14.581 International Trade
— Lecture 24: Multinationals Empirics II —

Plan for Today's Lecture

- We will focus today on studying the 'international fragmentation of production' (without regard for whether it is taking place within the multi-national enterprise or not, the focus of the previous lecture).
- Brief introduction to 'international fragmentation'.
- How widespread is the international fragmentation of production?
- Some consequences of increased international fragmentation for the study of trade flows.
- Some effects of increased international fragmentation for wages.

Plan for Today's Lecture

- **Brief introduction to 'international fragmentation'.**
- How widespread is the international fragmentation of production?
- Some consequences of increased international fragmentation for the study of trade flows.
- Some effects of increased international fragmentation for wages.

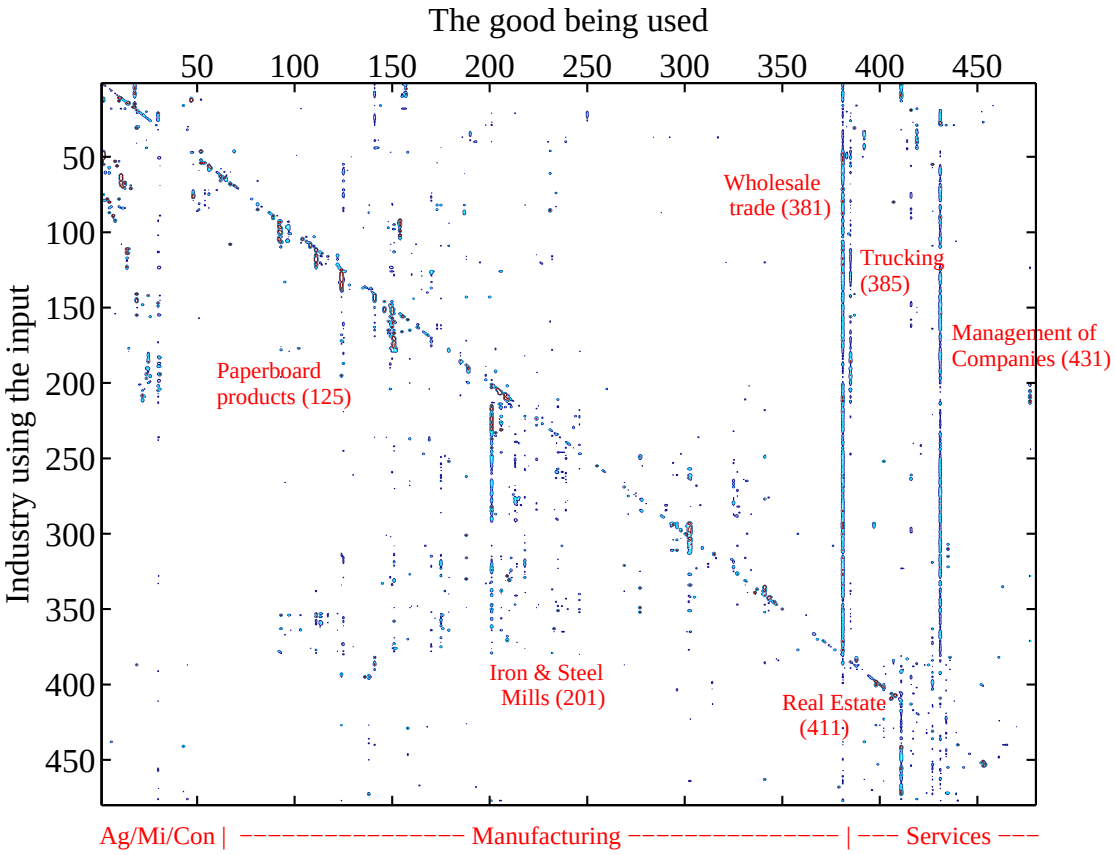
Introduction

- Estimates suggest that a large share (eg 2/3rds) of world trade is in intermediate goods.
- This suggests that a lot of production activity is being internationally fragmented. Or equivalently that the modern global economy features lots of what gets variously called:
  - "Offshoring"'.
  - "Slicing up of the value chain (internationally)."
  - "Vertical specialization."
  - "Outsourcing."
  - "Disintegration of production."
  - "Multi-stage production."
  - "Intra-product specialization."
  - ... !
- It thus seems important to understand this force for trade, and to understand its consequences for domestic economies in which international fragmentation is increasingly possible.

Jones (2007): (Domestic) I-O linkages appear to matter

Fine-level I-O table within the US

FIGURE 1. The U.S. Input-Output Matrix, 1997 (480 Industries)

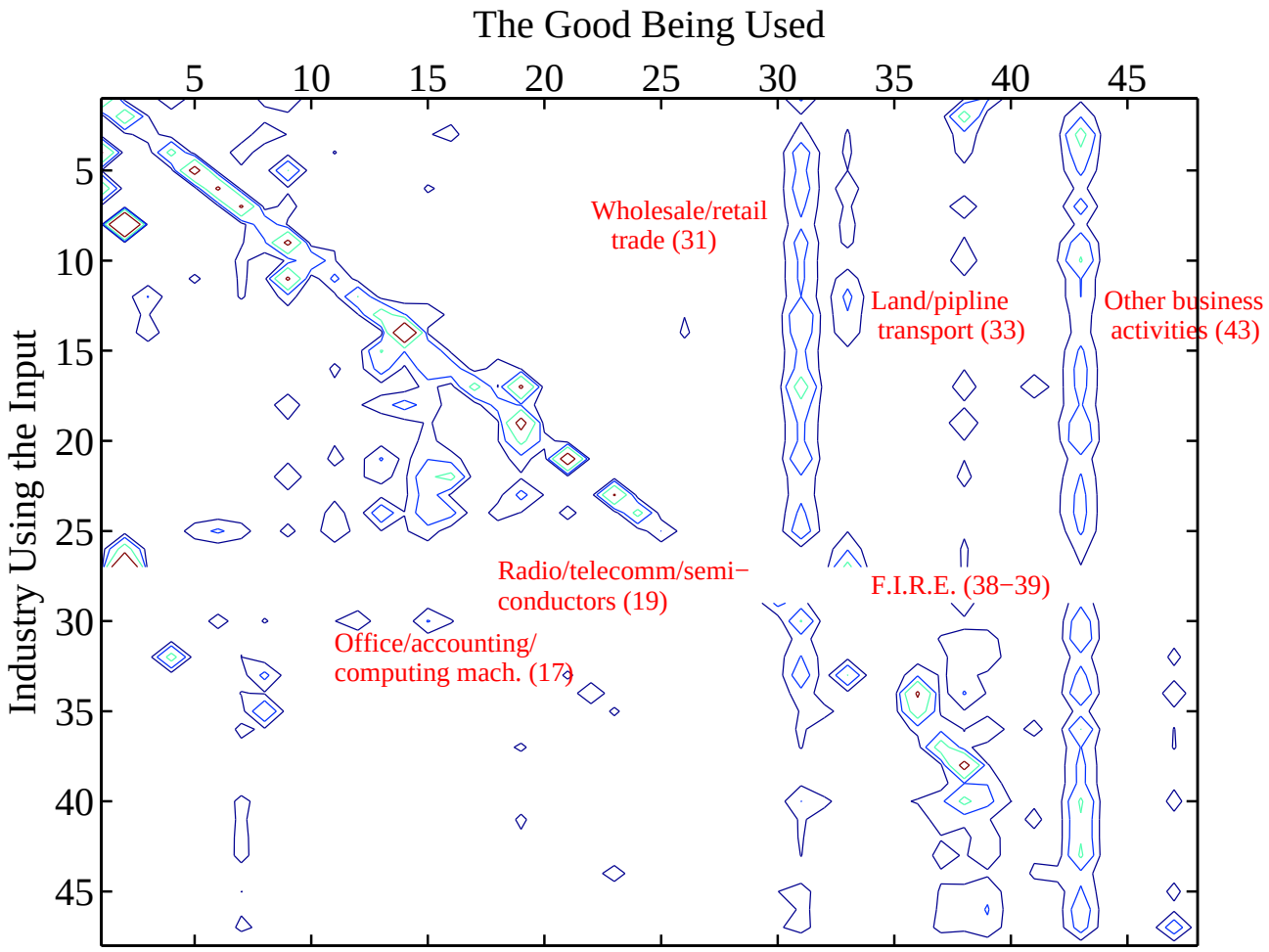


Note: The plot shows the matrix $[\sigma_{ij} + \lambda_{ij}]$, that is, the matrix of intermediate good shares for 480 industries. A contour plot method is used, showing only those shares greater than 2%, 4%, and 8%. Source: BEA 1997 Input-Output Benchmark data.

Jones (2007): (Domestic) I-O linkages appear to matter

Coarser I-O tables differ across countries

FIGURE 2. The U.S. Input-Output Matrix, 2000 (48 Industries)

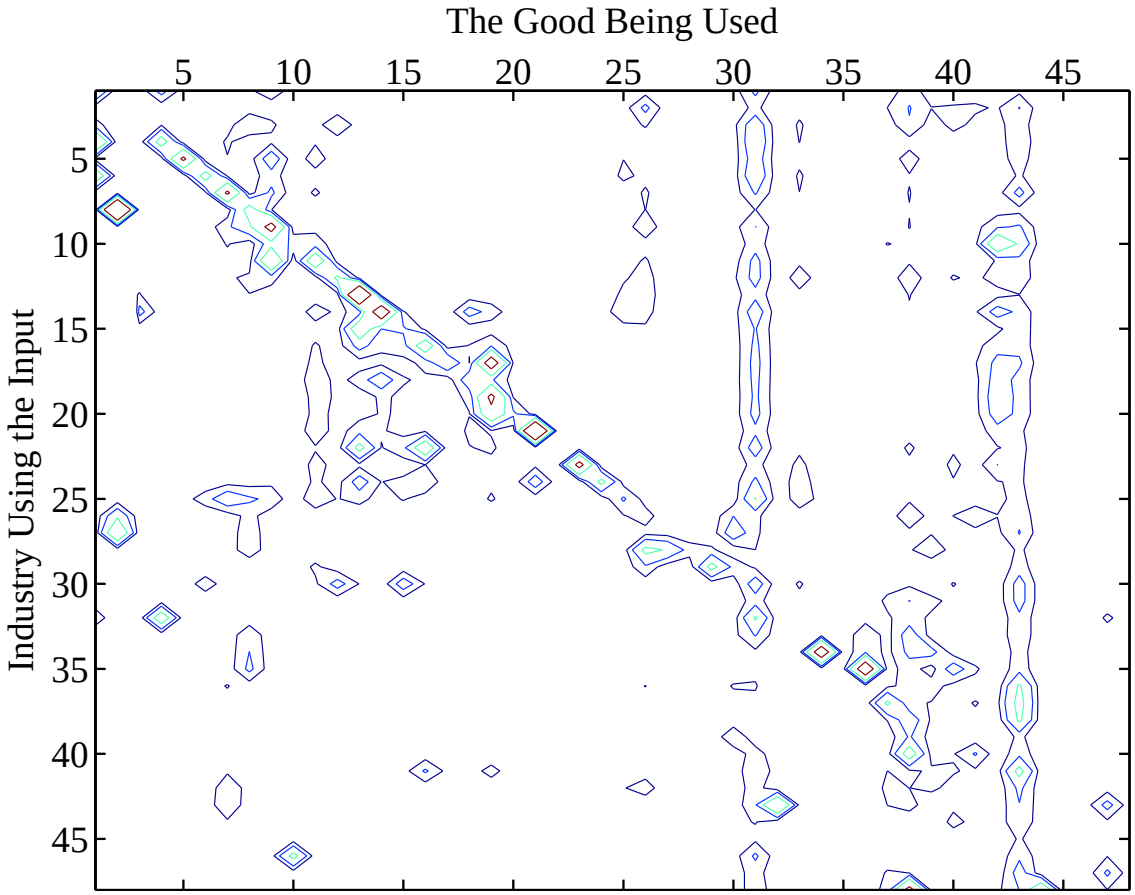


Note: See notes to Figure 1. Source: OECD 2006 database.

Jones (2007): (Domestic) I-O linkages appear to matter

Coarser I-O tables differ across countries

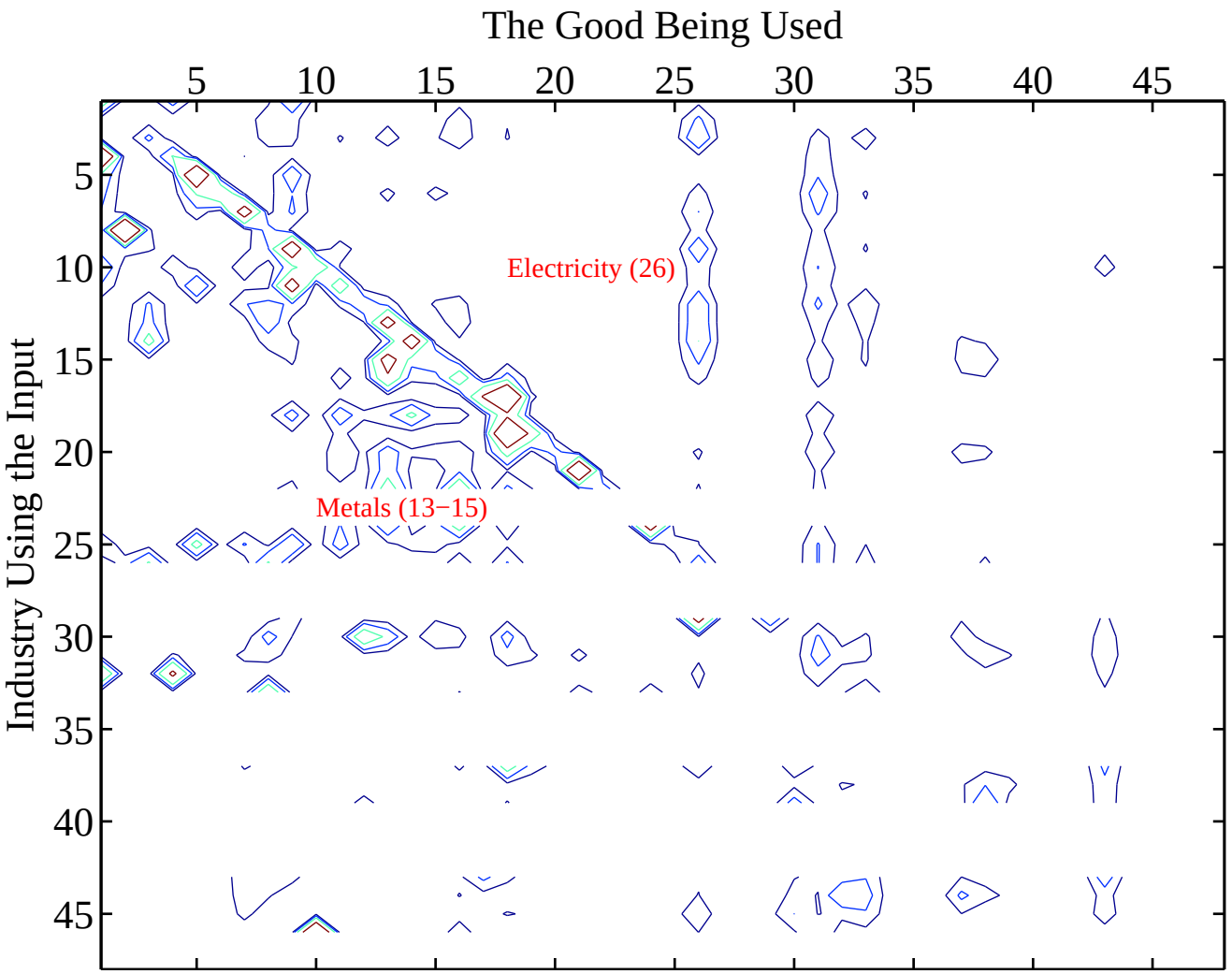
FIGURE 3. Input-Output Matrix in Japan and China (48 Industries)



(a) Japan

Jones (2007): (Domestic) I-O linkages appear to matter

Coarser I-O tables differ across countries



(b) China

Plan for Today's Lecture

- Brief introduction to 'international fragmentation'.
- How widespread is the international fragmentation of production?
- Some consequences of increased international fragmentation for the study of trade flows.
- Some effects of increased international fragmentation for wages.

Measuring International Fragmentation

- We start by briefly discussing 2 papers that attempt to measure the extent of international fragmentation.
- Why is this so hard?
  - Trade flows are classified into 'products'.
  - Recall that trade flows are measured as the amount of value added that is crossing the border, not the amount of value added that was added to the shipment while it was inside the exporting country.
  - Whether these are intermediate products or not is surprisingly hard to judge based on their descriptions (the state of the art, to my knowledge, is to call a product an intermediate if the word 'part' or 'component' etc appears in the description.)
  - There is certainly no 'official' declaration of products as final or intermediate.
  - And of course, many goods can be both intermediates and final goods (both within and across countries).
- Two recent papers consult Input-Output tables (which of course declare which goods are used as inputs and which are final outputs) to shed light on this.

Hummels, Ishii and Yi (2001)

- HIY (2001) focus one one particular type of international fragmentation:
  - When an intermediate good is imported, transformed into a final good, and then exported.
  - Example: Japan imports oil, produces petrochemicals, some of which are exported.
- Clearly this will be an underestimate of international fragmentation (because imported intermediates, without subsequent exporting, are a simpler form of fragmentation).
- HIY use I-O tables:
  - These contain industry-wise input purchases from both home and 'foreign' (never bilaterally foreign).
  - Also include total output and exports (again, not bilateral).

HIY (2001): Method

Define Vertical Specialization (here), in sector k, as: $VS_2^k = \left(\frac{A}{D+E}\right) E$

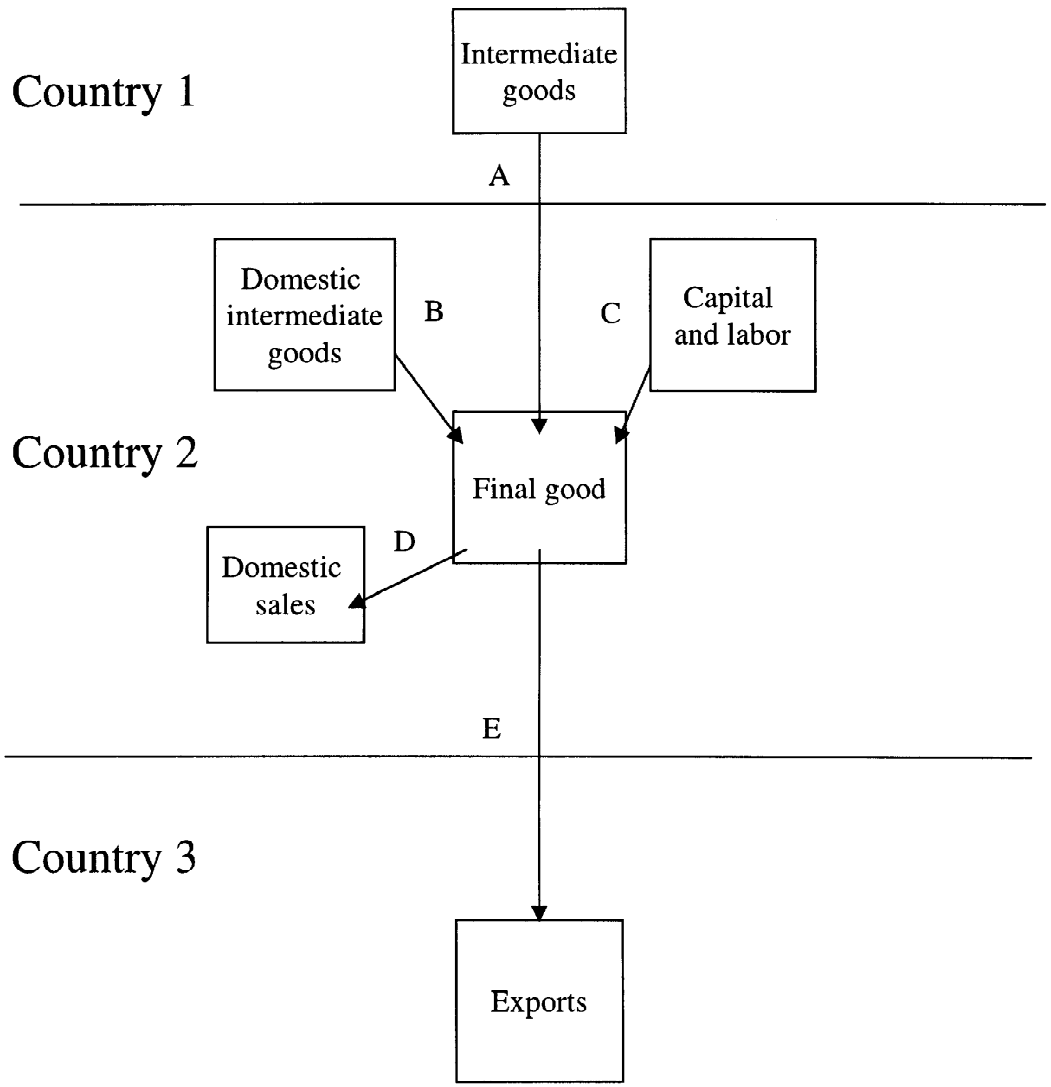


Fig. 1. Vertical specialization.

HIY (2001): Results

Many OECD countries are considerably engaged in fragmentation, even by this narrow measure

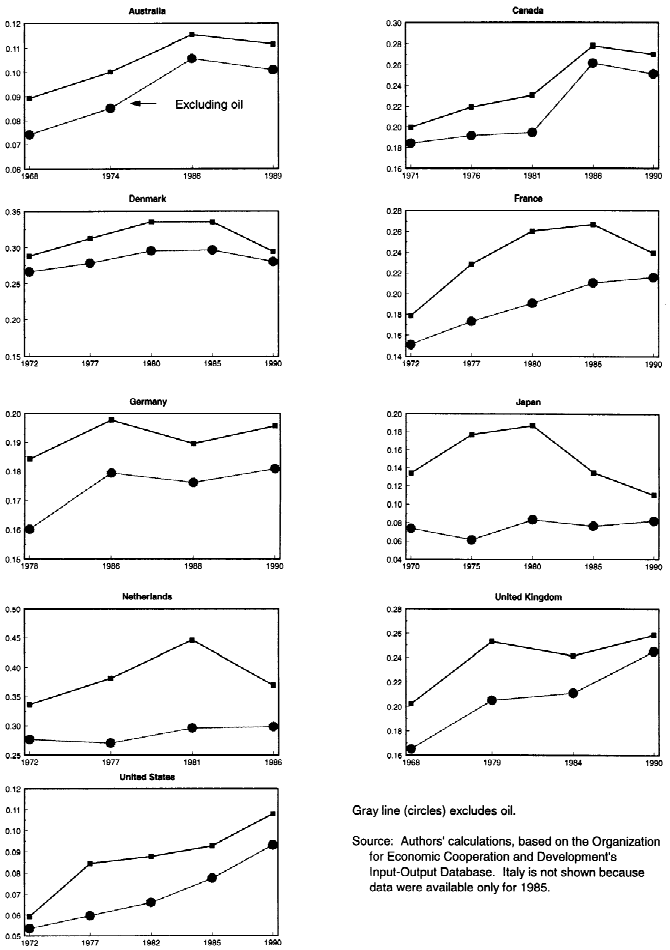


Fig. 2. VS exports as a share of total merchandise exports: OECD countries.

Johnson and Noguera (2009)

- JN (2009) extend the HIY (2001) methodology:
  - More complete measure of fragmentation.
  - Better data (more countries and sectors).
- Focus is on a quite natural question:
  - How much of a country's exports (which, recall, are 'gross output') are value added by that country?

JN (2009): Method I

- Unfortunately we don't have time to go through the details.
  - (Though they are worth knowing about since concepts based on I-O tables crop up all the time in economics.)
- JN (2009) lay this out nicely:
  - Start with a 2-country example.
  - Move to a special 3-country example. Motivated by popular case study of international fragmentation: iPods are made with a blueprint produced in the US, a Japanese display, a Japanese disk drive (manufactured in China), and assorted lesser components made in Taiwan, China, Korea etc. (Starts to remind us of that old adage in economics that: "no single person on the face of the planet knows how to make a pencil", yet millions of them are made every year for fractions of a cent.)
  - Move on to full N-country case.

JN (2009): Results

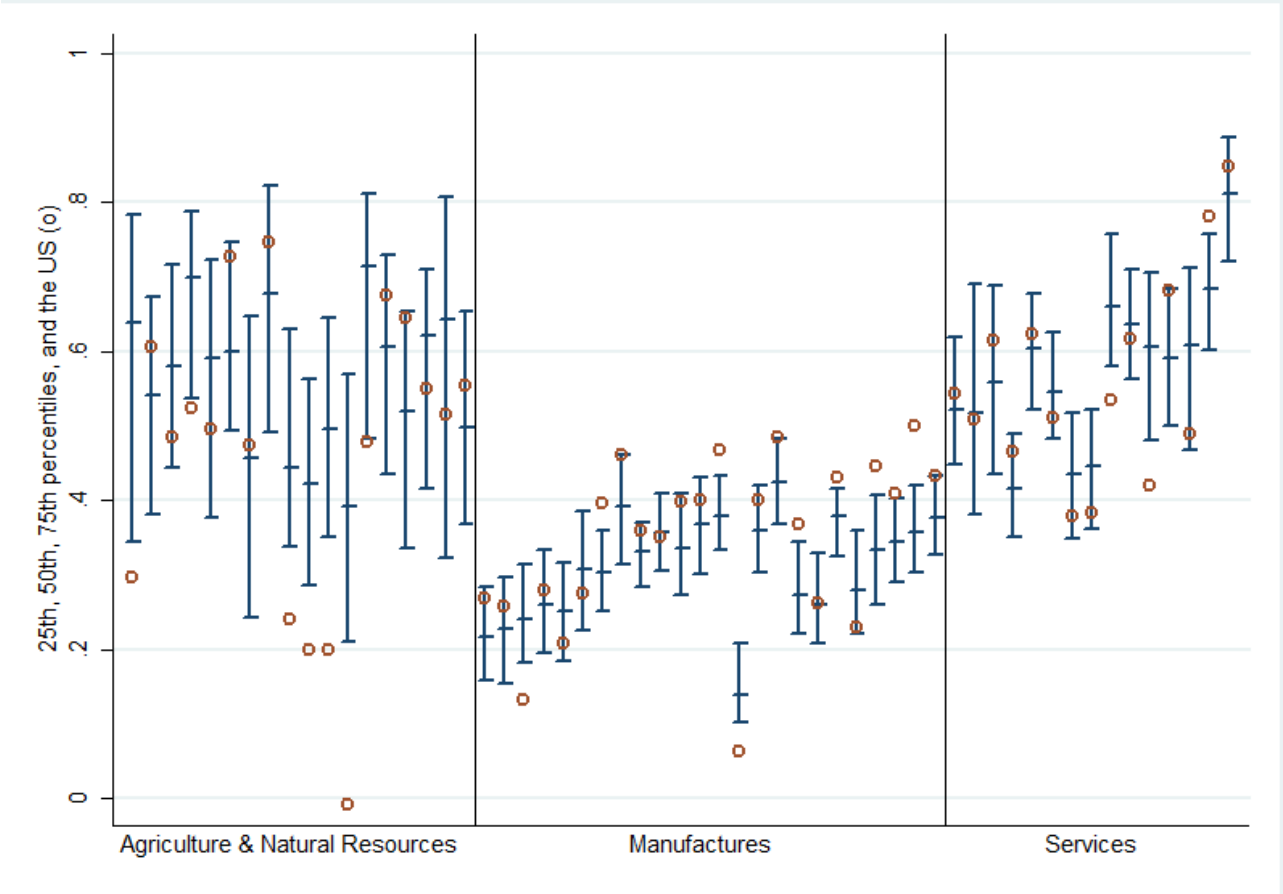


Figure 1: Ratio of Value Added to Output, by Sector

JN (2009): Results

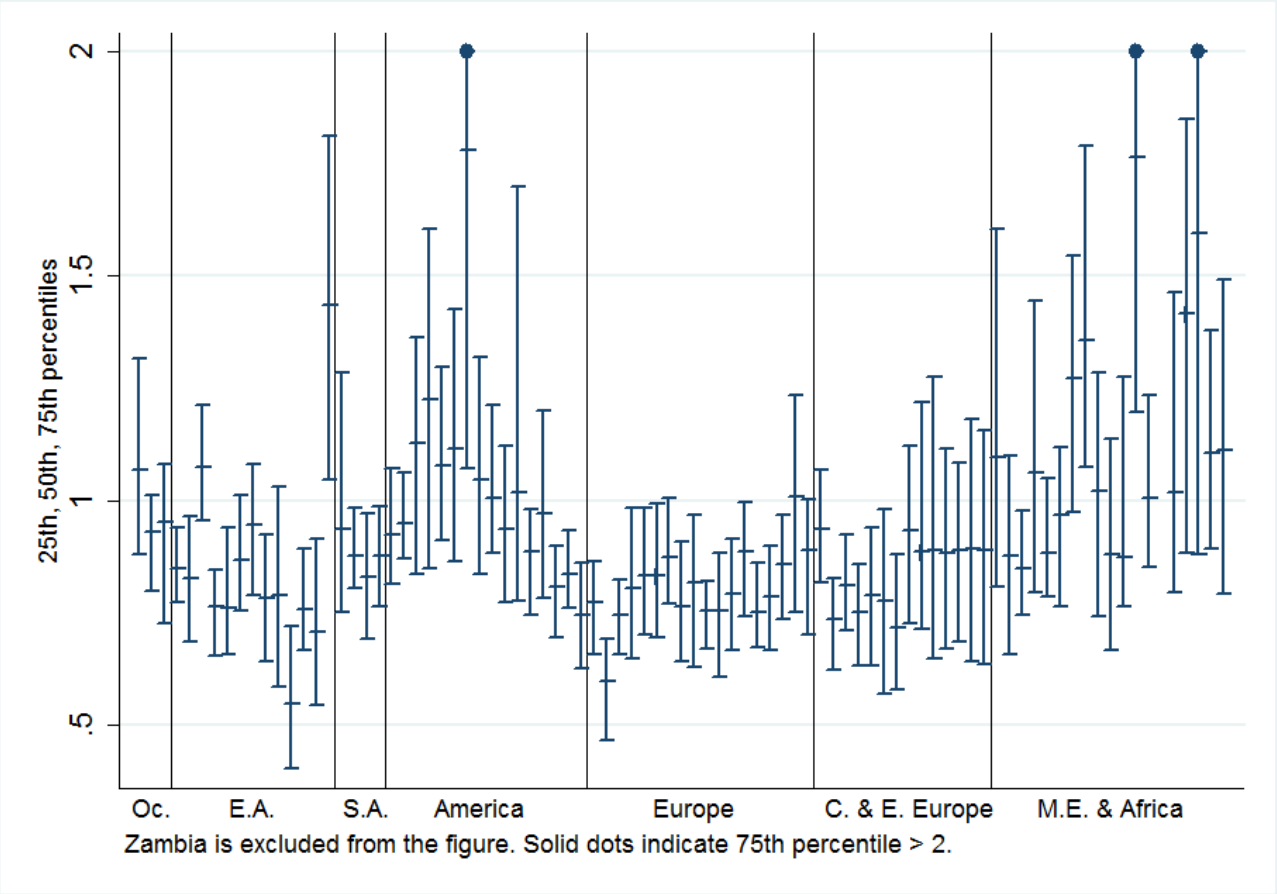


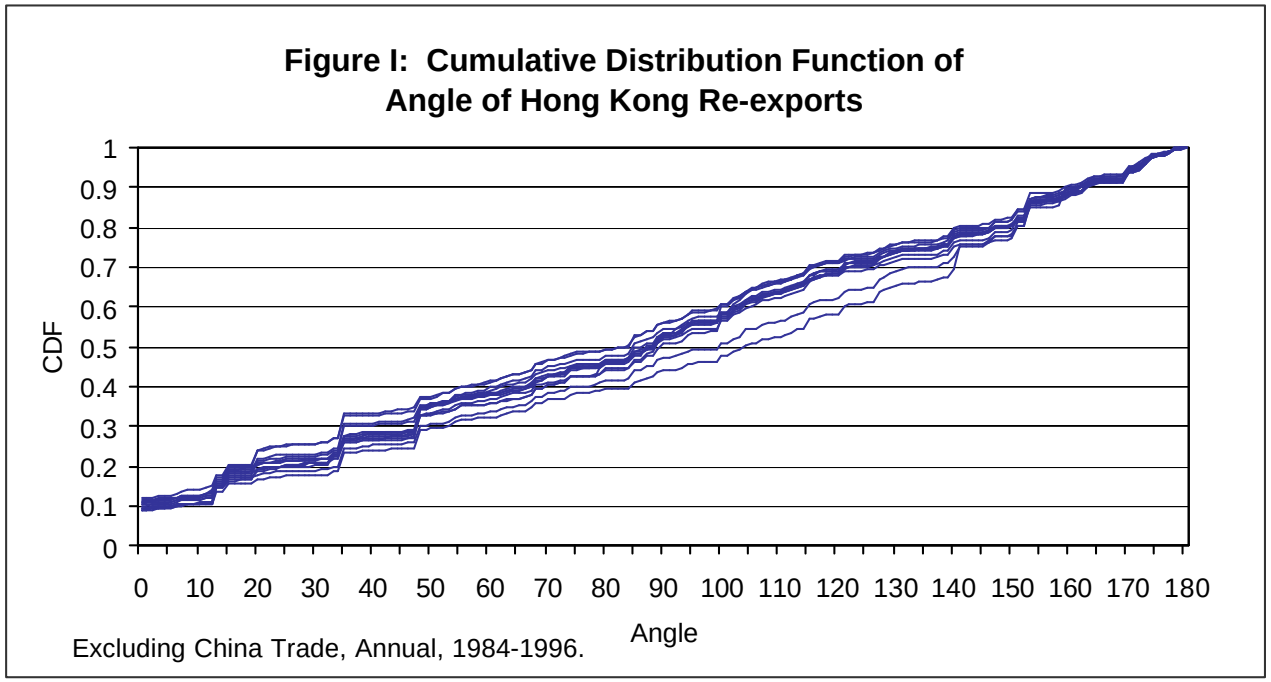
Figure 7: Bilateral Ratio of Value Added Exports to Gross Exports, by Country

Aside on Re-Exporting

- We haven't discussed 're-exporting' elsewhere in this course so far.
- Re-exporting is the phenomenon by which a country (typically Belgium, Hong Kong and Singapore) acts as a sort of international 'distribution hub'.
  - So lots of goods get imported by these hub countries, and then subsequently exported.
  - Some of these hubs (eg Hong Kong) keep separate trade statistics for re-exported goods (goods that 'are not sufficiently transformed in HK for their country of origin to plausibly be taken as HK'), but most don't.
  - So there is always a risk that re-exporting looks like trade in intermediates (though the I-O table methods described earlier are immune to this).
- Young (1999) studies Hong Kong's re-export data in detail and attempts to understand why this phenomenon is so prevalent (IRTS in transportation vs IRTS in 'processing' vs IRTS in matching buyers to sellers).

Young (1999): Hong Kong's Re-exporting 'angle' of diversion

Lots of re-exporting is acute. Eg, 15% of goods that come from US get sent back to the US. This is 65% for Israel.



Plan for Today's Lecture

- Brief introduction to 'international fragmentation'.
- How widespread is the international fragmentation of production?
- **Some consequences of increased international fragmentation for the study of trade flows.**
- Some effects of increased international fragmentation for wages.

Positive Consequences of International Fragmentation

- We now discuss some of the consequences of international fragmentation for the study of trade flows.
  1. Yi (JPE 2003): The possibility of international fragmentation raises the trade-to-tariff elasticity.
  2. Yi (AER, 2010): Similar consequences for estimation of the 'border effect'.

Yi (2003)

- Yi (2003) motivates his paper with 2 puzzles:
  1. The trade flow-to-tariff elasticity in the data is way higher than what standard models predict.
  2. The trade flow-to-tariff elasticity in the data appears to have become much higher, non-linearly, around the 1980s. Why?

- Yi (2003) formulates and calibrates a 2-country DFS (1977)-style model with and without 'vertical specialization' (ie intermediate inputs are required for production, and these are tradable).
  - The model without VS fails to match puzzles 1 or 2.
  - The calibrated model with VS gets much closer.
  - Intuition for puzzle 1: if goods are crossing borders N times then it is not the tariff $(1+\tau)$ that matters, but of course $(1+\tau)^N$ instead.
  - Intuition for puzzle 2: if tariffs are very high then countries won't trade inputs at all. So the elasticity will be initially low (as if $N=1$) and then suddenly higher (as if $N>1$).

Yi (2003): Puzzles 1 and 2

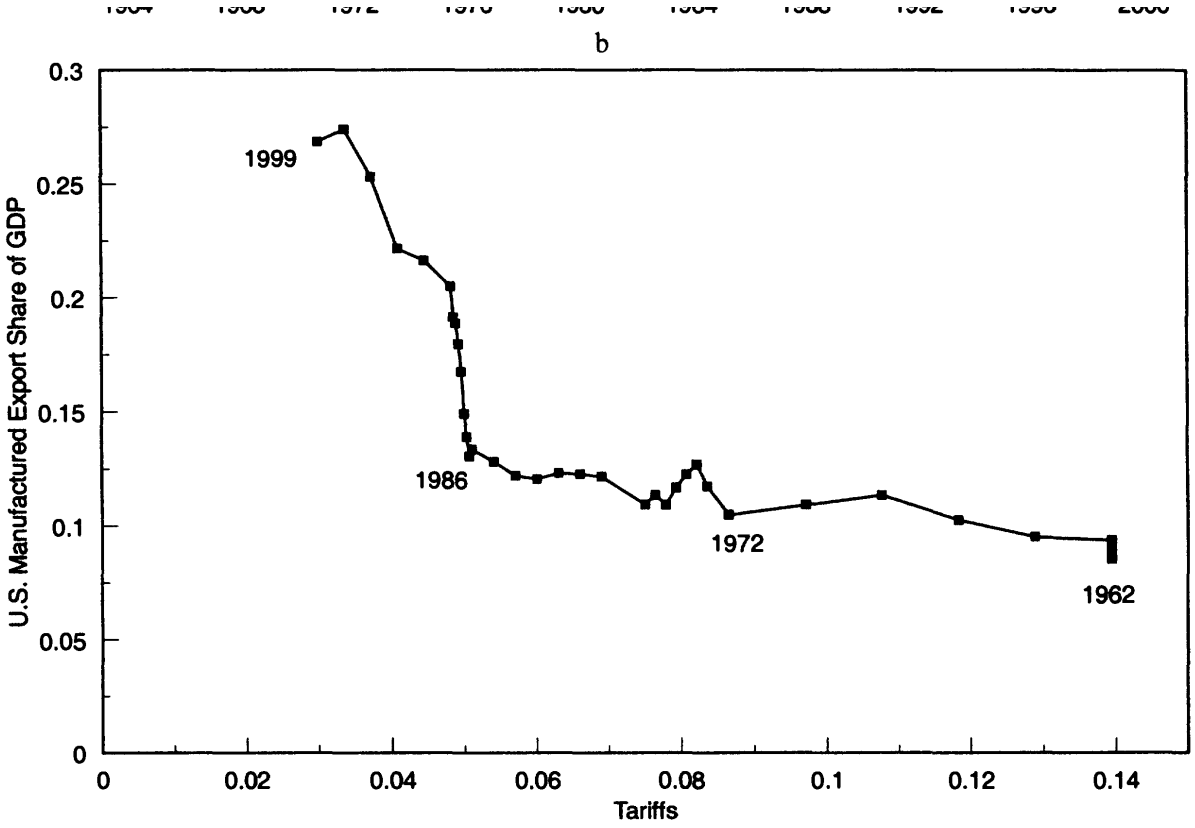


FIG. 1.—Manufacturing export share of GDP and manufacturing tariff rates. Source: World Trade Organization (2002) and author's calculations (see App. A and Sec. V).

Yi (2003): Simplified Version of Model

- Production takes 3 stages:
  1. $y_1^i(z) = A_1^i(z) l_1^i(z)$ with $i = H, F$. Inputs produced.
  2. $y_2^i(z) = x_1^i(z)^\theta \left[A_2^i(x) l_2^i(z)\right]^{1-\theta}$ with $i = H, F$. Sector uses inputs to produce final goods.
  3. $Y = exp\left[\int_0^1 \ln\left[x_2(z)\right] dz\right]$. Final (non-tradable) consumption good is Cobb-Douglas aggregate of Stage 2 goods.

Yi (2003): Simplified Version of Model

- If VS is occurring (ie τ is sufficiently low) then let z_l be the cut-off that makes a Stage 3 firm indifferent between using a "HH" and a "HF" upstream organization of production.
  - This requires that: $\frac{w^H}{w^F} = (1+\tau)^{(1+\theta)/(1-\theta)} A_2^H(z_l)/A_2^F(z_l)$.
  - Differentiating and assuming that the relative wage doesn't change much:

$$\widehat{1-z_l} = \left(\frac{1+\theta}{1-\theta}\right)\left[\frac{z_l}{(1-z_l)\eta_{A_2}}\right]\widehat{1+\tau}$$

- However, if VS is not occurring (ie τ is high) then:
  - This requires $\frac{w^H}{w^F} = (1+\tau) A_2^H(z_l)/A_2^F(z_l)$.
  - So the equivalent derivative is:

$$\widehat{1-z_l} = \left[\frac{z_l}{(1-z_l)\eta_{A_2}}\right]\widehat{1+\tau}$$

- For $\theta < 1$ (eg $\theta = \frac{2}{3}$) the multiplier in the VS can be quite big (eg 5).

Yi (2003): The Model and the 2 Puzzles

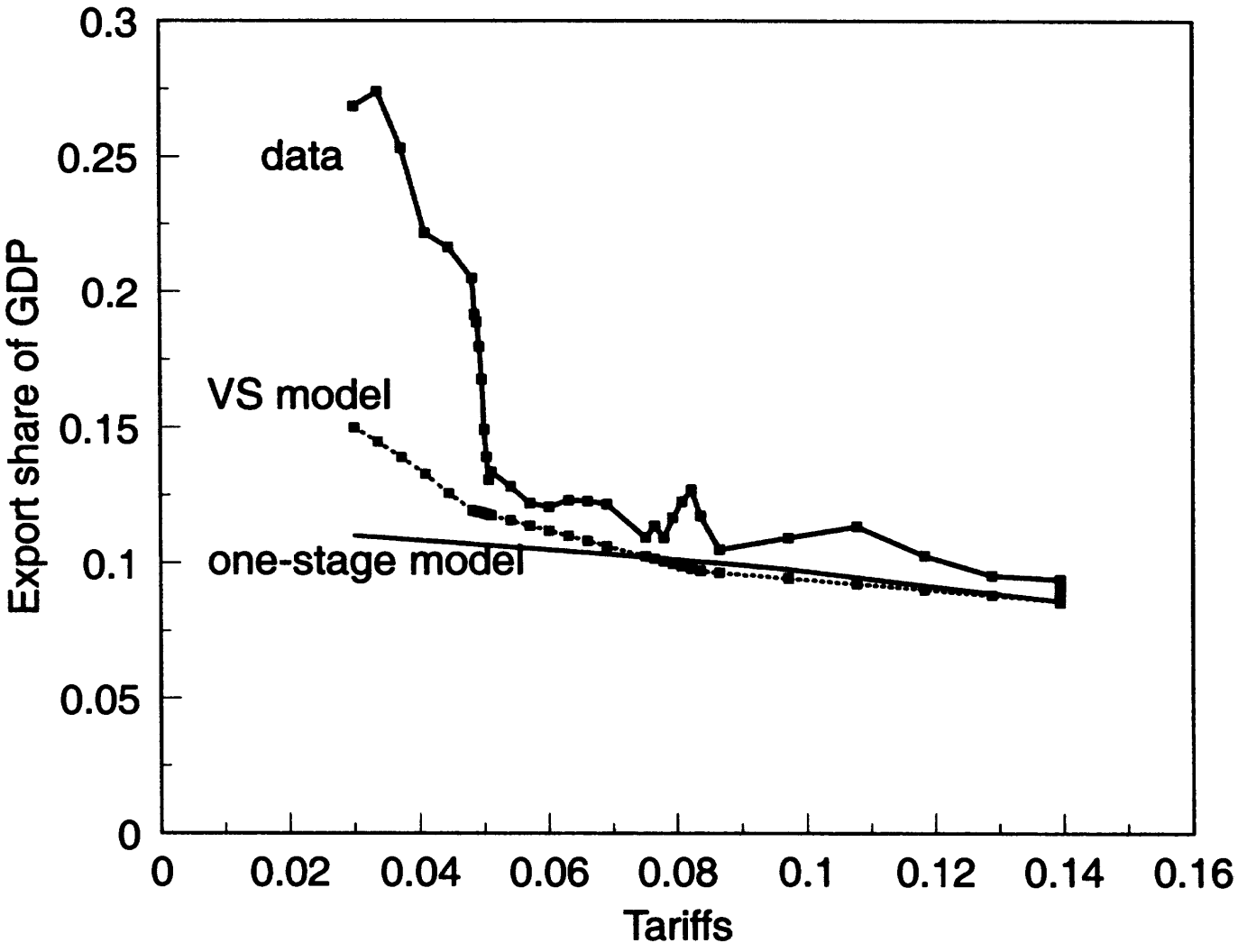


FIG. 10.—Narrow case: vertical model vs. one-stage model

Yi (AER, 2010)

- Yi (2010) points out that the Yi (2003) VS argument also has implications for cross-sectional variation in the trade elasticities
  - Recall that estimates of the gravity equation (eg Anderson and van Wincoop, 2003) within the US and Canada find that there appears to be a significant additional trade cost involved in crossing the US-Canada border. The tariff equivalent of this border effect is much bigger than US-Canada tariffs.
  - This is called the 'border effect' or the 'home bias of trade' puzzle.

- Yi (2010) argues that if production can be fragmented internationally then the (gravity equation-) estimated border-crossing trade cost will be higher than the true border-crossing trade cost.
  - This is because (in such a model) the true trade flow-to-border cost elasticity will be larger than that in a standard model (without multi-stage production).

Yi (2010): Results

- Yi (2010) uses data on tariffs, NTBs, freight rates and wholesale distribution costs to claim that the 'true' Canada-US border trade costs are 14.8%.
- He then simulates (a calibrated version of) his model based on this 'true' border cost.
- He then compares the border dummy coefficient in 2 regressions:
  - A gravity regression based on his model's predicted trade data.
  - And the gravity regression based on actual trade data.
- The coefficient on the model regression is about 2/3 of the data regression. A trade cost of 26.1% would be needed for the coefficients to match.
  - By contrast, a standard Eaton and Kortum (2002) model equivalent (without multi-stage production) would give much smaller coherence between model and data.

Plan for Today's Lecture

- Brief introduction to 'international fragmentation'.
- How widespread is the international fragmentation of production?
- Some consequences of increased international fragmentation for the study of trade flows.
- **Some effects of increased international fragmentation for wages.**

Consequences of Offshoring for Workers

- This is an enormous literature, of which we will only be able to see a small segment:
  - Hsieh and Woo (AER 2005)
  - Hummels, Jorgensen, Munch and Xiang (2008)
- But there is lots more ongoing work in this area, including:
  - Feenstra and Hanson (QJE 1999) and the 2008 Ohlin lecture series given by Feenstra.
  - Liu and Trefler (2008)
  - Jensen and Kletzer (Brookings, 2005)
  - Blinder (2006).
  - Autor and Handel (2008).
  - Kramarz (2008).
  - Bergin, Feenstra and Hanson (AER 2009) on volatility and outsourcing.

Hsieh and Woo (AER, 2005)

- HW (2005) examine the case of China's 1980 liberalization of foreign investment.
  - Hong Kong used to produce manufactured goods and then export them.
  - With the ability of HK firms to set up manufacturing operations in China and to buy manufactured goods from China—that is, to outsource the production stage of their business to China—manufacturing employment in China fell and 'outsourcing services' (the services that do the exporting) employment rose.
  - HW claim that this is one of the largest 'outsourcing shocks' in world history.
- What happened (to wages and employment) is what one would expect if outsourcing services are more skill-intensive.

HW (2005): Results

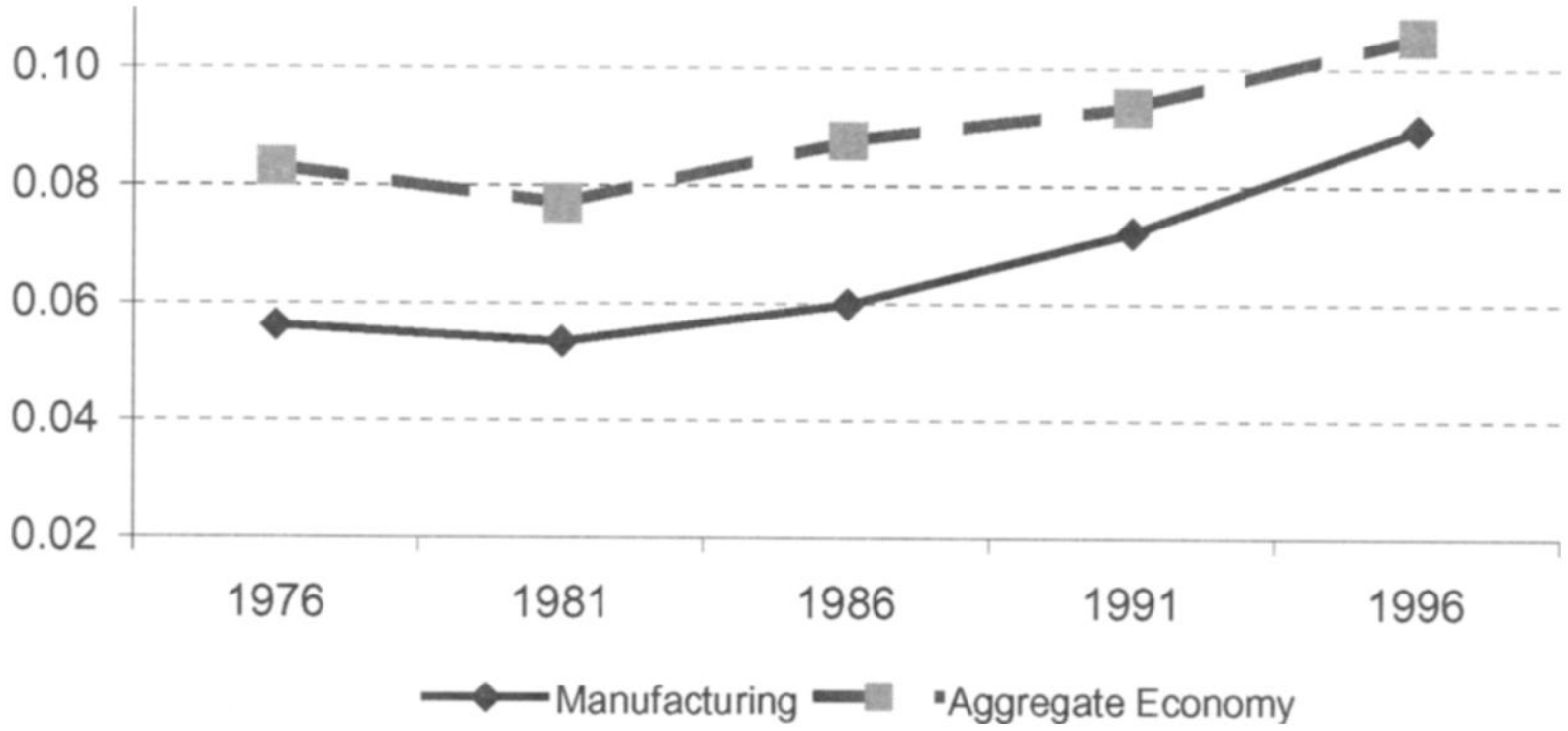


FIGURE 1. RETURNS TO EDUCATION IN HONG KONG, 1976–1996

Note: Coefficients from OLS regression of log monthly wage on years of schooling (other covariates include an indicator variable for sex and a quadratic in potential experience) from Hong Kong Population Censuses of 1976, 1981, 1986, 1991, and 1996.

HW (2005): Results

TABLE 1—SHARE OF EMPLOYMENT BY SECTOR (PERCENT)

	1971	1976	1981	1986	1991	1991
Agriculture	3.8	1.7	1.4	1.7	1.0	0.5
Manufacturing	41.2	41.5	39.3	35	29.9	19.0
Traded services	31.8	32.5	33.2	37.3	39.6	49.0
Non-traded services	23.2	24.3	26.1	26.0	29.5	31.5

Notes: Authors' tabulations from Hong Kong Population Censuses. Traded services is defined as wholesale trade, import and export trade, banking, insurance, accounting, legal and other business services; storage and warehouse services; transportation services; and communication services. Nontraded services are utilities, construction, community and social services; recreational and cultural services; personal and household services; and retail trade.

HW (2005): Results

TABLE 4—OLS ESTIMATES OF RELATIONSHIP BETWEEN INDUSTRY OUTSOURCING AND RELATIVE DEMAND SHIFT

	Dependent variable: dln(non-production worker wage-bill share)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Independent variable:										
dln[imports/(shipments + imports)]	0.3125	0.2671	0.2759	0.2671	0.2888					
	(0.1084)	(0.1104)	(0.1242)	(0.1108)	(0.1297)					
	[0.48]	[0.41]	[0.45]	[0.41]	[0.45]					
dln[imported int. inputs/(shipments + imported int.inputs)]						0.424	0.3548	0.3711	0.3600	0.3745
						(0.1506)	(0.1490)	(0.1641)	(0.1518)	(0.1727)
						[0.43]	[0.36]	[0.39]	[0.37]	[0.38]
Controls:										
dln(K/Y) and dln(Y)	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
1971–76 trends	No	No	Yes	No	No	No	No	Yes	No	No
World skill biased technical change	No	No	No	Yes	No	No	No	No	Yes	No
Industry dummies	No	No	No	No	Yes	No	No	No	No	Yes
R^2	0.55	0.59	0.65	0.59	0.48	0.54	0.59	0.65	0.59	0.47

Notes: Standard errors (clustered by industry) in parentheses. The observation is an industry-year period ($N = 54$). All regressions include time-period dummies. The brackets contain the share of a standard deviation of the dependent variable explained by a standard deviation increase in the independent variable. dln[imports/(shipments + imports)] is change in share of imports from China as a fraction of imports from China and domestic shipments. dln[imported int. inputs/(shipments + imported int. inputs)] is change in share of intermediate inputs imported from China. Control for 1971–76 trend is 1971–76 change in employment share of nonproduction worker in the industry. Controls for world skill biased technical change are worldwide rates of SBTC and change in wage-bill share of nonproduction workers in the United States.

HW (2005): Results

TABLE 5—EXPLAINING DIFFERENCES ACROSS INDUSTRIES IN OUTSOURCING TO CHINA

	Dependent variable							
	dln[imports/(shipments + imports)]				dln[imported intermediate inputs/(shipments + imported intermediate inputs)]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:								
Independent variable:								
1976 value-added share of labor	18.43	15.45	16.11	11.48	12.22	10.79	11.29	9.04
	(4.21)	(5.43)	(6.47)	(4.45)	(2.76)	(3.17)	(3.75)	(2.87)
	[0.88]	[0.74]	[0.77]	[0.55]	[0.89]	[0.78]	[0.82]	[0.66]
R^2	0.60	0.64	0.65	0.85	0.60	0.64	0.65	0.84
Panel B:								
Independent variable:								
1976 wage-bill share of nonproduction workers	−5.47	−3.91	−4.20	−3.00	−4.07	−4.60	−4.66	−2.19
	(2.03)	(1.32)	(1.76)	(0.84)	(1.06)	(1.47)	(1.19)	(0.69)
	[0.26]	[0.19]	[0.20]	[0.14]	[0.30]	[0.33]	[0.34]	[0.16]
R^2	0.60	0.62	0.62	0.65	0.60	0.56	0.56	0.63
Controls:								
dln(K/Y) and dln(Y)	No	Yes	Yes	Yes	No	Yes	Yes	Yes
1971–76 trends	No	No	Yes	No	No	No	Yes	No
World skilled biased technical change	No	No	No	Yes	No	No	No	Yes

Notes: Standard errors (clustered by industry) in parentheses. The observation is an industry-year period ($N = 54$). All regressions include time-period dummies. The brackets contain the share of a standard deviation of the dependent variable explained by a standard deviation increase in the independent variable. dln[imports/(shipments + imports)] is change in share of imports from China as a fraction of imports from China and domestic shipments. dln[imported int. inputs/(shipments + imported int. inputs)] is change in share of intermediate inputs imported from China. Control for 1971–76 trend is 1971–76 change in employment share of nonproduction worker in the industry. Controls for world skill biased technical change are worldwide rates of SBTC and change in wage-bill share of nonproduction workers in the United States.

HW (2005): Results

TABLE 6—IV ESTIMATES OF RELATIONSHIP BETWEEN INDUSTRY OUTSOURCING AND RELATIVE DEMAND SHIFTS

	Dependent variable: dln(nonproduction worker wage-bill share)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Instrument = value-added share of labor (in 1976)								
Independent variable:								
dln[imports/(shipments + imports)]	0.3497	0.2934	0.2827	0.3280				
	(0.1059)	(0.1178)	(0.1026)	(0.1166)				
	[0.54]	[0.45]	[0.44]	[0.51]				
dln[imported int. inputs/(shipments + imported int. inputs)]					0.5274	0.4205	0.4034	0.4164
					(0.1798)	(0.1830)	(0.1546)	(0.1743)
					[0.54]	[0.43]	[0.41]	[0.42]
Overidentification Test (*p*-value)	0.96	0.96	0.95	0.98	0.98	0.94	0.93	0.94
Panel B: Instrument = wage bill share of nonproduction workers (in 1976)								
Independent variable:								
dln[imports/(shipments + imports)]	0.7838	1.2613	0.6599	1.0695				
	(0.2405)	(0.6031)	(0.3130)	(0.4485)				
	[1.21]	[1.95]	[1.02]	[1.65]				
dln[imported int. inputs/(shipments + imported int. inputs)]					1.0536	1.3729	0.7129	1.4634
					(0.2593)	(0.4999)	(0.2388)	(0.7867)
					[1.07]	[1.39]	[0.72]	[1.48]
Overidentification test (*p*-value)	0.94	0.93	0.98	0.96	0.96	0.95	0.99	0.95
Controls:								
dln(K/Y) and dln(Y)	No	Yes	Yes	Yes	No	Yes	Yes	Yes
1971–76 trends	No	No	Yes	No	No	No	Yes	No
World skill biased technical change	No	No	No	Yes	No	No	No	Yes

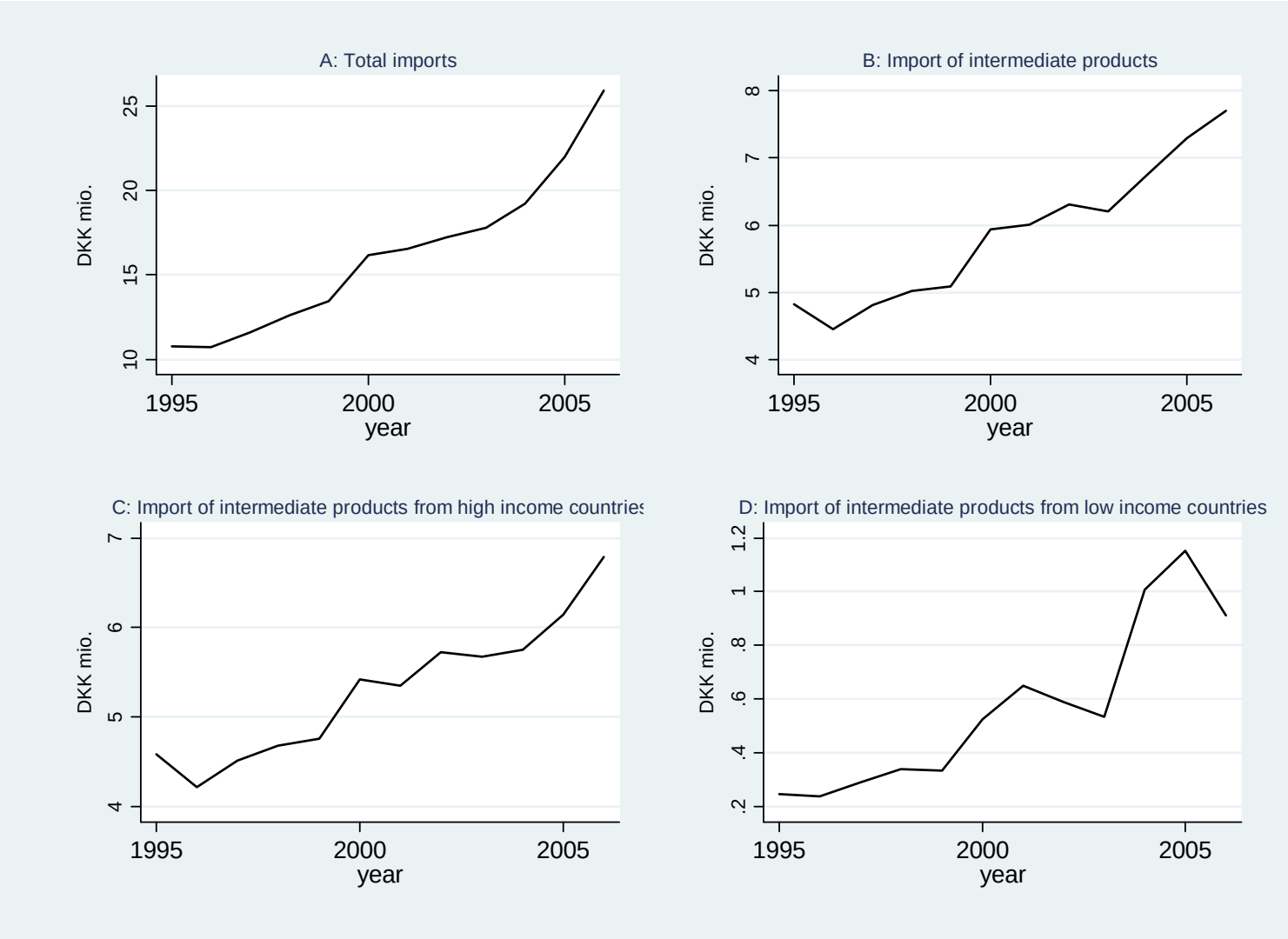
Notes: Standard errors (clustered by industry) in parentheses. The observation is an industry-year period ($N = 54$). All regressions include time-period dummies. The brackets contain the share of a standard deviation of the dependent variable explained by a standard deviation increase in the independent variable. dln[imports/(shipments + imports)] is change in share of imports from China as a fraction of imports from China and domestic shipments. dln[imported int. inputs/(shipments + imported int. inputs)] is change in share of intermediate inputs imported from China. Control for 1971–76 trend is 1971–76 change in employment share of nonproduction worker in the industry. Controls for world skill biased technical change are worldwide rates of SBTC and change in wage-bill share of nonproduction workers in the United States. Overidentification test is the *p*-value of a regression of the residuals of the second-stage regression on the instrument.

Hummels et al (2008)

- Hummels et al (2008) look at international outsourcing by Danish firms from 1996-2005.
- A significant attraction here is the data:
  - Employee-employer matched data.
  - Nice information on the firms (the employer).
  - This firm-level information includes trade information.
- Measure of 'outsourcing' of firm j in year t is: $OUTS_{jt} = \sum_{ck} M_{jtck}$, where M_{jtck} is imports by firm j in year t from country c and industry k.
- Instruments for outsourcing are:
  - In general: $I_{jt} = \sum_{ck} s_{jck} I_{ckt}$ where s_{jck} is the share of input k from country c in 1992-1993 (ie prior to the sample).
  - And I_{ckt} is: exchange rates, tariffs, transport costs and 'world export supply shocks' (world export supply by country c of good k in year t minus what they supply to Denmark).

Hummels et al (2008): Results

Figure 1: The Growth in Outsourcing for Denmark



Hummels et al (2008): Results

Table 4: First stage FE-IV regressions

	Log(Outsourcing)		Log(Exports)	
	Pre-sample weights	Average weights	Pre-Sample Weights	Average weights
Log(World Export Supply), outsourcing	0.1339***	0.3524***	-0.0646***	0.1062***
	[46.20]	[83.12]	[-21.74]	[24.48]
Log(1+Tariff), outsourcing	-2.2991***	-2.8599	-1.7016***	11.3881***
	[-5.43]	[-1.29]	[-3.96]	[5.05]
Log(Exchange rate), outsourcing	-0.1412***	0.4481***	0.0624***	0.5465***
	[-9.69]	[27.51]	[4.17]	[32.76]
Log(Transport cost), outsourcing	-5.4263***	-4.7099***	-3.9552***	-4.8095***
	[-26.82]	[-23.43]	[-19.03]	[-23.28]
Log(World Import Demand), exports	-0.0662***	-0.0501***	0.2566***	0.3937***
	[-23.36]	[-19.83]	[87.49]	[150.93]
Log(1+Tariff), exports	1.7376***	2.7856***	1.1359***	4.3329***
	[34.84]	[44.91]	[22.20]	[67.32]
Log(Exchange rate), exports	-0.2696***	-0.4927***	0.6282***	0.7794***
	[-20.76]	[-32.80]	[47.34]	[49.56]
Log(Transport cost), exports	10.6636***	9.0083***	3.4196***	1.8923***
	[42.87]	[36.54]	[13.39]	[7.47]
Log(Output)	0.1914***	0.1751***	0.2623***	0.2456***
	[82.19]	[75.21]	[110.62]	[103.65]
Log(Employment)	0.6056***	0.6001***	0.6167***	0.6182***
	[171.42]	[171.78]	[170.94]	[173.35]
Log(Value-added per worker)	-0.0618***	-0.0559***	0.0665***	0.0672***
	[-28.02]	[-25.47]	[29.56]	[30.05]
Log capital per worker	0.0028*	0.0026*	-0.0394***	-0.0086***
	[1.81]	[1.72]	[-25.26]	[-5.52]
Share of high-skilled workers	-0.3547***	-0.2850***	-0.7481***	-0.7983***
	[-14.15]	[-11.43]	[-29.03]	[-31.13]
Share of medium-skilled workers	0.1065***	0.0906***	0.4445***	0.4251***
	[4.89]	[4.19]	[19.68]	[18.93]
High-skilled worker	0.0147	0.0112	-0.0834***	-0.0853***
	[1.36]	[1.03]	[-7.55]	[-7.74]
Medium-skilled worker	0.0024	0.0011	-0.0065	-0.0154**
	[0.33]	[0.15]	[-0.88]	[-2.10]
Age	-0.0061***	-0.0163***	0.0552***	0.0364***
	[-3.24]	[-8.68]	[28.85]	[18.96]
Age2	0.0001***	0.0001***	-0.0002***	-0.0001***
	[3.62]	[3.53]	[-8.65]	[-7.39]
Experience	-0.0130***	-0.0130***	-0.0018	-0.0012
	[-8.88]	[-8.91]	[-1.19]	[-0.80]
Experience2	0.0000	0.0000	0.0001***	0.0001***
	[0.56]	[1.06]	[2.71]	[4.34]
Tenure	0.0095***	0.0095***	0.0023***	0.0040***
	[20.80]	[20.80]	[4.96]	[8.67]
Tenure2	-0.0001***	-0.0001***	-0.0003***	-0.0004***
	[-4.35]	[-4.43]	[-11.93]	[-19.51]
Union member	-0.0066**	-0.0076**	0.0030	0.0058*
	[-2.09]	[-2.42]	[0.93]	[1.81]
Married	-0.0051*	-0.0041	0.0003	-0.0003
	[-1.96]	[-1.57]	[0.13]	[-0.13]
Observations	2,204,007	2,211,510	2,171,657	2,178,448
Number of job spells	615,344	618,016	608,349	610,926
F-statistics of instruments	810.82***	1,550.00***	1,362.68***	7,284.78***
R-squared	0.0657	0.0691	0.1104	0.1215

Hummels et al (2008): Results

Table 5: Worker-Level Wage Regressions

	Dependent variable: worker-level hourly wage			
			FE-IV	
	OLS	Job Spell Fixed Effects	Pre-Sample Weights	Sample Average Weights
Firm-level variables:				
Log(outsourcing)	-0.0039***	0.0014***	-0.0424***	-0.0533***
	[-28.12]	[10.75]	[-19.31]	[-33.41]
Log(exports)	-0.0044***	0.0035***	0.0273***	0.0275***
	[-51.05]	[27.80]	[16.50]	[28.63]
Log(Output)	0.0359***	0.0122***	0.0141***	0.0160***
	[78.70]	[31.18]	[17.93]	[30.35]
Log(Employment)	-0.0166***	0.0143***	0.0247***	0.0312***
	[-36.05]	[23.84]	[12.43]	[26.51]
Log(Value-added per worker)	0.0240***	0.0022***	-0.0025***	-0.0029***
	[46.11]	[6.02]	[-6.02]	[-7.23]
Log capital per worker	0.0060***	0.0041***	0.0048***	0.0049***
	[26.54]	[16.07]	[18.23]	[18.64]
Share of high-skilled workers	0.3138***	0.0420***	0.0477***	0.0405***
	[155.03]	[10.00]	[10.48]	[9.28]
Share of medium-skilled workers	0.4430***	-0.0087**	-0.0106***	-0.0075**
	[218.71]	[-2.40]	[-2.76]	[-2.00]
Worker-level variables:				
High-skilled worker	0.2983***	0.3280***	0.3323***	0.3323***
	[579.19]	[180.06]	[178.82]	[179.35]
Medium-skilled worker	0.0687***	0.3546***	0.3554***	0.3554***
	[183.27]	[290.88]	[287.02]	[287.34]
Age	0.0239***	0.0375***	0.0360***	0.0361***
	[137.73]	[119.14]	[107.96]	[111.67]
Age2	-0.0003***	-0.0002***	-0.0002***	-0.0002***
	[-147.17]	[-68.53]	[-65.65]	[-65.67]
Experience	0.0078***	0.0017***	0.0011***	0.0009***
	[80.34]	[6.93]	[4.33]	[3.75]
Experience2	-0.0000***	-0.0002***	-0.0002***	-0.0002***
	[-10.19]	[-49.72]	[-48.77]	[-48.75]
Tenure	0.0084***	0.0044***	0.0048***	0.0049***
	[96.47]	[57.40]	[59.00]	[61.51]
Tenure2	-0.0003***	-0.0002***	-0.0002***	-0.0002***
	[-75.55]	[-53.05]	[-51.09]	[-51.58]
Union member	-0.1005***	0.0044***	0.0040***	0.0039***
	[-199.68]	[8.20]	[7.29]	[7.22]
Married	0.0197***	0.0011**	0.0009*	0.0008*
	[54.33]	[2.57]	[1.95]	[1.80]
Observations	2,267,212	2,267,212	2,171,657	2,178,448
No. job spells		646,586	608,349	610,926
$R2$	0.3405	0.3030	0.3051	0.3053

Hummels et al (2008): Results

Table 6: Worker-Level Wage Regressions: Skill Interactions

	FE-IV			
	Pre-Sample Weights	Sample Average Weights	Pre-Sample Weights	Sample Average Weights
Worker-level variables:				
High-skilled worker	0.3344***	0.3495***	0.4062***	0.3761***
	[21.66]	[22.96]	[20.16]	[22.59]
Medium-skilled worker	0.4282***	0.4502***	0.2781***	0.3881***
	[40.81]	[43.39]	[20.04]	[33.05]
Log(outsourcing) x low-skilled	-0.0210***	-0.0307***		
	[-16.01]	[-27.05]		
Log(outsourcing) x medium-skilled	-0.0253***	-0.0362***		
	[-18.19]	[-30.11]		
Log(outsourcing) x high-skilled	-0.0211***	-0.0317***		
	[-13.88]	[-23.52]		
Log(outsourcing, high income) x low-skilled			0.0193***	-0.0114***
			[11.50]	[-8.98]
Log(outsourcing, high income) x medium-skilled			0.0151***	-0.0188***
			[8.62]	[-14.08]
Log(outsourcing, high income) x high-skilled			-0.0076***	-0.0330***
			[-3.95]	[-22.17]
Log(outsourcing, low income) x low-skilled			-0.0125***	-0.0030***
			[-20.18]	[-6.62]
Log(outsourcing, low income) x medium-skilled			-0.0029***	0.0037***
			[-4.76]	[8.81]
Log(outsourcing, low income) x high-skilled			0.0153***	0.0211***
			[23.49]	[42.64]
Observations	2,171,657	2,178,448	1,057,737	1,641,494
No. job spells	608,349	610,926	293,971	499,210
R2	0.2051	0.2051	0.2103	0.2062

Note: *** p<0.01, ** p<0.05, * p<0.1. All specifications include industry, time and regional fixed effects.