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Endogenous Technology Choices and the Dynamics of Wage Inequality

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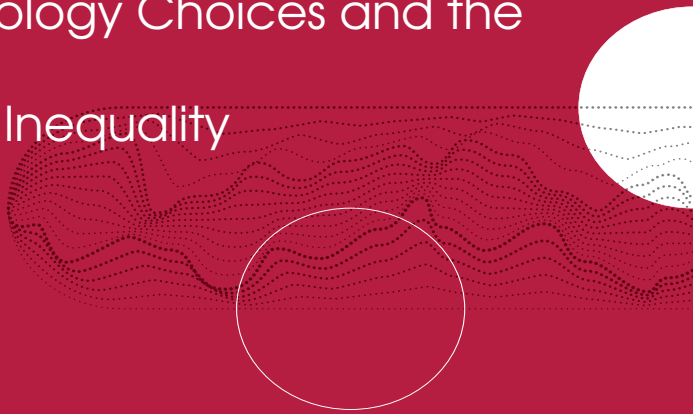


Dynamics of College Premium

- An increase in supply of skills and college wage premium in most OECD countries.

Dynamics of College Premium

- An increase in supply of skills and college wage premium in most OECD countries.
- A country that witnessed higher increase in number of college graduates than other countries saw:
  - fall in premium relative to the other countries immediately after increase in supply
  - increase in premium relative to the other countries a decade later

Two drivers of skill premium

- skill-bias of the global technological paradigm
- at country level, firms can choose between more and less skill-biased production methods
- sharp increase in supply of skills incentivise firms to adopt more skill-biased production.

Implications

- response of skill premium to skills supply increase is smaller in the long-run than in the short-run.
- non-global mechanisms can explain part of the growth in the premium across OECD

College Premium and Relative Supply of College Skills in US

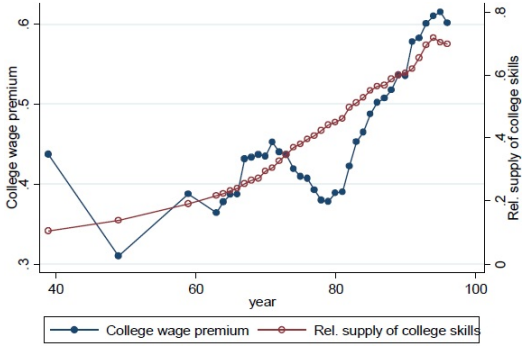


Figure: College premium and relative supply of college skills in US between 1939 and 1996

Plan of talk

1. theoretical model
2. its calibration
3. econometric exploration

Outline

Technology Choice and Skill Premium Dynamics

The Dynamic Model

Quantitative Analysis

The set-up of the model

- One product, many production methods.
- Production method i takes the form

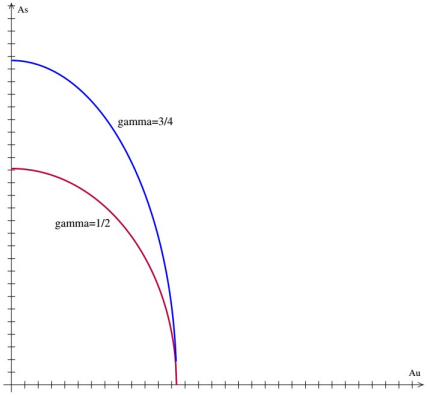
$$F_i = \left[(A_{is} L_s)^{\sigma} + (A_{iu} L_u)^{\sigma} \right]^{\frac{1-\theta}{\sigma}} k^{\theta}$$

  where L_s and L_u stand for skilled and unskilled labour inputs
- Each production method is characterized by a different pair (A_s, A_u) (unit productivities)

Available production methods

- The set of available production methods is determined by the global technology paradigm
- it is described by:

$$\frac{1}{\gamma} A_{is}^{\omega} + A_{iu}^{\omega} \leq B \tag{1}$$



Inelastic Supply of Skills

- supply of skills follows the process:

$$\log\left(\frac{L_s}{L_u}\right)\Big|_t = \log\left(\frac{L_s}{L_u}\right)\Big|_{t-1} + \mu + \xi_t \tag{2}$$

Firms Optimization

- Firm cannot switch the technology on the spot
- The firm's value function:

Model Prediction

$$\log\left(\frac{w_s}{w_u}\right)\Big|_t = -(1-\sigma)\log\left(\frac{L_s}{L_u}\right)\Big|_t + \frac{\sigma}{\omega-\sigma}\log(\gamma)\Big|_{t-1} + \\ + \frac{\sigma}{\omega-\sigma}E_{t-1}\left[\log\left(\frac{L_s}{L_u}\right)\Big|_t\right] \tag{3}$$

- Equilibrium skill premium is driven by three forces:
  - diminishing returns to skills
  - skill-bias of technological paradigm
  - firm's expectation about today's supply of skills driving technology choice.

Model Prediction

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- diminishing returns to skills
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Outline

Identification

- The empirical model can be directly derived from the baseline model:

$$\log\left(\frac{w_s}{w_u}\right)\Big|_t = -(1-\sigma)\log\left(\frac{L_s}{L_u}\right)\Big|_t + \frac{\sigma}{\omega-\sigma}\log(\gamma)\Big|_{t-1} + \\ + \frac{\sigma}{\omega-\sigma}E_{t-1}\left[\log\left(\frac{L_s}{L_u}\right)\Big|_t\right] \tag{4}$$

- Two identification issues:
  - Separate the negative effect due to diminishing returns to skills and positive effect of adjusting technology choice.
  - Separate the effect of change in technological possibilities and the effect of adjusting technology choices.

Empirical Model

- The empirical model is:

$$\triangle w_{it} = \alpha_1 \triangle l_{it} + + \alpha_2 \triangle l_{it-5} + \alpha_3 \triangle l_{it-10} + \hat{d}_t + \triangle \varepsilon_{it} \tag{5}$$

Identification - Intuition

- equivalent to

$$(\triangle w_{it} - \triangle w_t) = \alpha_1 (\triangle l_{it} - \triangle l_t) + \alpha_2 (\triangle l_{it-5} - \triangle l_{t-5})$$

$$+\alpha_3 (\triangle l_{it-10} - \triangle l_{t-10}) + (\triangle \varepsilon_{it} - \triangle \varepsilon_t)$$

- It isolates out the global factors (e.g. change in global technology paradigm).

Data

- EU KLEMS (2008 release)
- 23 countries
- 1970 and 2005 (unbalanced).

Model Estimation

	(1)	(2)	(3)
skills supply growth {t}	-0.804***	**-0.825*** **	-0.803***
skills supply growth {t-5}	-0.255*	-0.224	-0.253*
skills supply growth {t-10}	0.218**	0.217**	0.225**
d85		-0.006	
d90		-0.03	
d95		0.013	
d00		0.013	
year			0.001
constant	0.167***	0.163***	-1.466

Table: The dependent variable is five years change of college wage premium (in logs).

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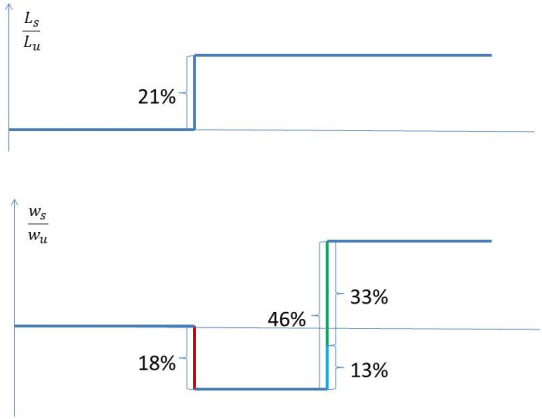
d90		**-0.030**	
d95		**0.013**	
d00		**0.013**	
year			0.001
constant	0.167***	**0.163***	-1.466

Table: The dependent variable is five years change of college wage premium (in logs).

Calibrated model

$$\Delta \log \left(\frac{w_s}{w_u} \right)_t = -0.82 \Delta \log \left(\frac{L_s}{L_u} \right) \Big|_t + 0.11 + 0.22 \left(\Delta \log \left(\frac{L_s}{L_u} \right) \Big|_{t-10} \right)$$

Calibrated model



- Estimation of the model - a possibility result
- Are there other possibilities?

Alternative Explanations

$$(\triangle w_{it} - \triangle w_t) = \alpha_1 (\triangle l_{it} - \triangle l_t) + \alpha_2 (\triangle l_{it-10} - \triangle l_{t-10})$$

$$+ (\triangle \varepsilon_{it} - \triangle \varepsilon_t)$$

- Alternative explanations:
  - bias due to inclusion of endogenous variable discussion
  - serial correlation of the error term discussion
  - reverse causality discussion
  - alternative mechanisms: spillover discussion, endogenous adoption discussion

Conclusion

- Countries with faster growth of college graduates witness also faster growth of college premium ten years later.
- The most likely candidate to explain this pattern is the endogenous technology choice hypothesis:
  - At any point in time a firm has an option to switch between production methods.
  - After increase in supply of college graduates firms decided to switch to more skill-biased production methods.
- The estimation shows that this switch can account for 1/3 of the growth in skill premium in OECD countries.
- Future Work.

Contribution

- Contribution to the literature on skill-biased technology change (Acemoglu (2002); Aghion (2002); Goldin and Katz (2008))
  - Show that switch to skill-biased production method (that lead to increase in skill premium) can happen even without change in technological paradigm
- Contribution to the literature on Endogenous Technology Choice (Samuelson (1965), Caselli and Coleman (2007), Peri (2009))
  - Elaborate and estimate a dynamic model (prediction on dynamics of wage inequality; the model is based on Caselli and Coleman static model)
  - Present a piece of empirical evidence to support the hypothesis.
  - Set the microfoundation for the model: How R&D sector can generate variety of production methods.

Serial Correlation

- Suppose that the error term in skill premium regression is the IMA(1,1) process:

$$\Delta\varepsilon_{it} = \eta_{it} + \beta\eta_{it-10} \tag{7}$$

- Intuitively $\beta > 0$ implies that there is a process whose impact on skill premium is not completed after 10 years.
- Moreover the process cannot affect all countries equally (e.g. ICT), since this is controlled for.
- Candidates:
  - Loss of importance of trade unions
  - Globalization

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Quantitative Results

	(2)	(4)
skills supply growth {t}	-0.825***	-0.822***
skills supply growth {t-5}	-0.224	-0.222
skills supply growth {t-10}	0.217**	0.213
d85	-0.006	-0.007
d90	-0.03	-0.028
d95	0.013	0.015
d00	0.013	0.013
supply of skills (level)		
change in union density		**-0.034**
change in export to gdp ratio		**-0.006**
constant	0.163***	0.161***

Table: The dependent variable is five years change of college wage premium (in logs).

Inclusion of Endogenous Variable

$$\triangle w_{it} = \alpha_1 \triangle l_{it} + \alpha_2 \triangle l_{it-10} + \hat{d}_t + \triangle \varepsilon_{it}$$

- Since $\triangle l_{it}$ may be correlated with the error term, all estimators are biased
- What is the sign of the bias for α_2 estimator?
- The assymptotic bias is

$$E\left[\hat{\alpha}_2 - \alpha_2\right] =$$

$$= \frac{-1}{det} E\left[\left(\triangle l_{it} - \triangle l_t\right)\left(\triangle l_{it-10} - \triangle l_{t-10}\right)\right] E\left[\left(\triangle l_{it} - \triangle l_t\right)\left(\triangle \varepsilon_{it} - \triangle \varepsilon_t\right)\right]$$

- Therefore we would expect the sign of the bias to be negative.

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Reverse Causality

- Skill supply will be correlated with future skill premium if workers predict future changes of skill premium.
- Workers would need to predict that growth of skill premium in their country will be higher than in other countries. They would need to know it 10 years ahead.
- If students in 1975 predict a sharp increase in skill premium in 1985 why students in 1970 would not be able to predict it?

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Spillover Effect

- The higher is the number of workers the more productive they are.
- Some effect should be visible after 5 years - disproved by data

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Endogenous Adoption

- Countries with higher number of skilled workers want to adopt ICT faster than other countries.
- Growth of Skill premium would need to depend on the *level* of supply of skills.

back

Quantitative Results

	(5)	(6)
skills supply growth {t}	-0.793***	-0.786***
skills supply growth {t-5}	-0.242	-0.242
skills supply growth {t-10}	0.191**	0.183*
d85	-0.018	-0.021
d90	-0.034	-0.031
d95	-0.001	0.000
d00	0.006	0.003
supply of skills (level)	**-0.041***	**-0.042***
change in union density		-0.053
change in export to gdp ratio		0.004
constant	0.274***	0.272***

Table: The dependent variable is five years change of college wage premium (in logs).

Future Work

- The data shows that in recent year positive correlation between skill supply growth and skill premium growth decade later seems to vanish.
  - More labour mobility across countries?
  - Technological Change greases Technological Choice?
- Microfoundation and more evidence for the trade-off between more and less skill-biased technologies.

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THANK YOU

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