Skill Premium in Wages

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Motivation

Our Explanation

The Model

Other Empirical Evidence

Alternative Explanations

Implications
Motivation
Facts: Skill Premium in Wage

Source: Author’s Computation using UHS data
Following Ge and Yang (2014), we examine the changes in skill premium in wage.

Data: National sample of Urban Household Surveys (1993-2012)

Specifically, the following regression function is used:

\[
\ln w^t_i = \beta^t_k S^t_{ik} + \beta^t_1 X^t_i + \beta^t_2 X^t_i^2 + \beta^t_g G^t_i + \sum_n \beta^t_n R^t_{in} + \epsilon^t_i
\]

- \( S^t_{ik} \): dummy variables for schooling levels (middle school, high school and above)
- \( X^t_i \): potential experience
- \( G^t_i \): gender
- \( R^t_{in} \): dummy variables for regions (province)

Robustness checks are done.
Facts: Wage Growth and Skill Intensity

Wage Growth and Average Education across Industries: 08-12

- Construction
- IT
Motivation

- What is the reason behind the observation?
Motivation

- What is the reason behind the observation?
- What does it say about the structure of the economy?
Our Explanation
Fact: Structure of Investment

Structure Investment Ratio

Source: National Bureau of Statistics
Fact: Structure of Investment

Structure Investment/Equipment Investment

Source: China Statistical Yearbook
Fact: Share of Construction in the Economy

Source: China Statistical Yearbook
A Simple Model

Subsidized Industries: Unskilled Labor Intensive

Large Investment

High Demand for Unskilled Labor

Crowding Out

High Wages for Unskilled Labor

Other Industries: Use Both Skilled and Unskilled Labor

High Cost of Investment

Small Investment

Low Wages for Skilled Labor
The Model
Model Environment

- Infinite horizon, representative household
- 2 sectors and 3 production factors
  - Infrastructure sector: unskilled labor and capital, unskilled labor intensive.
  - General good sector: skilled, unskilled labor and capital.
- Competitive banking provides loan for capital accumulation.
- Capital market is distorted:
  - infrastructure sector can rent the capital at a lower rate than the market loan rate
- Labor are freely mobile across the sectors
A representative household faces the following problem:

$$\max_{c_t, l_t, s_t, a_{t+1}} \sum_{t=0}^{\infty} \beta^t U(c_t) $$

s.t.  $$c_t + a_{t+1} = w_L l_t + w_S s_t + (1 + r_{dt}) a_t.$$ 

Euler equation:

$$\frac{U'(c_t)}{U'(c_{t+1})} = \beta (1 + r_{dt+1});$$
The firm uses unskilled labor $L_{lt}$ and capital $K_{lt}$ to produce infrastructure good $Y_{lt}$

$$Y_{lt} = e^{z_{lt}} A_l (K_{lt})^{1-\alpha_l} (L_{lt})^{\alpha_l};$$

Given factor prices $\{w_{Lt}, r_{St}, p_{lt}\}$, the equilibrium conditions:

$$w_{Lt} = \alpha_l p_{lt} e^{z_{lt}} A_{lt} \left( \frac{K_{lt}}{L_{lt}} \right)^{1-\alpha_l};$$

$$r_{St} = (1 - \alpha_l) p_{lt} e^{z_{lt}} A_{lt} \left( \frac{K_{lt}}{L_{lt}} \right)^{-\alpha_l};$$

*note that* $r_{st}$ is the government-regulated rate
In addition to $K_{Ct} & L_{Ct}$, the general good producer also need $S_{Ct}$ for production

$$Y_{Ct} = e^{z_{Ct}} A_C \left( K_{Ct} \right)^{1-\alpha_C - \beta_C} \left( S_{Ct} \right)^{\beta_C} \left( L_{Ct} \right)^{\alpha_C};$$

- note that $\alpha_C < \alpha_I$.

Given factor prices $\{w_{Lt}, w_{St}, r_{Lt}, p_{Ct}\}$, following conditions have to be satisfied in an equilibrium:

$$w_{Lt} = \alpha_C p_{Ct} e^{z_{Ct}} A_C \left( \frac{K_{Ct}}{L_{Ct}} \right)^{1-\alpha_C} \left( \frac{K_{Ct}}{S_{Ct}} \right)^{-\beta_C};$$

$$w_{St} = \beta_C p_{Ct} e^{z_{Ct}} A_C \left( \frac{K_{Ct}}{L_{Ct}} \right)^{-\alpha_C} \left( \frac{K_{Ct}}{S_{Ct}} \right)^{1-\beta_C};$$

$$r_{Lt} = (1 - \alpha_C - \beta_C) p_{Ct} e^{z_{Ct}} A_C \left( \frac{K_{Ct}}{L_{Ct}} \right)^{-\alpha_C} \left( \frac{K_{Ct}}{S_{Ct}} \right)^{-\beta_C};$$

- note that $r_{Lt}$ is the market rate.
The final goods are produced using infrastructure good and general good:

\[ Y_t = \left( \varphi \left( \frac{Y_{It}}{\sigma} \right)^{\frac{\sigma-1}{\sigma}} + \left( Y_{Ct} \right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} ; \]

The price of final good is used as the numeraire, and the standard price aggregation holds:

\[ \left[ \varphi^\sigma (p_I)^{1-\sigma} + (p_C)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} = 1; \]

Equilibrium condition:

\[ \frac{Y_I}{Y_C} = \left( \varphi \frac{p_C}{p_I} \right)^\sigma. \]
Banking Sector

- There exists a representative bank in the economy.
- The bank absorbs the deposit at the rate, \( r_{dt} \), convert it into capital goods, and then rent the capital to firms in both infrastructure sector and general good sector.
  - Rental rate for infrastructure sector, \( r_{St} \)
  - Rental rate for general good sector, \( r_{Lt} \)
- Competitive banking requires:
  \[
  (1 + r_{dt}) a_t = (1 - \delta + r_s) K_{lt} + (1 - \delta + r_l) K_{ct}
  \]
  where
  \[
  r_{Lt} \geq r_{dt} \geq r_{St}.
  \]
- Note that the investment in infrastructure sector is implicitly subsidized by the govn.
Equilibrium

Given initial labor and capital endowment, \( L_{t_0}, S_{t_0}, \) and \( K_{t_0} \), a set of exogenous rental rate, and sectorial TFP \( \{r_{st}, A_{lt}, A_{Ct}\} \) \( t \geq t_0 \). A competitive equilibrium consists of:

- Sequences of good prices and factor prices, 
  \( \{p_{lt}, p_{Ct}, w_{Lt}, w_{St}, r_{dt}, r_{lt}\} \) \( t \geq t_0 \);
- Firms allocations, \( \{K_{lt}, K_{Ct}, L_{lt}, L_{Ct}\} \) \( t \geq t_0 \);
- Household allocations, \( \{c_t, a_{t+1}\} \) \( t \geq t_0 \);

such that:

- Given the sequence of prices, the firm allocation solves \((FP)\);
- Given the sequence of prices, the household allocation solves \((HP)\);
- Market clears:
  - Capital allocation across sectors: \( K_{lt} + K_{Ct} = K_t \);
  - Unskilled-labor allocation across sectors: \( L_{lt} + L_{Ct} = L_t \);
  - Goods market: \( C_t + I_t = Y_t \)
  - Capital accumulation: \( K_{t+1} = I_t + (1 - \delta) K_t \)
- Competitive banking:
  \[
  (1 + r_{dt}) a_t = (1 - \delta + r_{St}) K_{lt} + (1 - \delta + r_{lt}) K_{Ct}.
  \]
The equilibrium is characterized by 16 variables and equations:

- Prices and factor prices: \( \{ p_{lt}, p_{Ct}, w_{Lt}, w_{St}, r_{dt}, r_{lt} \} \);
- Factor allocations across sectors: \( \{ K_{lt}, K_{Ct}, L_{lt}, L_{Ct}, Y_{lt}, Y_{Ct}, Y_{t} \} \);
- Consumption and saving: \( \{ C_{t}, I_{t}, A_{t+1} \} \).

Note that:

- The first two set of variables are static in the sense that they are functions of \( K_{t} \);
- \( \{ C_{t} \} \) involve dynamics and is a function of \( K_{t} & K_{t+1} \).

The transition path is characterized by:

\[
\frac{U' \left[ c_{t} \left( K_{t}, K_{t+1} \right) \right]}{U' \left[ c_{t+1} \left( K_{t+1}, K_{t+2} \right) \right]} = \beta \left[ 1 + r_{dt+1} \left( K_{t+1} \right) \right].
\]
Effects on Output and Factor Allocations

Suppose more subsidies to infrastructure sector, i.e., $r_{St} \downarrow$

**Theorem (1)**

In equilibrium, the factor allocations and sectoral output depend on $r_{St}$. When infrastructure sector receives more subsidies, i.e., facing a falling $r_{St}$, it attracts more capital and labor. As the results, the infrastructure sector expands, while the general good sector shrink. More formally, we have:

i) \[ \frac{d\tilde{k}_{It}}{dr_{st}} = -\phi (1 + \omega p_{lt}) [(1 - \alpha_I) \sigma + (1 - \alpha_C) \sigma \omega L_{lt} + \alpha_I + \alpha_C \omega L_{lt}] < 0; \]
\[ \frac{d\tilde{k}_{Ct}}{dr_{st}} = -\omega K_{lt} \frac{d\tilde{k}_{It}}{dr_{st}} > 0; \]

ii) \[ \frac{d\tilde{l}_{It}}{dr_{st}} = -\phi (1 + \omega p_{lt}) (\sigma - 1) [(1 - \alpha_I) + \omega K_{lt} (1 - \alpha_C - \beta_C)] < 0; \]
\[ \frac{d\tilde{l}_{Ct}}{dr_{st}} = -\omega L_{lt} \frac{d\tilde{l}_{It}}{dr_{st}} > 0; \]

iii) \[ \frac{d\tilde{y}_{It}}{dr_{st}} = (1 - \alpha_I) \frac{d\tilde{k}_{It}}{dr_{st}} + \alpha_I \frac{d\tilde{l}_{It}}{dr_{st}} < 0; \]
\[ \frac{d\tilde{y}_{Ct}}{dr_{st}} = (1 - \alpha_C - \beta_C) \frac{d\tilde{k}_{Ct}}{dr_{st}} + \alpha_C \frac{d\tilde{l}_{Ct}}{dr_{st}} > 0; \]
\[ \frac{d\tilde{y}_{lt}}{dr_{st}} = \omega Y_{lt} \frac{d\tilde{y}_{It}}{dr_{st}} + (1 - \omega Y_{lt}) \frac{d\tilde{y}_{Ct}}{dr_{st}} < 0, \text{ if } \omega Y_{lt} > \bar{\omega}. \]
Effects on Factor Prices

Suppose more subsidies to infrastructure sector, i.e., $r_{St}$ ↓

**Theorem (2)**

In equilibrium, the factor prices also depend on $r_{St}$. When facing a lower $r_{St}$, infrastructure sector crowds out capital for other sectors and drive up the market rental rate, $r_{lt}$. Meanwhile, skilled premium in wage decreases. More formally, we have:

\[ i) \quad \frac{d\tilde{r}_{lt}}{dr_{st}} = \frac{d\tilde{p}_{Ct}}{dr_{st}} + \alpha_C \left( \frac{d\tilde{l}_{Ct}}{dr_{st}} - \frac{d\tilde{k}_{Ct}}{dr_{st}} \right) - \beta_C \frac{d\tilde{k}_{Ct}}{dr_{st}} < 0; \]

\[ ii) \quad \frac{d(w_{st}/w_{Lt})}{dr_{st}} = \phi \omega_{Lt} \left( 1 + \omega_{p_{lt}} \right) (\sigma - 1) \left[ (1 - \alpha_I) + \omega_{K_{lt}} (1 - \alpha_C - \beta_C) \right] > 0; \]
Other Empirical Evidence
Other Empirical Evidence

- The relationship between the rate of return to capital and the skill intensity
The relationship between the rate of return to capital and the skill intensity

- Our prediction: lower rate of return to capital in the unskilled-labor-intensive sectors
Facts: Capital Return and Skill Intensity
## Supporting Facts: Firm Level Evidence

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Return to Capital</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>(1)</td>
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<tr>
<td>ASY (t=2007)</td>
<td>0.02827**</td>
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<td>ASY (t=2008)</td>
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<td>ASY (t=2009)</td>
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<td>ASY (t=2010)</td>
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<tr>
<td>Market Concentration</td>
<td>0.55035**</td>
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<td>LOG(capital stock)</td>
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</table>

\[ R^2 \] 0.07       0.07

\[ N \] 2,987,528 2,987,528

Note: * \( p < 0.05 \); ** \( p < 0.01 \)

*Note:** ***Significant at the 1 percent level.
The relationship between the rate of return to capital and the skill intensity

- Our prediction: lower rate of return to capital in the unskilled-labor-intensive sectors
Other Empirical Evidence

- The relationship between the rate of return to capital and the skill intensity
  - Our prediction: lower rate of return to capital in the unskilled-labor-intensive sectors

- Real market interest rate rises
  - Our prediction: more subsidies lead to higher real market interest (see Theorem 2)

\[
\frac{d\tilde{r}_{lt}}{dr_{st}} < 0.
\]
Other Empirical Evidence: Real Lending Rates

Data Source: National Bureau of Statistics for CPI & PPI; PBOC for lending rates
Other Empirical Evidence: Real Lending Rates

Data Source: National Bureau of Statistics for CPI & PPI; PBOC for lending rates

Real Lending Rates: PPI Adjusted

Data Source: National Bureau of Statistics for CPI & PPI; PBOC for lending rates
Annualized Interest Rates (%)

- Average WMP Return (Maturity ≤ 1 Yr)
- Average Interbank Repo Rate (Overnight)
Other Empirical Evidence

- The relationship between the rate of return to capital and the skill intensity
  - Our prediction: lower rate of return to capital in the unskilled-labor-intensive sectors
- Real market interest rate rises
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The relationship between the rate of return to capital and the skill intensity

- Our prediction: lower rate of return to capital in the unskilled-labor-intensive sectors

Real market interest rate rises

- Our prediction: higher real market interest rate with more subsidies (see Theorem 2)

\[
\frac{d\tilde{r}_{lt}}{dr_{st}} < 0.
\]

Average return to capital declines
Alternative Explanations
The supply of skilled labor increases relative to that of the unskilled labor, reducing the skill premium in wages.
Relative Labor Supply Change

- The supply of skilled labor increases relative to that of the unskilled labor, reducing the skill premium in wages.
- Implications of this explanation
  - If this is the case, skilled-labor intensive sectors should expand faster than unskilled-labor intensive sector.
Relative Labor Supply Change

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- Implications of this explanation
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- Evidence: the relationship between the growth rate of value added and skill intensity
## Supporting Facts: Firm Level Evidence

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Return to Capital (1)</th>
<th>Value-Added Growth (2)</th>
<th>Value-Added Growth (3)</th>
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\[ R^2 \]

- 0.07
- 0.07
- 0.01

\[ N \]

- 2,987,528
- 2,987,528
- 715,284

Note: * p<0.05; ** p<0.01
Relative Productivity Change

- If the productivity of skilled-labor intensive sectors increases slower than that of the unskilled-labor intensive sectors, than the skill premium in wages would decline.
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If this is the case, than the rate of return to capital in the skilled-labor intensive sectors should not be higher than that in the unskilled-labor intensive sectors.
Relative Productivity Change

- If the productivity of skilled-labor intensive sectors increases slower than that of the unskilled-labor intensive sectors, than the skill premium in wages would decline.
- If this is the case, than the rate of return to capital in the skilled-labor intensive sectors should not be higher than that in the unskilled-labor intensive sectors.
- Our empirical finding is that skilled-labor intensive sectors generate higher rate of return to capital.
If the demand for skilled-labor intensive products declines relative to that for unskilled-labor intensive products, then the skill premium in wages would decline.
Relative Demand Change

- If the demand for skilled-labor intensive products declines relative to that for unskilled-labor intensive products, than the skill premium in wages would decline.
- This case is similar to that of relative productivity change.
Implications
Facts: Labor Cost Rose Faster than GDP