Industrial Policy and Competition

(joint work with Philippe Aghion, Jing Cai, M. Dewatripont, Luosha Du, and P. Legros)

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Outline

• Why industrial policy?
• A brief literature review
  • A lot of interest in “picking winners”
  • Critical issue in this paper: not what to target but how
• Model: Industrial Policy (“IP”) more likely to work if combined with competition
• Empirics: identifying how IP impacts innovation when combined with competition
Why focus on industrial policy?
Remarkably few countries have transformed themselves from developing to industrial

“As a point of departure we review the cases of high, sustained growth in the postwar period. *Thirteen* economics qualify: Botswana; Brazil; China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; Malta; Oman; Singapore; Taiwan, China; and Thailand. Two other countries, India and Vietnam, may be on the way to joining this group. It is to be hoped other countries will emerge soon.”

–The Growth Commission Report
Other Considerations

• “Doomed to choose”
• New openness to thinking about government intervention post-2008-2009 crisis. Why?
  • Failed orthodox laissez faire policies associated with crisis
  • Perception (even at World Bank) that just relying on investment climate not enough
  • Perceived success of (pro-industrial policy) China and generally more successful performance of developing countries throughout the crisis.
How easy is it to succeed with IP?

USA

Bailing out sunset industries?

China

Promoting emerging sectors?
Brief Literature Review
**Skeptics: IP doesn’t work**

- Krueger and Tuncer (1982): IP leads to rent-seeking
- But Harrison (1994) shows promoted sectors grew faster
- Beason and Weinstein (1996) Japan targeted wrong sectors
- Josh Lerner: *Boulevard of Broken Dreams*
- Bloom et al (2013) on innovation, reallocation & growth

**Optimists: What you promote matters:**

- Clemens and Williamson (2001): Target emerging sectors
- Nunn and Trefler (2011): Target skill-intensive sectors
- Rodrik (2008) under-value XR to promote tradeables
- Alfaro and Charlton (2010): FDI promotion, which targets high-tech sectors, leads to higher quality FDI and growth

“Hard” industrial Policy:
- Tariffs
- Subsidies to specific sectors
- Tax breaks for foreign investors
- Domestic content requirements

“Soft” Industrial Policy:
- Special Economic Zones offering lower cost infrastructure
- Roads and ports designed to increase trade
- Special Credit for exporters (Trade Credit)
- Promoting clusters in order to export
This paper: combining industrial policy and competition

- Why sectoral policy may complement, rather than destroy, competition:
  - Competition weeds out bad projects, thus reduces the danger of picking the wrong winner
  - Sectoral focus preserves competition among firms that would otherwise differentiate horizontally (i.e., across products rather than within the same product line)

- We seek to show empirically and theoretically that the more intense product market competition within sectors, then the more innovation-enhancing industrial policy will be
The Model
Set Up

• Two consumption goods A, B
• Representative consumer has income 2E and utility

\[ U(x^A, x^B) = \log(x^A) + \log(x^B). \]

• Thus consumers spend E on each good A and B and

\[ x^i = \frac{E}{p^i}. \]
Set Up Continued

• Two potential innovators j=1,2
• Production can be carried out by one of these two firms 1,2 or by fringe firms.
• Fringe firms act competitively and have marginal cost $c_f$ while firms j=1,2 have initial marginal cost c, where

$$E > c_f > c$$
Innovation

• Each firm has probability $\frac{1}{2}$ to be selected as an innovator
• Costs of innovation are $q^2/2$ and innovation (cost reduction) occurs with probability $q$
• If a firm innovates on technology $k=A,B$ then unit cost is reduced down to

$$\frac{c}{\gamma_k}$$

where $\gamma_A = \gamma + \delta$, $\gamma_B = \gamma - \delta$
Laissez-faire versus Targeting

• **Laissez-faire**: firms choose where to locate: A or B
  - If they choose same product: we call this “focus”
  - If they choose different products: we call this “diversity”

• **Targeting**: The other possibility is to intervene: targeting is a form of industrial policy. The planner may decide to implement “targeting”, which means forcing firms to “focus” on either A or B. Note that in the model, the instrument for targeting is not described.
Price-setting

- Firms compete in price
- Under Bertrand competition, the price is equal to the second lowest unit cost
- Under diversity:
  \[ p = c_f \]

- Under focus:
  \[ p = c \]
Equilibrium Innovation Intensity under Diversity

If firm on technology \( i \) is chosen to be an innovator, it will get a profit margin of \( c_f - \frac{c}{\gamma_i} \) if it innovates and a profit margin of \( c_f - c \) if it does not. Hence this firm will choose innovation intensity \( q \) to maximize

\[
\pi = q \left( c_f - \frac{c}{\gamma_i} \right) x^i + (1 - q) (c_f - c) x^i - \frac{1}{2} q^2
\]

where \( x^i = E / c_f \)

Thus

\[
q^*_{i} = \frac{\gamma_i - \frac{1}{2} \frac{c}{c_f}}{\gamma_i}
\]
Equilibrium Innovation Intensity under Focus

If firms decide to locate on the same technology, it is optimal for them to choose technology with highest $\gamma_i$, namely $\gamma_i = \gamma_A = \gamma + \delta$.

If firm $j$ has the opportunity to innovate

\[ \longrightarrow \text{ gets a profit margin of } c \left(1 - \frac{c}{\gamma_A}\right) \text{ if it innovates and a profit margin of zero if it does not innovate} \]

\[ \longrightarrow \text{ hence this firm will choose innovation intensity } q \text{ to maximize} \]

\[ \pi = q \left(c - \frac{c}{\gamma_A}\right) x^A + (1 - q).0 - \frac{1}{2} q^2 \]

where $x^A = E/c$

Thus

\[ q^F = \frac{\gamma_A - 1}{\gamma_A} E \]
Competition and Innovation under Diversity versus Focus

Comparing innovation under diversity and under focus, we have

\[ q^F > q^D_i, \quad i=A,B \]

Intuition: tighter competition under focus induces firms to innovate more in order to escape competition
Always get minimum profit

Additional profit from Innovation

$p = \frac{E}{x}$
Focus

profit with probability $\frac{1}{2} q^F$

$p = \frac{E}{x}$

$\frac{c}{\gamma - \delta}$

$\frac{c}{\gamma + \delta}$

$c_f$

$\frac{E}{c_f}$ $\frac{E}{c}$
Introducing Collusion $\varphi$

- With collusion, the probability of diversity being the laissez faire outcome also increases, which means that innovation is less likely as collusion increases (competition falls):
- Firms will choose diversity (less innovation intensity $q$) if

$$\left(\frac{c_f-c}{c_f}\right)(1-\varphi) \geq \frac{1}{4}E\left[\left(\frac{\gamma+\delta-1}{\gamma+\delta} - \frac{\varphi c_f-c}{c_f}\right)^2 - \left(\frac{\gamma-\delta-1}{\gamma-\delta}\right)\left(\frac{c}{c_f}\right)^2\right].$$
So far what can we conclude:

- Innovation (cost reduction) is most likely when firms invest in new processes or products (high q)
- But firms will choose higher q when they are forced to “focus” ie compete head to head
- We cannot be sure that the market alone (“laissez faire”) will lead to this optimal outcome (especially if delta is not that big), hence the need for intervention
- Targeting means inducing firms to co-locate ie compete against each other producing the same goods
- Possibility of collusion also hurts innovation
- So… (1) targeting policies that can encourage leading firms to compete against each other spurs more innovation and (2) IP in conjunction with competition more successful
Does targeting more competitive sectors induce more innovation?
How do we evaluate the evidence?

- **Innovation measures:**
  - total factor productivity
  - new products produced by enterprise
- **Targeting measures:** subsidies, tax holidays, loans, and tariffs
- **Competition measures:**
  - Lerner index at beginning of period by sector
  - Export shares at beginning of period by sector
Dataset

- Chinese industrial firms from NBS: annual survey of all enterprises with more than 5 million RMB sales
- Annual data for 1998 through 2007
- Firm-specific reporting on subsidies, tax holidays, loans. Tax incentives based on deviations from statutory taxes, based on taxes paid/profits. VAT exemptions too.
- Tariff dataset from the World Integrated Trading Solution (WITS). Level of aggregation is 3 digit level: too high to be subject to city-level lobbying from any one industry
Define correlations at region-year level

- Patterns of targeting can be measured using correlations that vary by region and year:

\[ \omega_{rt} = \text{Corr}(\text{Tarif}_{jt}, \frac{\text{EXP}_{jr}}{\text{SALES}_{jr}}) \]

- Use two measures of competition: initial exports and initial Lerner (competition) measure.
- For example, the correlation above is between the industry-region level initial period export shares and current period tariffs for sector j in region r, measures whether tariff protection is biased towards export sectors in region r and year t.
- Exogenous with respect to any one sector j or firm i
Are tariffs and tax holidays skewed in favor of exports? Yes for tax holidays, no for tariffs.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cor(Tariff, Export/Sales)</th>
<th>Cor(Tax, Export/Sales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>0.0476</td>
<td>-0.1277</td>
</tr>
<tr>
<td>1999</td>
<td>0.0197</td>
<td>-0.1077</td>
</tr>
<tr>
<td>2000</td>
<td>-0.0049</td>
<td>-0.0857</td>
</tr>
<tr>
<td>2001</td>
<td>0.0322</td>
<td>-0.0783</td>
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<td>2002</td>
<td>0.0313</td>
<td>-0.1332</td>
</tr>
<tr>
<td>2003</td>
<td>0.0263</td>
<td>-0.1257</td>
</tr>
<tr>
<td>2004</td>
<td>0.0134</td>
<td>-0.1345</td>
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<tr>
<td>2005</td>
<td>0.0511</td>
<td>-0.0998</td>
</tr>
<tr>
<td>2006</td>
<td>0.0266</td>
<td>-0.0949</td>
</tr>
<tr>
<td>2007</td>
<td>0.0185</td>
<td>-0.0747</td>
</tr>
<tr>
<td>Total</td>
<td>0.0264</td>
<td>-0.1043</td>
</tr>
</tbody>
</table>
Does targeting in a competitive way induce more innovation?
Measure targeting with a modified Herfindahl measure

- *Herf_subsidy*: measures sectoral dispersion of subsidies, loans, or tax holidays. We construct a Herfindahl index using firm subsidy or tax holiday shares within a sector but excluding the own firm subsidy.

\[ \text{Herf}_{-}\text{subsidy}_{j,t} = \sum_{i \in j} \left( \frac{\text{Subsidy}_{ij,t}}{\text{Sum\_subsidy}_{j,t}} \right)^2 \]

- This measure allows us to explore which allocation within a sector of industrial promotion works best.

- To make a bigger number “better”, we make competition equal $1 - \text{Herf}_{-}\text{subsidy}$
Two Dependent Variables: Olley Pakes TFP and New Products

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent of firms with New Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>6.4</td>
</tr>
<tr>
<td>1999</td>
<td>6.3</td>
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<tr>
<td>2000</td>
<td>6.5</td>
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<tr>
<td>2001</td>
<td>6.5</td>
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<tr>
<td>2002</td>
<td>6.6</td>
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<tr>
<td>2003</td>
<td>6.2</td>
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<td>2005</td>
<td>9.9</td>
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<tr>
<td>2006</td>
<td>10.3</td>
</tr>
<tr>
<td>2007</td>
<td>8.6</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>Dep Var: Did Firm Introduce New Products?</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Competition Using Exports</td>
</tr>
<tr>
<td>cor_tariff_competition</td>
<td>-0.0250***</td>
</tr>
<tr>
<td></td>
<td>(0.00899)</td>
</tr>
<tr>
<td>cor_subsidy_competition</td>
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<td></td>
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<tr>
<td>cor_tax_competition</td>
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<tr>
<td>comp_herfsubsidy</td>
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<tr>
<td>comp_herftax</td>
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<td></td>
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<tr>
<td>Subsidy Dummy</td>
<td>0.0205***</td>
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<tr>
<td></td>
<td>(0.00148)</td>
</tr>
<tr>
<td>Competition (Exports or Lerner Measure)</td>
<td>-0.0148*</td>
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<tr>
<td></td>
<td>(0.00802)</td>
</tr>
<tr>
<td>Independent Variable</td>
<td>Dep Var: TFP Calculated Using Olley-Pakes</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Competition Using Exports</td>
</tr>
<tr>
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<td>cor_subsidy_competition</td>
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<tr>
<td></td>
<td>(0.00232)</td>
</tr>
<tr>
<td>cor_tax_competition</td>
<td>-0.0124***</td>
</tr>
<tr>
<td></td>
<td>(0.00338)</td>
</tr>
<tr>
<td>comp_herfsubsidy</td>
<td>0.00150</td>
</tr>
<tr>
<td></td>
<td>(0.00133)</td>
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<tr>
<td>comp_herftax</td>
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<tr>
<td></td>
<td>(0.00494)</td>
</tr>
<tr>
<td>comp_herfloan</td>
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</tr>
<tr>
<td></td>
<td>(0.00572)</td>
</tr>
<tr>
<td>Subsidy Dummy</td>
<td>0.00917***</td>
</tr>
<tr>
<td></td>
<td>(0.00128)</td>
</tr>
<tr>
<td>Competition (Exports or Lerner Measure)</td>
<td>0.341***</td>
</tr>
<tr>
<td></td>
<td>(0.0140)</td>
</tr>
</tbody>
</table>
## Impact of targeting innovators in allocating subsidies

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Dep Var: TFP or New Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp_herfsubsidy</td>
<td>0.000604</td>
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<tr>
<td>(No Weighting)</td>
<td>(0.00127)</td>
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<tr>
<td>Comp_herfsubsidy</td>
<td>0.00877*</td>
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<tr>
<td>(Weight by Size)</td>
<td>(0.00457)</td>
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<tr>
<td>Comp_herfsubsidy</td>
<td>0.0228***</td>
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<tr>
<td>(Weight by Inverse of Age)</td>
<td>(0.00656)</td>
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<tr>
<td>Comp_herfsubsidy</td>
<td>0.0480***</td>
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<tr>
<td>(Weight by Firm TFP)</td>
<td>(0.00806)</td>
</tr>
</tbody>
</table>
Conclusions

• Under imperfect competition, our model shows that the market “laissez faire” outcome results in too little productivity growth/innovation.
• Industrial policy when implemented either in competitive sectors or in a way that promotes competition (ie focus) leads to more innovation and growth.
• We use Chinese census data to see if the predictions of the theory are consistent with evidence.
• TFP and new product introductions are generally higher when industrial policy is instituted in more competitive sectors
• TFP and new product introductions are higher as a result of subsidies when they are allocated more competitively. Performance is even better when subsidies are systematically allocated to younger and more productive firms.