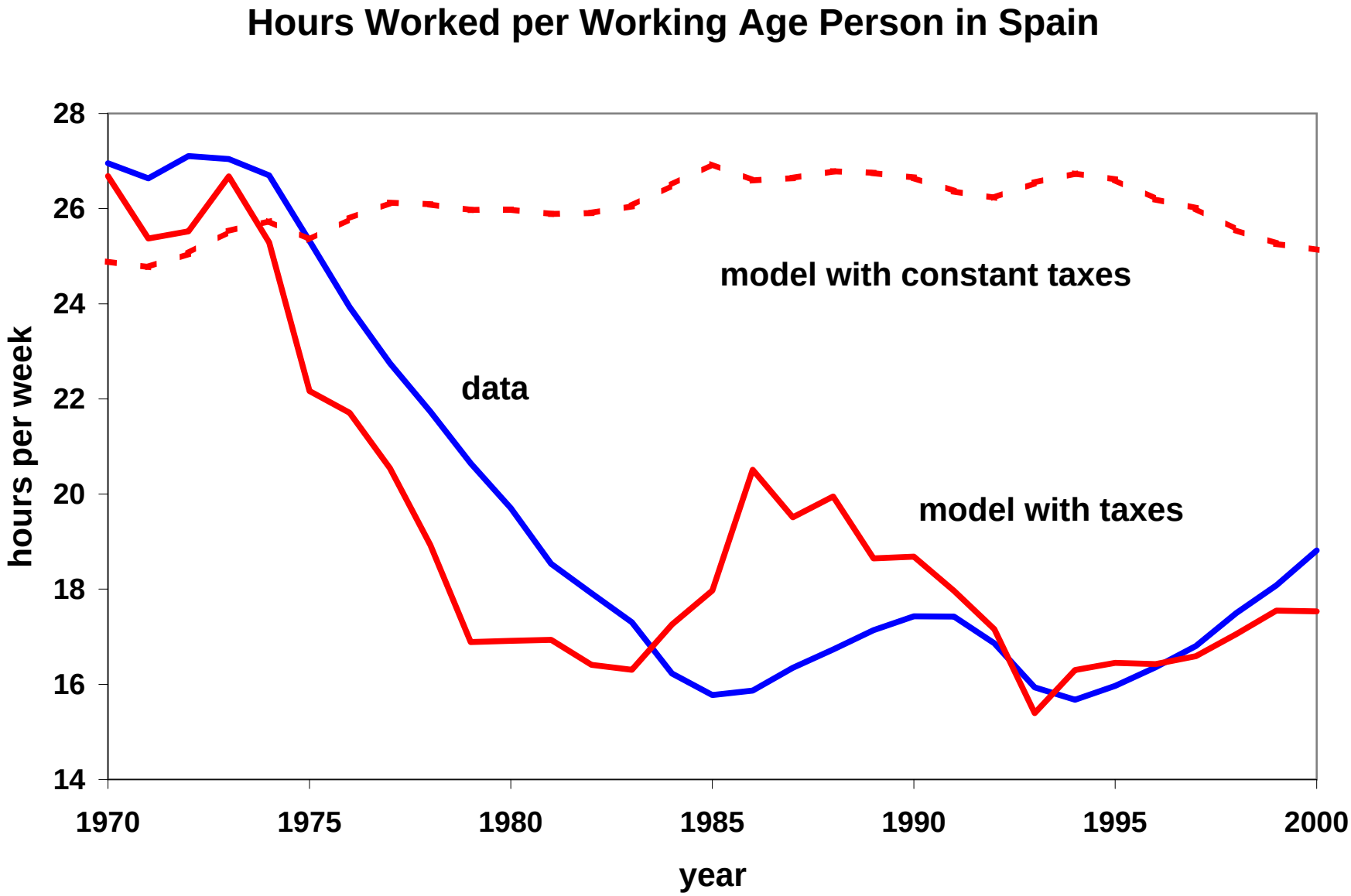
Calibrate:

$\beta = 0.987$, $\gamma = 0.351$ in model with constant taxes.

$\beta = 0.984$, $\gamma = 0.333$ in model with constant taxes.

The model does better in accounting for the evolution of hours worked, but worse in accounting for capital accumulation.


Detrended Real GDP per Working Age Person in Spain
index (1975=100)
140
130
120
110
100
90
80
70
60
1970
1975
1980
1985
1990
1995
2000
year
model with constant taxes
data
model with taxes


Hours Worked per Working Age Person in Spain
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16
14
hours per week
model with constant taxes
data
model with taxes
1970
1975
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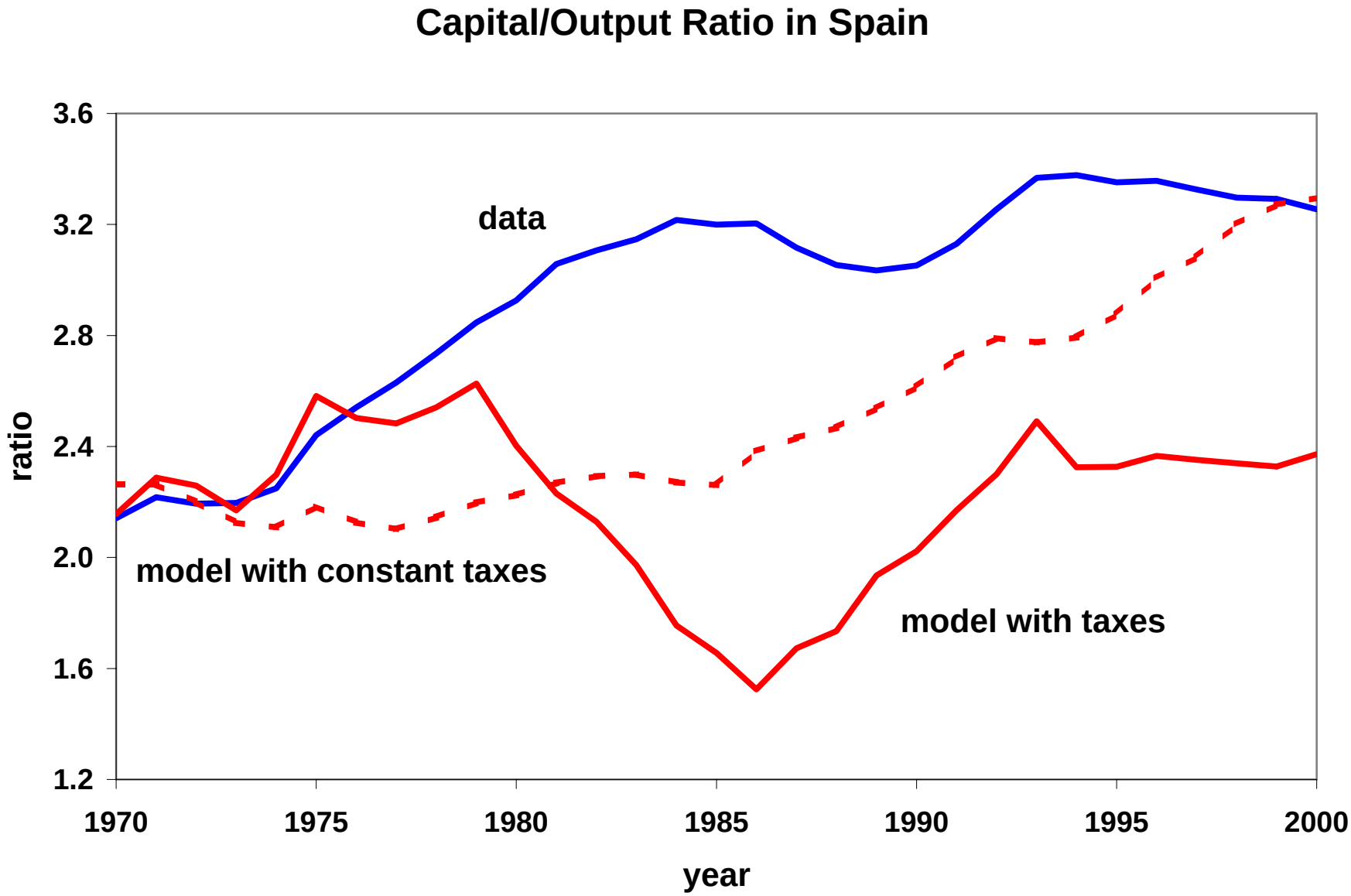
1990
1995
2000
year


Capital/Output Ratio in Spain
3.6
3.2
2.8
2.4
2.0
1.6
1.2
ratio
data
model with constant taxes
model with taxes
1970
1975
1980
1985
1990
1995
2000
year

Where could we go from here?

Disaggregated models of labor market

- different behavior along education/gender/age dimensions
  Jiménez-Martín (1998), Jiménez-Martín and Sánchez Martín (2003), Sanchez (2002)
- different behavior along sectoral dimensions
  Marimon and Zilibotti (1998)

Changes in institutions — Acuerdos de Moncloa, labor market reforms

Changes in taxes cannot be left out of the story!