

Cross Country Differences in Hours of Work: A First Look

Background/Motivation

What is the objective of research in economics?

Economics is the study of resource allocations.

A resource allocation is a description of what every individual does with their time and how much they consume of all the different commodities available, and what each firm does in terms of inputs and outputs.

Why do we study resource allocations?

The standard of living that people in an economy enjoy depends critically on how well the economy allocates its resources. As a result, one of the issues that economists focus on is assessing the extent to which economies allocate their resources in an efficient manner, and what factors lead to inefficient allocations. Experience indicates that there are large inefficiencies in many economies.

Some general questions that economists are interested in:

1. What are the important forces that shape the resource allocations achieved by decentralized market systems?
2. What are the properties of efficient resource allocations?
3. To what extent do economies produce inefficient allocations?
4. What are the important sources of inefficiencies, and how do we get rid of them?

If the only information you have concerns the resource allocation in one economy at one point in time it can be quite hard to draw any conclusions about whether the allocation is a good one or not.

But information on two or more economies at a point in time or on one economy at different points in time can provide very useful information. As a result, looking at time series or cross-section variation in resource allocations is a good way to learn about the forces that shape resource allocations.

But.....

Not all differences in resource allocations are significant.

For example, if we compare consumption allocations in Italy and Korea we find a substantial difference in consumption of pasta and rice. If we compare the US and the UK we find that in the US baseball is popular while in the UK soccer is popular.

Most people would not conclude that these differences are very important in assessing the extent to which these economies are achieving good resource allocations in a relative sense.

And in other cases, differences which one might presume are associated with inefficiency may turn out not to be.

The phenomenon of business cycles is a good case in point.

Business cycles refer to the fact that the resource allocation in an economy changes over time—in some periods the economy devotes more time to producing output than in other periods. Early economists argued that this must reflect an inefficiency—how could it be efficient to sometimes produce more and sometimes less? But modern research has argued that such a pattern may indeed be efficient!

Summary

One job of an economist is to uncover those aspects of resource allocations which are associated with important welfare losses and understand what factors account for these losses.

Objectives for the Lecture:

- Document large differences in hours of market work across economies
- Argue that these differences are potentially associated with large welfare consequences
- Assess the role of taxes in accounting for these differences

Data on Hours of Market Work

I rely on data from the OECD. You can visit the website at:
<http://www1.oecd.org/scripts/cde/members/lfsdataauthenticate>

I use three pieces of data:

- 1.** Total employment
- 2.** Annual hours of work per person in employment
- 3.** Population aged 15-64

Step 1: I compute total hours worked as:

total hours worked =

total employment x average annual hours per person in employment

Step 2: Need to normalize since countries are of different sizes. I normalize by number of people aged 15-64.

Step 3: I do this for each country and then express the values relative to the value for the US.

Findings

Annual Hours of Work Per Person of Working Age as % of
US in 2000

Italy	63	Austria	77	UK	90
Belgium	65	Norway	78	Canada	90
France	68	Ireland	78	Australia	93
Germany	69	Poland	80	New Zealand	95
Netherlands	71	Denmark	82	Japan	97
Spain	74	Sweden	86	Switzerland	97

Conclusion:

Differences in time allocated to market work are huge!

A Digression—The Role of Unemployment

Traditionally, macroeconomists viewed labor supply as fixed by population size and interpreted all changes in hours of market work relative to population as due to movements in unemployment.

How important are cross-country differences in unemployment in accounting for these differences in market work?

To answer this we ask what relative hours of market work would be across countries if all countries had the same fraction of their population unemployed.

Role of Unemployment in Accounting for Differences in Hours of Market Work

	Actual	Constant U
Belgium	63	70
France	68	72
Germany	69	73
Italy	63	68
Netherlands	71	70
Norway	78	78
Spain	74	83
Sweden	86	89

Conclusion: Unemployment explains very little of the difference in time devoted to market work across countries. Differences in participation rates and hours per employed person are both big.

To this point we have identified a dimension along which we see very large differences in allocations across economies. This is a good start. Next step is to assess whether this difference is something that we should care about.

It is difficult to do this without understanding something about what may be the underlying cause of these differences. If the cause is differences in preferences, then maybe each country is doing what is best for themselves.

I ask the following question. Suppose that the differences in hours of work are not due to differences in preferences, but rather are due to differences in policies, regulations, institutions etc...Under this assumption can we say something about how costly these differences in hours of work are from a welfare perspective?

I show how to answer this question in the context of the benchmark model used to carry out quantitative analyses in macroeconomics—the neoclassical growth model.

Model

Need to specify the primitives of the economy—preferences, technology and endowment.

Preferences

Representative Agent

$$\sum_{t=0}^{\infty} \beta^t u(c_t, 1 - h_t)$$

Technology

Aggregate Production Function:

$$y_t = F(k_t, A_t h_t)$$

Feasibility:

$$c_t + i_t = y_t$$

Accumulation:

$$k_{t+1} = (1 - \delta)k_t + i_t$$

Technological Progress:

$$A_{t+1} = (1 + \gamma)A_t$$

Endowment

Time:

$$0 \leq h_t \leq 1$$

Initial Capital Stock:

k_0 given

Question: Assuming no differences in the economic primitives, are differences in hours worked a serious concern?

I carry out a calculation that attempts to answer this question without taking a stand on what causes them. Specifically, I do the following:

Step I: Calibrate the model so that the steady state of the Social Planner's problem matches values for the US economy, including data on hours of work.

Step II: Consider an economy with hours worked different than the US. Ask what a social planner would do if they were restricted to choose hours of work equal to this value but were free to choose everything else optimally.

Step III: Remove the restriction on hours and solve for the dynamic path that the economy will follow starting from its initial steady state.

Step IV: Compute the welfare gain associated with removing the restriction.

If welfare gain is large then we conclude that differences in hours worked are significant from a welfare perspective.

Note: This welfare gain is likely to be a lower bound on the true welfare gain since we are assuming that whatever policy is causing the distortion in hours of market work is not distorting any other margins, which is often not the case.

Implementing the Steps

Step I: Calibration

Need to choose functional forms and parameter values:

Utility function:

$$u(c_t, 1 - h_t) = \alpha \log c_t + \frac{(1 - \alpha)}{1 - \gamma} (1 - h_t)^{1-\gamma}$$

motivation: choose preferences to be consistent with balanced growth path in the presence of technological change

Production function:

$$F(k_t, h_t) = k_t^\theta h_t^{1-\theta}$$

motivation: constant factor shares

Need to choose parameter values:

Strategy: Fix the value of γ and then use long run observations to tie down the values of β, θ, δ and α .

I set a time period equal to one year and use the following observations:

- capital output ratio of 2.5
- investment to output ratio of .2
- time allocated to market work of 1/3
- real rate of return to capital of 4% per year

β	δ	θ	α
.96	.08	.3	$\frac{1}{1+B}$

where $B = \theta \frac{Y}{C} \frac{(1-h)^\gamma}{h}$

Step 2: Solve a restricted Social Planner's Problem

Let c^*, k^*, y^*, i^* , and h^* be the solution to the original social planner's problem. Suppose we restrict that $h_t = \bar{h}$ and re-solve the social planner's problem. Use bar's to denote new steady state values.

New steady state solution scales everything by \bar{h}/h^* :

$$\bar{y} = \frac{\bar{h}}{h^*} y^*, \bar{k} = \frac{\bar{h}}{h^*} k^*, \bar{i} = \frac{\bar{h}}{h^*} i^*, \bar{c} = \frac{\bar{h}}{h^*} c^*$$

So, in particular, K/Y, I/Y, Y/H, ratios and real rate of return to capital are not changed.

Step 3: Solve for transition path with no hours restriction

Taking the restricted hours steady state as an initial condition we solve for the dynamic path assuming that the hours restriction is lifted.

Let $\{\hat{c}_t\} \{\hat{h}_t\} \{\hat{k}_t\} \{\hat{y}_t\} \{\hat{i}_t\}$ be new path. We know that these values will converge to the steady state values from the original social planner's problem: $c^*, h^* \dots$

Step 4: Compute Welfare Cost

We want to know the benefit of going from staying at the restricted steady state forever versus getting the path $\{\hat{c}_t\} \{\hat{h}_t\} \{\hat{k}_t\} \{\hat{y}_t\} \{\hat{i}_t\}$.

We need a welfare measure that is not affected by monotone transformations of the utility function.

Standard Choice:

By what fraction would you have to increase consumption each period relative to the original steady state in order to make individuals indifferent about having the hours restrictions?

Mathematically, let λ be the percent increase in consumption each period. Then λ is the solution to:

$$\sum_{t=0}^{\infty} \beta^t u((1 + \lambda)\bar{c}, 1 - \bar{h}) = \sum_{t=0}^{\infty} \beta^t u(\hat{c}_t, 1 - \hat{h}_t)$$

or:

$$\frac{1}{1 - \beta} u((1 + \lambda)\bar{c}, 1 - \bar{h}) = \sum_{t=0}^{\infty} \beta^t u(\hat{c}_t, 1 - \hat{h}_t)$$

Results

Welfare Cost of Hours Restrictions in %

\bar{h}/h^*	$\gamma = 0$	$\gamma = 1$	$\gamma = 5$
.65	7.7	10.2	18.5
.75	3.5	4.8	9.1
.85	1.2	1.6	3.3
.95	0.1	0.2	0.9
1.0	0.0	0.0	0.0

Conclusion: Welfare costs associated with having the wrong amount of labor input are large!

Note on Transition Paths

Contrast steady state to steady state welfare gains versus gains including the transition path.

\bar{h}/h^*	w/ transition	w/o transition
.65	10.2	19.2
.75	4.8	11.9
.85	1.6	6.2
.95	0.2	1.7
1.0	0.0	0

Causes of These Differences

If we think that these differences might be due to differences in policies/regulations/institutions rather than due to primitives, what are the types of factors that might be important?

- taxes and transfers, e.g., income taxation, social security, unemployment insurance
- unions and wage setting rules
- labor market regulation, e.g., employment protection policies
- product market regulation, e.g., restrictions on entry

How to proceed?

Economists find that the most useful way to start is to consider various factors in isolation in order to best determine the effect of that particular factor. In this lecture I will pick the first potential factor—taxes and show how to assess the potential effects of taxes.

Motivation:

There are large differences in tax rates across countries and these seem to be correlated with differences in hours of work. So this seems like a plausible candidate to investigate.

We carry out a crude exercise. We do not break down taxes and transfers into the various specific programs but rather consider the combined impact of all of them.

We assume that labor income is taxed at rate τ_h , consumption is taxed at rate τ_c and capital income is taxed at τ_k . We assume that the government uses all tax revenue to fund lump sum transfers to a representative agent, denoted by T .

We solve for the steady state competitive equilibrium corresponding to these tax rates.

An **Arrow-Debreu Comp. Eq.** for this economy is a list of sequences: $\{c_t^*\}$ $\{h_t^*\}$ $\{i_t^*\}$ $\{k_t^*\}$ $\{p_t^*\}$ $\{w_t^*\}$ $\{r_t^*\}$ $\{T_t^*\}$ s.t.

1. (Consumer maximization) Taking $\{w_t^*\}$ $\{r_t^*\}$ $\{p_t^*\}$ $\{T_t^*\}$ as given, $\{c_t^*\}$ $\{h_t^*\}$ $\{i_t^*\}$ $\{k_t^*\}$ solve:

$$\text{Max} \sum_{t=0}^{\infty} \beta^t u(c_t, 1 - h_t)$$

subject to

$$\sum_{t=0}^{\infty} p_t^* [(1 + \tau_c)c_t + i_t] = \sum_{t=0}^{\infty} p_t^* [(1 - \tau_k)r_t^*k_t + (1 - \tau_h)w_t^*h_t + T_t^*]$$

$$k_{t+1} = (1 - \delta)k_t + i_t$$

$$c_t \geq 0, k_t \geq 0, 0 \leq h_t \leq 1$$

2. (Firm maximization)

Taking $\{w_t^*\}$ $\{r_t^*\}$ $\{p_t^*\}$ as given, $\{h_t^*\}$ $\{k_t^*\}$ solve

$$\text{Max } p_t[F(k_t, h_t) - w_t h_t - r_t k_t]$$

subject to

$$k_t \geq 0, h_t \geq 0$$

3. (Government behavior)

$$\tau_h w_t^* h_t^* + \tau_c c_t^* + \tau_k r_t^* k_t^* = T_t^*$$

4. (Market Clearing)

$$c_t^* + i_t^* = F(k_t^*, h_t^*)$$

Solving for the Steady State Competitive Equilibrium with Taxes

Consumer FOC's:

c_t :

$$\beta^t u_1(c_t, 1 - h_t) = \lambda(1 + \tau_c)p_t$$

h_t :

$$\beta^t u_2(c_t, 1 - h_t) = \lambda(1 - \tau_h)w_t$$

k_t :

$$\lambda p_t [(1 - \delta) + (1 - \tau_k)r_t] = \lambda p_{t-1}$$

Firm FOC's:

$$F_1(k_t, h_t) = r_t$$

$$F_2(k_t, h_t) = w_t$$

Consumer FOC for k_t implies

$$\frac{p_{t-1}}{p_t} = (1 - \delta) + (1 - \tau_k)r_t \quad (1)$$

Consumer FOC for c_t and c_{t-1} implies

$$\frac{\beta u_1(c_t, 1 - h_t)}{u_1(c_{t-1}, 1 - h_{t-1})} = \frac{p_t}{p_{t-1}} \quad (2)$$

Combining equations (1) and (2) and using Firm FOC for r_t gives:

$$\frac{\beta u_1(c_t, 1 - h_t)}{u_1(c_{t-1}, 1 - h_{t-1})} = (1 - \delta) + (1 - \tau_k)F_1(k_t, h_t) \quad (3)$$

Combining consumer foc's for h and c gives

$$\frac{u_2(c_t, 1 - h_t)}{u_1(c_t, 1 - h_t)} = \frac{(1 - \tau_h)}{(1 + \tau_c)} w_t \quad (4)$$

and using firm foc for h_t gives:

$$\frac{u_2(c_t, 1 - h_t)}{u_1(c_t, 1 - h_t)} = \frac{(1 - \tau_h)}{(1 + \tau_c)} F_2(k_t, h_t) \quad (5)$$

There is also the feasibility constraint:

$$c_t + k_{t+1} = F(k_t, h_t) + (1 - \delta)k_t \quad (6)$$

Equations (3), (4), (5), and the transversality condition and the initial condition completely characterize the competitive equilibrium allocation.

In steady state these reduce to:

$$\frac{1}{\beta} = (1 - \delta) + (1 - \tau_k)F_1(k^*, h^*)$$

$$\frac{u_2(c^*, 1 - h^*)}{u_1(c^*, 1 - h^*)} = \frac{(1 - \tau_h)}{(1 + \tau_c)}F_2(k^*, h^*)$$

$$c^* + \delta k^* = F(k^*, h^*)$$

Remark:

Note that τ_h and τ_c matter only as far as the combination $\frac{(1-\tau_h)}{(1+\tau_c)}$. Define τ by

$$1 - \tau = \frac{(1 - \tau_h)}{(1 + \tau_c)}$$

to capture the effective tax rate on labor by a single parameter.

Results

I now calibrate the model as before except that I now assume that $\tau = .40$ in the US. I set $\gamma = 1$.

τ	Relative h^*
.30	1.00
.35	.94
.40	.88
.45	.82
.50	.75
.55	.68
.60	.61

In the data presented at the beginning we saw that hours in Germany, Italy and France were about 2/3 of those in the US.

Tax data indicates that tax rates in these countries are about 50%.

Hence, our calculations suggest that much of the difference in hours of work can be understood as the result of differences in taxes.

How Important is the Value of γ

τ	$\gamma = 5$	$\gamma = 2$	$\gamma = 1.5$	$\gamma = 1.0$
.3	1.0	1.0	1.0	1.0
.35	.98	.96	.94	.92
.40	.96	.91	.89	.83
.45	.94	.87	.83	.75
.50	.92	.82	.76	.67
.55	.90	.76	.70	.58
.60	.87	.70	.63	.50

Conclusion

Review of what we have done:

- 1.** We discussed one perspective on the role of economics—uncover important dimensions of inefficient resource allocations and learn about their causes.
- 2.** We documented one dimension of resource allocations along which there are very large differences across countries, namely the time devoted to market work.
- 3.** We argued that these differences could reflect large differences in welfare.
- 4.** We assessed the potential of differences in one factor—tax rates—to account for these these differences.
- 5.** We found that taxes could plausibly explain the bulk of the differences for countries in Continental Europe.

