Long-Term Changes in Labor Supply and Taxes: Evidence from OECD Countries, 1956-2004

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Background/Motivation

Hours Worked Relative to US in 2003

$H < .75$	$.75 < H < .85$	$.85 < H < .95$	$H > .95$
Belgium	Austria	Denmark	Australia
France	Finland	Greece	Canada
Germany	Ireland	Portugal	Japan
Italy	Netherlands	Sweden	New Zealand
	Norway	UK	Switzerland
	Spain		

Issue: What factors account for the large differences in hours worked across countries.

What We Do:

1. Argue that to understand current differences it is useful to try to understand the evolutions that lead to these differences.
2. We assess the role of changes in taxes in accounting for these evolutions in the context of the standard growth model by computing labor wedges.

Preview of Results:

- Benchmark growth model without distortions can account for virtually none of the changes in hours worked over time.
- Allowing for subsistence consumption helps to account for some of the decrease in hours worked early in the period, but it remains true that the model cannot account for a large part of the changes in hours worked.
- Once taxes are incorporated, the number of puzzling episodes decreases dramatically, and their qualitative nature changes as well.
- Other commonly mentioned factors of interest account for relatively small amount of change in labor wedges over time in a statistical sense.

Related Literature

Methodology

Mankiw et al (1985), Parkin (1988), Bencivenga (1992), Ingram et al (1994), Hall (1997), Gali et al (2002), Mulligan (2002), Cole and Ohanian (2004), Chari et al (2002), Prescott (2004)

Taxes and Hours of Work

Prescott (2004), Davis and Henreksen (2004), Rogerson (2005), Conesa and Kehoe (2005), Olovsson (2005), Ragan (2006), Pissarides (2006)

Background: Properties of the Hours Worked Distribution

Four Facts:

- Mean Hours Worked have decreased significantly
- There are large differences in the extent of the decrease
- There are large differences in hours worked at all times during the period 1956-2004
- Much of the variance in hours is accounted for by differences in trends

Data on Hours Worked

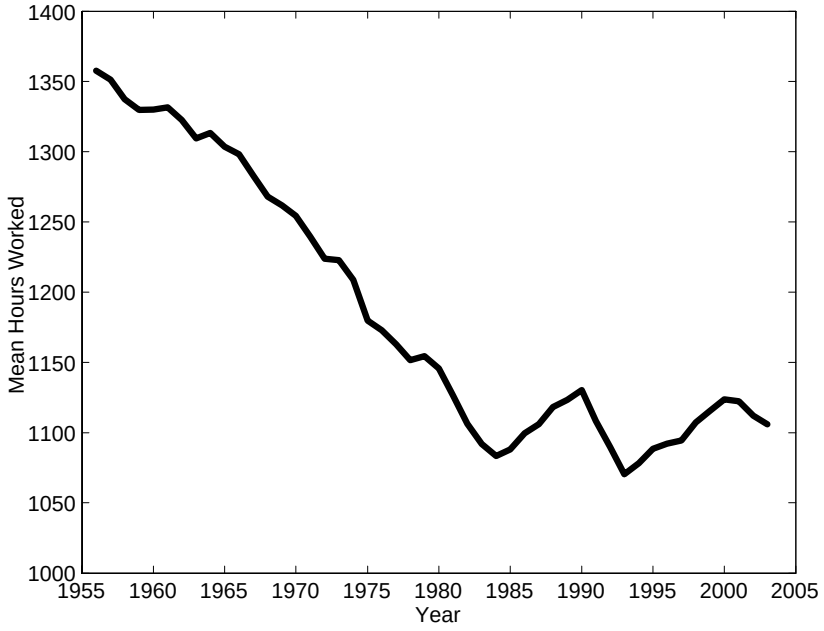
Total hours worked=total civilian employment×annual hours worked per person in employment

employment data from OECD

hours data from GGDC

To compare across countries we express total hours relative to the size of the population aged 15-64.

Mean Hours Worked: 1956-2004



Hours Worked in 2004 Relative to 1956

Australia	.97	Germany	.62	Norway	.81
Austria	.74	Greece	1.00	Portugal	.83
Belgium	.68	Ireland	.69	Spain	.86
Canada	1.07	Italy	.73	Sweden	.79
Denmark	.80	Japan	.86	Switzerland	.81
Finland	.72	Netherlands	.80	United Kingdom	.79
France	.65	New Zealand	1.04	United States	1.00

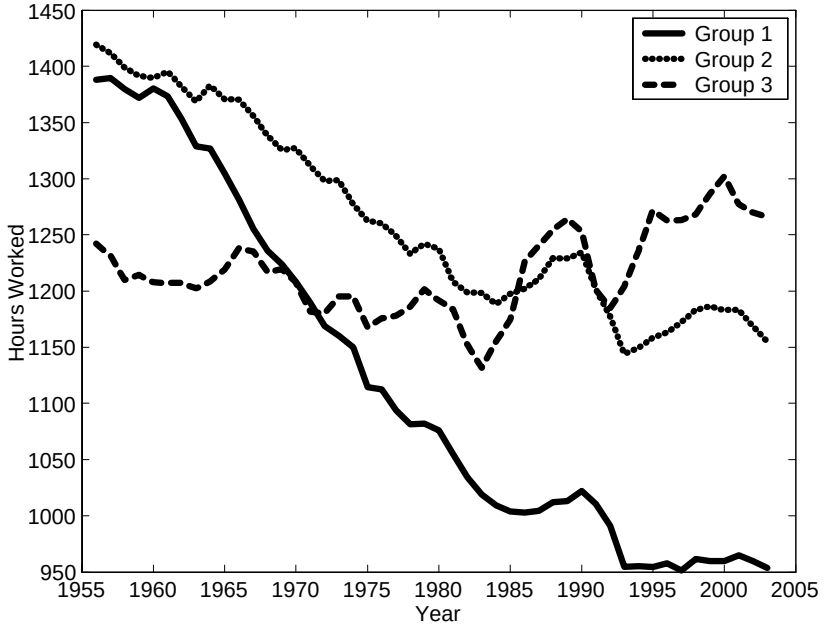
It will be useful to consider three groups based on the extent of the drop:

Group 1: Austria, Belgium, Finland, France, Germany, Italy.

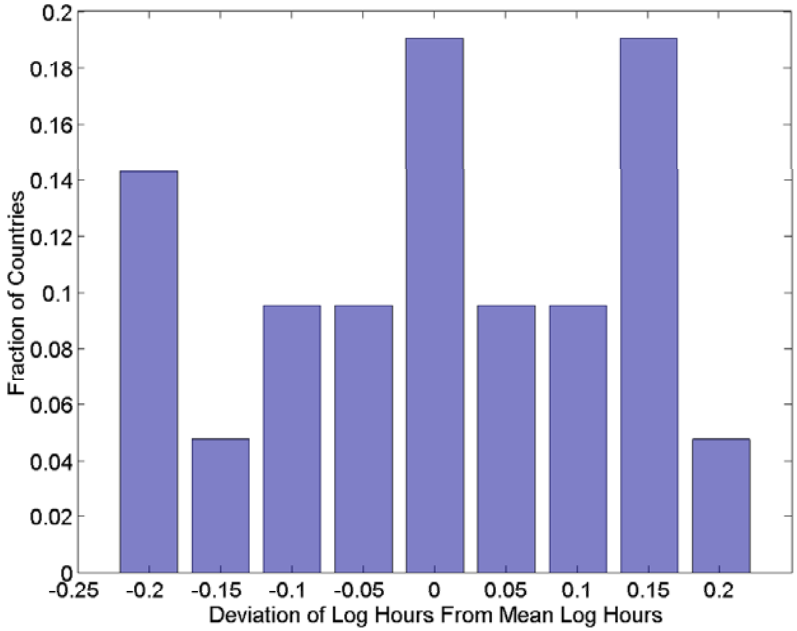
Group 2: Denmark, Japan, Norway, Portugal, Sweden, UK.

Group 3: Australia, Canada, New Zealand, U.S.

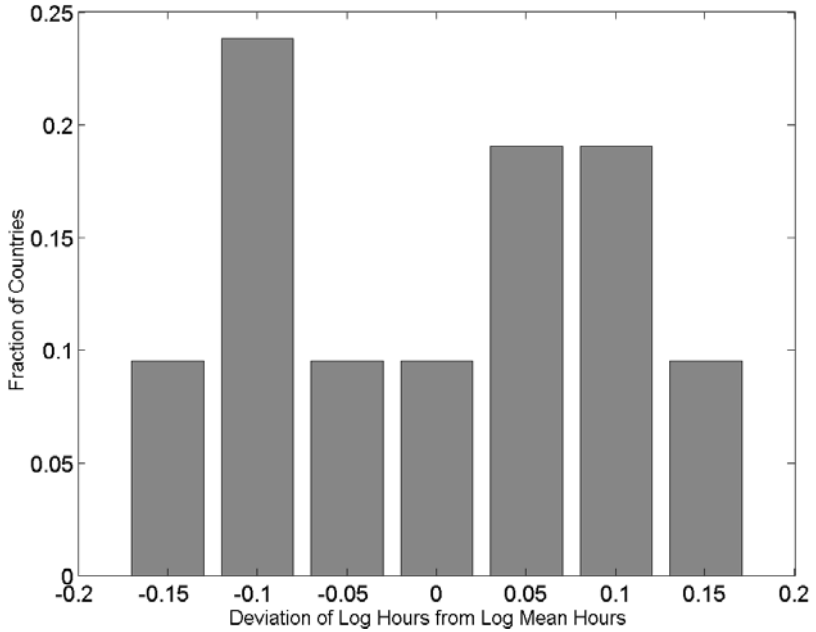
Mean Hours Worked by Group



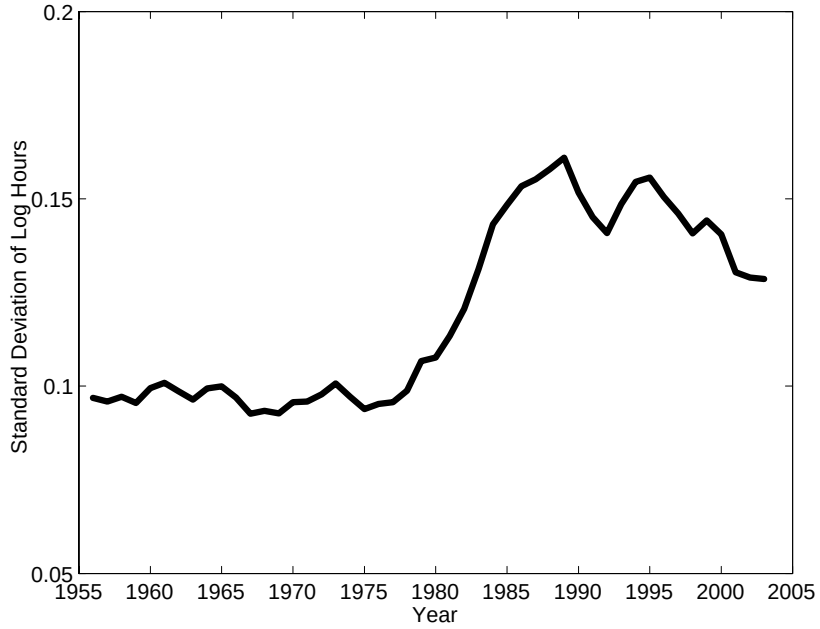
Dispersion in 2004



Dispersion in 1956



Standard Deviation of Log Hours Over Time



Importance of Trend Differences

Consider the regression:

$$\log h_{it} = a + b_i t + \varepsilon_{it}$$

The R-squared from this regression is $.76$.

Without country specific trends it is $.26$

With country specific intercept it is $.89$

Digression on Unemployment Rate Evolutions

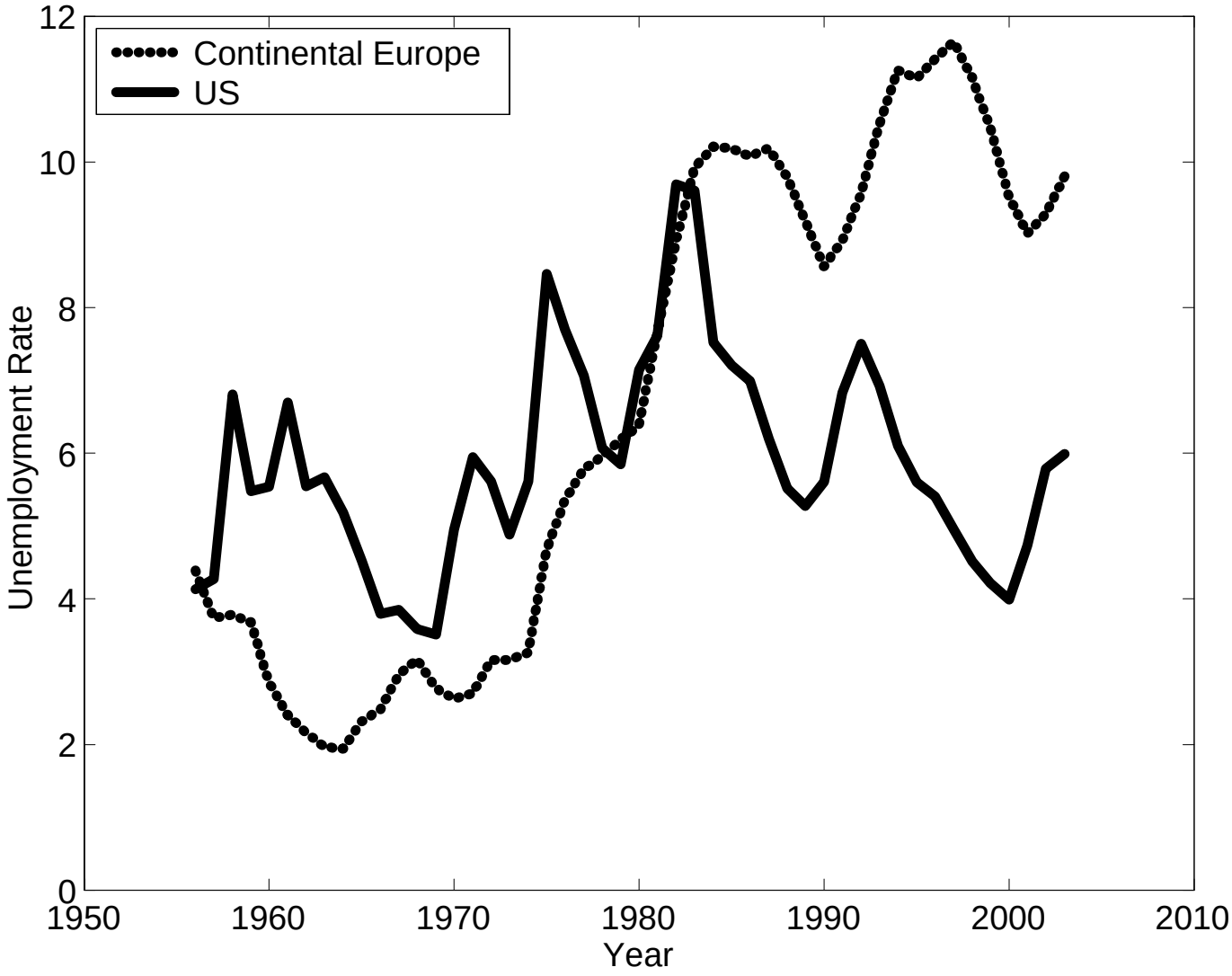
There is a large literature that summarizes and seeks to understand the differing evolutions of unemployment rates across countries

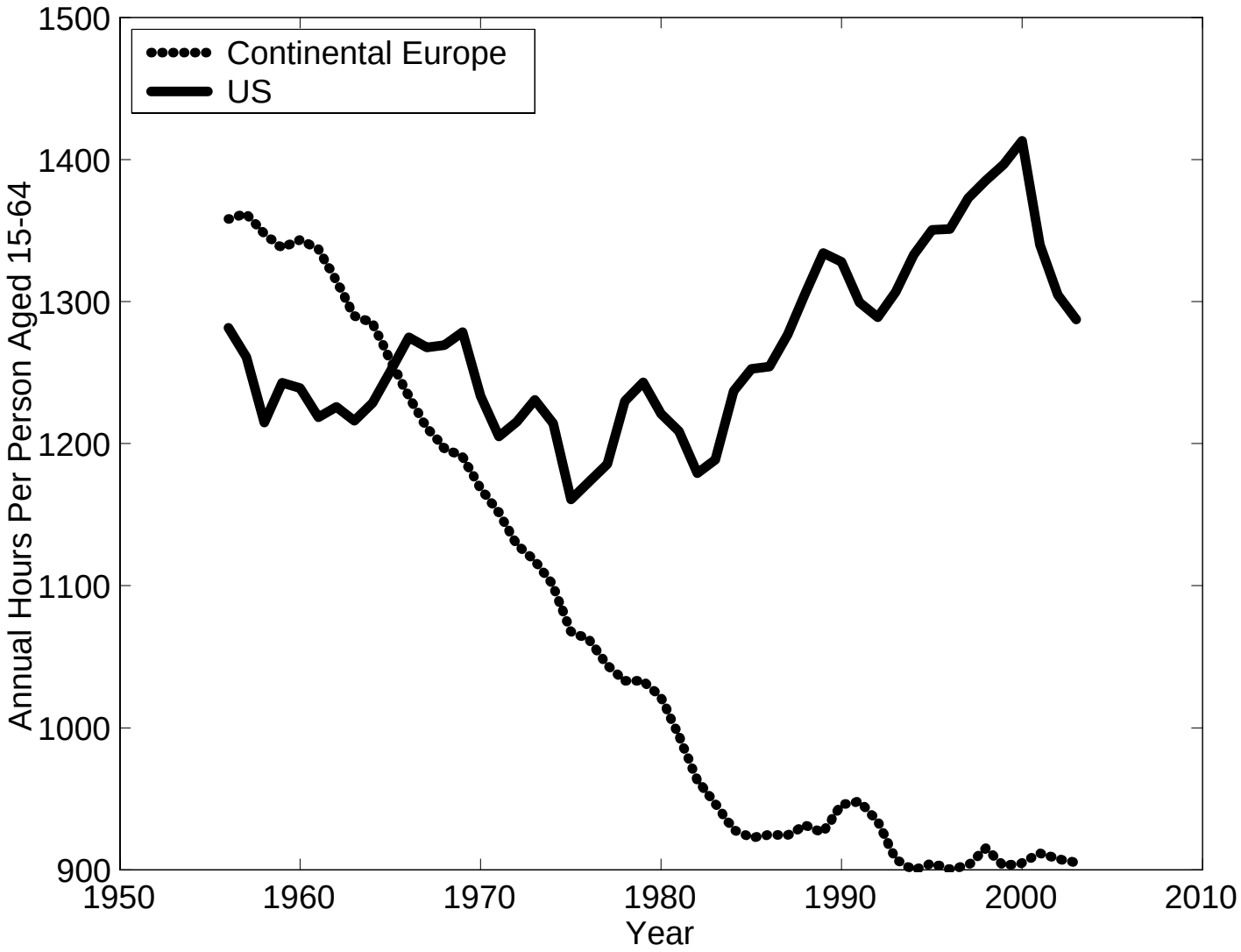
One prominent pattern is that unemployment in the US has changed relatively little since 1960 whereas unemployment in several European countries has increased dramatically

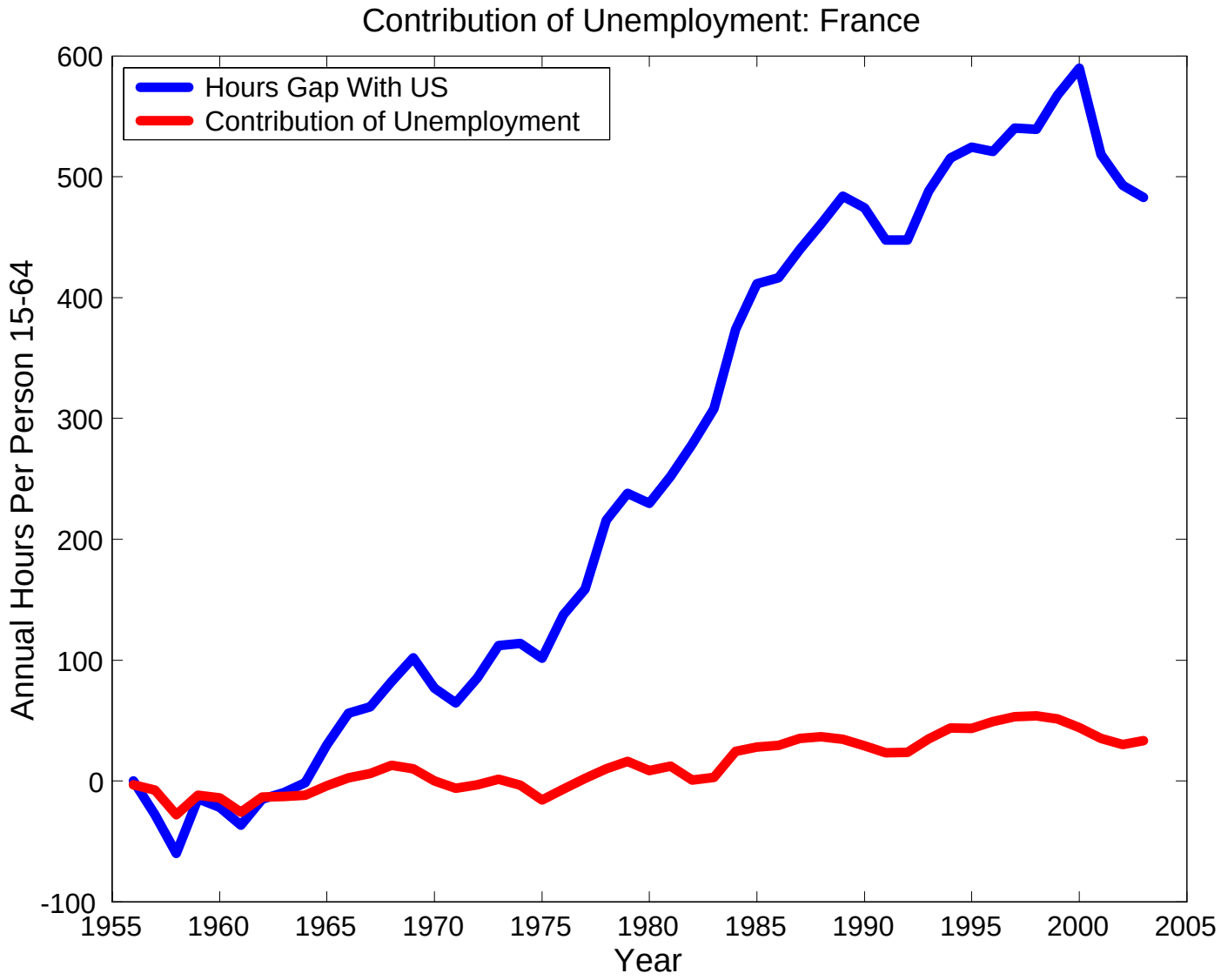
Question: Are the changes in unemployment and hours worked just two different ways of describing the same underlying phenomenon?

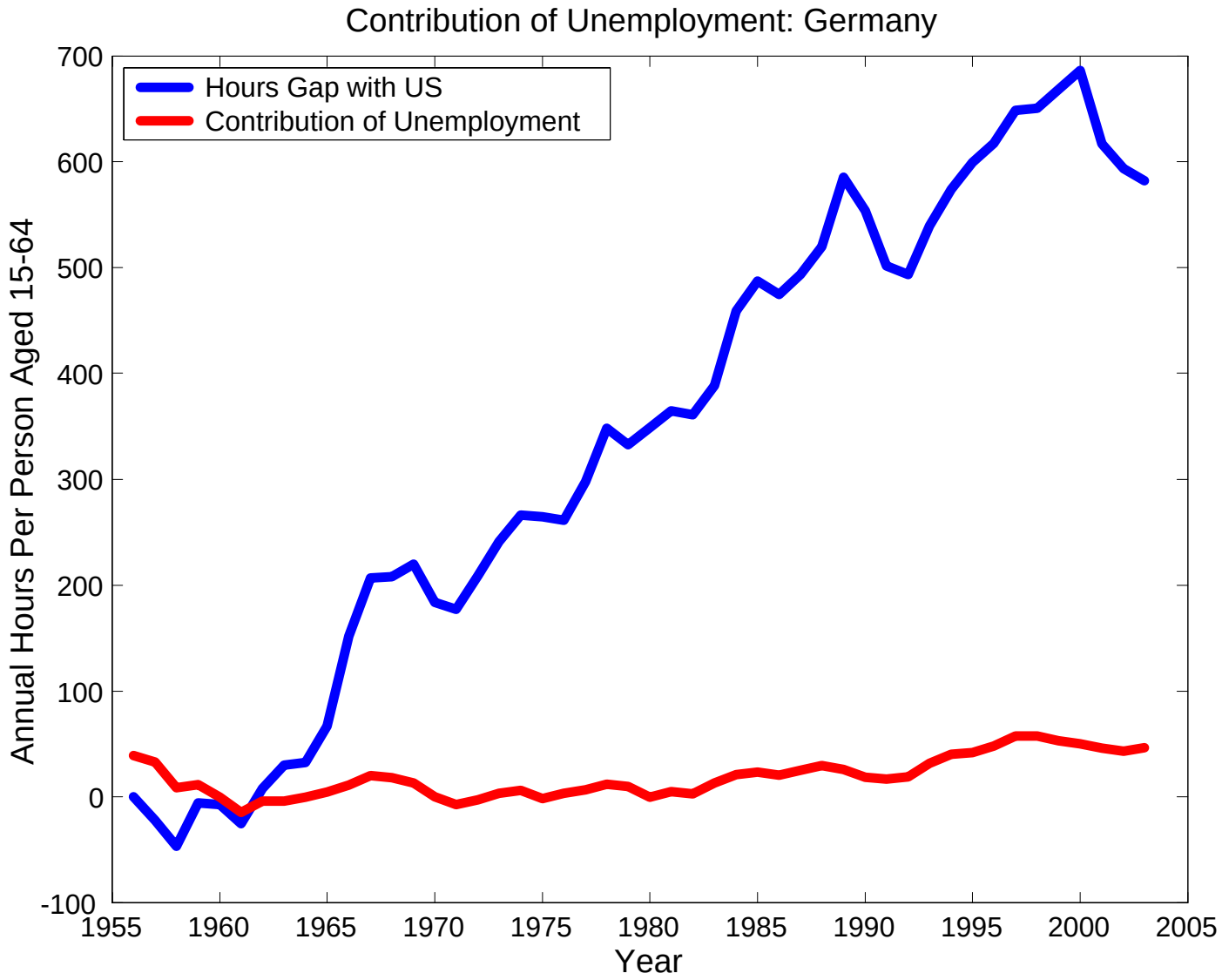
Answer: No, both qualitatively and quantitatively

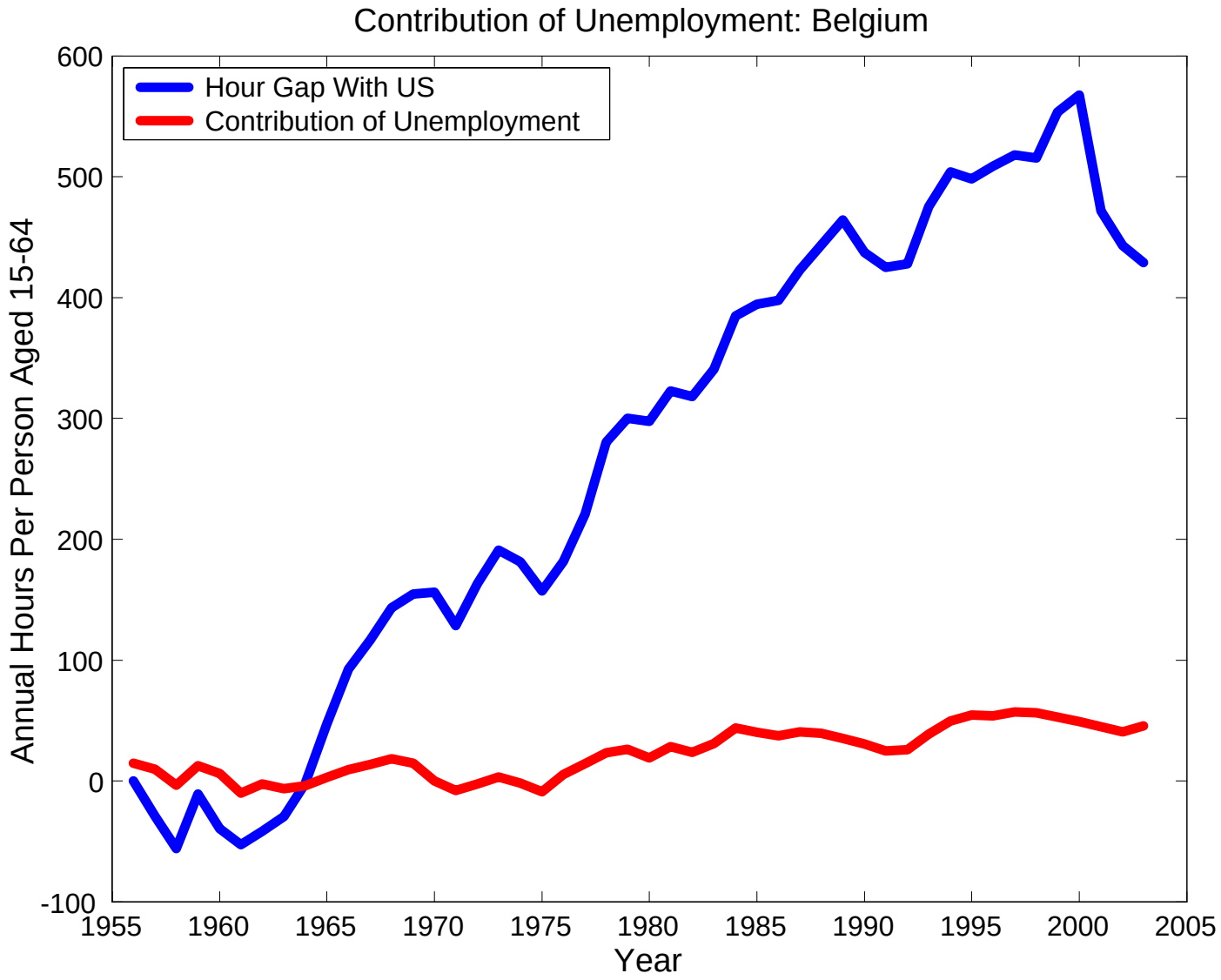
Qualitatively:




Continental Europe
US
Annual Hours Per Person Aged 15-64
1500
1400
1300
1200
1100
1000
900
1950
1960
1970
1980
1990
2000
2010
Year


Contribution of Unemployment: France
Hours Gap With US
Contribution of Unemployment
Annual Hours Per Person 15-64
600
500
400
300
200
100
0
-100
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year


Contribution of Unemployment: Germany
Hours Gap with US
Contribution of Unemployment
Annual Hours Per Person Aged 15-64
700
600
500
400
300
200
100
0
-100
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year


Contribution of Unemployment: Belgium
Hour Gap With US
Contribution of Unemployment
Annual Hours Per Person Aged 15-64
600
500
400
300
200
100
0
-100
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

Summary

There are large differences in trends in hours worked across countries and these differences in trends account for much of the variance in hours worked in the panel

We seek to understand these trend differences in the context of a standard growth model, imposing that it is consistent with balanced growth. For each country i we have:

A representative agent with preferences:

$$\sum_{t=0}^{\infty} \beta^t [\alpha_i \log c_{it} + (1-\alpha_i) \frac{(\bar{h} - h_{it})^{1-\gamma}}{1-\gamma}]$$

An aggregate production function:

$$y_{it} = A_{it} k_{it}^{\theta_i} h_{it}^{1-\theta_i}$$

Feasibility requires:

$$c_{it} + k_{it+1} = y_{it} + (1-\delta) k_{it}$$

We focus on the competitive equilibrium for this economy.

Combining FOCs from the consumer and firm problem we obtain the standard “static” first order condition:

$$\frac{u_2^i(c_{it}, 1-h_{it})}{u_1^i(c_{it}, 1-h_{it})} = F_2^i(k_{it}, h_{it})$$

which with our functional forms can be written as:

$$\frac{(1-\alpha_i)}{\alpha_i} \frac{h_{it}}{(1-h_{it})^{\gamma}} = (1-\theta_i)\frac{y_{it}}{c_{it}}$$

Our analysis will focus on this first order condition.

The Labor Wedge

The labor wedge measures the extent to which this condition is violated in the data.

Define the "wedge factor" Δ_{it} so that the above equation holds with equality:

$$\frac{(1-\alpha_i)}{\alpha_i}\frac{h_{it}}{(1-h_{it})^{\gamma}} = (1-\Delta_{it})(1-\theta_i)\frac{y_{it}}{c_{it}}$$

Define B_{it} by:

$$B_{it} = \frac{h_{it}}{(\bar{h} - h_{it})^{\gamma}} \frac{c_{it}}{y_{it}}$$

Then:

$$\frac{1 - \Delta_{it'}}{1 - \Delta_{it}} = \frac{B_{it'}}{B_{it}}$$

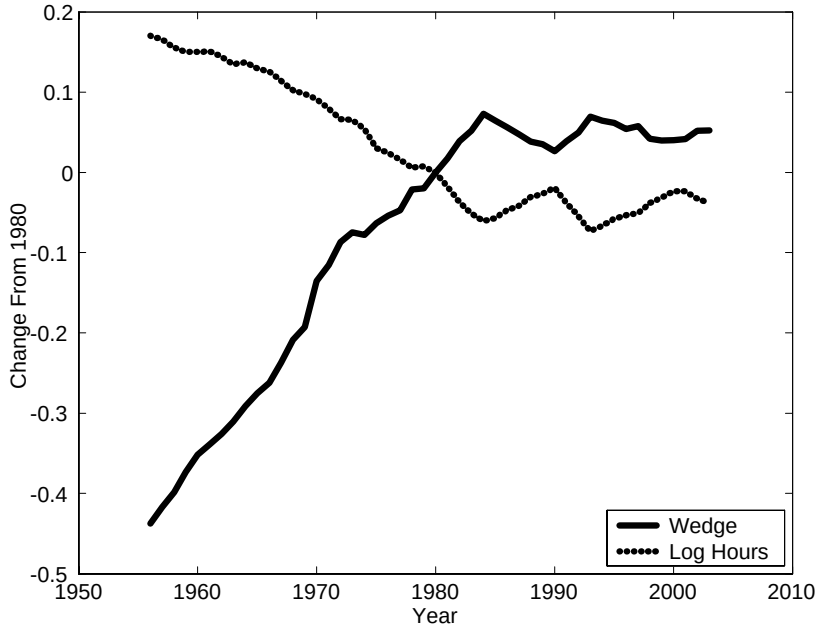
We normalize the wedge to be zero in all countries in 1980 and then use this equation to solve for the wedge in all other years.

Note: Do not need to make any assumptions about α and θ to compare wedges across time within a country.

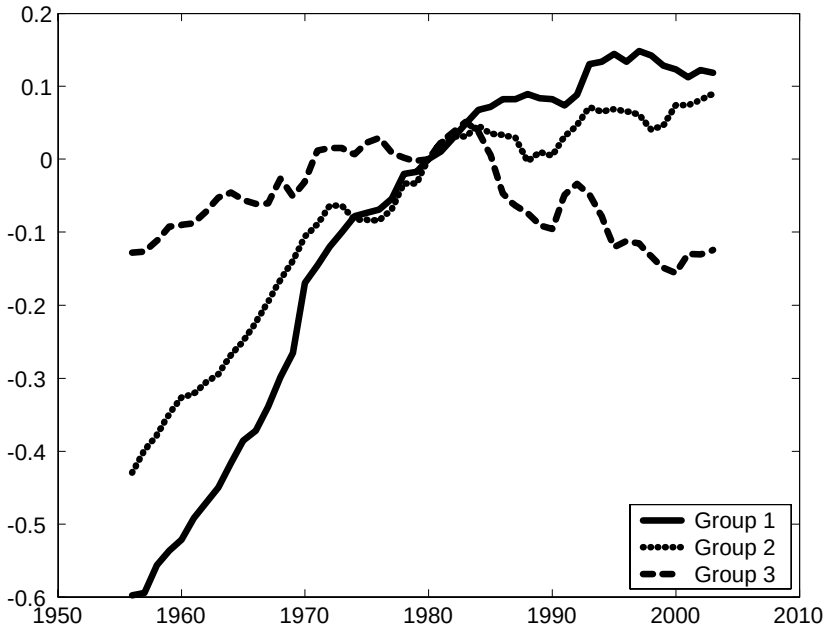
For our benchmark results we set $\gamma = 1$ (i.e., log) and $\bar{h} = 365 \times 14$.

Findings From Benchmark Model

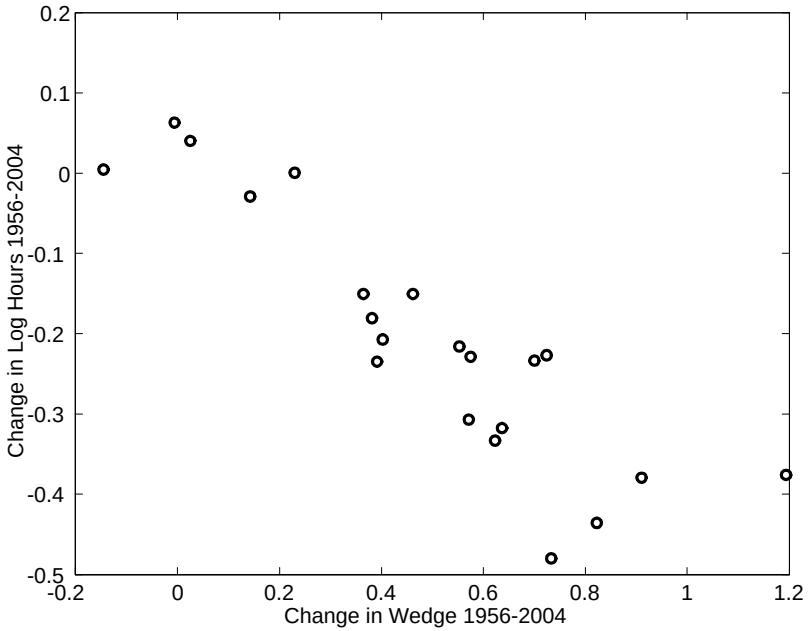
Mean Wedge versus Mean Log Hours



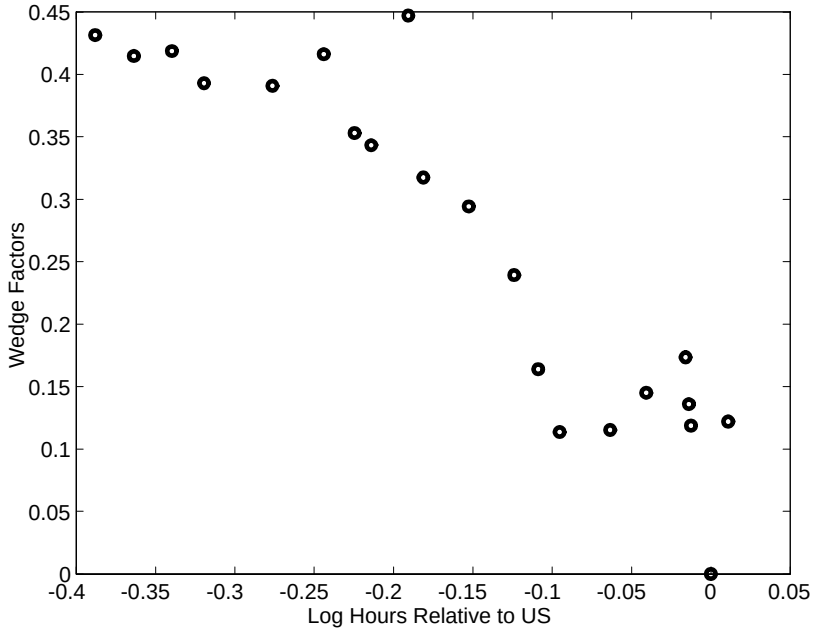
Wedges in the Three Groups:

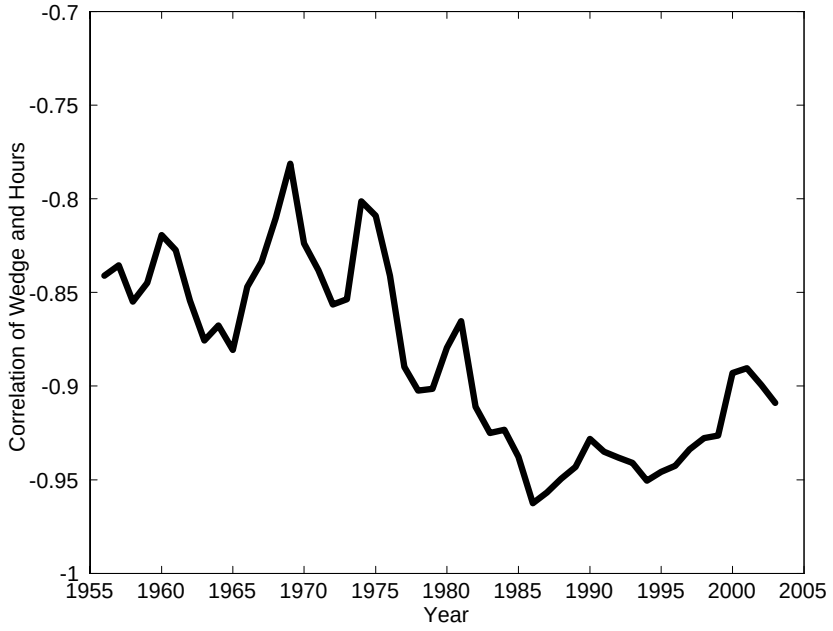


Change in Wedge and Change in Log Hours: 1956-2004



Digression: Assuming that α and θ are the same across countries we can compute wedges for all countries by normalizing one wedge to zero. We set the wedge in the US to 0 in 2004.



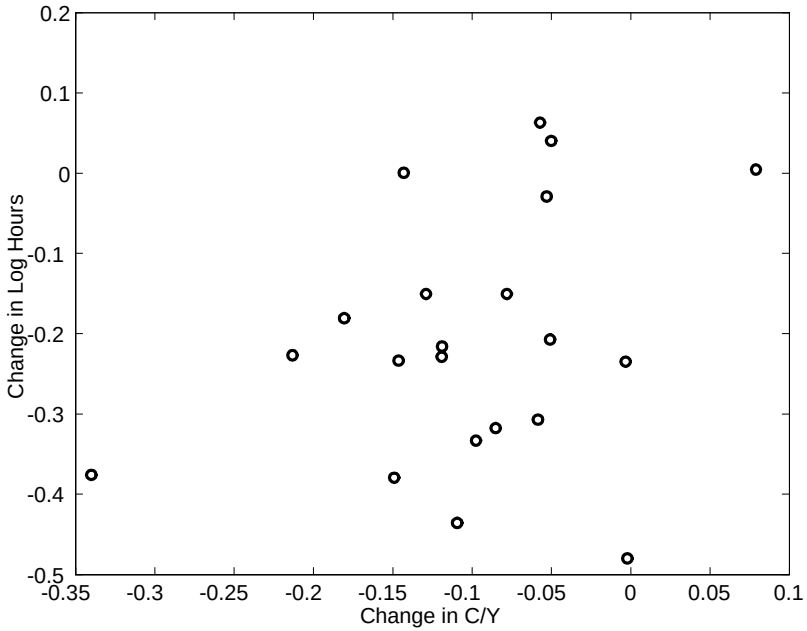

-0.7
-0.75
-0.8
-0.85
-0.9
-0.95
-1
Correlation of Wedge and Hours
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year

Previous results tell us that countries with large changes in hours have large changes in wedge factors.

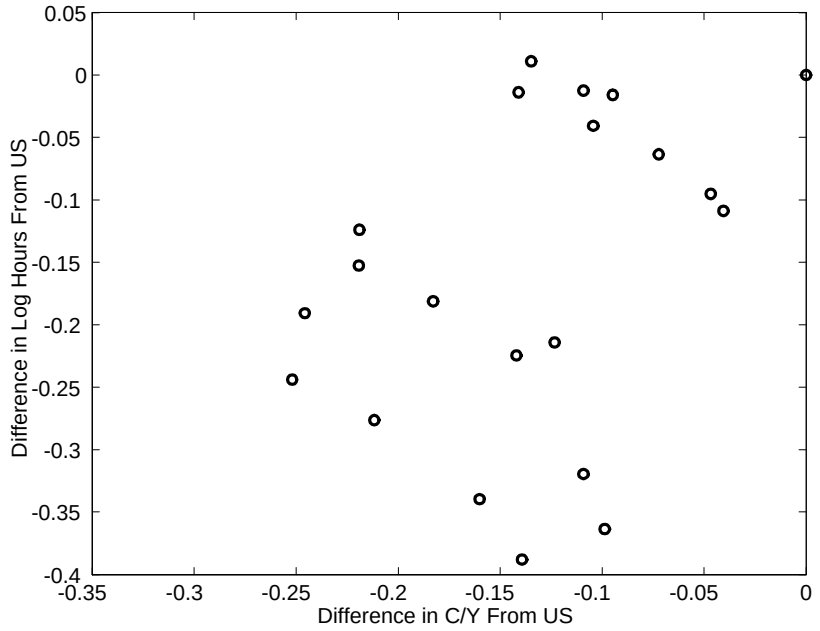
In the model, the only factor that influences the mapping from changes in hours to changes in wedges is the change in c/y.

A natural question is: How much do changes in c/y affect the computed wedges?

Time Series Changes in c/y and Hours:



Cross-Sectional Differences in c/y and Hours:

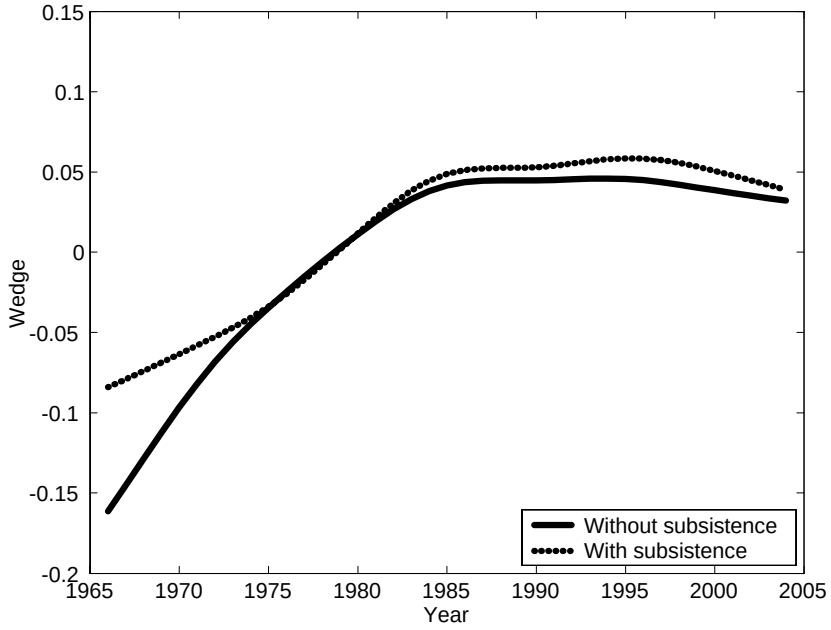


Variations and Sensitivity

- Include government consumption
- Allow for subsistence consumption
- Different values of γ

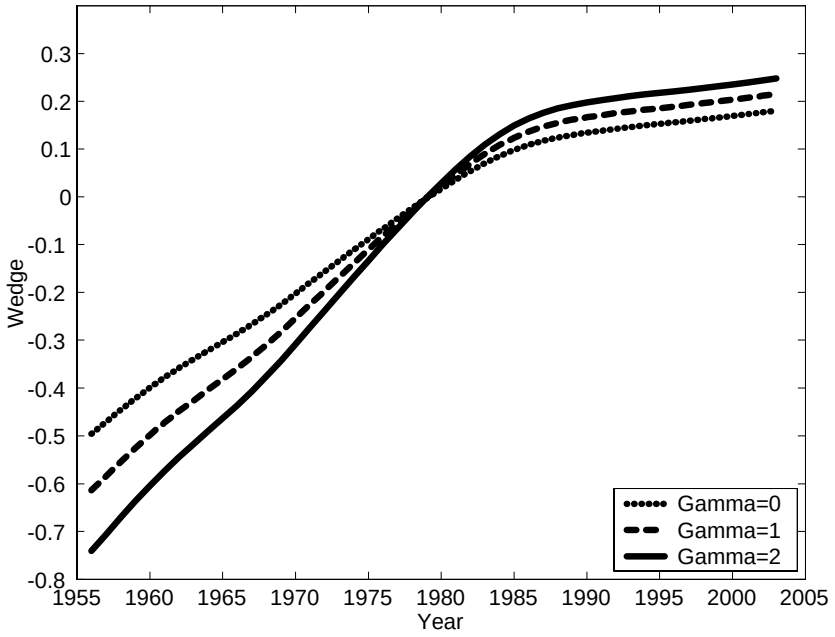
Adding Subsistence

Change preferences from $\log c_t$ to $\log(c_t - \bar{c})$



Sensitivity to γ

Consider France as an example:



Directions for Research

Given that changes in hours worked are associated with large changes in wedges, we should look for factors that generate wedges and have experienced large changes over time.

The literature has identified many factors for which changes will produce changes in wedges in the static FOC:

- taxes
- employment protection
- minimum wages
- imperfect competition in product markets
- imperfect competition in labor markets
- home production
- preferences

Incorporating Taxes

We assume proportional taxes on labor income and consumption given by τ_{hit} and τ_{cit} for country i in period t.

Revenues fund government spending g and lump-sum transfers T.

Preferences are given by:

$$\sum_{t=0}^{\infty} \beta^t [\alpha \log(c_{it} + \lambda_{it} g_{it} - \bar{c}) + (1-\alpha) \frac{(1-h_{it})^{1-\gamma}}{1-\gamma}]$$

The static first order condition is now given by:

$$\frac{(1-\alpha_i)}{\alpha_i}\frac{h_{it}}{(\bar{h}-h_{it})^{\gamma}} = (1-\tau_{it})(1-\theta_i)\frac{y_{it}}{(c_{it}+\lambda_{it}g_{it}-\bar{c})}$$

where

$$(1-\tau_{it}) \equiv \frac{(1-\tau_{hit})}{(1+\tau_{cit})}$$

And the wedge is now defined by:

$$\frac{(1-\alpha_i)}{\alpha_i}\frac{h_{it}}{(\bar{h}-h_{it})^{\gamma}} = (1-\Delta_{it)}(1-\tau_{it})(1-\theta_i)\frac{y_{it}}{(c_{it}+\lambda_{it}g_{it}-\bar{c})}$$

Tax Rates

To implement the analysis with taxes one obviously needs time series data on effective labor tax rates for a large set of countries.

Previous Work:

Mendoza et al (1994) use NIPA data and OECD Revenue Statistics to estimate average tax rates on labor, consumption and capital.

Basic idea is to allocate tax revenue across categories and then compute appropriate tax base for each type of tax.

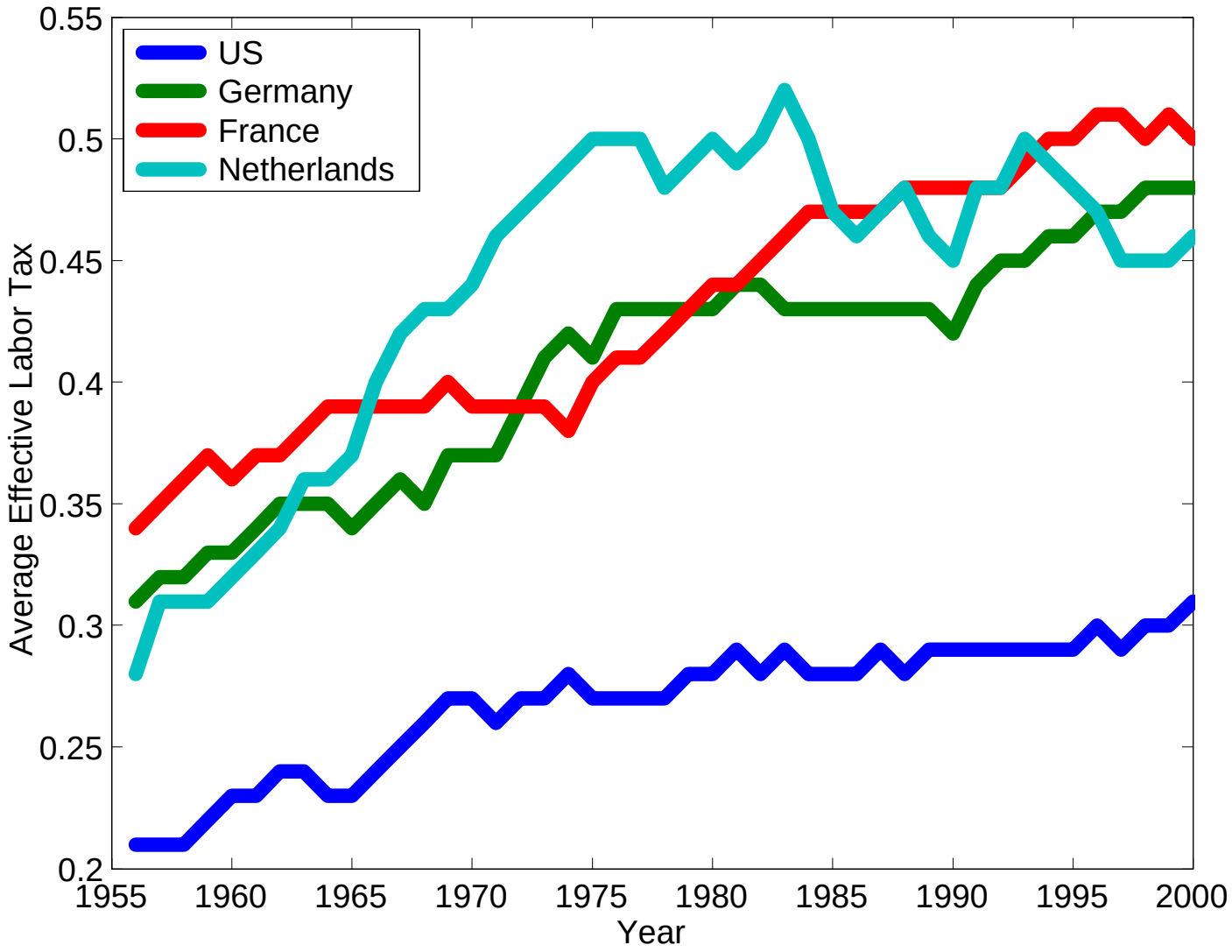
Issues that arise in implementing this procedure:

- household tax payments not separated according to source
- proprietors income not separated into labor and capital components
- property taxes
- indirect taxes

Limitation of the estimates: Estimates are for average tax rates not marginal tax rates.

For our purposes another issue is that the Mendoza et al estimates do not start until 1965 for most countries, and even later for some others.

McDaniel (2006) carries out a similar exercise using only NIPA data and therefore is able to produce estimates for a much longer time period. We use her estimates.

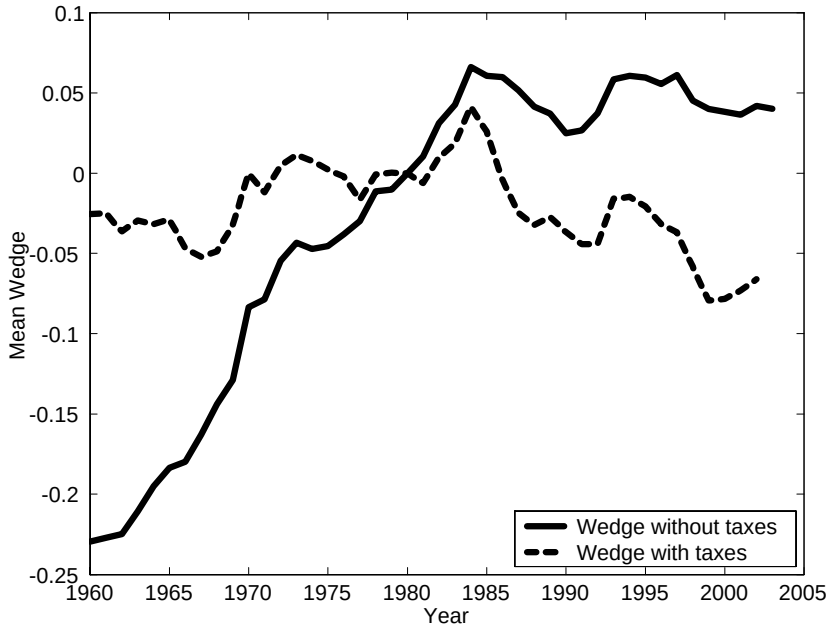

US
Germany
France
Netherlands
Average Effective Labor Tax
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year

Results of the Analysis With Taxes

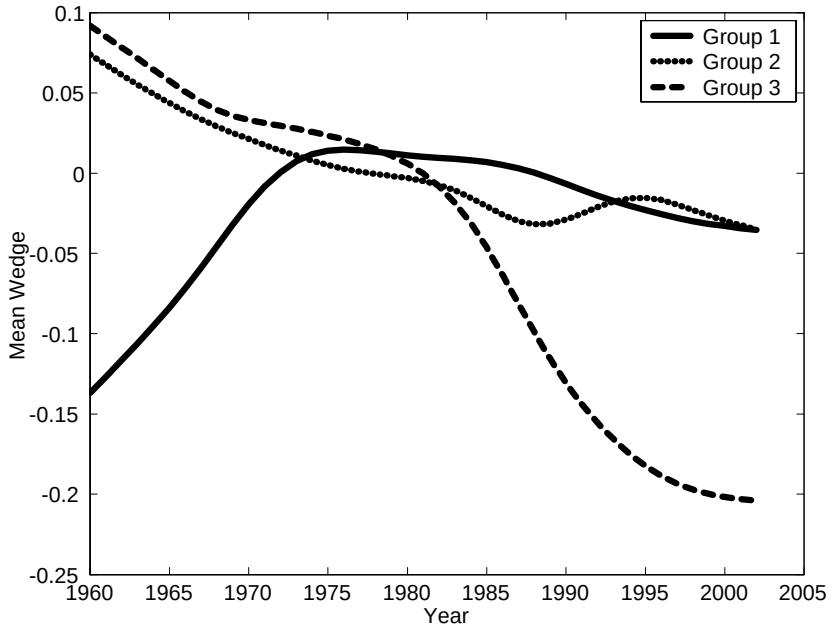
We repeat the earlier analysis, computing wedges for each country, normalizing the wedge to equal 0 in 1980.

I will start with results that assume $\gamma = 1$, $\bar{c} = 0$, $\lambda_{it} = 1$.

Results: Effect on Average Wedge



Average wedges by group:

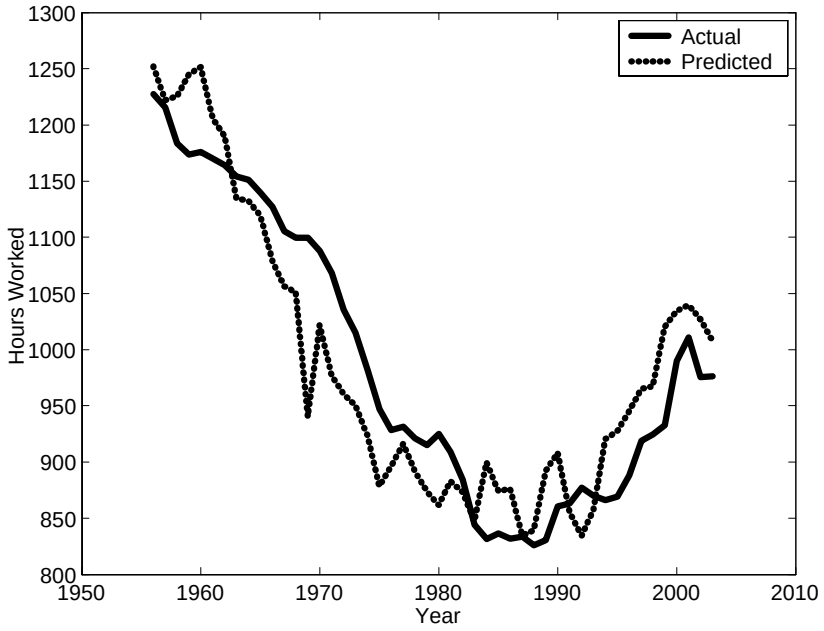


One can also map wedges into hours gaps by asking what value of hours worked would imply a zero wedge in each period.

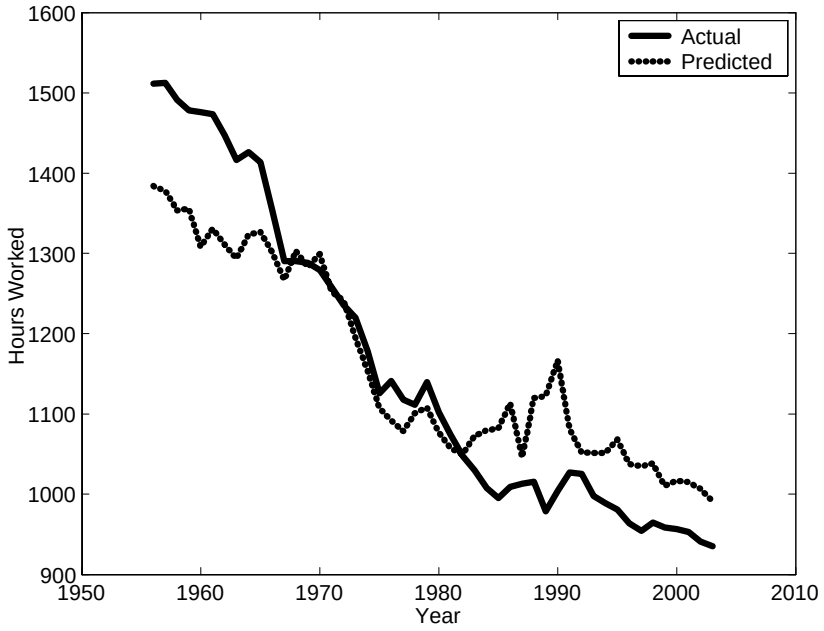
We will call the resulting hours series “predicted hours” and compare them with actual hours.

To illustrate the range of findings we show results for four countries: the Netherlands, Germany, Sweden and the US.

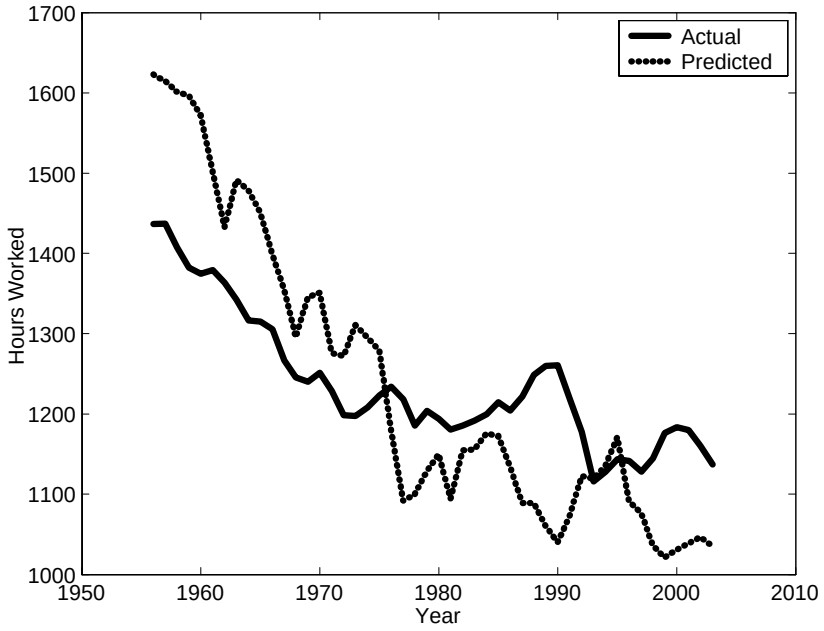
Netherlands



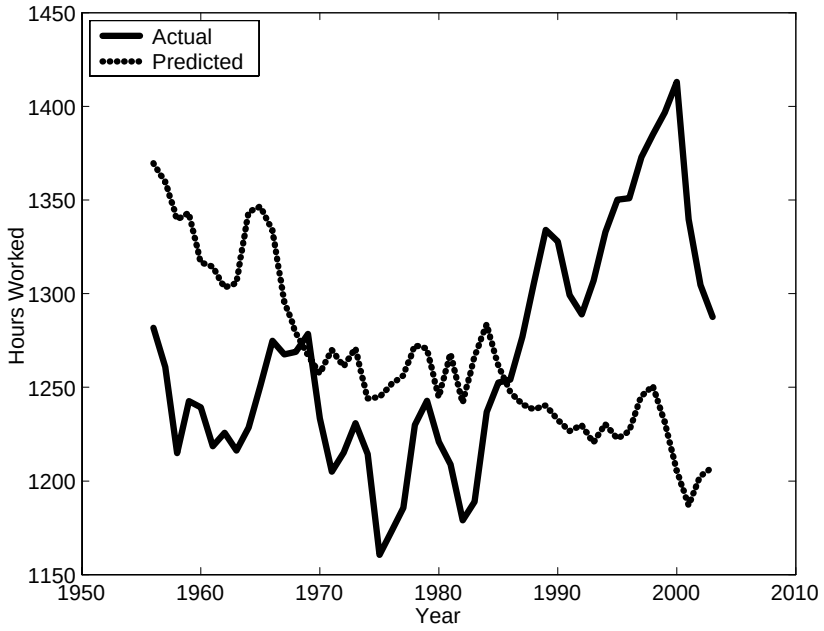
Germany


Actual
Predicted
Hours Worked
Year
1600
1500
1400
1300
1200
1100
1000
900
1950
1960
1970
1980
1990
2000
2010

Sweden


Actual
Predicted
Hours Worked
Year
1700
1600
1500
1400
1300
1200
1100
1000
1950
1960
1970
1980
1990
2000
2010

US


Actual
Predicted
Hours Worked
Year
1450
1400
1350
1300
1250
1200
1150
1950
1960
1970
1980
1990
2000
2010

Identifying Puzzling Episodes

We treat each country-decade pair as an episode. By computing the change in the value of the wedge over the course of the decade, we have a method for determining which episodes stand out as most “puzzling”.

Δ **Wedge**	*Number of Observations* **Pre-Tax**	**After-Tax**	
		$\bar{c} = 0$	$\bar{c} > 0$
$\leq -.125$	2	5	9
$(-.125, -.075]$	4	7	14
$(-.075, -.025)$	7	11	16
$[-.025, +.025]$	13	18	13
$(+025, +.075)$	17	15	11
$[+.075, +.125)$	9	9	7
$\geq +.125$	23	9	4

Statistical Analysis of Wedges and Various Factors

Other factors are not as easily incorporated analytically.

As a first pass we consider a statistical analysis of the relationship between the wedges generated by our analysis and several factors.

We use series from Nickell for employment protection, UI, centralization of wage setting, union density.

	(1)	(2)	(3)	(4)	(5)	(6)
Tax	.73(.05)	.69(.05)	.76(.05)	.71(.05)	.60(.06)	.68(.06
EP		.13(.04)				.10(.04
UD			-.21(.09)			-.33(.09
CO				-.42(.02)		.00(.02
COW						-.04(.01
BRR						.09(.04
BD					-.22(.05)	-.26(.05
R-sq	.36	.38	.37	.37	.40	.46

Conclusions

- Wedges are a useful diagnostic in the effort to understand the factors underlying the large changes in hours worked across countries
- Given a fairly high labor supply elasticity, taxes lead to a large reduction in the implied wedges. This holds for a large set of countries over a long time period.
- Once taxes are taken into account, the issue for many countries becomes understanding why hours worked have not decreased by more.