Trading Tasks:
The International Organization of Production

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with:
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Introduction

- Revolutionary progress in communication and information technologies has enabled an historic (and ongoing) break-up of the production process.

- Increasingly countries participate in global supply chains.
  - Many tasks required to manufacture complex industrial goods or knowledge-intensive services are performed in several, disparate locations.
  - Need new models to study international trade: frameworks that underscore trade in tasks or “Offshoring”
Examples of Task Trade

- Offshoring of tasks in manufacturing:
  - Global process for producing a Barbie doll (Tempest, 1996)
  - Texas Instruments' high-speed telecommunications chip (Burrows, 1995)
  - 37 percent of the production value of an “American” car is generated in the United States (WTO, 1998)

- Offshoring of service tasks:
  - India’s customer service call centers (Friedman, 2004)
  - X-rays readings (Pollak, 2003)
  - Software development (Thurm, 2004)
  - Tax form preparation (Robertson, et al., 2005)
  - Heart surgery for American patients (Baker 2006)

- Blinder (2006): Refers to it as the “Third Industrial Revolution”
Evidence of Increased Task Trade

- Hard evidence on the extent of task trade is difficult to come by
  - May occur between affiliates of a multinational firm or as arms-length transactions between unaffiliated firms
  - Reporting requirements for these alternatives forms of trade differ
  - Incentive to manipulate transfer prices in case of trade between affiliates
- May not involve movement of physical goods across international boundaries
  - Performance of business functions that do not result in any good passing through a customs house
- Trading tasks inherently concerns the disintegration of the production process and the adding of value at disparate locations
  - But, unlike recording for domestic transactions as value added in national income accounting, trade data are collected as gross flows
Figure 1: Imported Inputs
Source: OECD Input-Output Matrices

- Share of Imported Inputs in Total Inputs in Goods Producing Sectors, US
- Share of Imported Inputs in Gross Output in Goods Producing Sectors, US
Figure 2: Related Party Trade as a Share of U.S. Imports

Source: BEA

CHINA  KOREA  MEXICO  TAIWAN

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Figure 3: Total Imports of Business, Professional, and Technical Services

Source: BEA

[Diagram showing total imports from 1997 to 2004, categorized as unaffiliated and affiliated.]
Labor Market Evidence

- If task trade has been on the rise due to ongoing improvements in firms' ability to separate functions in time and space,
  - We should see workers performing
    - fewer of the tasks that can be performed at a distance at relatively little cost
    - and more of those for which proximity is more valuable
  - Autor, Levy and Murnane (2003) have paired data on job task requirements with samples of employed workers
  - We aggregate their task categories into two:
    - “Routine” and “nonroutine” tasks
Figure 4: Trends in Nonroutine and Routine Tasks
Source: Autor, Levy and Murnane (2003)
Task Trade: Two Approaches

- First: Heterogeneous skills and two tasks
  - Useful to study effects on the distribution of wages
  - “Offshoring in a Knowledge Economy” (*QJE*, 2006)
    - Useful to study the formation of international production teams
    - Agents specialize in the production of routine tasks (workers) or non-routine tasks (managers)
    - Emphasizes skill complementarities
    - Globalization allows economies to take advantage of these complementarities across countries
  - “Organizing Offshoring”
    - Same but study the ‘extensive margin of offshoring’
    - What determines offshoring flows to a developing country?
Two Approaches

- Second: Continuum of tasks few skill levels
  - Useful to study GE effects on wages of reduction in the cost of trading tasks
  - “Trade in Tasks: A Simple Theory of Offshoring”
  - Decompose the impact on wages of any improvements in the technology for offshoring into three components:
    - labor-supply effect and relative-price effect
    - productivity effect
  - Offshoring as factor-biased technological change
    - Developing countries that are targets of offshoring do not experience productivity effect
First Approach

- Role of organization is to manage the communication and acquisition of knowledge in a world with heterogeneous skills
- Wages are allocative: Allocate workers to teams and organizations
- Complementarity of skills in production:
  - Good workers allow managers to increase their spans of control
  - Good managers increase the productivity of workers
- In equilibrium:
  - Positive sorting, segregation of occupations by skill
  - Wages and rents are convex: Having more units of skill increases the wage/rent received per unit of skill
- Use framework to study the impact of the formation of international teams
  - Essentially study equilibrium with world distribution of skills
An Equilibrium
Implications of First Approach

- Globalization implies, in developing countries (the one with less skilled agents):
  - More production jobs
  - Firm exit
  - A more compressed size distribution of firms
  - An increases in within-worker wage inequality
  - An increases in the skill premium

- Effects on levels of wages depend on communication costs and the distribution of skills, but
  - Some workers receive lower wages
  - If country is very scarce in skilled agents and communication technology is good, lowest skilled workers gain

- Consumption and welfare go up in both countries
Extensive Margin of Offshoring

- What makes a country a good target of offshoring
  - Intermediate skills help: Secondary or tertiary education
  - Intermediate skilled agents can become local managers for multinational firms
  - In their absence organization requires more international communication which is costly
  - However, intermediate skills lead to more offshoring only if local communication technology is not very good
  - Good local communication technology creates more efficient local teams, not more efficient multinationals
### Table 1: Median Regression Results

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<td>(8.76)</td>
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**Countries:**
- \( B C I = 1 \)
- \( B C I = 0 \)
- All

**# of Obs.**
- 93
- 29
- 122
- 122
- All
- 122
- 122
- All
Approach 2: Trade in Tasks

- In contrast with standard trade theory, the production process involves sets of tasks
  - Some tasks are performed by low-skilled labor (L-tasks)
  - Others are performed by high-skilled workers (H-tasks)
  - There may be still other tasks that are performed by other factors of production
    - e.g., capital, or additional categories of labor
  - Allow for the possibility of substitution between factors by assuming that the set of tasks performed can be operated at different intensities
Modeling Trade in Tasks

- Firms in each industry undertake a set of L-tasks and a set of H-tasks to produce their output.
  - If an industry is intensive in low-skilled labor, the ratio of low-skilled to high-skilled employment exceeds the similar ratio in the other industry.
- For the time being, assume that it is only possible to offshore tasks performed by low-skilled labor.
  - All other tasks must be performed in close proximity to a firm's headquarters.
Task Trade Costs

- In both industries the various L-tasks differ in their suitability for offshoring.
- We assign a number between 0 and 1 to each of the L-tasks.
  - Choose them so that tasks with lower indexes can more readily be performed offshore than those with higher indexes.
  - Suppose task $i$ would require some amount of domestic low-skilled labor if performed close to a firm's headquarters.
  - The same task would require $\beta t(i)$ units of foreign labor per unit of local labor if performed abroad.
- $\beta$ reflects the overall ease of offshoring at a point in time.
  - We can represent improvements in transport and communication technology as reductions in $\beta$. 
Which Tasks Will a Firm Send Offshore?

- The benefit of offshoring derives from the lower wages abroad
- The cost derives from instructing and monitoring workers at a distance or from impersonal delivery of services
- Firms offshore those tasks for which the benefits exceed the costs
- Let $w$ and $w^*$ be the domestic and foreign low-skilled wage rates
- Then a firm will choose to
  - offshore those L-tasks (with low indexes $i$) for which $\beta t(i) w^* < w$
  - and to keep in close proximity those tasks (with high indexes $i$) for which $\beta t(i) w^* > w$
- We denote by $I$ the index of the marginal task, or the fraction of L-tasks performed offshore, so
  $$\beta t(I) w^* = w$$
Unit Cost

- Denote by $c$ the cost of producing one unit of some good, which is given by
  \[ c = w a_L(1 - I) + w^* a_L \beta T(I) + s a_H + \ldots \]
  
- Cost comprises
  - the amount paid to domestic low-skilled labor for L-tasks performed at home: $w a_L(1 - I)$
  - the amount paid to foreign low-skilled labor for L-tasks performed abroad: $w^* a_L \beta T(I)$
  - the amount paid to high-skilled labor for performing H-tasks: $s a_H$
  - and the amount paid to any other factors that may be used in production
Offshoring as Technological Progress

- Substituting $\beta t(I) w^* = w$ into the unit cost equation we obtain that unit costs are given by
  $$c = w \Omega a_L + s a_H + \ldots$$
  where $\Omega < 1$ since the least-cost tasks are offshored first
- Similar to the costs of a firm that has no opportunity to offshore but that employs low-skilled workers with productivity $1 / \Omega$
- When offshoring becomes less costly (lower $\beta$), so that $1 / \Omega$ increases, this generates a cost savings for a firm that conducts some L-tasks abroad
- In this sense, reductions in the costs of offshoring are economically equivalent to labor-augmenting technological progress!
Implications for Low-Skilled Wages

- The percentage change in the domestic wage of low-skilled labor resulting from a decline in $\beta$ can be written as

$$\hat{w} = -\hat{Q} - \alpha_1 \hat{p} - \alpha_2 \frac{dI}{1 - I}$$

- where $\hat{p}$ is the terms-of-trade of the offshoring country
- and $dI$ is the change in the fraction of tasks offshored

- Three main effects on low-skilled wages:
  - Productivity effect
  - Relative-Price effect
  - Labor-Supply effect
Productivity Effect

- All else equal, as a decline in the cost of offshoring
  - Reduces cost of inframarginal tasks
  - Costs fall in proportion to low-skilled labor usage
  - The fall in $\Omega$ tends to boost demand for low-skilled labor and thus push up their wages

- We can show that the productivity effect is larger the more tasks are offshored (the larger $I$)

- But note, no productivity effect for the target country
  - Developing countries, usually the targets not the source of offshoring, do not obtain this benefit
Relative-Price and Labor-Supply Effects

- Relative-price effect:
  - Change in offshoring costs will alter the terms-of-trade
    - Negative for workers if tasks traded are L-tasks
    - Positive for workers if tasks traded are H-tasks
    - Same effect on wages of both countries

- Labor-supply effect:
  - The expanded offshoring of L-tasks \( dl > 0 \) frees up the domestic labor that otherwise would perform these tasks
  - Increases use of foreign labor
  - Effects analogous to an increase/decrease in the supply of this factor
  - Positive for developing and negative for developed countries
Policy Conclusions

- Task trade has the potential to benefit developing countries
  - But it will also imply more wage inequality and firm destruction
  - Need to alleviate these effects or opposition will increase
    - Latin America is a good example
    - Training of middle managers seems important
    - Telecommunications reforms seem key as well

- Labor supply effects may dominate relative price effects and benefit workers
  - Liberalize trade and facilitate offshoring
  - Globalization implies that reductions in offshoring costs will tend to equalize wages across countries
  - Reducing these costs should be a key policy objective
    - E.g.: Education, Telecommunications, Contracts