Levels Accounting With Human Capital and Skill-biased Technology

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Objective

Levels accounting:

Decompose cross-country income gaps into contributions of human capital, physical capital, ...

Jones (2014): **imperfect substitutability** between skilled and unskilled labor is important.

Key intuition:

- skilled / unskilled labor input much higher in rich countries
- skill premiums are about the same in rich and poor countries
- therefore: skilled / unskilled labor productivity must be much higher in rich countries

Key question

Why is skilled labor relatively more productive in rich countries?

Potential answers:

1. Human capital ("school quality"; Jones, 2014)
2. Skill biased technology (Caselli and Coleman, 2006; Acemoglu, 2007)
3. Capital-skill complementarity (Krusell et al., 2000)

Our goal: estimate the contributions of all three.

Contribution: Literature assumes one source of productivity differences

- except Rossi (2017)

Approach

Calibrate a model with

1. human capital
2. a technology frontier
3. capital-skill complementarity

to match data on

1. output gaps
2. skill premiums
3. capital shares
4. wage gains at migration (from Hendricks and Schoellman 2018)

Results

1. The model is **identified**.
   1.1 The elasticity of substitution between skilled and unskilled labor is not identified.
   1.2 It does not matter for levels accounting.
2. Without capital-skill complementarity: the model implications for
   2.1 human capital stocks
   2.2 aggregate labor input
   2.3 levels accounting

   are the **same as for the Jones (2014) human capital model**.
3. With capital-skill complementarity: we'll see...

Model Without Capital-skill Complementarity

Model Elements

Aggregate production function:

$$y_c = k_c^{\alpha} (z_c L_c)^{1-\alpha} \tag{1}$$

Labor aggregator:

$$L_c = CES(L_{j,c}, \theta_{j,c}, \rho) = \left[\sum_{j=1}^{J} (\theta_{j,c} L_{j,c})^{\rho} \right]^{1/\rho} \tag{2}$$

Labor input in efficiency units: $L_{j,c} = h_{j,c} N_{j,c}$.

Technology frontier:

$$CES(\theta_{j,c}, \kappa_j, \omega) = \left(\sum_j [\kappa_j \theta_{j,c}]^{\omega} \right)^{1/\omega} \leq B_c^{1/\omega} \tag{3}$$

Special Cases

Jones (2014):

- no technology frontier
- no skill bias differences across countries: $\theta_{j,c} = 1$

Caselli and Coleman (2006):

- no human capital
- technology frontier fixed: $B_c = 1$

Acemoglu (2007):

- no human capital
- firms invest in technology frontier B_c

Firm Problem

$$\max_{k_c, N_{j,c}, \theta_{j,c}, B_c} y_c - qk_c - \sum_j p_{j,c} L_{j,c} - \mu B_c \tag{4}$$

subject to technology frontier.

As in Caselli and Coleman (2006): symmetric equilibrium exists if $\Omega = \omega - \rho - \omega\rho > 0$.

Analytical Results

Labor Aggregator

Result:

> *After substituting out the optimal $\theta_{j,c}$, the model implies the reduced form labor aggregator*
>
> $$\tilde{L}_c = CES(L_{j,c}, 1, \Psi) = \left[\sum_j (L_{j,c})^{\Psi} \right]^{1/\Psi} \tag{5}$$
>
> *where*
>
> $$\Psi = \frac{\rho\omega}{\omega - \rho} \geq \rho \tag{6}$$

Of course, without technology choice: $\omega \to \infty \implies \Psi = \rho$.

The point: Technology choice is equivalent to a higher elasticity of substitution between skilled and unskilled labor

Intuition

Increase the skill premium p_s/p_u

Direct effect: labor substitution (governed by ρ)

Indirect effect: movement along the technology frontier (governed by ω)

This effectively increases the elasticity of substitution.

Key point: the labor aggregator only depends on Ψ, not on ρ and ω separately.

Estimation

Data moments: 6

1. output gap (1)
2. capital share (1)
3. skill premiums (2)
4. wage gains at migration (2)

Parameters to estimate: 6

1. 1 $\{z\}_{rp}$
2. 1 α
3. 3 $h_{j,c}$ (one normalized to 1)
4. 1 Ψ (not ρ and ω separately)

Levels Accounting

Fixed saving rate or interest rate implies fixed k/y.

Therefore, we use

$$y_c = (k_c/y_c)^{\alpha/(1-\alpha)} z_c \tilde{L}_c$$

We wish to estimate the share of output gaps due to human capital:

$$\text{share}_h = \frac{\{\ln \tilde{L}\}_{rp}}{\{\ln y\}_{rp}} = 1 - \frac{\left\{\ln z\,(k/y)^{\alpha/(1-\alpha)}\right\}_{rp}}{\{\ln y\}_{rp}} \qquad (7)$$

Notation: $\{x\}_{rp} = x_r/x_p$ is the rich/poor ratio of x.

Levels Accounting

If two models imply the same reduced form labor aggregator $\tilde{L}_c$, they imply the same human capital share in output gaps.

Therefore, the main result:

The contribution of human capital to output gaps is the same for Jones (2014) and for our model.

Things that don't matter:

- the elasticity of substitution between skilled and unskilled labor
- whether firms can choose technology
- whether firms can invest in the frontier B_c.

Future Work

Implement capital-skill complementarity.

We know:

1. The model is still identified with the same data moments.
2. The reduced form labor aggregator again looks like $\tilde{L}_c$.

But share_h will be different from the baseline model.

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