Misallocation or Mismeasurement? Factor Income Shares and Factor Market Distortions in China's Manufacturing Industries

(Preliminary work in progress)

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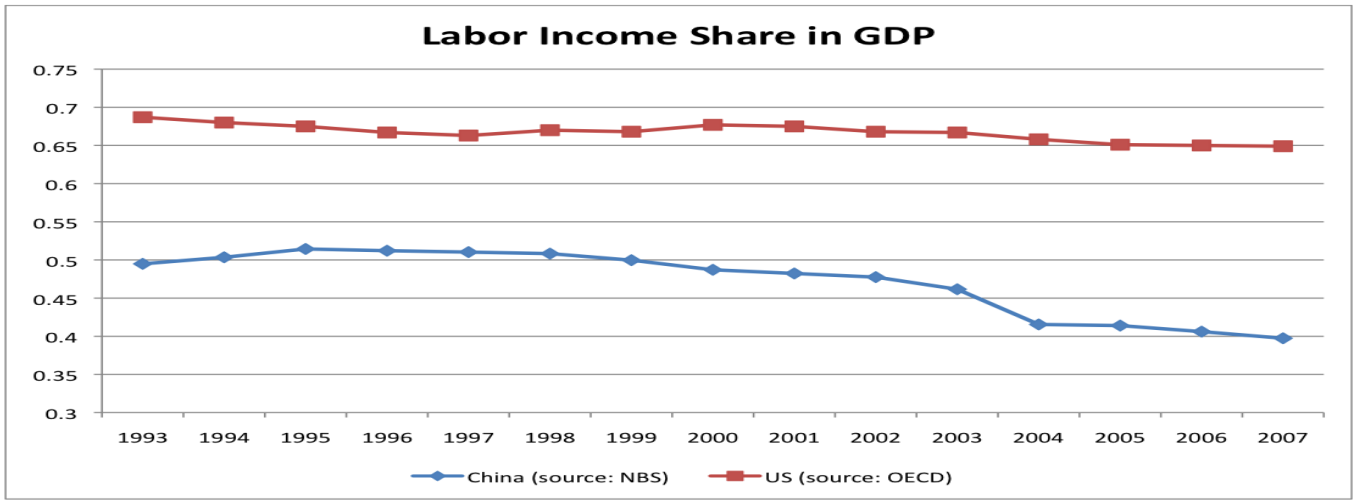
Motivation

Accurate measures of factor income shares are important for

- measuring total factor productivity and growth accounting
- measuring factor returns and factor market distortions
- examining competitiveness (unit labor cost)

Reported labor income shares in China show some puzzling patterns

Labor income shares in China and US



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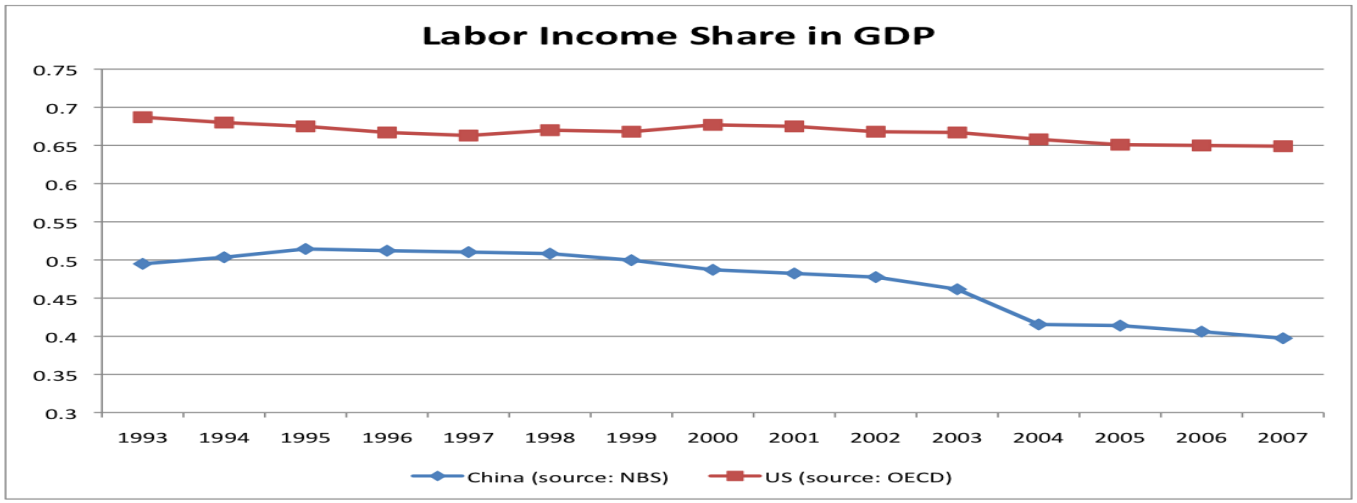
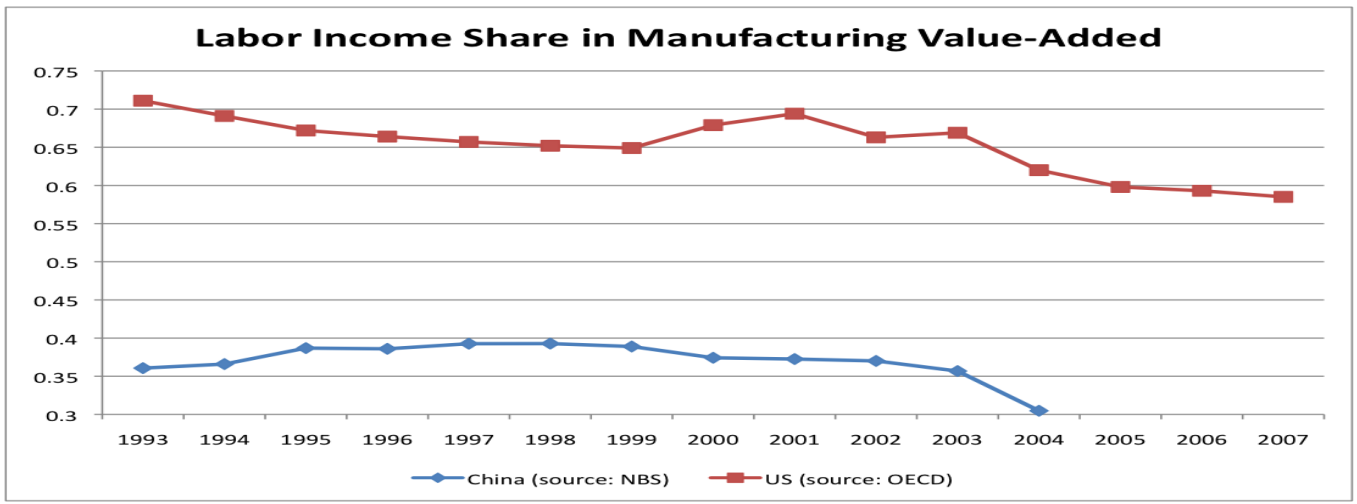




Two observations

1. Labor income share is much lower in China than in the US

   Are technologies more capital intensive in China?

$$max_L \left\{ AK^{\alpha} L^{1-\alpha} - wL \right\} \Longrightarrow \frac{wL}{AK^{\alpha} L^{1-\alpha}} = 1 - \alpha$$

2. Labor income share has been declining in China

   The fact received much attentions in the press, academia and policy making circles
   New labor regulations implemented in 2008, partly intended to reverse the trend

Potential explanations

- Measurement issue
  - Self employment income not reported as labor income (Gollin, 2002)
    - A potential problem for some countries, but not a problem in China
- Industry structure (Bai and Qian, 2010)
  - Different aggregate labor income shares may reflect differences in industry structure between China and US
  - Variations in aggregate labor income share may be due to structural changes in China
- Frictions in product and factor market (Hsieh and Klenow, 2009; Bai and Qian, 2010)
  - Marginal labor cost does not equal to marginal revenue product of labor

This paper

- Focuses on labor income shares in China's manufacturing industries
- Measures labor income shares at four digit industry level to control for differences in industry structure
- Shows systematic differences in labor income shares between the Chinese and US industries
- Examine a capital market distortion that may potentially account for the differences

Data

China

- Annual Survey of Industries (ASI) from 1998 to 2007 for all the SOEs and non-SOEs with sales over 5 million yuan in mining, manufacturing, and energy sectors
- The dataset has been widely used by researchers, including Hsieh and Klenow (2009)
- For the year 2004, ASI covers over 90% of sales and 70% of employment of all the manufacturing firms in the census

US

- BEA Input-Output Table in 2002

A first look at the ASI data (1)

Table 1: Reported value-added and income items
Sample mean in 1000 Yuan's

year	obs	value-added	indirect taxes	depreciation	profits	labor compensation
1998	115169	12348	2449	1518	1580	3562
1999	115996	13484	2637	1658	1890	3708
2000	120078	15200	2849	1762	2432	3985
2001	131411	15790	2870	1821	2541	3967
2002	140647	17652	3080	1881	3128	4166
2003	158710	20393	3425	2052	3996	4406
2004	226899	18082	2693	1689	3526	3781
2005	225775	23970	3406	2365	4665	4777
2006	251814	26963	3687	2526	5624	5281
2007	283608	31001	4498	2780	7366	5972

A first look at the ASI data (2)

Table 2: Reported income share in reported value-added (including taxes)

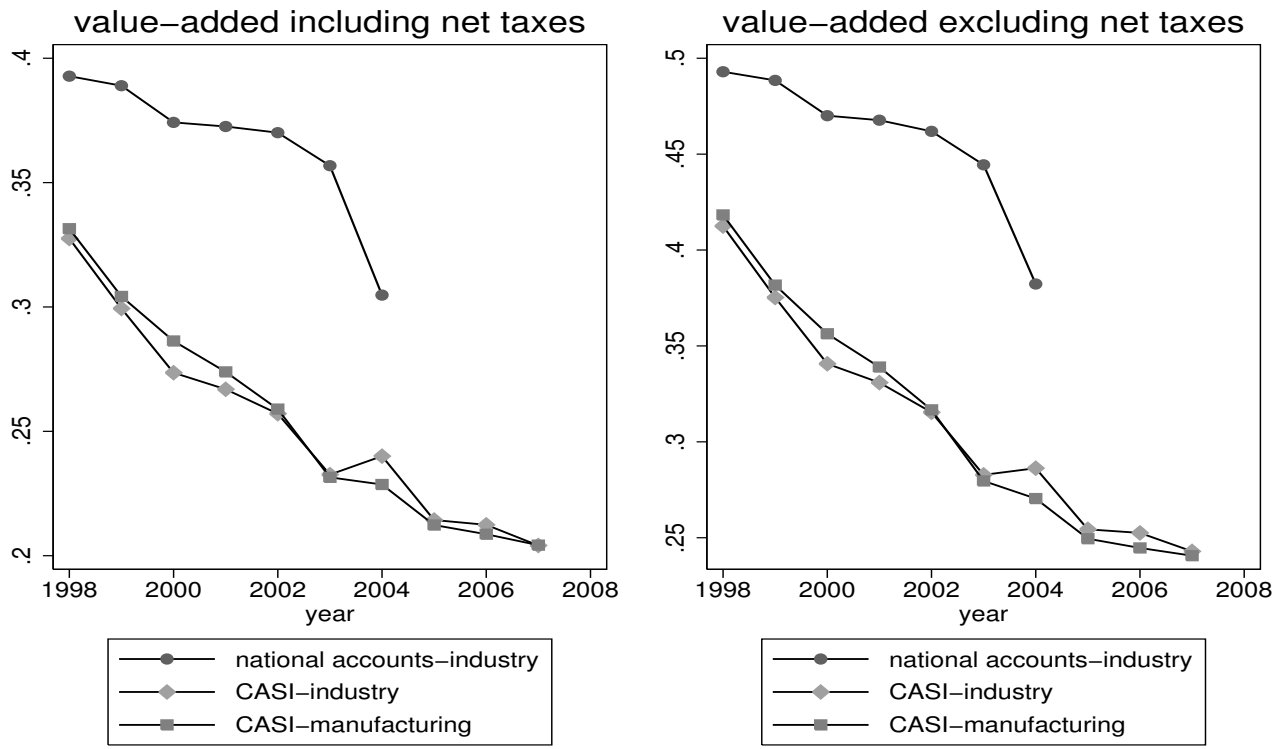
Year	indirect taxes	depreciation	profits	labor income	total
1998	0.20	0.12	0.13	0.29	0.74
1999	0.20	0.12	0.14	0.27	0.73
2000	0.19	0.12	0.16	0.26	0.73
2001	0.18	0.12	0.16	0.25	0.71
2002	0.17	0.11	0.18	0.24	0.69
2003	0.17	0.10	0.20	0.22	0.68
2004	0.15	0.09	0.20	0.21	0.65
2005	0.14	0.10	0.19	0.20	0.63
2006	0.14	0.09	0.21	0.20	0.63
2007	0.15	0.09	0.24	0.19	0.67

A first look at the ASI data (3)

Table 2 (continued): Reported income share in reported value-added (excluding taxes)

Year	depreciation	profits	labor income	total
1998	0.15	0.16	0.36	0.67
1999	0.15	0.17	0.34	0.67
2000	0.14	0.20	0.32	0.66
2001	0.14	0.20	0.31	0.64
2002	0.13	0.21	0.29	0.63
2003	0.12	0.24	0.26	0.62
2004	0.11	0.23	0.25	0.58
2005	0.12	0.23	0.23	0.57
2006	0.11	0.24	0.23	0.58
2007	0.10	0.28	0.23	0.61

Labor income share: NBS vis a vis ASI



Anomalies in reported income shares from ASI

- Reported labor income shares are much lower than those reported in NIPA
  - Hsieh and Klenow (2009) noticed this problem, and scaled up the labor income for all firms to match an average of 50%
- Reported income shares do not add up to 100%
  - underreporting of income?
  - over reporting of value-added?

Two methods to generate consistent value-added and factor income

Rather than using reported income values and reported value-added, which are inconsistent to each other, we have two alternatives

- Taking reported value-added and output as given, use other accounting information to estimate labor compensation and profits
- Taking reported labor compensation and profit as given, calculate value-added by income approach

Method 1: Estimating labor income and profit

- Total cost = labor cost + intermediate input cost + indirect taxes + depreciation
- Estimated labor income = total cost - intermediate input cost - indirect taxes - depreciation
- Estimated profit = output - total cost
- With labor income and profit estimated above, we have

labor income + profit + indirect taxes + depreciation = output - intermediate input cost = value-added

$$lsh_{QZ} = \frac{\text{estimated labor income}}{\text{reported value-added}}$$

Potential biases of method 1

- Overestimate the true labor income share if total cost is over reported
- Underestimate the true labor income share if output and/or intermediate input are over reported

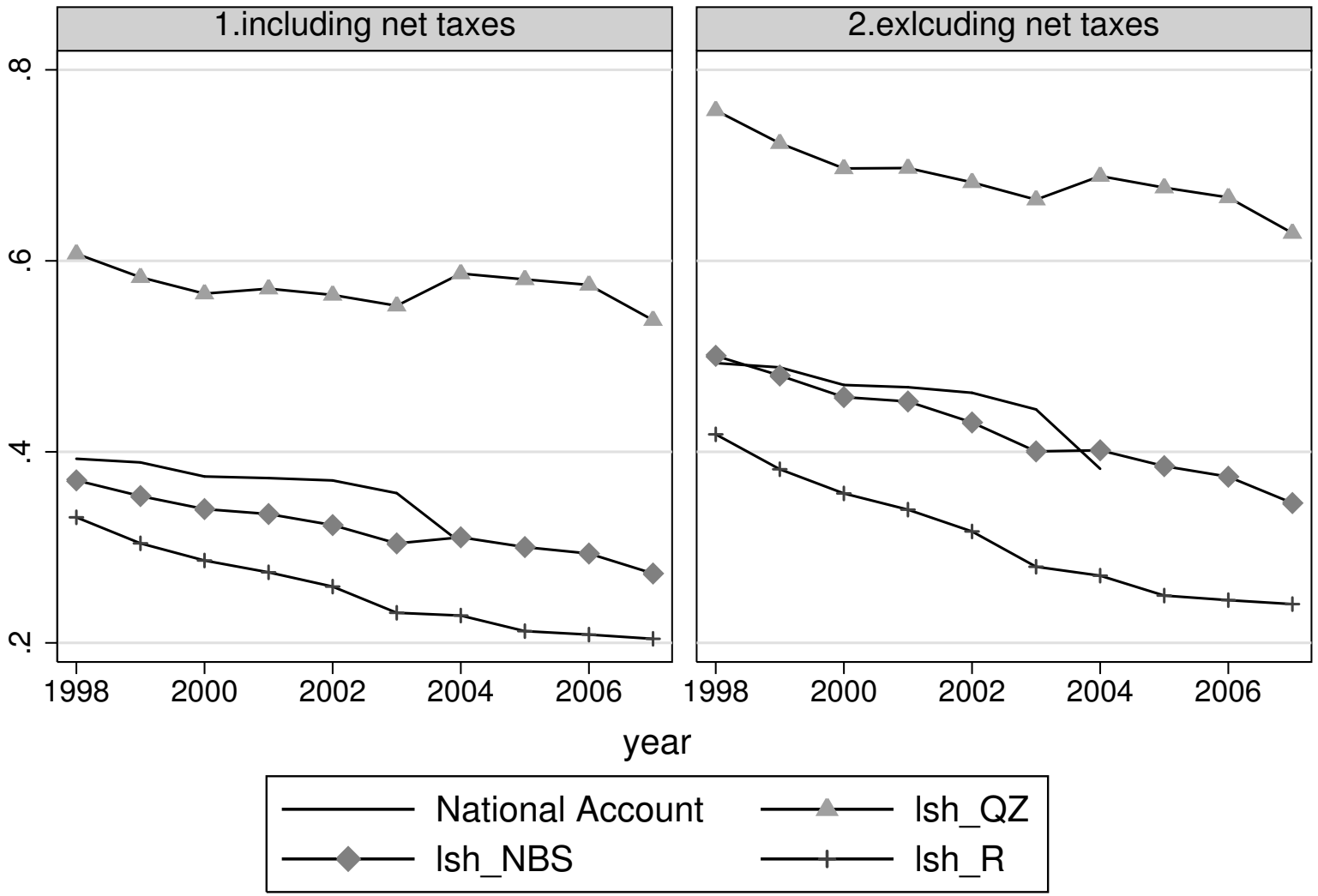
Method 2: Estimating value-added from income

Estimated value-added = reported labor income + reported profit + net taxes + depreciation

$$lsh_{NBS} = \frac{\text{reported labor income}}{\text{reported labor income} + \text{reported profit} + \text{indirect taxes} + \text{depreciation}}$$

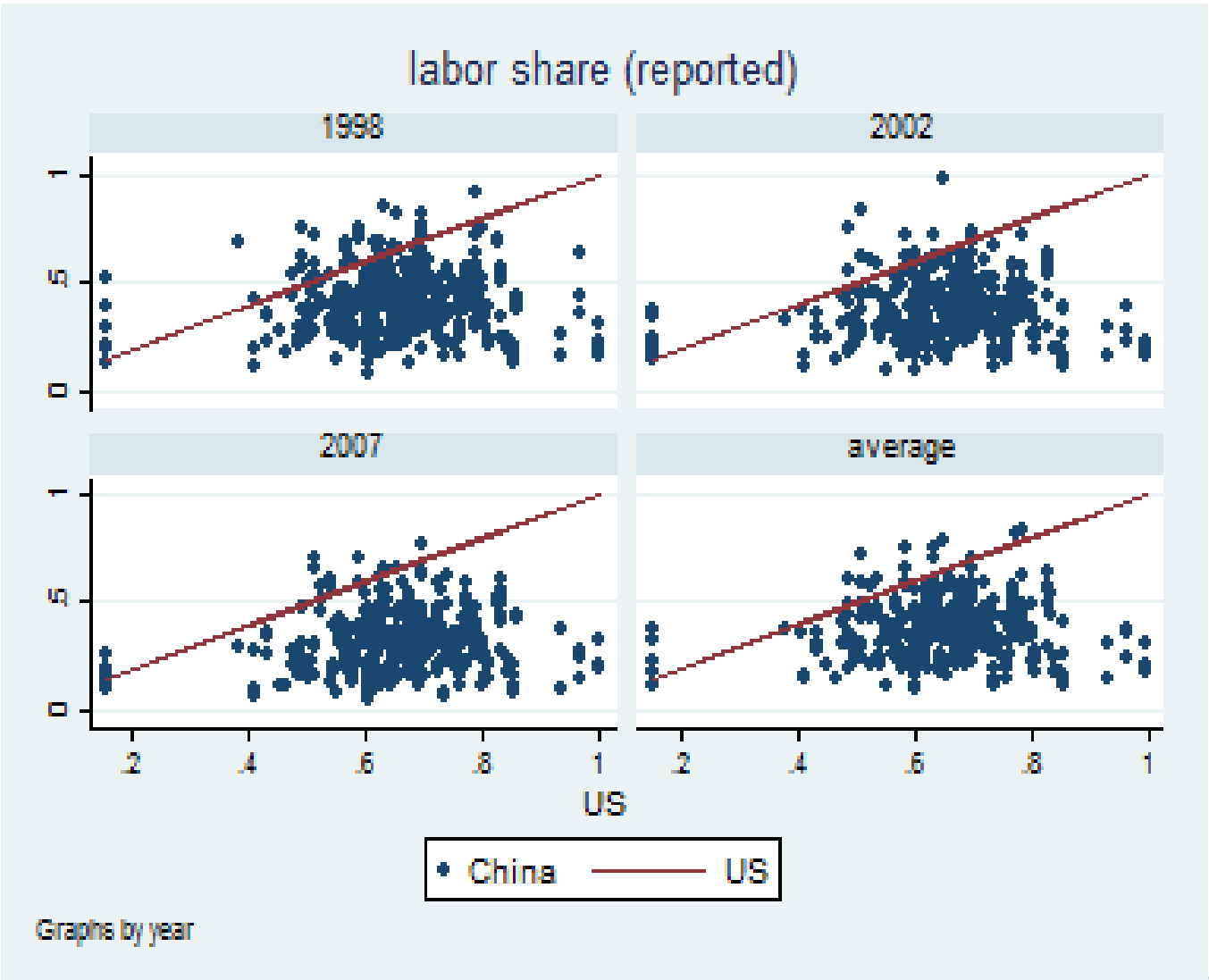
- This approach is followed by the NBS, according to the National Account Manual of NBS (2007, 2008)

Labor income shares in manufacturing sector

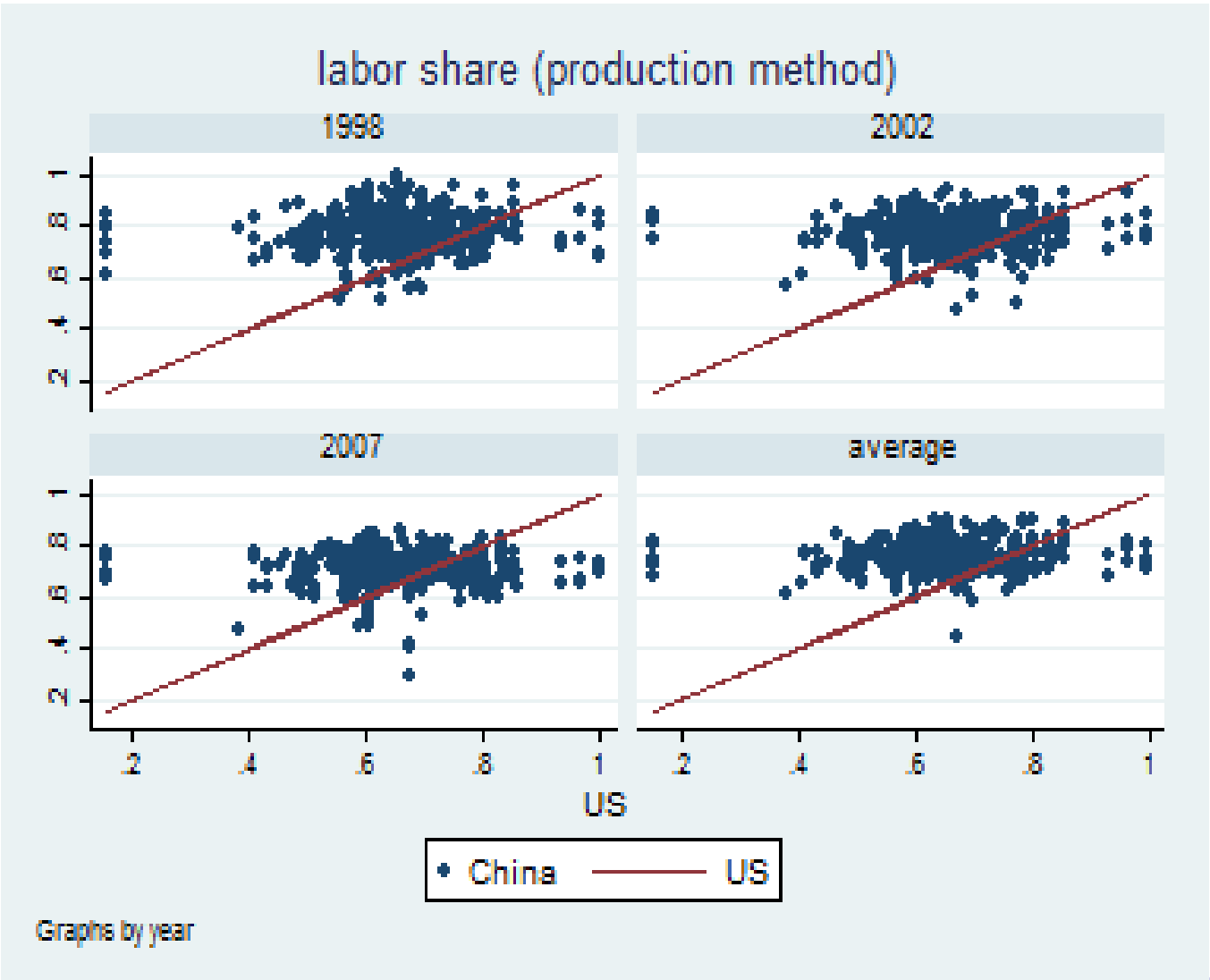


Graphs by definition of value−added

Labor income shares in four-digit manufacturing industries (1)



Labor income shares in four-digit manufacturing industries (2)



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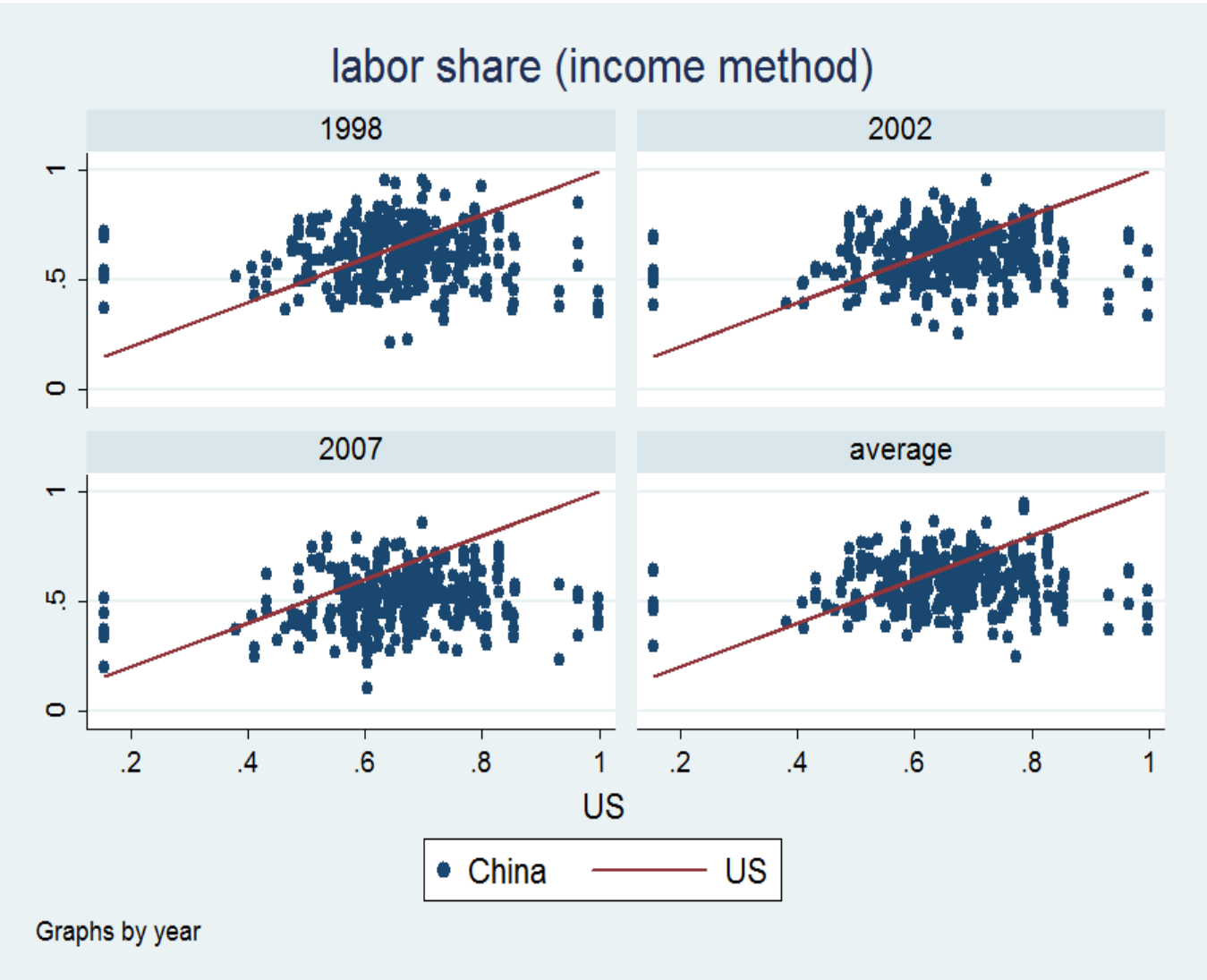


Correlation of China and US labor income shares

year	income method		production method		reported	
	mean	correlation	mean	correlation	mean	correlation
1998-2007	0.5832	0.1270*	0.7534	0.0704	0.3653	0.0978*
1998	0.6170	0.0651	0.7665	0.0742	0.4077	0.0567
1999	0.6234	0.0069	0.7673	0.0454	0.4074	0.0349
2000	0.6205	0.0461	0.7617	0.0157	0.4099	0.0395
2001	0.6149	0.1063*	0.7643	0.0555	0.3977	0.0676
2002	0.6076	0.0882*	0.7642	0.0162	0.3734	0.0576
2003	0.5827	0.0901*	0.7548	0.0597	0.3532	0.0894*
2004	0.5780	0.1779*	0.7654	0.1047*	0.3331	0.0893*
2005	0.5406	0.1519*	0.7320	0.0564	0.3250	0.1299*
2006	0.5277	0.1731*	0.7278	0.0197	0.3158	0.1307*
2007	0.5088	0.1876*	0.7091	0.0450	0.3097	0.1374*

*significant at 10%

Note: 1.US average in 2002 is 0.66, value added excluding net production taxes;

2. correlation calculated for US and China across 4-digit industry

Summary

- For all three measures of labor income shares, we find
  - Across four-digit manufacturing industries, the correlation between labor income shares in China and US is low
  - Relative to US, China's labor income shares are low in labor intensive industries
- What's the reason behind this pattern?
  - We propose an explanation based on a capital market distortion

The Model

- Same as the model in Hsieh and Klenow (2009)
- Competitive markets for final and sectoral output

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s}$$

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

- Each differentiated product is produced by a monopolist using Cobb-Douglas technology:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$$

Distortion

- Instead of idiosyncratic distortions, we consider a capital distortion that is linked to a firm's employment:

$$R_{si} = RL_{si}^{-\gamma}, \gamma > 0$$

  Here R_{si} is the rental price of capital faced by firm i in industry s.
- A firm that employs more workers face lower marginal cost of capital
  - High employment is a political objective of local government leaders
  - They try to influence firms' employment decision through credit policy

Firm's profit maximization problem

$$max_{K_{si},L_{si}} \left\{ P_{si} Y_{si} - R L_{si}^{-\gamma} K_{si} - W L_{si} \right\}$$

subject to the constraint $P_{si} = (Y_{si}/Y_s)^{-1/\sigma} P_s$.
The first order conditions are

$$\alpha_s (1 - \sigma^{-1}) P_{si} Y_{si} / K_{si} = R L_{si}^{-\gamma} \tag{1}$$

$$(1 - \alpha_s)(1 - \sigma^{-1}) P_{si} Y_{si} / L_{si} = W - \gamma R L_{si}^{-\gamma - 1} K_{si} \tag{2}$$

which implies

$$W L_{si} = (1 - \alpha_s + \gamma \alpha_s)(1 - \sigma^{-1}) P_{si} Y_{si} \tag{3}$$

Implied labor income share

Labor income share of value-added for the firms in sector s is

$$\beta_s = \frac{WL_{si}}{P_{si}Y_{si}} = (1 - \alpha_s + \gamma\alpha_s)(1 - \sigma^{-1})$$

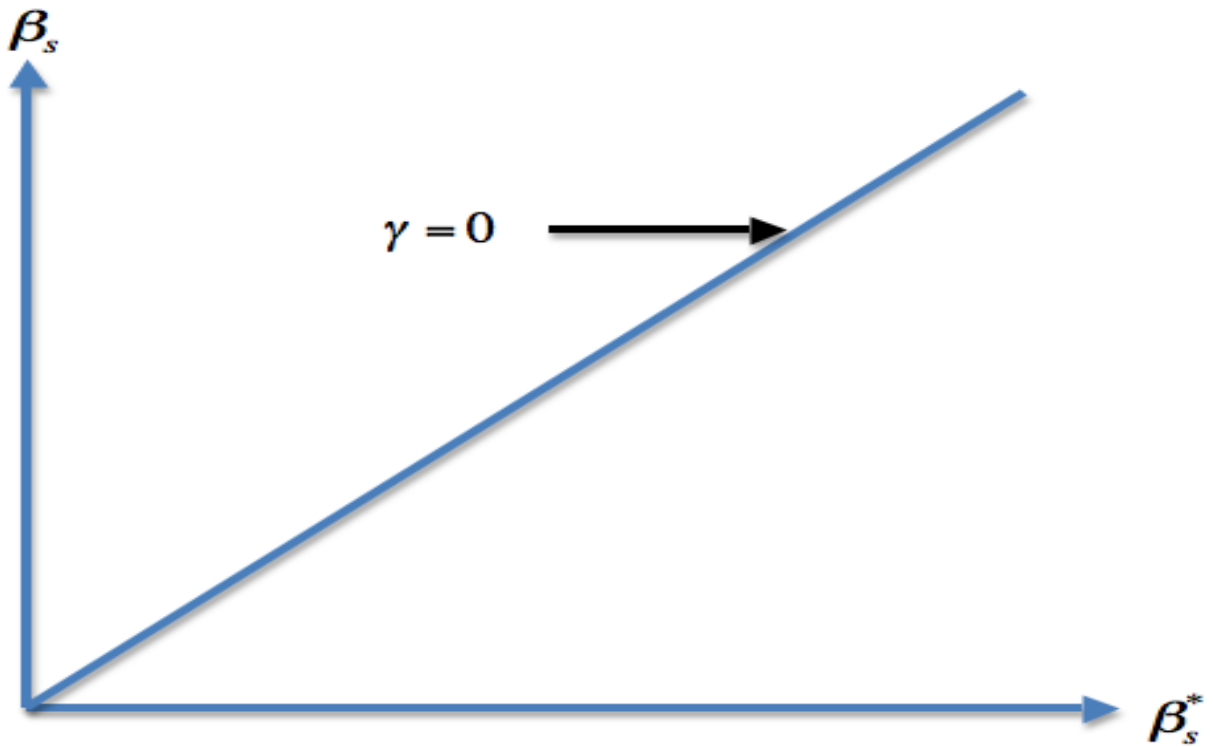
Note that when $\gamma > 0$, the labor income share is greater than the value-added elasticity of labor

$$\beta_s > (1 - \alpha_s)(1 - \sigma^{-1})$$

Let $\beta_s^* = (1 - \alpha_s)(1 - \sigma^{-1})$ be the labor income share when there is no capital distortion ($\gamma = 0$), then

$$\beta_s = (1 - \sigma^{-1})\gamma + (1 - \gamma)\beta_s^*$$

Capital distortion and labor income share



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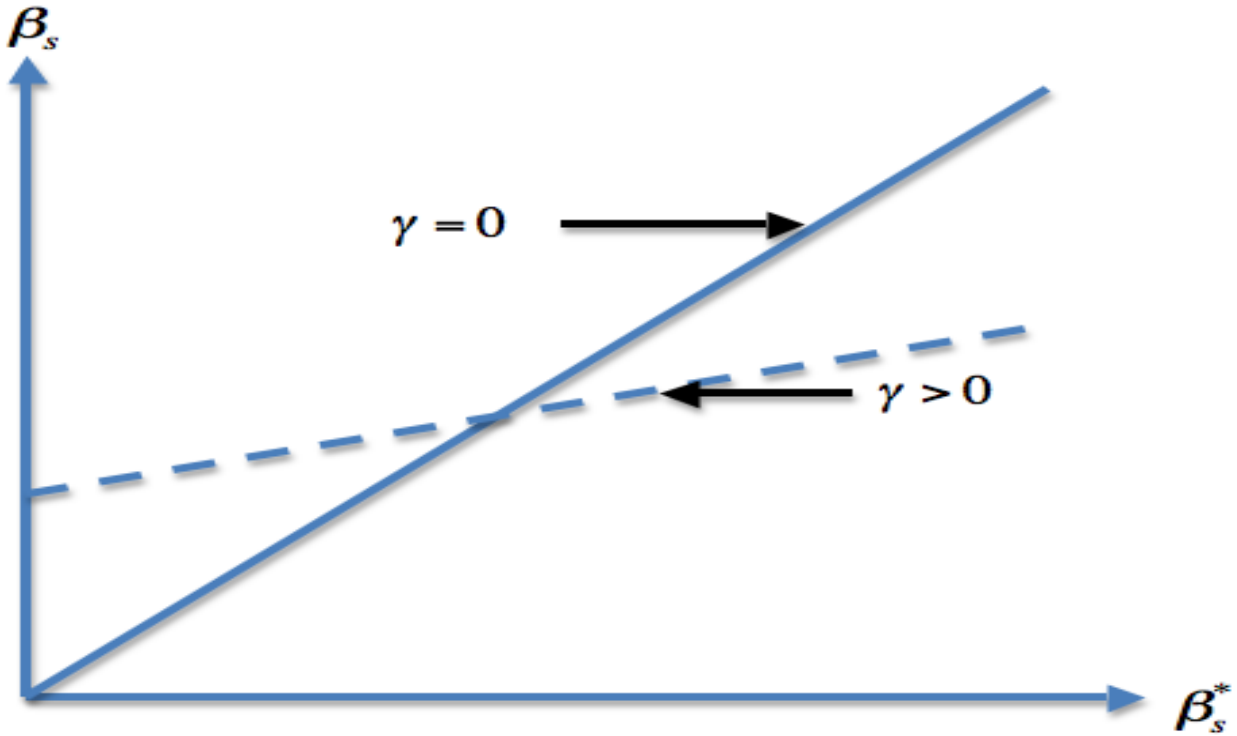


Relative to undistorted economy, firms employ too many workers in capital intensive industries and too little workers in labor intensive industries

Cross-industry labor allocation

$$L_s = \frac{\theta_s \beta_s}{\sum_{s'=1}^{S} \theta_{s'} \beta_{s'}} L$$

Relative to undistorted economy, more employment will be allocated to capital intensive industries when $\gamma > 0$:

- Firms in capital intensive industries have incentives to increase employment in order to reduce capital cost

Within-industry labor allocation

$$L_{si} = \frac{A_{si}^{\frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}}}{\sum_{i'=1}^{M_s} A_{si'}^{\frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}}} L_s$$

Thus,

$$\sigma_{ln(Lsi)} = \frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}\sigma_{ln(Asi)}$$

Relative to undistorted economy, within-industry employment dispersions are higher when $\gamma > 0$, even more so in capital intensive industries

State vs Nonstate firms

- State-owned firms are in more capital intensive industries and, within the same industries, generally use more capital intensive technologies
- However, state-owned firms also have higher labor income shares

Employment and capital cost

- If firms with higher employment face lower marginal cost of capital, we should find a negative relationship between returns to capital and employment
- We do a panel regression of ln(capital return) on ln(employment), controlling for year and industry fixed effect
    - the coefficient on ln(employment) is -0.0385 with a standard error of 0.0106

Implied labor income share

Labor income share of value-added for the firms in sector s is

$$\beta_s = \frac{WL_{si}}{P_{si}Y_{si}} = (1 - \alpha_s + \gamma\alpha_s)(1 - \sigma^{-1})$$

Note that when $\gamma > 0$, the labor income share is greater than the value-added elasticity of labor

$$\beta_s > (1 - \alpha_s)(1 - \sigma^{-1})$$

Let $\beta_s^* = (1 - \alpha_s)(1 - \sigma^{-1})$ be the labor income share when there is no capital distortion ($\gamma = 0$), then

$$\beta_s = (1 - \sigma^{-1})\gamma + (1 - \gamma)\beta_s^*$$

Value-added elasticity of labor and labor income share

Table 4: Average of (Labor income share-Value-added elasticity)/Value-added elasticity

	labor share measure used		
Year	lsh_nbs	lsh_qz	lsh_r
1998	0.3361	0.8299	0.1732
1999	0.3055	0.7847	0.1012
2000	0.2578	0.7528	0.0433
2001	0.2470	0.7517	0.0239
2002	0.1933	0.7302	-0.0328
2003	0.1201	0.6919	-0.1472
2004	0.1153	0.7022	-0.1541
2005	0.0504	0.6477	-0.2217
2006	0.0199	0.6212	-0.2438
2007	-0.0496	0.5482	-0.2710

Note: The value-added elasticities are estimated using the method of Ackerberg, D., Caves, K., and Frazer, G. (2006) "Structural Identification of Production Functions"

Within-industry labor allocation

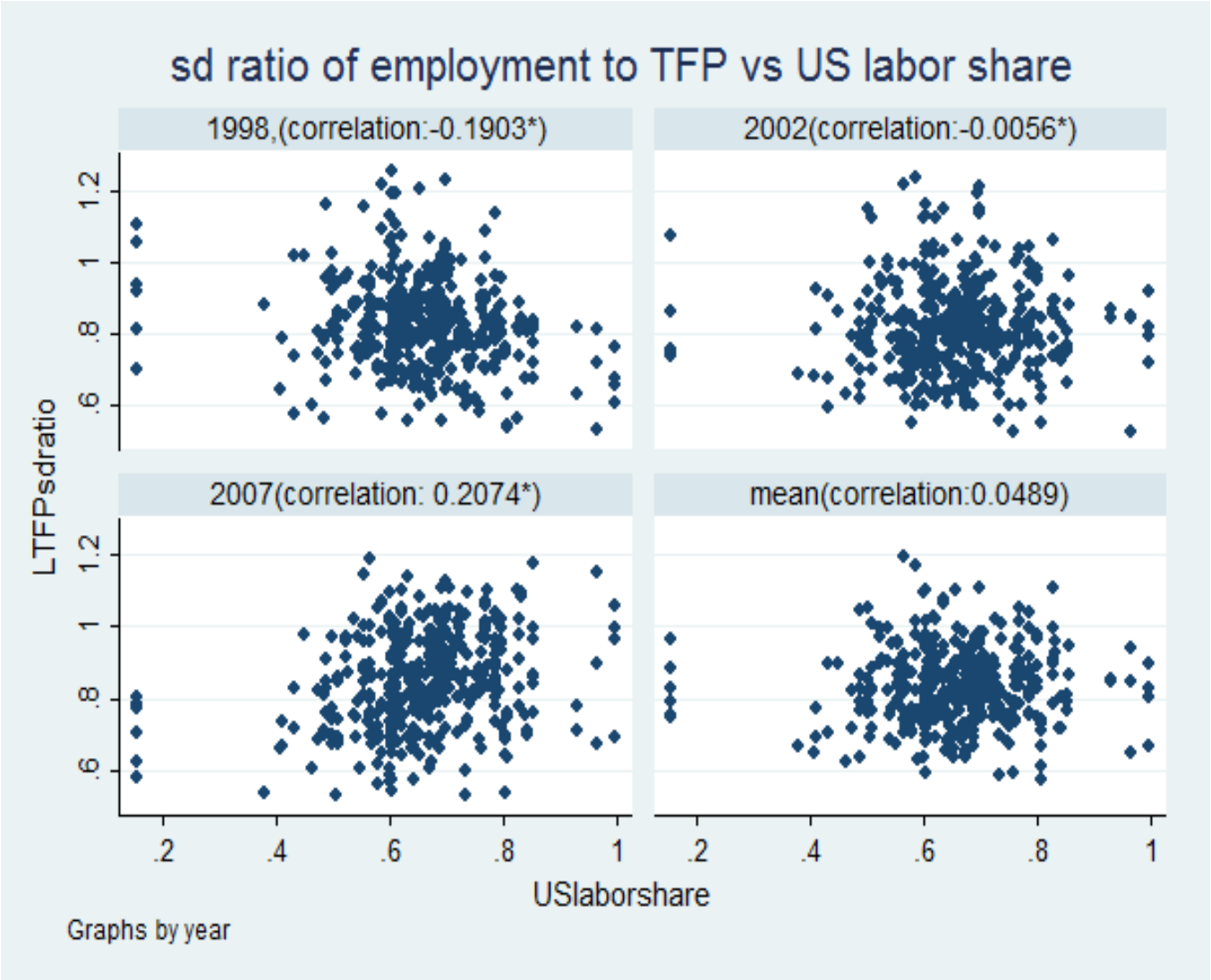
$$L_{si} = \frac{A_{si}^{\frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}}}{\sum_{i'=1}^{M_s} A_{si'}^{\frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}}} L_s$$

Thus,

$$\sigma_{ln(Lsi)} = \frac{\sigma-1}{1-(\sigma-1)\gamma\alpha_s}\sigma_{ln(Asi)}$$

Relative to undistorted economy, within-industry employment dispersions are higher when $\gamma > 0$, even more so in capital intensive industries

Capital intensity and within-industry employment dispersion



Conclusion

- Reported labor compensation significantly understates the labor income shares in China
- We construct two alternative measures of labor income share.
- For all three measures of labor income shares, we find
  - Across four-digit manufacturing industries, the correlation between labor income shares in China and US is low
  - China's labor income shares are low in labor intensive industries

Conclusion

- We propose an explanation based on a capital market distortion: Firms that hire more workers face lower marginal cost of capital
  - some very preliminary evidence
- To be completed:
  - estimate the capital market distortion
  - evaluate how much it can account for the observed differences in labor income shares between China and US
  - quantifying the TFP gains from eliminating the capital market distortion