Factor Market Distortions Across Time, Space and Sectors in China

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Motivation

At the beginning of reform, distortions within the Chinese economy were large, and related to:

- restrictions on migration (Chan, Henderson, and Tsui, 2008)
- local protectionism (Poncet, 2003; Young, 2000)
- non-market allocation of capital (Dollar and Wei, 2007; Boyreau-Debray and Wei, 2005)
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General presumption that distortions have been significantly reduced over time

- $\sim$ 150 million inter-provincial migrants
- Growing volume of inter-regional trade
- Reform of the banking sector
- Privatization of SOEs
Return to Labor by Province and Sector

Returns to Labour, Box Plot

State Sector

Nonstate Sector

Log of nominal labour returns
Relative Return to Labor by Province

Log Differences, Nonstate–State, Labour Returns

-1 -0.5 0 0.5 1 1.5

Return to Capital by Province and Sector

Returns to Capital, Box Plot

State Sector

Nonstate Sector

Log of nominal capital returns
Log Differences, Nonstate–State, Capital Returns

Motivation

Most existing studies measure market distortions in terms of factor return dispersions.

We build upon Hsieh and Klenow (2009) and examine the link between factor market distortions and aggregate TFP.

We also decompose the overall distortions into between-province and within-province inter-sectoral distortions:

- Within province (misallocation of capital and labor between state and nonstate)
- Between province (misallocation of capital and labor within state or nonstate)
- Between province (product market distortions)
Related Literature

Factor market distortions in China

- Capital (Bai, Hsieh, and Qian, 2006; Dollar and Wei, 2005; Boyreau-Debray and Wei, 2003)
- Capital and labour - separately (Zhang and Tan, 2007; Gong and Xie, 2006)
- Capital, labour and product market for the manufacturing sector (Hsieh and Klenow, 2009)
Related Literature

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Misallocation and aggregate productivity

- Across firms (Banerjee and Duflo, 2005; Restuccia and Rogerson, 2008; Alfaro, Charlton and Kanczuk, 2008; Bartelsman, Haltiwanger and Scarpetta, 2008; Guner, Ventura and Xu, 2008; and Hsieh and Klenow, 2009)
- Across sectors (Gollin, Parente and Rogerson, 2004; Restuccia, Yang and Zhu, 2008; and Vollrath, 2009)
Main Results

For the period 1985-2007, we find

- Actual average TFP 31% below potential, due to distortions
- Cost of distortions declining to mid-90s, rising afterward
- Between-province roughly constant between 1985-1997, rising slightly afterward
- Within province distortions are worse than between province distortions
Main Results

Within-province distortions:

- Declining between 1985-1997, contributing to 0.96% of TFP growth
- Rising after 1997, reducing TFP growth by 1.4%
- Nearly all within-province distortions due to misallocation of capital between state and nonstate
- Across provinces, the cost of within-province distortions is negatively correlated with income
Model

$m$ province, indexed by $i=1,...,m$, and two sectors (state and non-state), indexed by $j=s,n$

\[ Y_{ij} = A_{ij} L_{ij}^a K_{ij}^{1-a} \]  

(1)

\[ Y_i = \left( Y_{is}^{1-\phi} + Y_{in}^{1-\phi} \right)^\frac{1}{1-\phi} \]  

(2)

\[ Y = \left( \sum_{i=1}^{m} Y_i^{1-\sigma} \right)^\frac{1}{1-\sigma} \]  

(3)

Here $\phi^{-1}$ and $\sigma^{-1}$ are the elasticities of substitution among sectors and provinces, respectively.
Factor Allocation and Aggregate TFP

The provincial and aggregate TFP:

\[ A_i = \left[ Y_{is}^{1-\phi} + Y_{in}^{1-\phi} \right]^\frac{1}{1-\phi} \left[ \left( A_{is} l_{s|i}^a k_{s|i}^b \right)^{1-\phi} + \left( A_{in} l_{n|i}^a k_{n|i}^b \right)^{1-\phi} \right] \]

\[ A = \left[ \sum_{i=1}^{m} Y_i^{1-\sigma} \right]^\frac{1}{1-\sigma} \left[ \left( L^a K^b \right)^{1-\sigma} \right] \]

Here, for \( j = s, n \) and \( i = 1, ..., m \)

\[ l_{j|i} = \frac{L_{ij}}{L_i}, k_{j|i} = \frac{K_{ij}}{K_i} \]

\[ l_i = \frac{L_i}{L}, k_i = \frac{K_i}{K} \]

are the shares of employment and capital.
Efficient Allocation

Proposition 1. For any given \( L \) and \( K \), the efficient allocation of labor and capital is given by the following:

\[
\frac{L_{ij}}{L_i} = \frac{K_{ij}}{K_i} = \frac{A_{ij}}{A_{is} + A_{in}}^{\frac{1-\phi}{\phi}}
\]

\[
\frac{L_i}{L} = \frac{K_i}{K} = \frac{(A_i^*)^{\frac{1-\sigma}{\sigma}}}{\sum_{i'=1}^{m} (A_{i' i})^{\frac{1-\sigma}{\sigma}}}
\]

where

\[
A_i^* = \left[ A_{is}^{\frac{1-\phi}{\phi}} + A_{in}^{\frac{1-\phi}{\phi}} \right]^{\frac{\phi}{1-\phi}}
\]

is the TFP in province \( i \) and the aggregate TFP is

\[
A^* = \left[ \sum_{i=1}^{m} (A_i^*)^{\frac{1-\sigma}{\sigma}} \right]^{\frac{\sigma}{1-\sigma}}
\]
Measure of Distortions

Within-province distortion for province $i$

$$D_i = \log \left( \frac{A_i^*}{A_i} \right)$$

Aggregate distortion

$$D = \log \left( \frac{A^*}{A} \right)$$
Competitive Equilibrium

\[
\max_{Y_i, i=1,\ldots,m} \left\{ P \left( \sum_{i=1}^{m} Y_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}} - \sum_{i=1}^{m} \tau_i^{y} P_i Y_i \right\}
\]

\[
\Rightarrow \tau_i^{y} P_i = P \left( \frac{Y_i}{Y} \right)^{-\sigma}, \ i = 1, \ldots, m \tag{6}
\]

\[
\max_{Y_{is}, Y_{in}} \left\{ P_i \left( Y_{is}^{1-\phi} + Y_{in}^{1-\phi} \right)^{\frac{1}{1-\phi}} - P_{is} Y_{is} - P_{in} Y_{in} \right\}
\]

\[
\Rightarrow P_{ij} = P_i \left( \frac{Y_{ij}}{Y_i} \right)^{-\phi}, \ j = s, n; \ i = 1, \ldots, m \tag{7}
\]
Competitive Equilibrium (continued)

\[
\max_{K_{ij}, L_{ij}} \left\{ P_{ij} A_{ij} L_{ij}^{a} K_{ij}^{1-a} - \tau_{ij}^{l} w L_{ij} - \tau_{ij}^{k} r K_{ij} \right\}
\]

\[\implies a P_{ij} A_{ij} L_{ij}^{a-1} K_{ij}^{1-a} = \tau_{ij}^{l} w \quad (8)\]

\[\implies (1 - a) P_{ij} A_{ij} L_{ij}^{a} K_{ij}^{a} = \tau_{ij}^{k} r \quad (9)\]
Competitive Equilibrium (continued)

Proposition 2

• For any set of positive taxes \( \{ \tau^y_i, \tau^l_{ij}, \tau^k_{ij} \}_{i=1,...,m; j=n,s} \), the competitive allocation implemented by the set of taxes exists and is unique.

• For any allocation \( \{ l_i, k_i, l_{ij}, k_{ij} \}_{i=1,...,m; j=n,s} \), there exists a set of taxes such that the allocation is the competitive allocation implemented by the set of taxes.

• Two sets of taxes \( \{ \tau^y_i, \tau^l_{ij}, \tau^k_{ij} \}_{i=1,...,m; j=n,s} \) and \( \{ \theta^y_i, \theta^l_{ij}, \theta^k_{ij} \}_{i=1,...,m; j=n,s} \) implement the same allocation if and only if there exists some positive constants, \( \alpha, \beta \) and \( \gamma \) such that \( \theta^y_i = \alpha \tau^y_i, \theta^l_{ij} = \beta \tau^l_{ij} \) and \( \theta^k_{ij} = \gamma \theta^k_{ij} \).
Data


We require annual data for each province and sector on
- nominal and real GDP
  \[ Y_{ij} = \left( \frac{w_{ij}L_{ij}}{\sum_{j \in \{s,ns\} w_{ij}L_{ij}} \right) Y_i \]
  Assumes each sector’s relative Y/L equals its relative wages
- employment
- capital stock

Ownership definition
- Include shareholding-corporations in state sector
- Urban collectives and TVEs in nonstate sector
Parameter Values

The model parameters are set as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$</td>
<td>Labour Share</td>
<td>0.5</td>
</tr>
<tr>
<td>$\sigma^{-1}$</td>
<td>Inter-provincial elasticity</td>
<td>1.5</td>
</tr>
<tr>
<td>$\phi^{-1}$</td>
<td>Inter-sectoral elasticity</td>
<td>1.5</td>
</tr>
</tbody>
</table>
TFP by province and sector

TFP, Box Plot

State Sector

Nonstate Sector

Log of total factor productivity
Actual vs. Efficient Productivity

Productivity over Time

Note: $\Phi=.67$ and $\Sigma=.67$
Change in Distortions and TFP growth

**Table:** TFP Growth Rates, Efficient and Actual

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient</td>
<td>4.69%</td>
<td>4.43%</td>
<td>5.01%</td>
</tr>
<tr>
<td>Actual</td>
<td>4.58%</td>
<td>5.39%</td>
<td>3.60%</td>
</tr>
</tbody>
</table>

**Impact of Distortion:**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.11%</td>
<td>0.96%</td>
<td>-1.41%</td>
<td></td>
</tr>
</tbody>
</table>
Identifying Taxes

Labor and capital taxes:

\[ \tau_{ij}^l \propto \frac{P_{ij} Y_{ij}}{L_{ij}} \]  \hspace{1cm} (10)

\[ \tau_{ij}^k \propto \frac{P_{ij} Y_{ij}}{K_{ij}} \]  \hspace{1cm} (11)

Output taxes:

- Choose \( \tau_i^y \) such that the model predicted \( L_i/L \) matches that in the data
Counterfactual Experiments

No within-province distortion:

- in capital allocation: Eliminating the within-province inter-sectoral difference in capital taxes
- in labor allocation: Eliminating the within-province inter-sectoral difference in labor taxes

No between-province distortion:

- in product market: Eliminating the cross-province differences in output taxes.
- in capital allocation: Eliminating the cross-province differences in capital taxes.
- in labour allocation: Eliminating the cross-province differences in labor taxes.
Main Results

Aggregate Distortions, Over Time

- Overall
- No Within-Province
- No Between-Province

Main Results - Compare with US

Between-State Distortions Through Time for the United States
Main Results

Contribution of Between- and Within-Province Distortions

-0.1 -0.05 0 0.05 0.1 0.15 0.2 0.25 0.3

Within
Between

Main Results

Contribution of Between–Province Distortions

Overall Between
Capital
Labour
Product
Contribution of Within–Province Distortions

Overall Within
Capital
Labour

-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
What Causes the Increase in Within-Province Distortions?

In the late 1990s, the Chinese government implemented a series of regional policies, most prominently, Developing the Great West (Xibu Kaifa)

The objective of these policies is to reduce income disparity between coastal and other provinces

Through fiscal and credit channels, state-directed investment to poor provinces increased

However, most of these investments went to the state sector
Regional Income Differences

Output per Worker, by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>1987</th>
<th>1997</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Middle</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>West</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Regional K/Y Differences

Capital–Output Ratio, by Region

East  Middle  Northeast  West

1987  1997  2007

East  Middle  Northeast  West

1987  1997  2007
Regional and Sectoral K/Y Differences

Capital Output Ratio, by Region

State Sector

- East
- Middle
- Northeast
- West

Nonstate Sector

- East
- Middle
- Northeast
- West

Legend:
- Blue: 1987
- Red: 1997
- Green: 2007
Regional and Sectoral TFP Differences

Total Factor Productivity, by Region

State Sector

Nonstate Sector

[Bar charts showing TFP differences by region and sector for 1987, 1997, and 2007.]
Regional Differences in Within-Province Distortions

Table: Average TFP Growth Rates by Region

<table>
<thead>
<tr>
<th>Period</th>
<th>1997-2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>East</td>
</tr>
<tr>
<td>Actual</td>
<td>3.90%</td>
</tr>
<tr>
<td>No Within-Province Distortion</td>
<td>4.85%</td>
</tr>
<tr>
<td>Impact of Distortion:</td>
<td></td>
</tr>
<tr>
<td>Change on TFP</td>
<td>-0.95%</td>
</tr>
</tbody>
</table>
Concluding Thoughts

- Overall, eliminating distortions can increase aggregate TFP in China by 50%.

- Within-province misallocation of capital between state and nonstate sectors is a *much* more serious problem than misallocation of capital across provinces.
  - This distortion has also increased in the last decade.
  - More serious in poor regions, perhaps as a consequence of stronger state-sector presence in the economy, reinforced by government regional policy.

- Despite large-scale migration, labor across provinces is *still* inefficiently allocated.
  - TFP differences grew faster than labor movements.
Infrastructure Share of Total Capital Stock

Infrastructure’s Share of Capital Stock

<table>
<thead>
<tr>
<th>Year</th>
<th>East</th>
<th>Middle</th>
<th>Northeast</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Incorporating Infrastructure Capital

\[ Y_{ij} = A_{ij} L_{ij}^a K_{ij}^b X_i^{1-a-b} \]

\( X_i \): infrastructure capital in province \( i \)

Optimal allocation of infrastructure capital:

\[ \frac{X_i}{K_i} = \frac{1 - a - b}{1 - a} \]

Parameter choices:

- \( a=0.5 \), as before
- \( b=0.39 \), so that the optimal fraction of capital used for infrastructure match the average fraction in the data
Results with Infrastructure Capital

Aggregate Distortions, Over Time

- Overall
- No Within
- No Between
- No Within or Between

Y-axis: 0 to 0.4
X-axis: 1988 to 2006
Results with Infrastructure Capital

Contribution of Between–Province Distortions

- Overall Between
- Capital
- Labour
- Product

Yearly data from 1988 to 2006 showing the contribution of between-province distortions with infrastructure capital.
Results with Infrastructure Capital

Contribution of Within–Province Distortions

Overall Within
Capital
Labour


-0.05 0 0.05 0.1 0.15 0.2
Results with Infrastructure Capital

Contribution of Between- and Within-Province Distortions

- Blue line: Within
- Green line: Between