Accounting for Rising Wages in China

Suqin Ge (Virginia Tech) Dennis T. Yang (CUHK)

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Motivation

- Dramatic changes in China's wage structure: 1992–2007
  - Urban real wage increased by 202 percent
  - Distribution of wage growth is uneven
  - Similar experiences in labor market history: e.g. Taiwan, Korea in 1980s
  - Little is known about the sources and determination of rising wages and wage inequality in fast growing economies
- Changes in labor market conditions in China
  - Demand: export expansion, FDI, capital deepening, R&D expenditure
  - Supply: expansion of college enrollment
  - Institution: SOE restructuring
- Understanding wage structural changes using China as a laboratory for research

Main Objectives

- Documenting major changes in wage and employment structures in China between 1992 and 2007 based on a unique national sample of urban households
- Identifying the main sources of wage growth
- Accounting for the driving forces behind China's wage growth and rising wage inequality using an aggregate production function model

Related Literature

- Massive literature on wage structure in developed and developing countries, but largely focus on inequality
  - Supply-demand-institution framework: e.g., Katz & Murphy (1992), Juhn et al. (1993), Bound and Johnson (1992)
  - Aggregate production: Krusell et al. (2000)
  - Developing economies: Latin American and East Asian countries (Goldberg and Pavcnik, 2007)
- Studies on labor market issues in China typically rely on data for certain regions in specific survey periods.
  - Wage differentials between state and non-state sectors
  - Wage discrimination and inequality
  - Employment effects of SOE restructuring
  - Returns to education
- No comprehensive examination on wage and employment structural changes and the forces behind wage growth in China!

Data: National Urban Household Surveys 1992–2007

- Access to 16 years of cross-sectional household sample
- Geographic coverage: all provinces except Tibet
- Full-time wage earners:
  - Aged between 16 to 55 for females, 16 to 60 for males
  - No retirees, no self-employers, no farm workers
  - Full-time wage workers: applying minimum wage criteria
- Real annual wage: deflated by provincial price indices, 2007=100
- Observations: 22,418–30,306 individuals per year in 1992–2001, and above 62,206 individuals since 2002

Changes in Wage and Employment Structures in China

	Wage level (2007 yuan)		Growth (%)	Employment share (%)		Change (%)
	1992	2007	1992-2007	1992	2007	1992-2007
Whole sample	6,193	18,695	201.9	100	100	100
By education:						
Middle school	5,764	13,547	135.0	41.9	25.7	-16.2
High school	6,135	16,590	170.4	41.4	40.7	-0.7
College	7,414	25,208	240.0	16.7	33.6	16.9
By ownership:						
CIP	5,067	14,096	178.2	28.5	43.7	15.2
State	6,550	23,565	259.8	69.7	32.6	-37.1
JSF	10,291	20,501	99.2	1.8	23.7	21.9

Estimation of Conditional Mean Wages

Conditional wage function

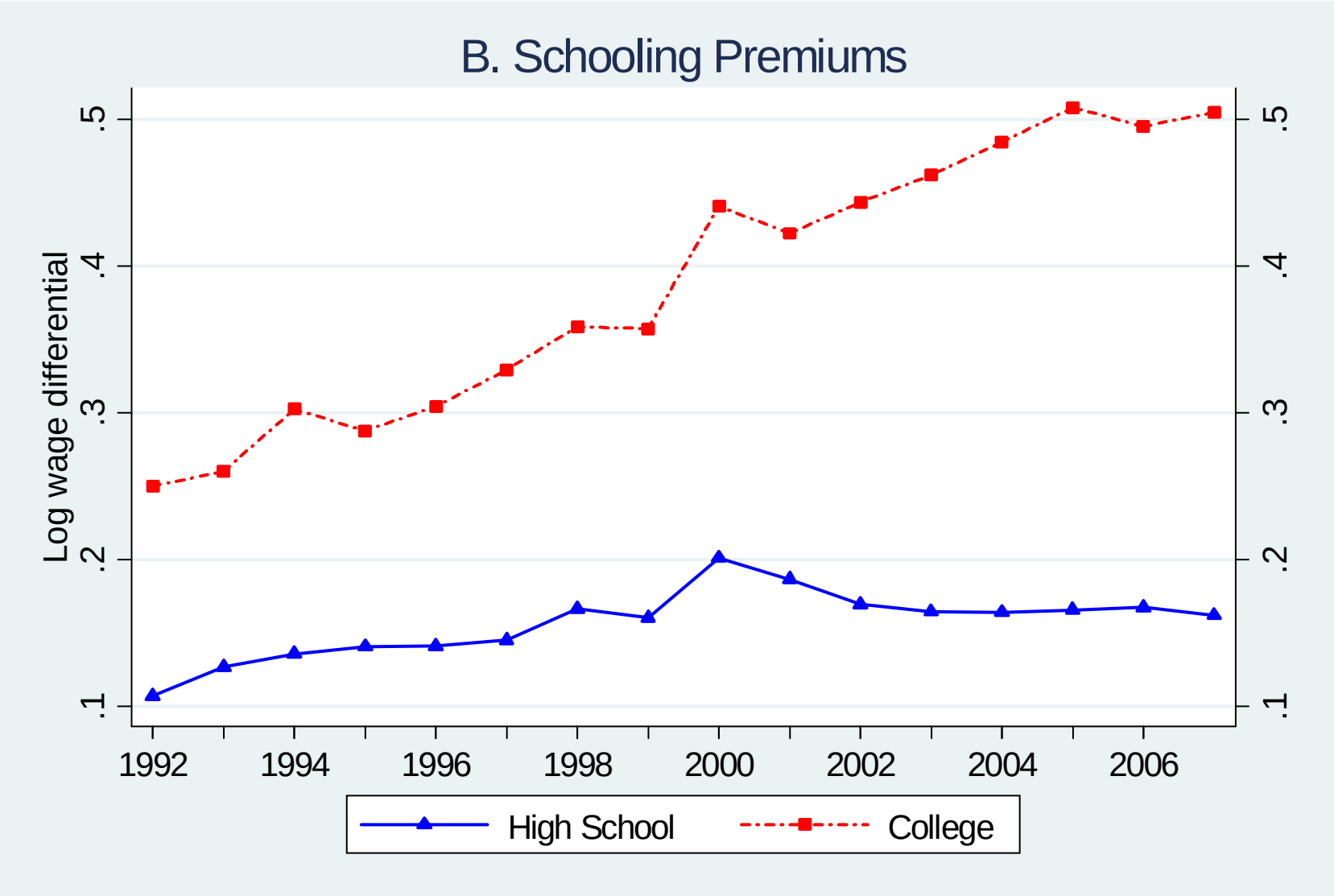
$$\begin{aligned} \ln w_i^t &= \sum_k \beta_k^t S_{ik}^t + \beta_g^t GEN_i^t + \sum_l \beta_l^t O_{il}^t + \sum_m \beta_m^t I_{im}^t + \\ &\quad \sum_n \beta_n^t R_{in}^t + \beta_1^t EXP_i^t + \beta_2^t EXP_i^{t^2} + \varepsilon_i^t. \end{aligned}$$

S_{ik}^t : dummy variables for schooling levels
GEN_i^t : dummy variable for male
O_{il}^t : dummy variables for ownership categories
I_{im}^t: dummy variables for industries
R_{in}^t : dummy variables for regions
EXP_i^t : potential experience

Major Changes in China's Wage Structure

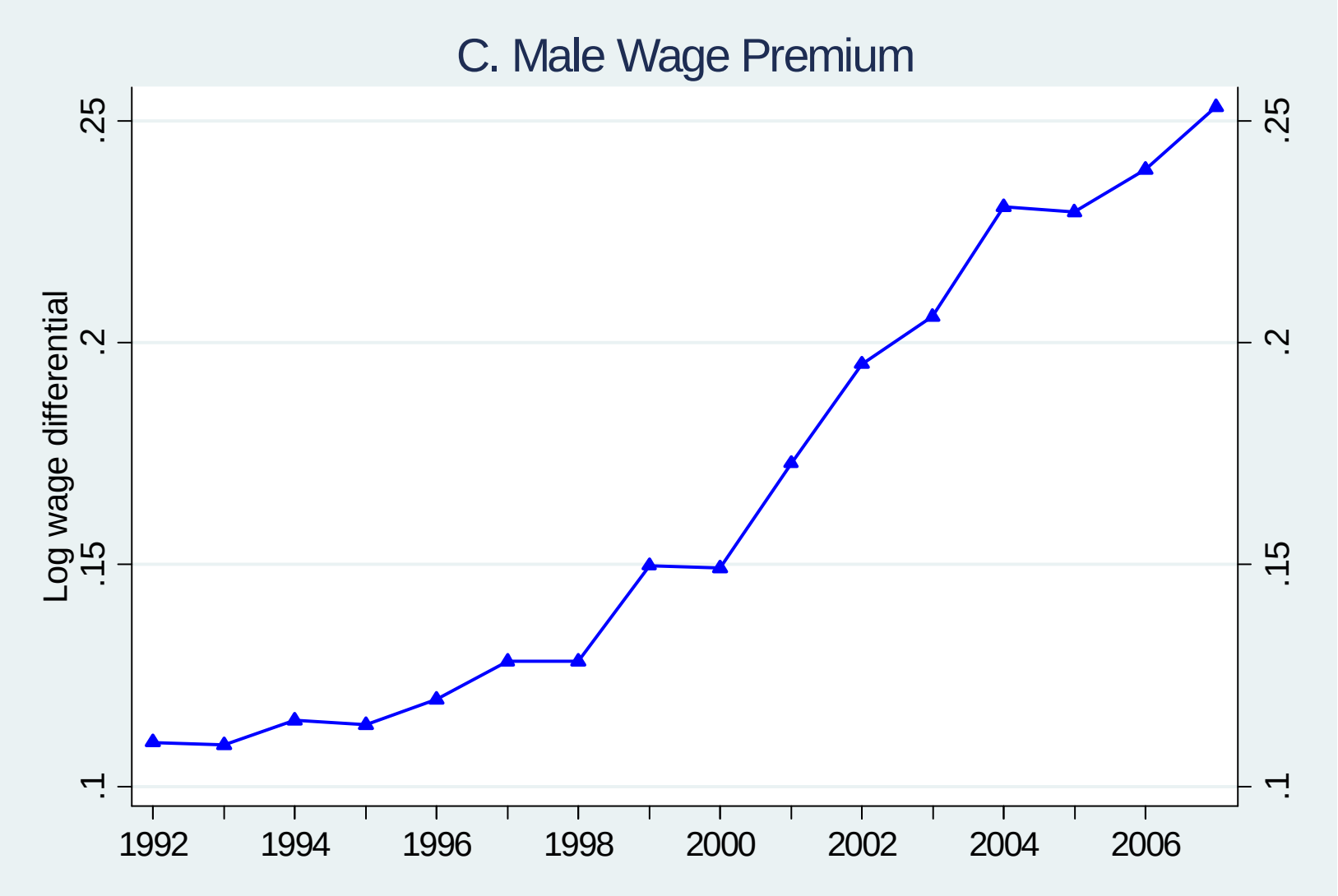
Base wage: wage for female with middle school or below, no experience, working in basic service sector, collective/private enterprise, in the Northeast region.

Major Changes in China's Wage Structure



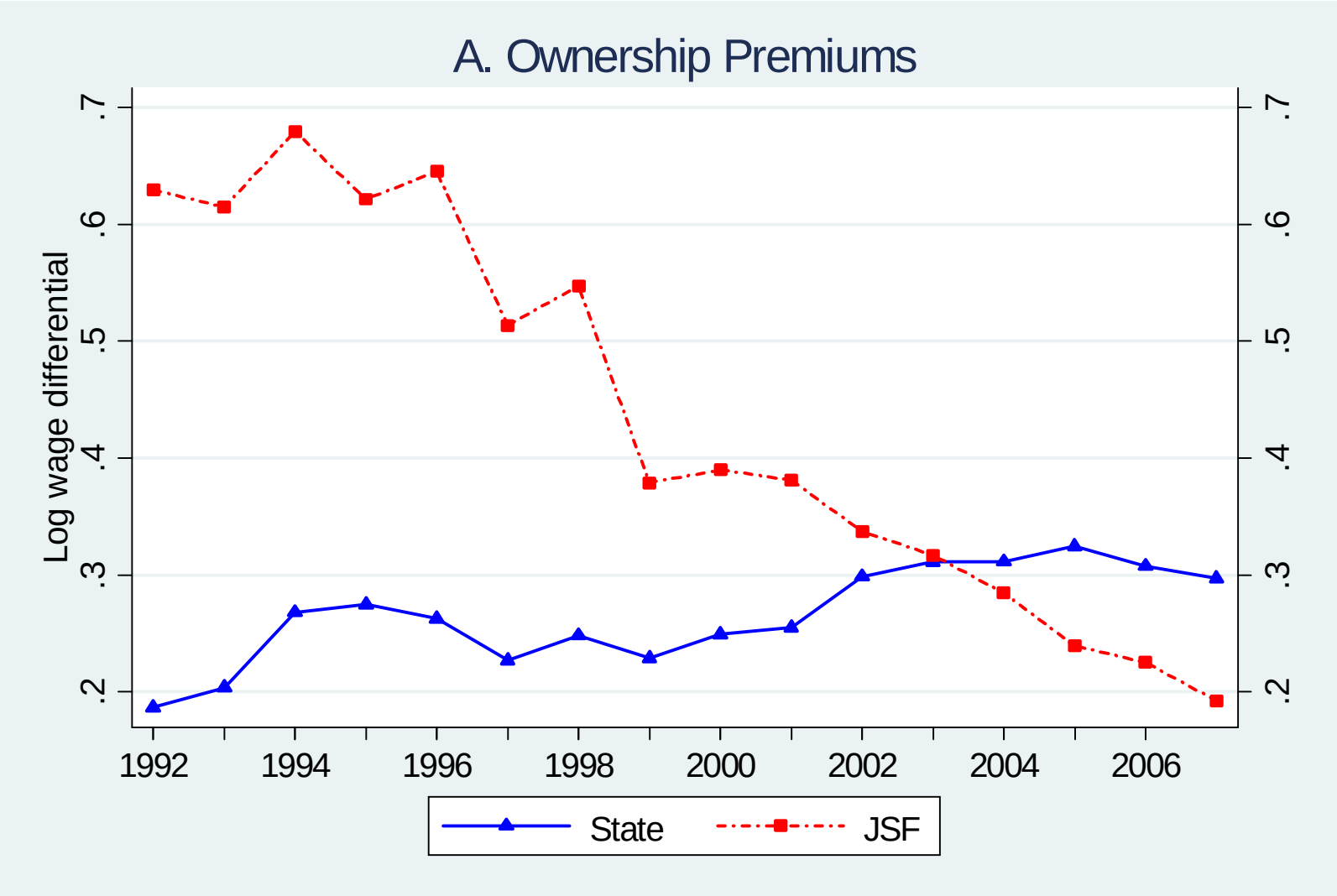
Reference: workers with middle school education and below.

Major Changes in China's Wage Structure



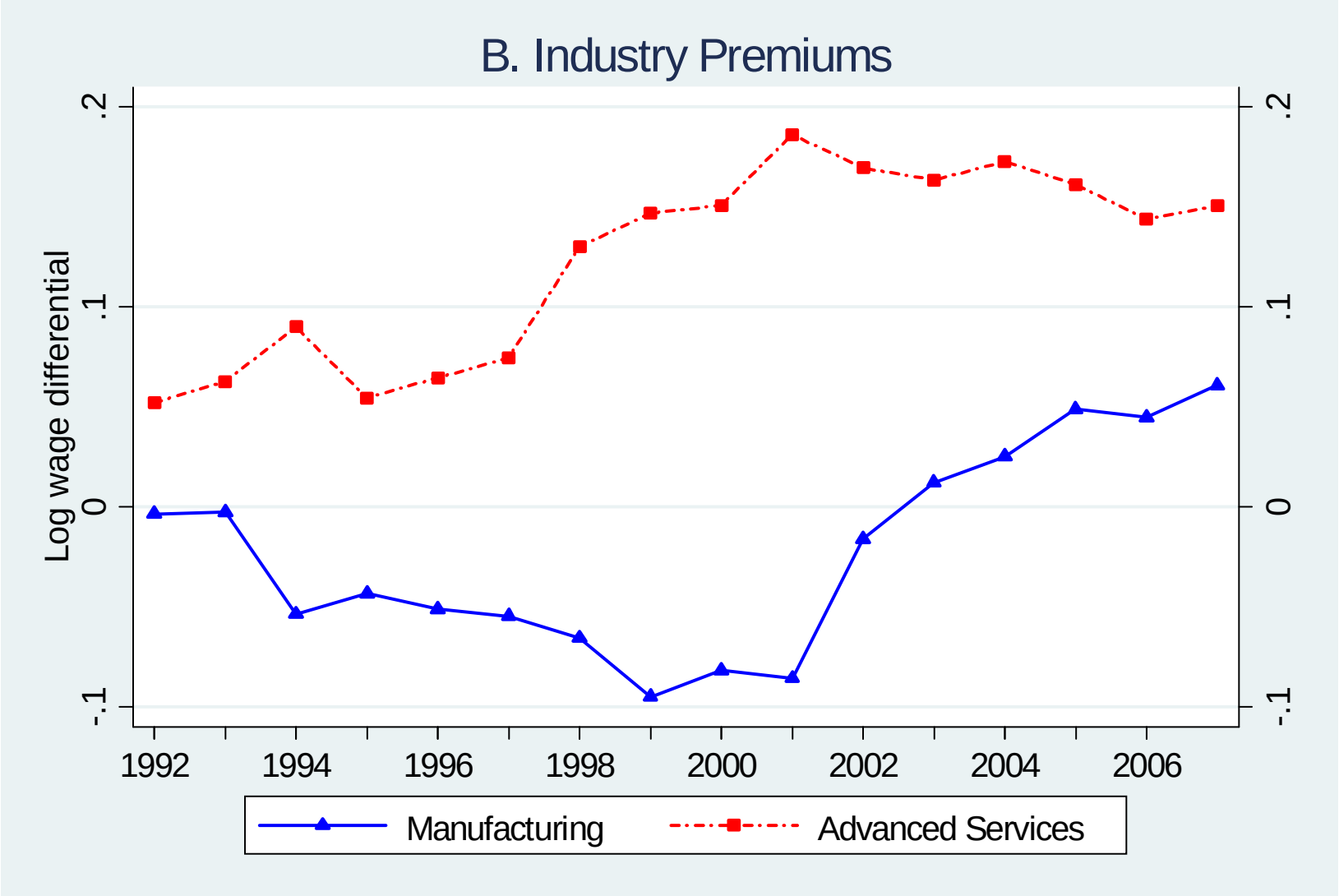
Reference: female

Major Changes in China's Wage Structure



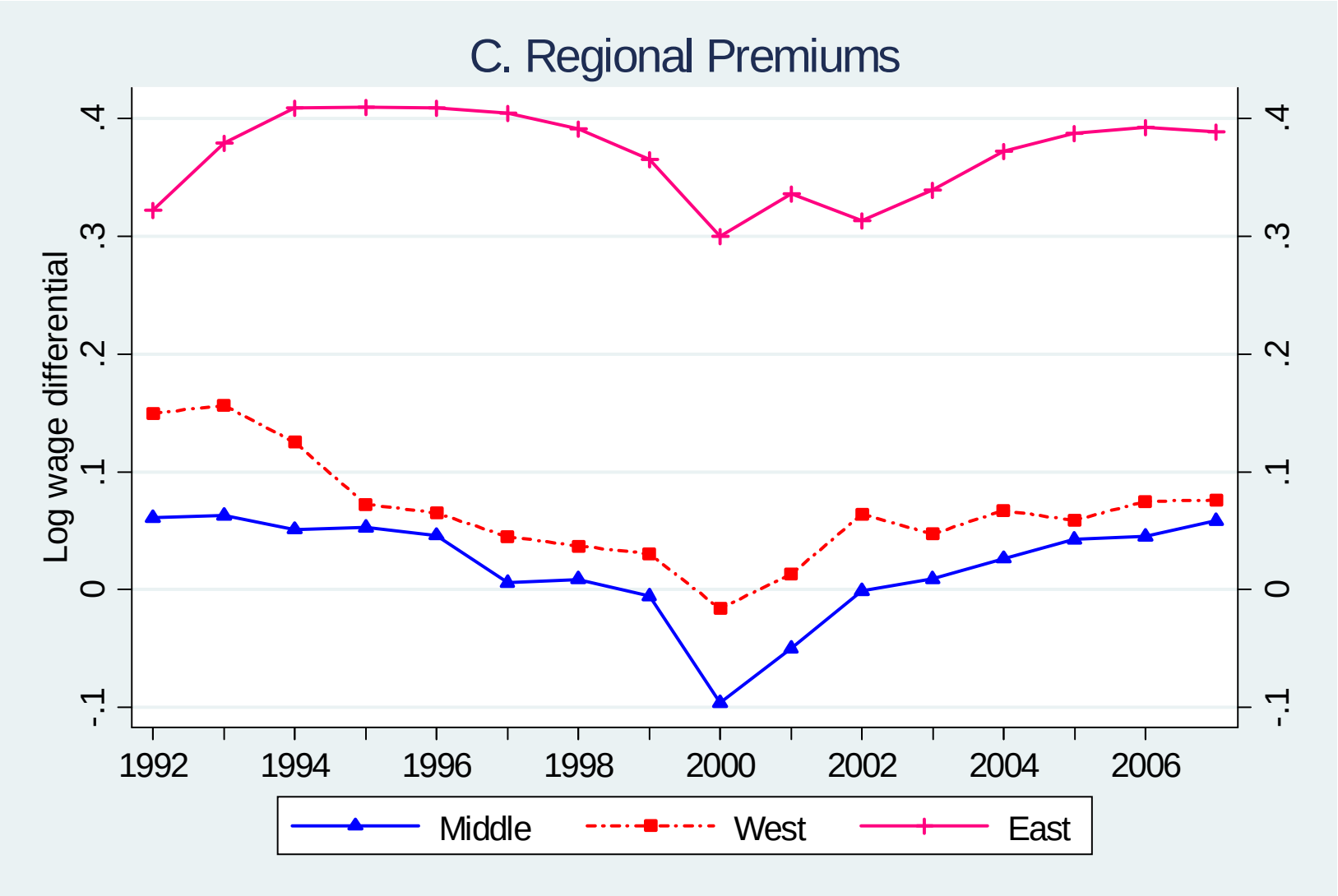
Reference: CIP = collective, individual and private enterprises. JSF = joint-venture, stock-holding and foreign firms

Major Changes in China's Wage Structure



Reference: basic service sector

Major Changes in China's Wage Structure



Reference: Northeast region

Major Changes in the Wage Structure

- Base wage of raw labor increased persistently and rapidly
- The college wage premium rose sharply
- The wage of men relative to women increased
- The wage of the state sector rose relative to the non-state sector
- Wage inequality across industries has widened over time
- The eastern regions maintained high wage premiums relative to other regions

Decomposition of Wage Growth

Wage differential between 1992 and 2007:

$$\begin{aligned}\overline{\ln w^{07}} - \overline{\ln w^{92}} &= \sum_{j=1}^{K} \widehat{\beta}_j^{07} \overline{X}_j^{07} - \sum_{j=1}^{K} \widehat{\beta}_j^{92} \overline{X}_j^{92} \\ &= \sum_{j=1}^{K} \widehat{\beta}_j^{07} (\overline{X}_j^{07} - \overline{X}_j^{92}) + \sum_{j=1}^{K} \overline{X}_j^{92} (\widehat{\beta}_j^{07} - \widehat{\beta}_j^{92})\end{aligned}$$

$\overline{\ln w^t}$: average log wage for year t
$\overline{X}_j^t$: mean values of the jth regressor
$\widehat{\beta}_j^t$: obtained from

$$\ln w_i^t = \sum_{j=1}^{K} \beta_j^t X_{ij}^t + \varepsilon_i^t.$$

Potential Sources of Wage Increases

- Changes in base wage:

$$\overline{X}_1^{92}(\widehat{\beta}_1^{07} - \widehat{\beta}_1^{92})$$

- Changes in returns to characteristics or sector premiums:

$$\sum_{j=2}^{K} \overline{X}_j^{92}(\widehat{\beta}_j^{07} - \widehat{\beta}_j^{92})$$

- Changes in worker characteristics or sector of employment:

$$\sum_{j=1}^{K} \widehat{\beta}_j^{07}(\overline{X}_j^{07} - \overline{X}_j^{92})$$

Decomposition of Log Wage Differentials 1992–2007

Sources of wage differential	Change in log wage	Contribution to total change (%)
Observed total change	0.989	100.00
Base wage	0.372	37.58
Factor returns and sector premiums	0.554	55.96
Schooling and experience	0.352	(35.56)
Ownership	0.069	(7.00)
Gender	0.072	(7.26)
Industry	0.058	(5.87)
Region	0.003	(0.26)
Worker characteristics and reallocation	0.064	6.46
Schooling and experience	0.091	(9.17)
Ownership	-0.068	(-6.88)
Gender	0.009	(0.91)
Industry	-0.011	(-1.06)
Region	0.043	(4.32)

Major Sources of Wage Growth

- Three major sources of wage growth:
  - Rise in base wage
  - Rise in school premiums
  - Rise in SOE wage premiums
- These changes in "prices" of labor account for 80% of China's wage growth in 1992–2007
- Next, investigate the determination of base wage, schooling premiums and state-sector wage premiums

Accounting for Wage Growth: A Simple Model

- Two sectors: state and private $(j = s, p)$
- Two types of labor: low-skilled $\left(N^l\right)$ and high-skilled $\left(N^h\right)$
- Double-CES production technology (Fallon and Layard, 1975; Krussell et al., 2000):

$$Y_{jt} = A_{jt}\{\mu(N^l_{jt})^{\sigma} + (1-\mu)\left[\lambda(K_{jt})^{\rho} + (1-\lambda)\left(N^h_{jt}\right)^{\rho}\right]^{\frac{\sigma}{\rho}}\}^{\frac{1}{\sigma}}$$

A_{jt} is a sector-specific factor-neutral efficiency parameter
When $\sigma > \rho$: capital-skill complementary

Employment

- Labor in efficiency units:

$$
\begin{aligned}
N_{jt}^{l} &= \psi_t^{l} n_{jt}^{l} \\
N_{jt}^{h} &= \psi_t^{hs} n_{jt}^{hs} + \psi_t^{c} n_{jt}^{c}
\end{aligned}
$$

n_{jt}^{l}, n_{jt}^{hs}, n_{jt}^{c} are no. of middle school, high school, and college workers
ψ_t^{l}, ψ_t^{hs}, ψ_t^{c} are unmeasured quality per worker of each type

- Effects of technological change on labor quality:

$$
\begin{aligned}
\psi_t^{l} &= \psi_0^{l} + \gamma^{l} X_t + \omega_t^{l} \\
\psi_t^{hs} &= \psi_0^{hs} + \gamma^{hs} X_t + \omega_t^{hs} \\
\psi_t^{c} &= \psi_0^{c} + \gamma^{c} X_t + \omega_t^{c}
\end{aligned}
$$

where X_t includes proxies for technological change such as domestic R&D expenditures and FDI.

Basic Elements of the Model

- Static model: take aggregate stocks of capital and labor as given
  - Capital depeening in both sectors
  - Supply of skill: rapid expansion of college enrollment since late 1990s, $n^c \Uparrow$
- Partial equilibrium: take trade, FDI, R&D, SOE restructuring as exogenous
  - Export expands the scope of output market
  - FDI and domestic R&D could induce technological change to affect labor efficiency
  - SOE restructuring: in early periods, there's employment protection in SOEs for unskilled labor, $\overline{n_s^l} > n_s^l$.

Base Wage and Wage Premiums

- Base wage:

$$w_{pt}^{l} = \mu {A_{pt}}^{\sigma} Y_{pt}^{1-\sigma} (N_t^l - \overline{N_{st}^l})^{\sigma-1} \psi_t^l$$

- Schooling premiums:

$$\frac{w_{pt}^{hs}}{w_{pt}^{l}} = \frac{\eta}{\mu} \left[\lambda \left(\frac{K_{pt}}{N_t^h - N_{st}^h} \right)^{\rho} + (1-\lambda) \right]^{\sigma/\rho-1} \left(\frac{N_t^h - N_{st}^h}{N_t^l - \overline{N_{st}^l}} \right)^{\sigma-1} \frac{\psi_t^{hs}}{\psi_t^l}$$

$$\frac{w_{pt}^{c}}{w_{pt}^{l}} = \frac{\eta}{\mu} \left[\lambda \left(\frac{K_{pt}}{N_t^h - N_{st}^h} \right)^{\rho} + (1-\lambda) \right]^{\sigma/\rho-1} \left(\frac{N_t^h - N_{st}^h}{N_t^l - \overline{N_{st}^l}} \right)^{\sigma-1} \frac{\psi_t^{c}}{\psi_t^l}$$

- State-sector wage premium:

$$\frac{w_{st}^{l}}{w_{pt}^{l}} = \frac{{A_{st}}^{\sigma} Y_{st}^{1-\sigma} (\overline{N_{st}^l})^{\sigma-1}}{{A_{pt}}^{\sigma} Y_{pt}^{1-\sigma} (N_t^l - \overline{N_{st}^l})^{\sigma-1}}$$

Quantitative Analysis

- Data for aggregate production:
  - Estimated base wage, skill premiums, SOE premium, 1992-2007
  - Supply of labor by schooling completion levels
  - Capital stock by ownership types, state vs. CIP
  - Aggregate output values by ownership type
  - Proxies for technological change and globalization

- Benchmark Model:
  - Estimation using simulated method of moments (SMM)
  - 14 parameters: substitutability $\{\sigma, \rho\}$, income share $\{\lambda, \mu\}$, initial values of labor efficiency φ_0^i, efficiency growth and shocks $\{\gamma^i, \eta_\omega\}$
  - Compare model simulated changes in base wage, high school and college premiums, state-sector wage premium to data

SMM Estimation

Moment conditions (4 per year, 64 in total)

A. Base wages:

$$(w_{pt}^{l})^{UHS} = w_{pt}^{l}(Z_t;\theta)$$

B. Schooling premiums

$$\left(\frac{w_{pt}^{hs}}{w_{pt}^{l}}\right)^{UHS} = \frac{w_{pt}^{hs}}{w_{pt}^{l}}(Z_t;\theta), \quad \left(\frac{w_{pt}^{c}}{w_{pt}^{l}}\right)^{UHS} = \frac{w_{pt}^{c}}{w_{pt}^{l}}(Z_t;\theta)$$

C. State-sector premiums

$$\left(\frac{w_{st}^{l}}{w_{pt}^{l}}\right)^{UHS} = \frac{w_{st}^{l}}{w_{pt}^{l}}(Z_t;\theta)$$

where $Z_t \equiv \{Y_{st}, Y_{pt}, K_{st}, K_{pt}, n_t^l, n_t^{hs}, n_t^c, \overline{n_t^l}, X_t\}$.

Parameter Estimates: Capital-Skill Complementarity

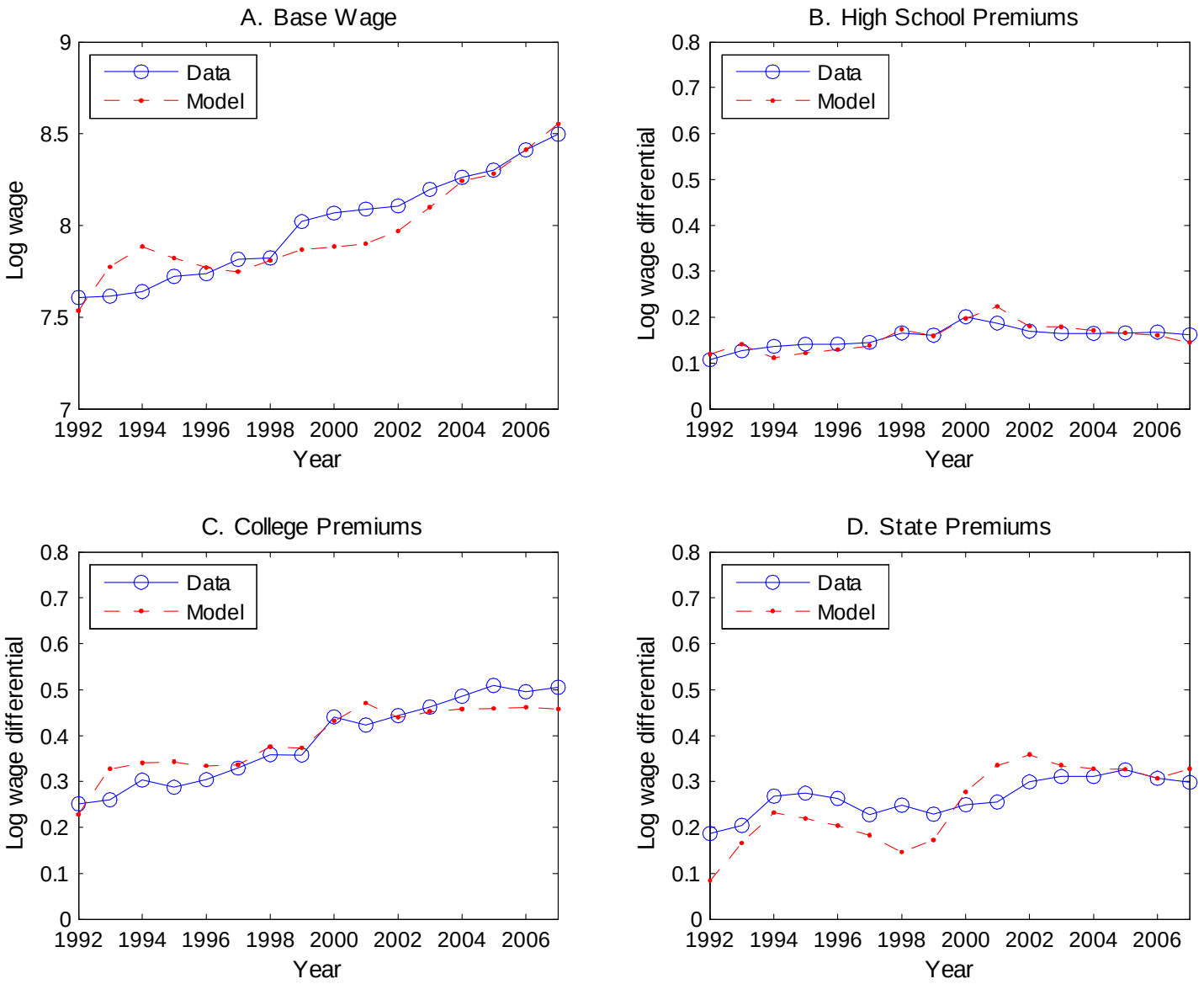
Curvature parameters	Benchmark Estimates
σ	0.575
ρ	0.303

Elasticity between Labor and K	Benchmark
Low skill $1/(1-\sigma)$	2.35
High skill $1/(1-\rho)$	1.43

Sensitivity Analysis: Potential Endogeneity

- Capital stock: un-depreciated stock plus investment
  - investment may respond to concurrent wage
  - potentially endogenous, although investment is a fraction of capital stock
  - IVs: military expenditures, administrative expenses and world oil price
- Size of labor force
  - participation may respond to concurrent wage
  - IVs: cohort size for women aged 16-55 and men aged 16-60
- Results are not sensitive to IV estimation

Base Wage and Wage Premiums: Model Fit

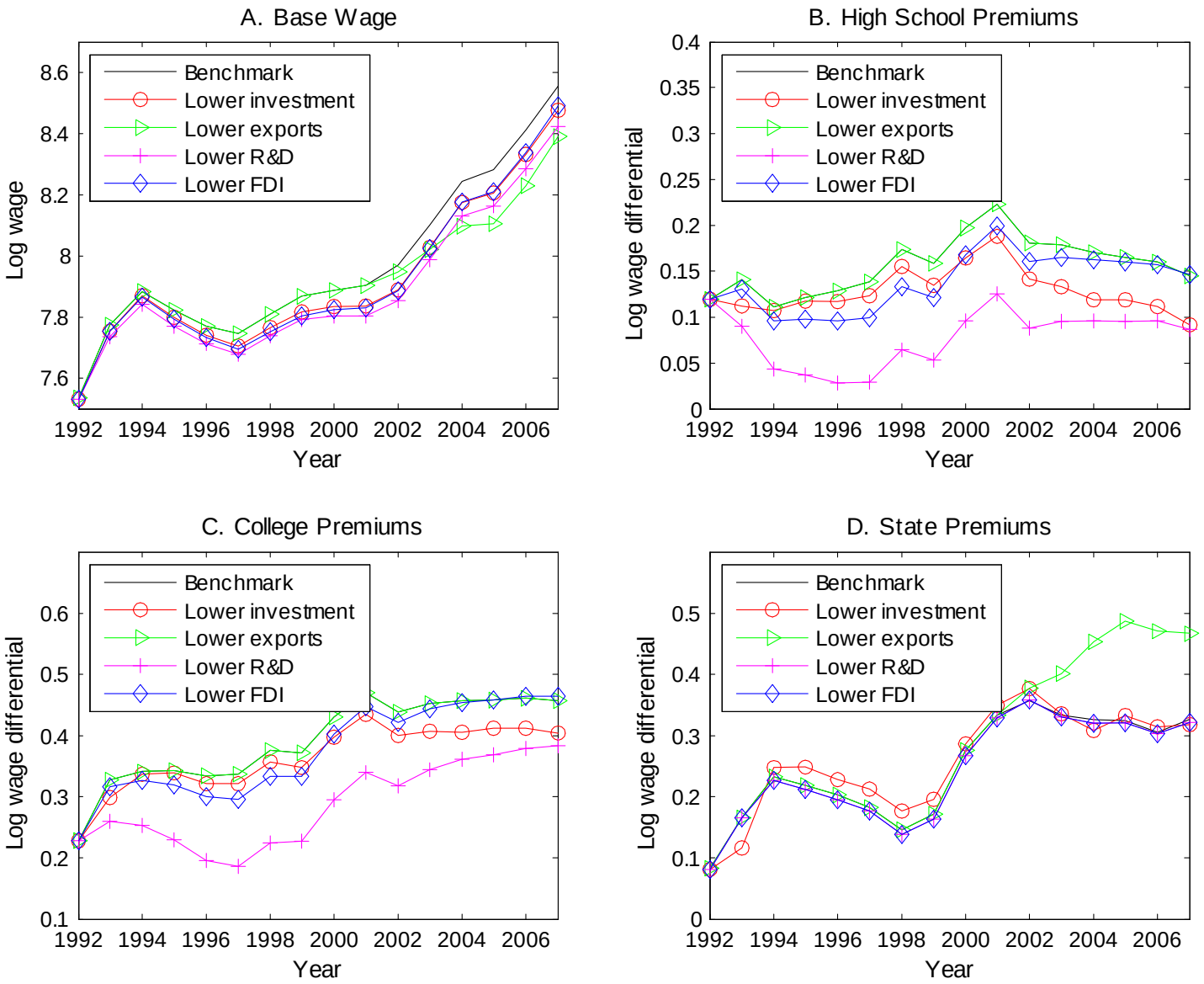


Counterfactual Experiments

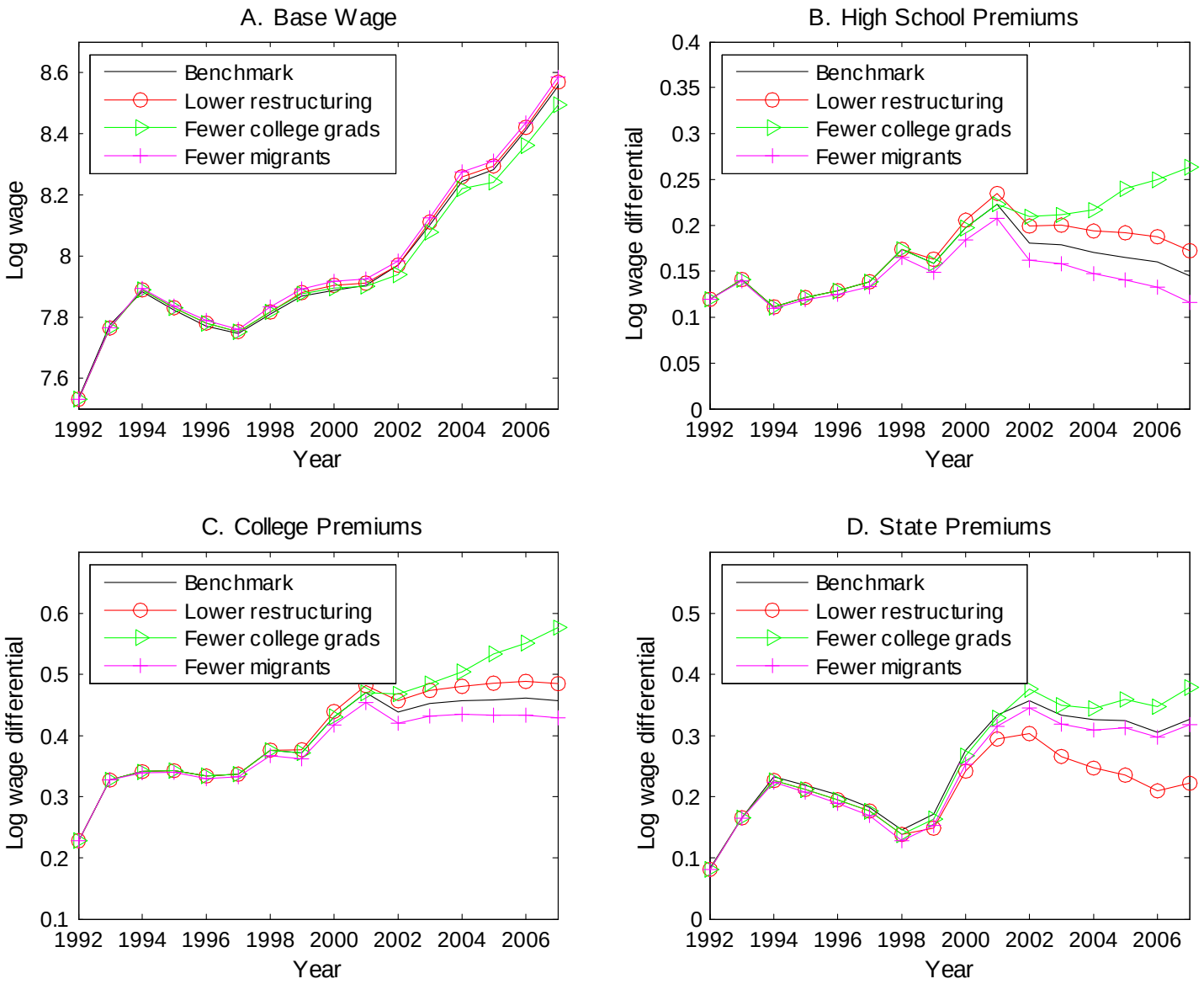
- Impact of demand factors:
  - Capital deepening effects: lower annual investment (20%)
  - WTO and accelerated trade effects: lower exports growth rates to pre-WTO levels (7.1% vs 9.1% in state; 41.6% vs 54.1% in private)
  - *R&D* effects: lower *R&D* expenditure (20%)
  - *FDI* effects: lower annual *FDI* (20%)

- Impact of supply and institutional factors:
  - SOE restructuring effects: decline in low-skilled workers in the state sector is reduced since 1999 (20%)
  - College supply effects: supply of college workers grows at a lower rate since 2002 (2.1% vs 8.9%)
  - Migrant effects: lower annual growth in migrant size (20%)

Counterfactuals: Impact of Demand Factors



Counterfactuals: Impact of Supply and Institutional Factors



Contributions to the Total Change in Average Wages

	Base wage (i)	High school wage (ii)	College wage (iii)	State premium (iv)	Sum of Change (v)
Total change in data	0.372	0.390	0.191	0.077	1.030
Total change in benchmark	0.426	0.431	0.208	0.170	1.235
Impact of demand factors:					
(1) Lower investment	-0.030 (3)	-0.052 (3)	-0.021 (3)	-0.005 (3)	-0.108 (2)
(2) Lower exports	-0.069 (1)	-0.068 (2)	-0.027 (2)	0.098 (7)	-0.066 (3)
(3) Lower R&D growth	-0.053 (2)	-0.076 (1)	-0.033 (1)	-0.002 (4)	-0.164 (1)
(4) Lower FDI	-0.025 (4)	-0.024 (4)	-0.009 (4)	-0.002 (5)	-0.060 (4)
Combination of (1)-(4)	-0.188	-0.233	-0.095	0.095	-0.422
Impact of supply and institutional factors:					
(5) Lower restructuring	0.008 (6)	0.019 (7)	0.008 (7)	-0.072 (1)	-0.037 (5)
(6) Lower supply of college graduates	-0.023 (5)	0.026 (6)	0.011 (6)	0.037 (6)	0.051 (7)
(7) Lower migrant size	0.014 (7)	0.002 (5)	0.001 (5)	-0.005 (2)	0.013 (6)
Combination of (5)-(7)	-0.007	0.042	0.017	-0.036	0.016
Total impact of (1)-(7)	-0.197	-0.193	-0.079	0.061	-0.409

Note: Rank order of each factor's contribution to wage growth is in parentheses.

Conclusions

- Average real wage in urban China increased 202 percent between 1992 and 2007
- Rising base wage, schooling premiums and state-sector premium can account for 80% of total wage increase
- Major driving forces behind wage growth in China:
  - labor-augmenting technological change
  - capital deepening
  - export expansion

Implications of Wage Analysis for China's Inflation

1992-2007:

- Wage growth lagged behind GDP growth by about 2% per year
- A period of increased corporate profits and government savings
- No evidence of cost push to raise the price level

2008-present:

- New Labor Contract Law: took effect on January 1, 2008
  - Regulations on labor hours, overtime pay, job termination, etc.
  - Could push up costs, especially in labor-intensive industries
- Nationwide increases in minimum wage after July 1, 2010
  - 30 provinces have increased minimum wage by 15-20%
  - Policies to close earnings gap between white and blue collar workers

Cost Push from Labor Regulations and Institutions?