Offshoring: General equilibrium effect on wages, production and trade

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A new paradigm?

- “In the future, and to a great extent already in the present, the key distinction for international trade will no longer be between things that can be put in a box and things that cannot. It will, instead, be between services that can be delivered electronically over long distances with little or no degradation of quality, and those that cannot.”

  Blinder 2005

Background

- Globalisation
  - Two great ‘unbundlings’ (Baldwin 2006)
- First unbundling
  - Sector-by-sector separation of production and consumption (Baldwin and Martin 1999)
- Second unbundling
  - Fragmentation; offshoring of services

This paper

- A simple theory of offshoring
  - Standard 2x2x2 neoclassical trade model
  - One advanced nation has better technology
- Integrates many ambiguous results derived in the literature
  - Trace down the source of ambiguity

Foretaste of results

- Offshoring as **shadow migration**
  - Effects on *production* (Rybczynski)
  - Effects on *prices*; Effects on *trade patterns*
- Offshoring as **technological progress**
  - Effects on wages
  - Offshoring as a source of *comparative advantage*

Foretaste of results (ctd)

- Winners and losers from offshoring may be very different from those of first unbundling
  - White collars turn blue
- General equilibrium effects
  - Pains and gains might be quite different from impact effects

Plan of talk

- Globalisation
  - First unbundling
  - Second unbundling
    - Princeton paradigm
- Model: HO
  - Normalisations and autarky
  - The four theorems
- Model: Trade in tasks
  - Free trade equilibrium
  - Offshoring and the four theorems
  - Extensions
- Policy implications
- Conclusions

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First unbundling

- Separation of production and consumption
  - Specialisation by sector
- Causes
  - 1870-1914, trade costs for goods, people and ideas fall rapidly, but especially for goods (steam ships and railroads)
  - 1960-1995, trade costs for goods, people and ideas fall rapidly, but especially for goods (containerisation & air cargo & advanced supply chain management)

First unbundling (ctd)

- Industrialisation / De-industrialisation
- International divergence/convergence
- Trade
- Growth Take-off
  - 1st Wave in North, 2nd wave in some South nations
- Urbanisation
- Internal divergence:
  - Wages in flexible economies
  - Employment in inflexible economies.
- History of the world part I (Krugman&Venables)

First unbundling (ctd)

- Unit of analysis
  - Sectors and firms
  - Activities are glued together at the firm level
  - Change in trade costs
- Winners and losers from globalisation
  - Factors used intensively in comparative advantage sectors (Stolper-Samuelson)
  - Winners = skilled workers in North

First unbundling (ctd)

- Policy recommendations
  - Encourage people to acquire more education
  - Lisbon agenda to reinforce knowledge, skills, “information society”
- European social model
  - Pre-commitment to share pains and gains from trade
  - Essential to maintain political coalition for globalisation
- United States
  - (Perceived) social mobility

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Second unbundling

- Unbundling of sectors
  - The **global factory**
  - Fragmentation of manufacturing process & heightened trade in intermediate goods (parts & components)
  - Gradual increase with acceleration (Yi 2003)
- Offshoring of service inputs in various sectors
  - The **global office**
  - Newer phenomenon (Amiti and Wei 2005)

Second unbundling (ctd)

- Causes
  - 1995-to-present, trade costs for goods, people and ideas fall rapidly, but especially for ideas
  - Internet, fibre optics & competition in telecom
- Regionalization of offshoring (time cost of travel)
  - Chinese subsidiaries of Japanese firms
  - Maquiladora programme in North America

Second unbundling (ctd)

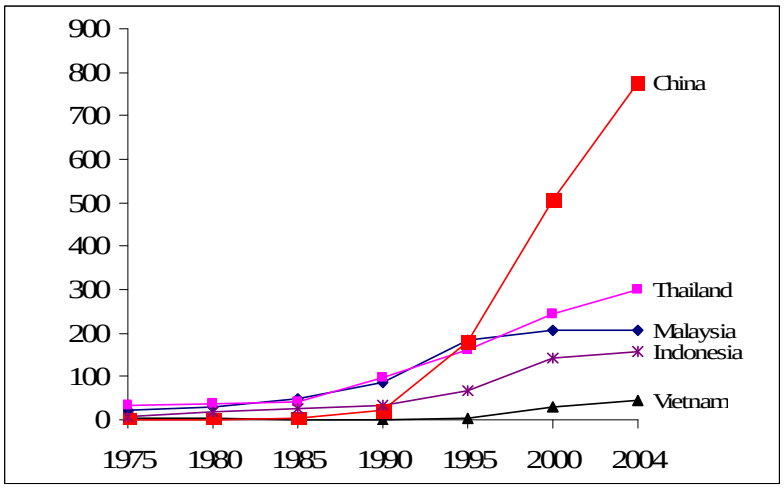

Figure: Placement of Japanese automobile and electronics plants in East Asia, 1975 – 2004.
Source: Baldwin (2006), Figure 2.

Second unbundling (ctd)

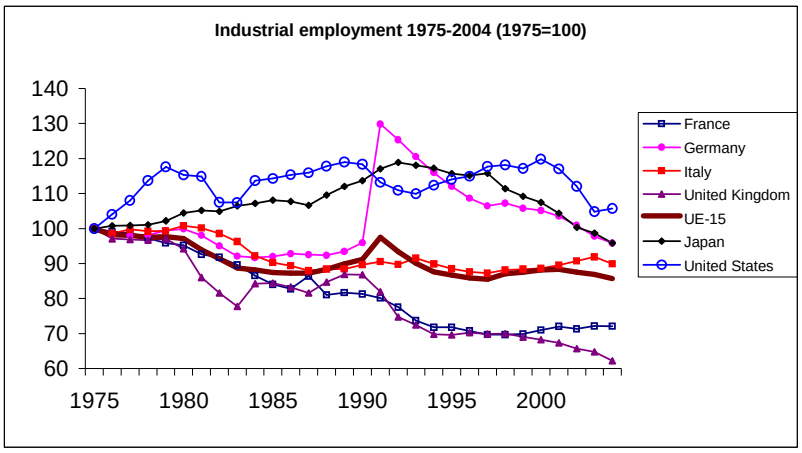

Figure: Industrial employment in large OECD nations, 1975-2004.
Source: Debande (2006), Baldwin (2006)

Second unbundling (ctd)

- Theory
  - Series of special cases
    - Jones and Kierzkowski (1990)
    - Jones and several co-authors
    - Deardoff (1998)
    - Venables (1999)
    - Markusen (2005)
    - Robert-Nicoud (2006)
    - Trade in intermediates: Batra and Casas (1973)

Second unbundling (ctd)

- New paradigm
  - Information revolution is changing the cost of trading ideas
  - This facilitates global factory (trade in intermediates)
  - Also facilitates trade in some services
    - Call centre services & data entry

Princeton paradigm

- New paradigm (ctd)
  - 'Princeton paradigm'
    - Krugman 1996
    - Blinder 2005
    - Grossman and Rossi-Hansberg 2006
- Change in trade costs do not line up with sectors as much as before

Princeton paradigm (ctd)

- Trade cost drop depends upon the nature of the 'task'
  - Not on the factor intensity of the good or sector
- Routine, IT-intensive, codifiable tasks
  - Tasks that can be done remotely become trade-able
  - Employment offshored if true productivity gap is less than wage gap

Princeton paradigm (ctd)

- "In the future, and to a great extent already in the present, the key distinction for international trade will no longer be between things that can be put in a box and things that cannot. It will, instead, be between services that can be delivered electronically over long distances with little or no degradation of quality, and those that cannot."

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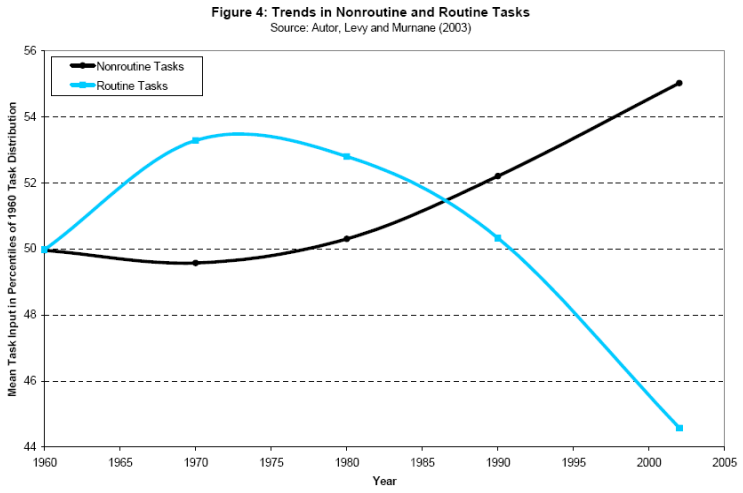

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Model: Heckscher-Ohlin 2x2x2

- Home and Foreign (*)
  - Home is K-abundant
  - Foreign is less productive (Hicks neutral) : $\gamma > 1$
- Capital K and Labour L
- Sectors X and Y
  - X is L-intensive: $D = a_{LX} - a_{LY} > 0$
- Preferences are homothetic
  - Cobb-Douglas: shares α (Y) and $1-\alpha$ (X)

Normalisations & autarky

- Normalisations / Numéraire
  - $a_{KX}=a_{KY}=1$ and $p_X=1$
- Autarky
  - Pricing equations: $\mathbf{p} = \mathbf{A}^T \mathbf{w}$
  - Employment equations: $\mathbf{F} = \mathbf{A}\,\mathbf{Z}$
  - Market clearing: $p_Y Y/X = \alpha E/[(1-\alpha)E]$
- Same for Foreign

Trade and the four theorems

Free trade

- Terms of trade and output

$$p_Y = \left(\frac{\alpha}{1-\alpha}\right)\left(\frac{L^w/K^w - a_{LY}}{a_{LX} - L^w/K^w}\right); \qquad L^w \equiv L + \frac{L^*}{\gamma}, \quad K^w \equiv K + \frac{K^*}{\gamma}$$

$$X = \frac{L/K - a_{LY}}{D}K, \qquad Y = \frac{a_{LX} - L/K}{D}K$$

- Factor Price equalisation

$$w = \frac{1-p_Y}{D}, \quad r = \frac{p_Y a_{LX} - a_{LY}}{D}, \quad w^* = \frac{w}{\gamma}, \quad r^* = \frac{r}{\gamma}$$

Four theorems (ctd)

- HO theorem

$$M_X = \frac{\alpha K}{D}\left(a_{LX} - \frac{L}{K}\right)\left(\frac{L^w/K^w - a_{LY}}{a_{LX} - L^w/K^w} - \frac{L/K - a_{LY}}{a_{LX} - L/K}\right)$$

- Stolper-Samuelson theorem (Partial Equ.)

$$\frac{dw/w}{dp_Y/p_Y} = \frac{-p_Y}{1-p_Y} < 0, \qquad \frac{dr/r}{dp_Y/p_Y} = \frac{a_{LX}p_Y}{a_{LX}p_Y - a_{LY}} > 1$$

- Rybczynski theorem (Partial Equilibrium)

$$\frac{dX/X}{dL/L} = \frac{L/K}{L/K - a_{LY}} > 1, \qquad \frac{dY/Y}{dL/L} = \frac{-L/K}{a_{LX} - L/K} < 0$$

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Offshoring and trade in tasks

- Production of X involves three tasks
  - X1, X2 and X3
  - Segments of production process (intermediates)
  - Or, Service inputs
  - $a_{LX} = a_{LX1} + a_{LX2} + a_{LX3}$
- Production of Y involves three tasks
  - Similar way

Offshoring (ctd)

- Modelling offshoring
  - Combination of home technology with foreign wages
  - Idea: pay foreign workers their reservation wage, not their MPL
  - But MNC exports its superior technology
- Here: offshoring from H to F is economical

Offshoring (ctd)

- Trade-off
  - Offshoring involves coordination and communication costs
  - Assume iceberg form $\chi(X3) > \chi(X2) > \chi(X1)$
  - Assume $\chi(X2) > \gamma > \chi(X1) = 1$
  - Same ordering for Y
  - Firm-to-firm coordination costs are prohibitive

Free trade in goods and tasks

- Employment equations

$$\begin{pmatrix} L \\ K \end{pmatrix} = (\mathbf{A} - \mathbf{A_o}) \begin{pmatrix} X' \\ Y' \end{pmatrix}, \qquad \begin{pmatrix} L^* \\ K^* \end{pmatrix} = \gamma \mathbf{A} \begin{pmatrix} X^{*\prime} \\ Y^{*\prime} \end{pmatrix} + \mathbf{A_o} \begin{pmatrix} X' \\ Y' \end{pmatrix}$$

- Pricing equations

$$\begin{pmatrix} 1 \\ p_Y' \end{pmatrix} = (\mathbf{A}^{\mathbf{T}} - \mathbf{A}_{\mathbf{o}}^{\mathbf{T}}) \begin{pmatrix} w' \\ r' \end{pmatrix} + \mathbf{A}_{\mathbf{o}}^{\mathbf{T}} \begin{pmatrix} w^{*\prime} \\ r^{*\prime} \end{pmatrix}, \qquad \begin{pmatrix} 1 \\ p_Y' \end{pmatrix} = \gamma \mathbf{A}^{\mathbf{T}} \begin{pmatrix} w^{*\prime} \\ r^{*\prime} \end{pmatrix}$$

Trade in goods and tasks (ctd)

- Equilibrium
  - Shadow migration with technology transfer

$$\begin{pmatrix} L + \Delta L \\ K + \Delta K \end{pmatrix} = \mathbf{A} \begin{pmatrix} X' \\ Y' \end{pmatrix}, \qquad \begin{pmatrix} L^* - \Delta L \\ K^* - \Delta K \end{pmatrix} = \gamma \mathbf{A} \begin{pmatrix} X^{*\prime} \\ Y^{*\prime} \end{pmatrix}, \qquad \begin{pmatrix} L^{w\prime} \\ K^{w\prime} \end{pmatrix} = \mathbf{A} \begin{pmatrix} X^{w\prime} \\ Y^{w\prime} \end{pmatrix}$$

  - Offshoring = expansion of world L and K

$$\begin{pmatrix} \Delta L \\ \Delta K \end{pmatrix} \equiv \mathbf{A_o} \begin{pmatrix} X' \\ Y' \end{pmatrix} > \mathbf{0}; \quad L^{w\prime} \equiv L + \frac{L^*}{\gamma} + (1 - \frac{1}{\gamma})\Delta L, \quad K^{w\prime} \equiv K + \frac{K^*}{\gamma} + (1 - \frac{1}{\gamma})\Delta K$$

Trade in goods and tasks (ctd)

- Equilibrium (ctd)
  - Rybczynski outcome

$$X' = X + \left\{\frac{\Delta L}{\Delta K} - a_{LY}\right\}\frac{\Delta K}{D}, \qquad Y' = Y + \left\{a_{LX} - \frac{\Delta L}{\Delta K}\right\}\frac{\Delta K}{D}$$

  - Foreign : $\Delta X^* = -\Delta X/\gamma$, $\Delta Y^* = -\Delta Y/\gamma$
- Offshoring boosts Home and World X iff shadow migration of L (relative to K) exceeds L-intensity of Y sector

Trade in goods and tasks (ctd)

- Equilibrium (ctd)
  - Cost saving

$$\begin{pmatrix} 1+S_X \\ p'_Y + S_Y \end{pmatrix} = \mathbf{A}^{\mathrm{T}}\begin{pmatrix} w' \\ r' \end{pmatrix}, \qquad \begin{pmatrix} 1 \\ p'_Y \end{pmatrix} = \gamma\mathbf{A}^{\mathrm{T}}\begin{pmatrix} w^{*\prime} \\ r^{*\prime} \end{pmatrix}$$

  - Or,

$$\begin{pmatrix} S_X \\ S_Y \end{pmatrix} \equiv \mathbf{A}_{\mathbf{O}}^{\mathrm{T}}\begin{pmatrix} w' - w^{*\prime} \\ r' - r^{*\prime} \end{pmatrix}$$

  - Terms of trade

$$p'_Y = \frac{\alpha}{1-\alpha}\left(\frac{L^w{}'/K^w{}' - a_{LY}}{a_{LX} - L^w{}'/K^w{}'}\right)$$

Trade in goods and tasks (ctd)

- Efficiency gains: Who gets the rents thus generated? (Jones 1965)
  - Home's factor owners

$$w' = w + \frac{S_X - S_Y - \Delta p_Y}{D}, \qquad r' = r + \frac{a_{LX} S_Y - a_{LY} S_X + a_{LX} \Delta p_Y}{D}$$

$$w^{*\prime} = w^* - \frac{\Delta p_Y}{\gamma D}, \qquad r^{*\prime} = r^* + \frac{a_{LX} \Delta p_Y}{\gamma D}$$

  - Home L-workers are better if cost saving is larger in L-intensive sector
  - Nominal wages of Home K-workers even fall if L-savings are very skewed towards L-intensive sector

Trade in goods and tasks (ctd)

- Equilibrium trade patterns

$$M'_X = \frac{\alpha K'}{D}\left(a_{LX} - \frac{L'}{K'}\right)\left(\frac{L^{w\prime}/K^{w\prime} - a_{LY}}{a_{LX} - L^{w\prime}/K^{w\prime}} - \frac{L'/K' - a_{LY}}{a_{LX} - L'/K'}\right)$$

  - Offshoring is a source of comparative advantage $\frac{L}{K} = \frac{L^w}{K^w} \Rightarrow \frac{L'}{K'} \neq \frac{L^{w\prime}}{K^{w\prime}}$
  - (Note:)

$$L' \equiv L + \Delta L, \quad K' \equiv K + \Delta K$$

Trade in goods and tasks (ctd)

- Equilibrium trade patterns (ctd)

$$M'_X = \frac{\alpha K'}{D}\left(a_{LX} - \frac{L'}{K'}\right)\left(\frac{L^w{}'/K^w{}' - a_{LY}}{a_{LX} - L^w{}'/K^w{}'} - \frac{L'/K' - a_{LY}}{a_{LX} - L'/K'}\right)$$

  - Offshoring creates intra-industry trade
    - Home imports intermediates/services X1 and Y1
    - Final goods: Home trades X for Y

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Trade in tasks and the four theorems

- The strict predictions of each theorem fails
- In all four cases, a modified version of the theorem holds
  - Correct factor endowments
  - Correct prices
  - See Trefler 1993

Tasks and four theorems (ctd)

- FPO breaks down
  - Effective factor prices are not equalised by free trade in goods and tasks
    - Econometric test of FPO rejects it
  - Extra trade associated with offshoring widens the wage gap between advanced nation and backward nation
  - Offshoring can widen or reduce wage inequality

Tasks and four theorems (ctd)

- HO breaks down
  - Inter-industry trade with similar factor endowments
  - Capital-abundant nation might import L-intensive final good on net ('Leontief Paradox')
  - Using average factor intensities to evaluate factor content of X1 and Y1
    - Sign prediction: correct
    - Volume-of-trade prediction: violated
  - 'Missing trade' or excess trade

Tasks and four theorems (ctd)

- Stolper Samuelson
  - No change on Foreign prices
  - Impact on w is amplified
  - Impact on r is dampened

$$\frac{dw/w}{dp_Y/p_Y} = \frac{-p_Y}{1-(p_Y+S_Y)}, \qquad \frac{dr/r}{dp_Y/p_Y} = \frac{a_{LX}\,p_Y}{a_{LX}(p_Y+S_Y)-a_{LY}}$$

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Extensions

- Inter-firm coordination costs are zero
  - Home firms sell X1 and Y1 to Foreign firms
    - Foreign firms use advanced technology for tasks X1 and Y1
  - Efficiency gains are shared worldwide
    - Foreign labour gains if Home labour gains
    - But Foreign factors loose/gain by less (factor γ)
    - GE effects similar as in previous case

Extensions (ctd)

- Intra-industry, two-way offshoring
  - Assume mirror-image Ricardian differences
  - $a_{LX} = a_{LX1} + a_{LX2} + \gamma a_{LX3}$, $a_{LX}^* = \gamma a_{LX1} + a_{LX2} + a_{LX3}$; $a_{LX} = a_{LX}^*$
  - Same in Y
- Two-way offshoring is isomorphic to L-saving productivity improvement in both nations
  - By a factor $a_{LX} / (a_{LX1} + a_{LX2} + a_{LX3}) > 1$
  - X expands and Y contracts (Jones 1965)
  - TOT effect: w rises in both nations (r unaltered)

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Policy implications (Baldwin 2006)

- The nature of trade cost reduction for ideas matters
- Some 'information society' jobs are likely to be subject to dramatic changes in trade costs
  - These may be offshored
  - Some but not all 'information society' services can be delivered by fibre optic cable

Policy implications (ctd)

- It implies that history of globalization's winners and losers is less relevant to future globalization (2nd unbundling)
  - Medical technician's job cannot be offshored but the task of interpreting it can be done in New York or New Delhi
  - Taxi drivers' jobs may never be offshored

Policy implications (ctd)

- New paradigm: trade in tasks
- Unpredictability
  - Glue that binds all tasks is little known
- Suddenness
  - Safe jobs might be offshored to India in a few years
- Individuals, not firms or sectors
  - Competition increasingly takes place at task level

Policy implications (ctd)

- Offshorability may be affected by:
  - Network externalities
  - Radical re-organisation of working concepts, e.g. re-arranging work plans to allow some workers to telecommute may make it easier to offshore these jobs
  - Agglomeration (e.g. India's software sector's competitiveness may depend positively on its size)

Policy implications (ctd)

- Is education good?
  - Don't try to pick winners, since determinants of offshorability are not well understood
  - Greater need for flexibility and continuing education
    - Service workers may need to change professions, not just sectors
    - E.g. Estate agents in the US

Policy implications (ctd)

- Not at all clear that the 'jobs of the EU's future' will involve workers specialised in information industries
  - Not all 'information society' jobs are obvious winners
- The superstar economics may get reinforced
  - Pay for top CEO's & strikers versus dental hygienists
- Social policy needed more than ever to maintain social cohesion

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Conclusions

- Winners and losers from second unbundling may be very different from those of first unbundling
  - White collars turn blue
- General equilibrium effects
  - Pains and gains might be quite different from impact effects