Hsieh and Klenows's Paper 'Misallocation and Manufacturing TFP in China and India' Econ 43750

N.C. Mark

University of Notre Dame and NBER

This material is covered in

- Hsieh and Klenow article, "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*.
- The article is dense and a bit inaccessible. Read the text, look at the figures and tables, but don't try to understand the mathematical model.
- I will explain the essentials of the modelling in these slides.

Topic Overview

- China has implemented substantial and significant market reforms. However, there remain many distortions in the economy.
- In the narrow context of our course, we want to know
  - **How efficient** are Chinese firms and industries, relative to the US?
- Hsieh and Klenow also contribute to a larger issue
  - **Big picture**: Why are some countries so rich and others so poor?
  - We know **TFP** (total factor productivity) varies enormously across countries. How important is misallocation in explaining TFP variation across countries?

Properties of the Cobb-Douglas Production Function

- Assume Cobb-Douglas with capital share α

$$Y = AK^{\alpha}L^{1-\alpha} \tag{1}$$

  then A is TFP–the part of Y that can't be explained by K and L
- Calculate marginal products

$$\text{MPK} = \alpha\frac{AK^{\alpha}L^{1-\alpha}}{K} = \alpha\frac{Y}{K} \tag{2}$$

$$\text{MPL} = (1-\alpha)\frac{AK^{\alpha}L^{1-\alpha}}{L} = (1-\alpha)\frac{Y}{L} \tag{3}$$

- In **efficient economy**, real wage is equal to MPL, the real cost of capital is equal to MPK for all firms. Hence,

$$w = (1-\alpha)\frac{Y}{L} \Rightarrow \text{Labor share} = \frac{wL}{Y} = (1-\alpha) \tag{4}$$

$$r = \alpha\frac{Y}{K} \Rightarrow \text{Capital share} = \frac{rK}{Y} = \alpha \tag{5}$$

How Misallocations Affect Aggregate TFP

- Assume two firms. $Y_1 = A_1 K_1^{\alpha} L_1^{1-\alpha}$, $Y_2 = A_2 K_2^{\alpha} L_2^{1-\alpha}$.
- Aggregate GDP $Y = AK^{\alpha} L^{1-\alpha}$.
- $Y = Y_1 + Y_2$ implies

$$AK^{\alpha} L^{1-\alpha} = A_1 K_1^{\alpha} L_1^{1-\alpha} + A_2 K_2^{\alpha} L_2^{1-\alpha} \tag{6}$$

  where $K = K_1 + K_2$ and $L = L_1 + L_2$.
- Assume $A_1 = A_2 = 1, K = 100, L = 100, \alpha = 0.34$
- An efficient allocation
  - Set $K_1 = 60, L_1 = 60$. Plug in, solve for A gives $A = 1$.
  - Indeed, any allocation where firm 1 exactly scales up firm 2 is efficient
- An inefficient allocation
  - Set $K_1 = 70, L_1 = 30$. Plug in, solve for A gives $A = 0.92$.
  - Firm 1 uses 'too much' capital and 'not enough' labor.
  - Aggregate TFP falls by 8%

TFP Heterogeneity across Countries

- **Hall and Jones TFP** for selected countries, relative to the US.
- We observe Y, K, and L, can to impute A.

Country	TFP
Hong Kong	108
USA	100
Canada	98
China	43
Argentina	72
Australia	89
Haiti	27
Somalia	20
India	34
Philippines	39

Potential Sources of Misallocations

- **Financial frictions**–differential access to credit
  - Starving rural enterprises of credit
  - Subsidized SOB credit to urban SOEs
- **Policy related** distortions–taxes and subsidies, government favors some firms/industries
- Case of **Huawei** telecommunications firm (been in the news lately for trying to steal trade secrets). (See posted Wall Street Journal Article)
  - 46B (USD) subsidized SOB loans and credit lines
  - 25B USD in tax savings
  - 1.6B USD in governmental grants
  - 2B USD in land discounts

Hsieh-Klenow Organizational Framework

- Hypothesis: Misallocation explains variation of TFP across countries.
- Section 2 of the paper is a little model that demonstrates how misallocation lowers TFP. I showed you this in a simpler, easier to understand fashion.
- They measure misallocation in China relative to the US, and estimate the impact of that misallocation on TFP
- Misallocation in China is modeled through availability of credit and favors to the politically connected. Politically connected firms, SOEs get access to bank credit. TVEs, private entrepreneurs do not get bank loans.
  - Reduced cost of capital to politically connected is $r(1-\tau)$. Higher cost of capital to unconnected is $r(1+\tau)$, where τ is the implicit or explicit tax on the unconnected. Economists call τ a **wedge**.

Sketch of Approach

- There is a final product Y. To produce it requires inputs from M different firms who produce **differentiated** products. Final product production function is called the constant elasticity of substitution σ production function,

$$Y = \left(\sum_{i=1}^{M} Y_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{7}$$

  - The exact form of this function is not important for you to know.
  - The important thing to know is the individual firms are monopolistically competitive.
  - Each Y_i is a differentiated product. That means they face downward sloping demand for their products, which Hsieh and Klenow know. Firms have price setting ability.
- Technology of the differentiated firms is Cobb-Douglas

$$Y_i = A_i K_i^{\alpha} L_i^{1-\alpha} \tag{8}$$

Sketch of Approach

- They model two possible distortions.
  - τ_Y for firms facing (favorable and unfavorable) government bias.
  - τ_K for firms favored and or excluded from credit markets.
  - No distortions in labor market, every firm sees the same wage w. (This is obviously unrealistic, but that's what they do)
- Nominal profits for firm i

$$\pi_i = \underbrace{\left(1 - \tau_{Y_i}\right)}_{\text{Lowers Profit}} P_i Y_i - wL_i - \underbrace{\left(1 + \tau_{k_i}\right)}_{\text{Higher cost}} rK_i \tag{9}$$

Sketch of Approach

- Profit maximization tells us to hire labor until the marginal revenue product of labor equals the marginal cost. Differentiate profits with respect to L_i and set result to 0. After some rearrangement, if if $\tau_{Y_i} > 0$, true marginal revenue product of labor exceeds the wage.

$$\underbrace{(1-\alpha)\, P_i \frac{A_i K_i^{\alpha} L_i^{1-\alpha}}{L_i}}_{\text{true MRPL}} = \frac{w}{(1-\tau_{Y_i})} \geq w \tag{10}$$

- This firm employs not enough labor. If you remove the distortion, the firm will hire more labor. Hsieh and Klenow can compute what happens to $K_i^{\alpha} L_i^{1-\alpha} / L_i$. Output will increase and P_i will decrease. Hsieh and Klenow know what the demand for Y_i looks like, so they can compute the effect on P_i too. All this has to equal the reduction in $\frac{w}{(1-\tau_{Y_i})}$. The change in A_i is whatever is necessary to maintain equality. A_i will increase.
- To rephrase the experiment: In eq.(10), remove the distortion.

$$\downarrow \tau_{y_i} \rightarrow \downarrow w/(1-\tau_{y_i}) \rightarrow \uparrow L_i, Y_i \rightarrow \downarrow P_i.$$

Then make a final adjustment for A_i to achieve equality with w.

Sketch of Approach

- Similar story with capital. Differentiate profits with respect ot K_i, set the result to 0

$$\underbrace{\alpha P_i \left(1 - \tau_{Y_i}\right) \frac{A_i K_i^{\alpha} L_i^{1-\alpha}}{K_i}}_{\text{true MRPK}} = \left(1 + \tau_{k_i}\right) r \geq r$$

- Hsieh-Klenow look at actual inputs to plants (firms), evaluate the effect of distortions.

Empirical Work

- We'll talk about their work on US and China (ignore India).
- US data: from US Census of Manufacturing. Covers all manufacturing plants
- China: Annual Survey of Industrial Produduction
- Observations on
  - Wages paid, w_i
  - Value added, y_i
  - Capital Stock, k_i

Empirical Work

Assumptions

- Rental cost of capital, $R = 10\%$. 5% interest and 5% depreciation.
- For each industry $s = 1, ..., S$, use α_s industry capital shares from the US.

Let's **look at the data**. They plot the distribution of TFP across plants/firms. **TFP measured by revenue.** TFPQ uses plant-specific deflator. TFPR uses industry deflator .

Empirical Work

Look closely. China TFP distribution **skewed left**, more fat-left tailed than US.

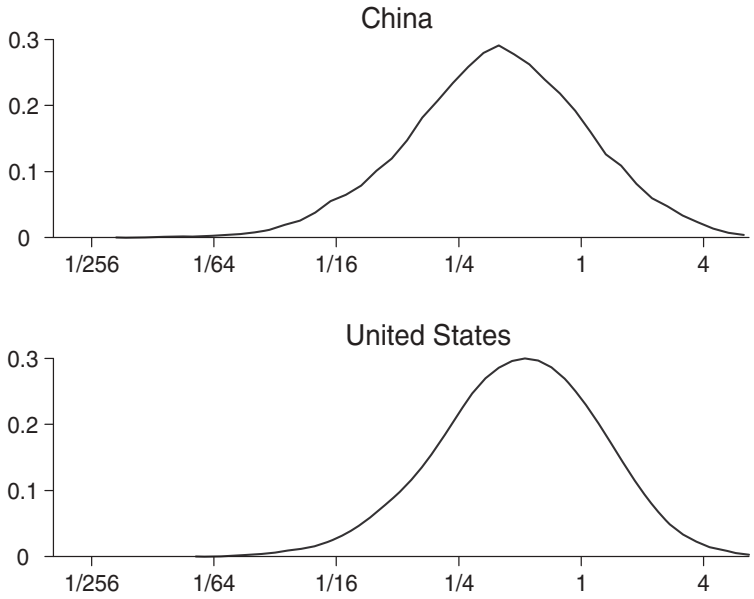
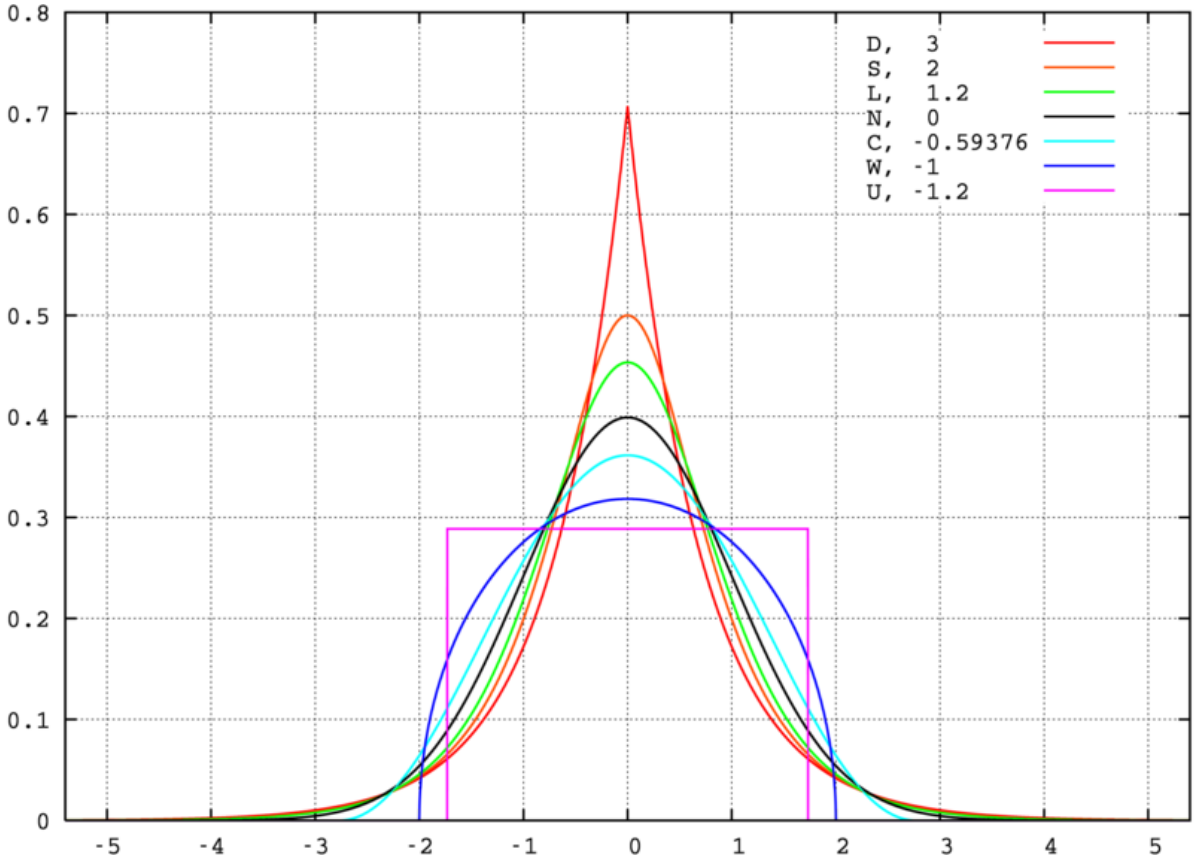


FIGURE I
Distribution of TFPQ

Figure: Distribution of TFP

- Heavier left tail: China has higher percentage of **low TFP firms** than US.
- **Thought Experiment**. Government grants monopoly power to a firm. But monopolist doesn't produce enough. The lower output lowers TFP.

The More Peaked Distribution Has Fatter Tails



Empirical Work

Next, Hsieh and Klenow compute the **size distribution** of 'efficient' output, compare to the actual distribution of output (firm size).

- **Efficient** output is where you **equalize** marginal products across plants within an industry, by **reallocating** labor and capital, subject to the industry-wide quantity (of factor) constraint.
- Size is plant value added y_i
- **Actual** distribution is **peaked**. This means it is **fat tailed** relative to efficient distribution. Some firms should be bigger, others should be downsized (smaller).
- Also, they say that ones that are too **large** and too **small** are the most distorted. Large firms have too much capital and small ones don't have enough.

Empirical Work

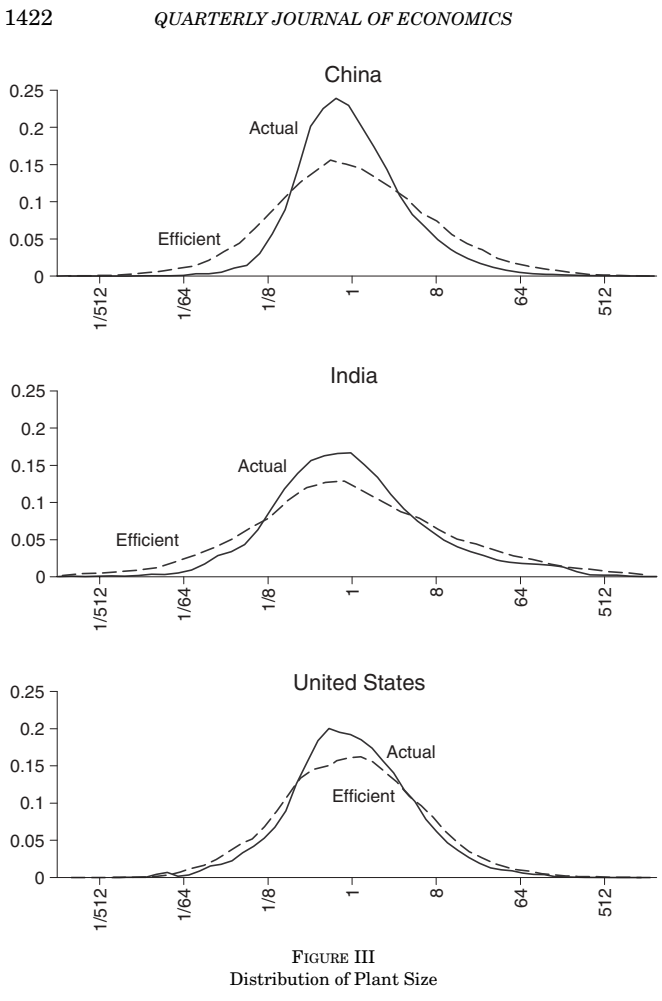


FIGURE III
Distribution of Plant Size

- Figure III–The efficient **size** distribution of firms.
- There should be fewer very small and and very large firms.

Figure: Efficient size distribution

Empirical Work

TABLE VI
TFP GAINS FROM EQUALIZING TFPR RELATIVE TO 1997 U.S. GAINS

China	1998	2001	2005
%	50.5	37.0	30.5

Figure: Efficient size distribution

- Maybe the truly efficient is not feasible. How about getting to US efficiency?
- Table VI shows **percent TFP gain** from reallocations in China that attain the same efficiency as in the USA.
- In 2005, it would result in a 30.5% improvement in TFP

Empirical Work

What is the relationship between TFP dispersion and state ownership? The table shows

- Massive shrinking of state sector over time.
- Collective enterprises also vanishing
- Growth in private domestic

TABLE XI
OWNERSHIP OF INDIAN AND CHINESE PLANTS

China	1998	2001	2005
Private domestic	15.9	37.4	62.5
Private foreign	20.0	21.7	21.9
State	29.0	18.5	8.1
Collective	35.1	22.4	7.5

Figure: Distribution of ownership

Empirical Work

- In Table VII, they regress TFP on ownership dummies. Excluded category is privately owned plants.
- Conclude: SOEs and Collectives have lower TFP

TABLE VII
TFP BY OWNERSHIP

	TFPR	TFPQ
China		
State	−0.415	−0.144
	(0.023)	(0.090)
Collective	0.114	0.047
	(0.010)	(0.013)
Foreign	−0.129	0.228
	(0.024)	(0.040)

Figure: Ownership and TFP