Globalization and Labor Markets

Offshoring and the Demand for Skills

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Introduction

- Offshoring/international outsourcing/fragmentation
  - Location of activities abroad (independent of choice of organization).
  - Manifests itself through trade and FDI.
  - But there is also trade and perhaps even FDI that is unrelated to offshoring.

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Definition of offshoring

Table 1. **Production options for an enterprise (or group of enterprises)**

Location	Internal production (*in-house*)	External production (*outsourcing*)
Within the country (*domestic*)	Production within the enterprise and the country (*domestic in-house*)	Production outside the enterprise but within the country (*domestic outsourcing*)
Abroad (*offshoring* or *cross-border*)	Production within the group to which the enterprise belongs but abroad (by its own affiliates) (*offshore in-house sourcing* in the sense of *relocation abroad*)	Production outside the enterprise (or the group) and outside the country by non-affiliated firms. This involves foreign subcontracting (*offshore outsourcing* or *subcontracting abroad*)

Source: US Government Accountability Office (GAO)/UNCTAD (2004), *World Investment Report* 2004; OECD (2004), *Information Technology Outlook*.

Introduction, cont'd

- Increase related to decreased costs of communication and information.
  - To some extent to opening up of countries to FDI.
- Measuring offshoring:
  - Imports of intermediate inputs and services
    - e.g. Feenstra and Hanson unbundled measures of vertical vs. horizontal offshoring based on information from input-output tables.
  - Foreign affiliate activities
  - (Relation between turnover and value added)

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- *Narrow* offshoring:

$$z_i^N = \frac{m_{ii}}{Y_i}$$

  - m_{ij} is industry i's use of imported intermediate inputs from industry j
  - Y_i is production

- *Broad* offshoring :

$$z_i^B = \frac{\sum_{j=1}^{N} m_{ij}}{Y_i}$$

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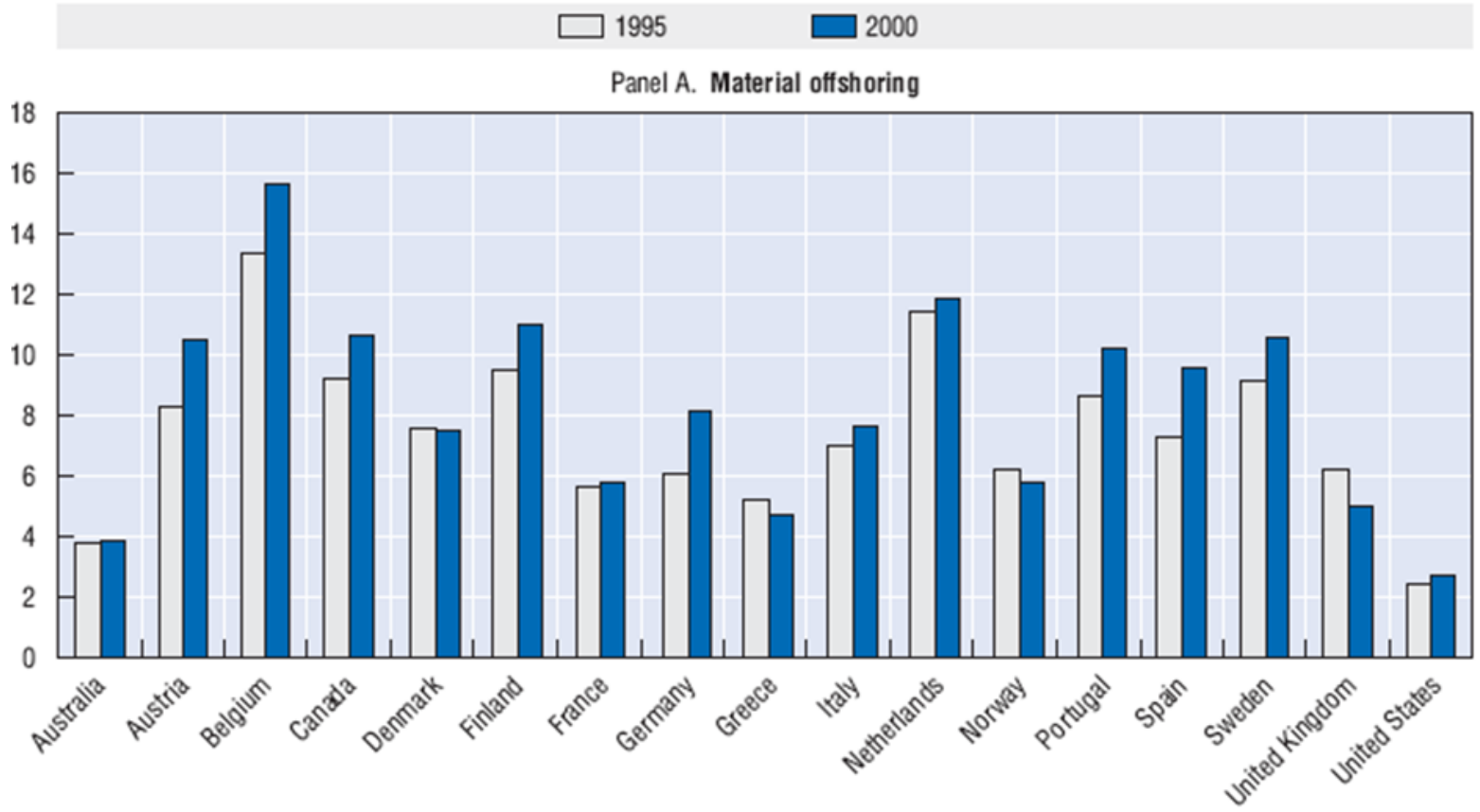
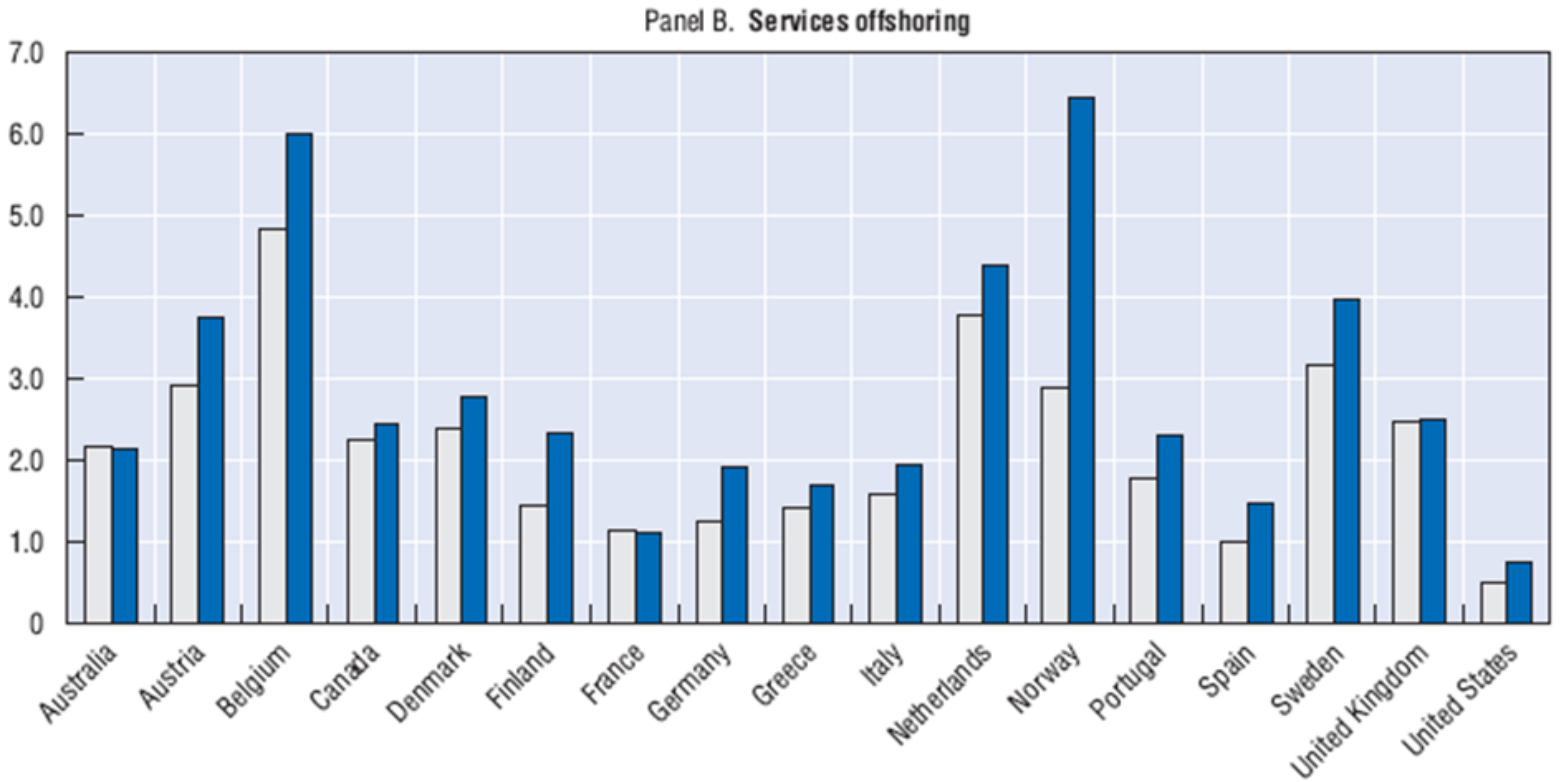
Offshoring of intermediate inputs 1995 and 2000

Figure 3.3. **Offshoring in selected OECD countries, 1995 and 2000**[a]

Share of imported intermediates in the total output (percentage)



Offshoring of services inputs 1995 and 2000



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- Labor market effects of offshoring:
  - Effects on employment (Amiti and Wei 2005, OECD 2007), controlling for and not controlling for output.
  - Effects on relative demand for different types of labor (Feenstra and Hanson 1996, 1999; Falk and Koebel 2002; Strauss-Kahn 2004; Hijzen et al. 2005, Ekholm and Hakkala, 2008).
- Short-run substitutability between different types of inputs using *cost-function approach*.
  - Effects via changes in output and investment?
- Longer-run view focusing on how offshoring affect productivity and prices using the *zero profit condition*.

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Translog cost function

- Widely used relatively flexible cost function is the so-called translog cost function (Diewert 1974).
- Translog cost function of single-product firm i:

$$\ln C_i = \beta_i + \sum_{j=1}^{S} \alpha_j \ln w_j + \sum_{j=1}^{S}\sum_{s=1}^{S} \gamma_{js} \ln w_j \ln w_s + \phi \ln Q_i$$
$$+ \sum_{j=1}^{S} \phi_j \ln Q_i \ln w_j + \sum_{r=1}^{R} \kappa_r z_{ir} + \sum_{j=1}^{S}\sum_{r=1}^{R} \lambda_{jr} z_{ir} \ln w_j$$

  - $j = 1, ...S$, $s = 1, ...S$, $r = 1, ...R$
- For the function to be linearly homogenous in factor prices $\sum_{j=1}^{S} \alpha_j = 1$ and $\sum_{j=1}^{S} \gamma_{js} = \sum_{s=1}^{S} \gamma_{js} = 0$ need to hold.

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Translog cost function, cont'd

- Differentiating translog cost function with respect to w_j:

$$\theta_{ij} = \alpha_j + \sum_{s=1}^{S} \gamma_{js} \ln w_s + \phi_j \ln Q_i + \sum_{r=1}^{R} \lambda_{jr} z_{ir}$$

- where θ_{ij} is the cost-share of factor j:

$$\theta_{ij} \equiv \frac{\partial C_i}{\partial w_j} \frac{w_j}{C_j}$$

- and $\frac{\partial C_i}{\partial w_j} = L_{ij}$ according to Shephard's lemma.

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Factor demand

- Firm *i*'s demand for factor *j* can then be written as:

$$L_{ij} = \frac{C_j}{w_j}\left[\alpha_j + \sum_{s=1}^{S}\gamma_{js}\ln w_s + \phi_j \ln Q_i + \sum_{r=1}^{R}\lambda_{jr}z_{ir}\right]$$

- Differentiation yields:

$$\widehat{L}_{ij} = \widehat{C}_j - \widehat{w}_j + \frac{1}{\theta_{ij}}\left[\sum_{s=1}^{S}\gamma_{js}\widehat{w}_s + \phi_j\widehat{Q}_i + \sum_{r=1}^{R}\lambda_{jr}dz_{ir}\right]$$

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Factor demand, cont'd

- Substituting $\widehat{C}_j$ for $\sum_{s=1}^{S} \theta_{is} \widehat{w}_s$ and collecting terms:

$$\widehat{L}_{ij} = \left(\frac{\gamma_{jj} + \theta_{ij}^2}{\theta_{ij}} - 1 \right) \widehat{w}_j + \sum_{k=1}^{S-1} \left(\frac{\gamma_{jk} + \theta_{ik}\theta_{ij}}{\theta_{ij}} \right) \widehat{w}_k + \frac{1}{\theta_{ij}} \left[\phi_j \widehat{Q}_i + \sum_{r=1}^{R} \lambda_{jr} dz_{ir} \right]$$

Factor demand, cont'd

- Hicksian wage elasticities can be expressed as:

$$\frac{\widehat{L}_{ij}}{\widehat{w}_j} = \frac{\gamma_{jj} + \theta_{ij}^2}{\theta_{ij}} - 1$$

$$\frac{\widehat{L}_{ij}}{\widehat{w}_k} = \frac{\gamma_{jk} + \theta_{ik}\theta_{ij}}{\theta_{ij}}.$$

- The former needs to be negative for well-behaved cost functions.
- The latter tells you wether factor j and k are price substitutes or price complements.

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- Elasticities with respect to structural variables:

$$\frac{\widehat{L}_{ij}}{dz_{ir}} = \frac{\lambda_{jr}}{\theta_{ij}}$$

- If positive (negative) an increase in z_r tends to increase (decrease) the demand for factor j.

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Using the cost-function approach

- Several ways one can use in order to estimate impact of e.g. offshoring:
  - Treat offshoring as structural variable and estimate λ_{jr} for different r's.
    - Feenstra and Hanson 1996; Hijzen, Gorg and Hines 2005; Ekholm and Hakkala 2008; Becker, Ekholm and Muendler, 2009.
  - Treat offshoring as input with a price and estimate γ_{jk} to compute cross-price elasticities.
    - Papers estimating cross-wage elasticities of affiliate and parent workers within multinational firms (Slaughter, Brainard and Riker 1997, 2001; Braconier and Ekholm 2000; Becker, Ekholm, Jäckle and Muendler 2005).
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Using the cost-function approach, cont'd

- Typical estimated function based on cost-function approach:

$$\Delta\theta_{iS} = \alpha_0 + \alpha_K \Delta \ln K_i + \alpha_Q \Delta \ln Q_i + \alpha_Z' \Delta z_i$$

  - S denotes skilled workers.
  - Capital treated as fixed factor.
  - Wages kicked out with argument that economy-wide wages get picked up by time dummies.
    - Sometimes are included, often estimates violate standard properties of cost function.
    - May try other specifications of the cost function.

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Results from Feenstra and Hanson 2003

	(1) Mean	(2) Regression	(3) Regression	(4) Regression	(5) Contri-bution
Δln(K/Y)	0.706	0.047 (0.011)	0.044 (0.011)	0.040 (0.009)	7.3-8.5%
Δln(Y)	1.541	0.020 (0.006)	0.017 (0.006)	0.010 (0.006)	4.0-7.8%
Outsourcing	0.223	0.197 (0.096)	0.221 (0.100)	0.135 (0.088)	14.6-24.0%
Computer and other high-tech capital measured with *ex post* rental prices:					
Computer share	0.251	0.195 (0.091)			12.6%
Other High-tech share	0.144	-0.065 (0.137)			--
Computer and other high-tech capital measured with *ex ante* rental prices:					
Computer share	0.070		0.431 (0.167)		7.8%
Other High-tech Share	0.166		0.005 (0.071)		0.2%
Computers measured as share of investment:					
Computer share	6.561			0.018 (0.007)	30.5%
High-tech share (*ex post* rental prices)	0.395			0.032 (0.052)	3.3%
Constant		0.203 (0.043)	0.206 (0.040)	0.157 (0.045)	40.4-53.1%
R^2		0.156	0.159	0.189	
N		447	447	447	

Results from Feenstra and Hanson 2003, cont'd

- Industry-level data for the US 1979-1990.
- Proxy skilled workers with nonproduction workers.
- Offshoring found to account for 15-24 percent of observed shift towards nonproduction labor.

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Other results using the cost-function approach

- Studies of FDI (production transfer within multinationals): Slaughter (2000), Head and Ries (2002), Hansson (2005), Becker, Ekholm and Muendler (2009).
- Studies measuring skills by occupations or educational attainment: Hijzen et al. (2005), (Ekholm and Hakkala 2008).
  - Distinguish between more than two groups and estimate systems of share equations.
  - Find that offshoring decreases relative demand for workers with low or intermediate level of skills.

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Results from Ekholm and Hakkala 2008

Table 6. Implied changes in demand for workers of actual increase in offshoring 1995-2003

Level of education	Type of offshoring	Estimation method	Estimated elasticity	Perc change. in demand
Upper-sec.	Low-income	non-inst.	-6.06	-4.10
		inst	-14.0	-9.47
	High-income	non-inst.	0.78	0.45
		inst	3.70	2.13
Tertiary	Low-income	non-inst.	10.6	7.15
		inst	30.1	20.3
	High-income	non-inst.	-1.65	-0.95
		inst	-8.30	-4.78

Note: The calculations are based on the actual change in the weighted average of offshoring between 1993 and 2003, which was .0068 for offshoring to low-income countries and .0058 for offshoring to high-income countries. Source: authors' own calculations.

Estimations based on zero-profit condition

- Production function linearly homogenous in inputs imply:

$$C(\mathbf{w}_i, Q_i, \mathbf{z}_i) = Q_i c(\mathbf{w}_i, \mathbf{z}_i)$$

  - Zero-profit condition can then be expressed as:

$$p_i = c(\mathbf{w}_i, \mathbf{z}_i)$$

  - Suppose that z affect productivity and define TFP as:

$$TFP_i = \sum_j^S \theta_{ij} \widehat{w}_{ij} - \widehat{p}_i$$

  - Productivity improvements imply that factor prices can rise more than product prices.

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Estimations based on zero-profit condition, cont'd

- Typical estimating equation:

$$\Delta \ln p_i = -TFP_i + \sum_j^S \theta_{ij}\omega_j + \varepsilon_i$$

- Use data on prices, TFP and factor cost shares to estimate ω_j, which are interpreted as the implied changes in factor prices.
- Problem that error term likely to be correlated with the factor cost shares (industries with fast-growing wage gaps likely to be relatively skill intensive).
- Trying to control for this by including interindustry factor price differentials leads to the estimation of what is basically an identity (Feenstra and Hanson 2003).

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Feenstra and Hanson 1999

- Propose a two-stage procedure:
  - First estimate the impact of structural variables (e.g. offshoring, technical change) on the *effective* total factor productivity and price.
  - The estimated coefficients of the structural variables give measures of how the structural variables have impacted on the amount that can be spent paying factors of production.
  - In a second stage these measures are regressed on factor cost shares, which generate the implied change in average factor prices from changes in the structural variables.

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Feenstra and Hanson 1999, cont'd

- *Effective* TFP (ETFP):

$$ETFP_i = TFP_i - \sum_j^S \theta_{ij}(\overline{\Delta \ln w_j} - \Delta \ln w_{ij})$$

  - TFP adjusted by the factor-cost share weighted difference between the average change and the industry change in factor prices.
- First stage:

$$\Delta \ln p_i + ETFP_i = \alpha + \eta' \Delta \mathbf{z}_i + \epsilon_i$$

- Suppose there are two structural variables, offshoring and computerization:

$$\Delta \ln p_i + ETFP_i = \alpha + \eta_O \Delta z_{Oi} + \eta_C \Delta z_{Ci} + \epsilon_i$$

Feenstra and Hanson 1999, cont'd

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- The estimate of ω can be interpreted as the portion of the total change in factor-prices that are explained by the structural variables.

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First stage results from Feenstra and Hanson 1999

TABLE IV

DEPENDENT VARIABLE—CHANGE IN VALUE-ADDED PRICES PLUS EFFECTIVE TFP, 1979–1990

	(1)	(2)	(3)
Independent variables:			
Outsourcing (narrow)	0.064	0.080	0.040
	(0.031)	(0.035)	(0.030)
Outsourcing (difference)	0.079	0.113	0.035
	(0.047)	(0.044)	(0.049)
Capital services (ex post rental prices):			
Computer share	0.167		
	(0.066)		
High-tech share (difference)	0.076		
	(0.072)		
Capital services (ex ante rental prices):			
Computer share		0.192	
		(0.108)	
High-tech share (difference)		−0.048	
		(0.082)	
Computer investment:			
Computer share			0.008
			(0.004)
High-tech share (ex post rental prices)			0.093
			(0.049)
constant	4.263	4.294	4.244
	(0.032)	(0.039)	(0.033)
R^2	0.153	0.109	0.213

Second stage results from Feenstra and Hanson 1999

TABLE V
ESTIMATED FACTOR-PRICE CHANGES—1979–1990

Dependent variable, Change in share-weighted factor prices explained by:	*Outsourcing (narrow)* (1)	*Outsourcing (difference)* (2)	*Computer share* (3)	*High-tech share (difference)* (4)
Mean of dependent variable	0.014	0.013	0.031	0.008
Independent variables:				
Production labor share	−0.010	0.020	−0.005	0.026
	(0.009)	(0.014)	(0.012)	(0.025)
Nonproduction labor share	0.099	0.063	0.248	0.007
	(0.049)	(0.039)	(0.100)	(0.004)
Capital share	0.002	−0.001	0.001	0.004
	(0.003)	(0.003)	(0.004)	(0.004)
R^2	0.256	0.227	0.505	0.310
N	447	447	447	447

Coefficient estimates used to construct the dependent variable are those from column (1) of Table IV. Standard errors are in parentheses and are calculated as described in the text to account for cross-observation correlation in the disturbances that arises from the construction of the dependent variable. Observations are by four-digit SIC industry. All regressions are weighted by the average industry share of total manufacturing

Summary of results so far

- Offshoring has contributed significantly to observed increase in relative wage of nonproduction workers in the US up until early 1990s.
- It has tended to shift labor demand away from workers with low or intermediate levels of skills in other countries.
  - But reported magnitudes are typically relatively modest.
- Some (weak) evidence of offshoring to low-wage countries having a differential effect from offshoring to high-wage countries.

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Remains to be done

- Using micro data.
  - Some work by Geishecker and Gorg using household data together with industry measures of offshoring).
- Estimating long-run general-equilibrium effects.
- Establishing causal relationships.
- Investigating impact on other aspects of worker characteristics.
  - Better measures of skills, nature of tasks carried out etc.

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