Vertical Foreign Direct Investment:
Evidence from Japanese and U.S. Multinational Enterprises

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Introduction (1)

- Lael Brainard (1997, AER)

  "The finding that rising per-worker income differentials reduce affiliate sales is inconsistent with explanations of multinational activity that depend on factor-proportions differences."

- Carr, Markusen, and Maskus (2001, AER)

  "When the United States is parent, an increase in host-country skilled-labor abundance increases U.S. affiliate production in the host country."

- Blonigen, Davies, and Head (2003, AER)

  "We find that absolute skill differences reduce affiliate sales. This supports the horizontal model of the MNE."

Introduction (2)

Figure 3. Affiliate Sales and Relative Skill Endowments for Year 1995
By Home Country
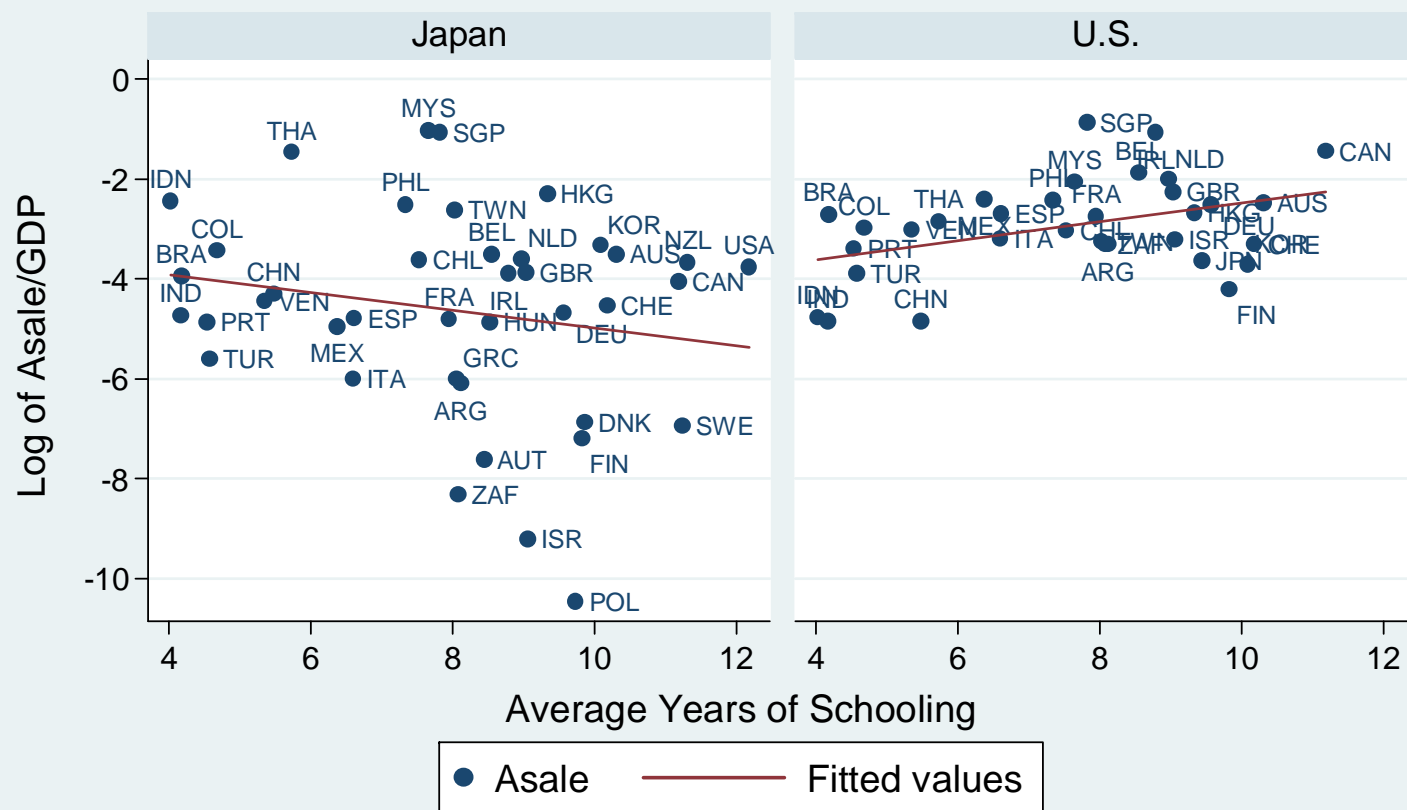
Source: RIETI, BEA, and Barro and Lee(2000)
Note: Asale and GDP are measured in billions of U.S. dollars.

Introduction (3)

1. Large negative impacts of host-country skilled-labor endowments on Japanese affiliate sales

2. Strong evidence for vertical FDI in the case of Japanese MNEs, but not U.S. MNEs

3. U.S. data may drive the view in favor of horizontal FDI.

Presentation Outline

Literature on Vertical FDI (1)

- Helpman (1984), Helpman and Krugman (1985)
  - MNEs consist of headquarters and production plant.
  - Vertical MNEs produce in a foreign country.
  - Factor-proportions differences motivate vertical MNEs.

- Markusen (1984), Brainard (1997)
  - Horizontal MNEs produce in both home and host countries.
  - Trade and fixed plant costs motivate horizontal MNEs.
  - Factor-proportions differences have no direct incentive for horizontal MNEs

Literature on Vertical FDI (2)

- Evidence for horizontal FDI
  - Brainard (1997) and Markusen and Maskus (2001, 2002) in the case of U.S. MNEs
  - Ekholm (1998) in the case of Swedish MNEs

- Evidence for vertical FDI
  - Braconier, Norbäck, and Urban (2005), Davies (2008)
    - Specification issues
  - Yeaple (2005)
    - Industry skill intensity and skill endowments
  - Alfaro and Charlton (2007)
    - Firm-level dataset

Literature on Vertical FDI (3)

- My contribution
  - A consistent dataset on Japanese and U.S. MNEs

  - Distinctive pattern of Japanese and U.S. multinational sales

  - Instrumental variables for endogeneity of skill abundance

  - Data and endogeneity issues matter in search of vertical FDI

Presentation Outline

1. Introduction
2. Literature on Vertical FDI
3. Empirical Strategy

   - **<u>Specification for FDI Determinants</u>**
   - Instrumental Variables Approach

4. Descriptive Statistics
5. Estimation Results

   - OLS Regression
   - IV Regression
   - Sensitivity Analysis

Specification for FDI Determinants

For a host country i and year t:

$$ASALE_{it} = \beta_0 + \beta_1 SKILL_{it} + \eta X'_{it} + \Sigma_t \gamma_t T_t + \varepsilon_{it}$$

ASALE = Real sales of host-country i's affiliates owned by parent firms

      in a home country

SKILL = Relative supply of skilled labor in the labor force of host country i

X = A vector of control variables:

    Host-market size, Market potential, Distance, Trade cost, Investment cost

T = Year dummy

Coefficient of interest: β_1

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Instrumental Variables Approach (1)

- Exogeneity of SKILL for consistency
  - Previous work implicitly assumed for no valid reason.

- Possible reasons for violation

1. Omitted variables
   - Millions of determinants of FDI activity

2. Measurement errors
   - A difficult distinction between skilled and unskilled workers

3. Simultaneity
   - A contribution of inward FDI to host-country skill intensity
   - Growth in FDI and schooling in many countries since the 1980s

- Endogeneity bias in an estimated coefficient of SKILL

Instrumental Variables Approach (2)

- Past schooling characteristics as instruments for SKILL
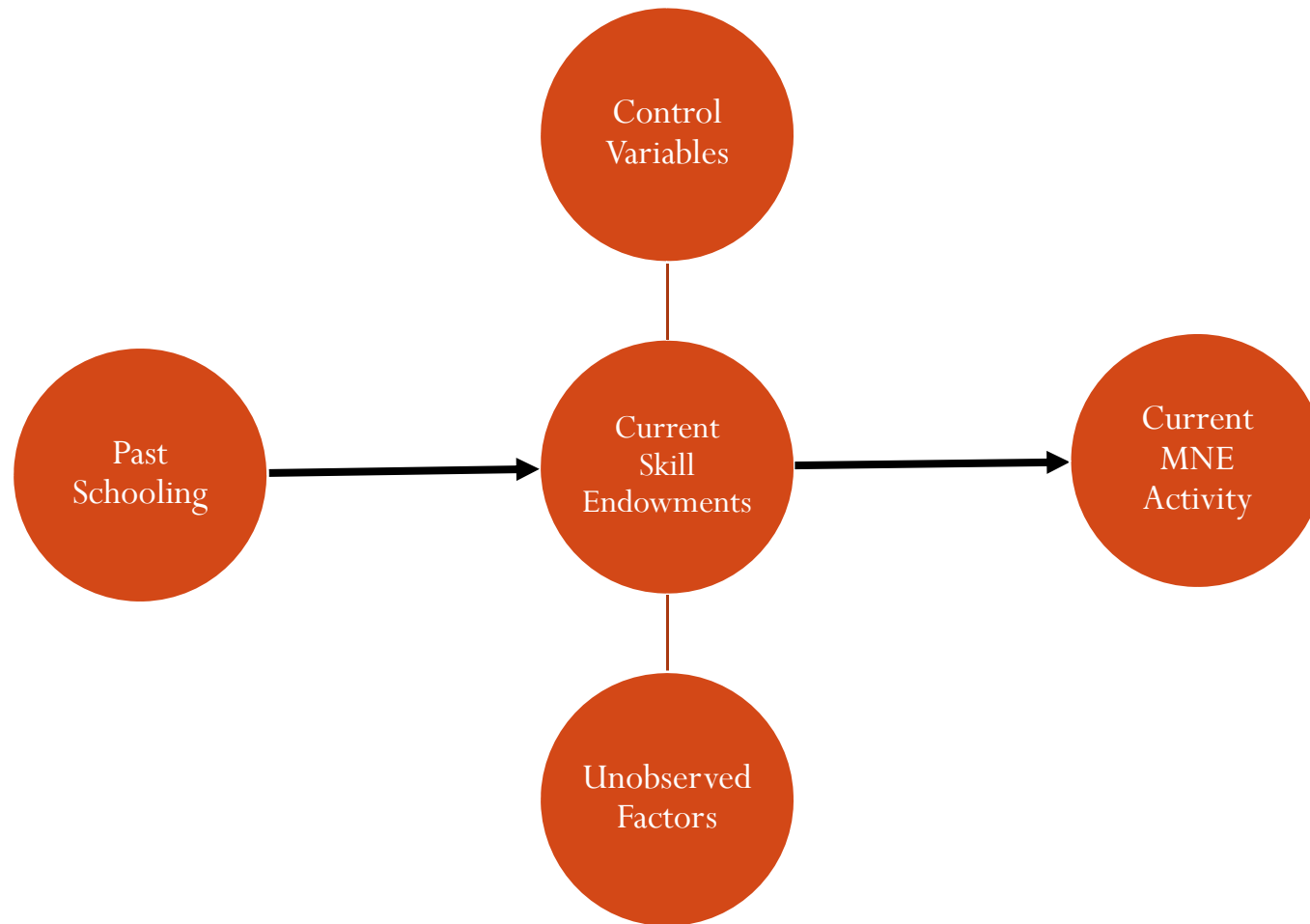
For a host country i and year t;

$$SKILL_{it} = \delta_0 + \delta_1 PSCHOOL_{i,\,t-10} + \delta_2 SSCHOOL_{i,\,t-10} + \delta X_{it} + \Sigma_t \mu_t T_t + v_{it}$$

SKILL t = Total schooling length of population in year t

PSCHOOL (t − 10) = Primary-schooling length in year t − 10

SSCHOOL (t − 10) = Secondary-schooling length in year t - 10

Instrumental Variables Approach (3)

Instrumental Variables Approach (4)

1. Instrument Relevance

    - High correlation between past schooling and current skill endowments

    - F test of joint significance of instruments in 1st stage regression

2. Instrument Irrelevance

    - No correlation between past schooling and an error term

   - Hansen's J statistics for overidentification test

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Descriptive Statistics (1)

- Panel data on foreign affiliate sales in manufacturing
  - The Research Institute of Economy, Trade, and Industry (RIETI)
  - U.S. Bureau of Economic Analysis (BEA)

- Advantages
  - Clear definition of subsidiary ownership by survey on parent firms
  - Good indicator of offshore production by multinationals
  - Wide host-country coverage

- Disadvantages
  - Slight differences in foreign affiliate coverage → Check consistency

Descriptive Statistics (2)

Sales by Japanese Manufacturing Affiliates in the US

- BEA Data
- RIETI Data
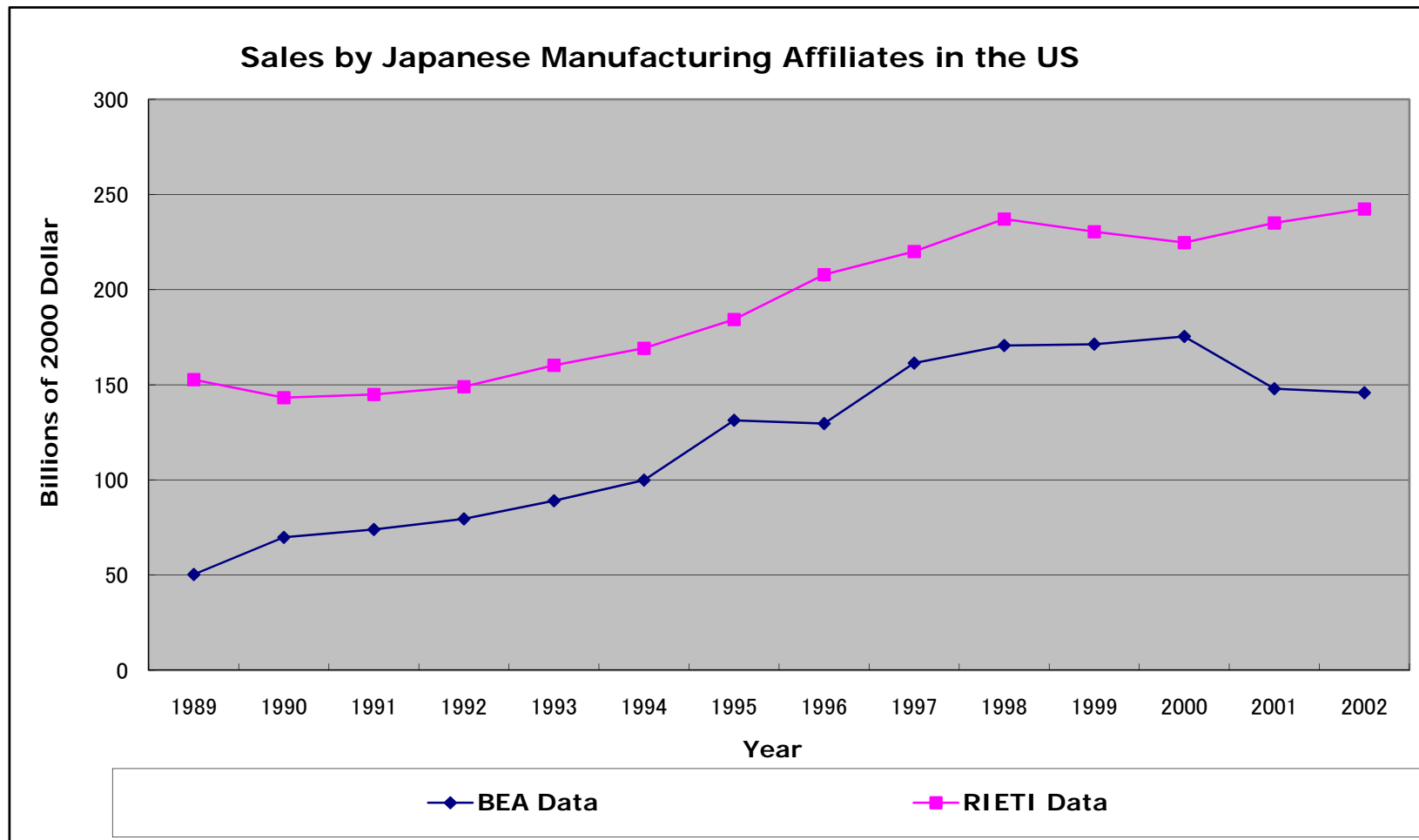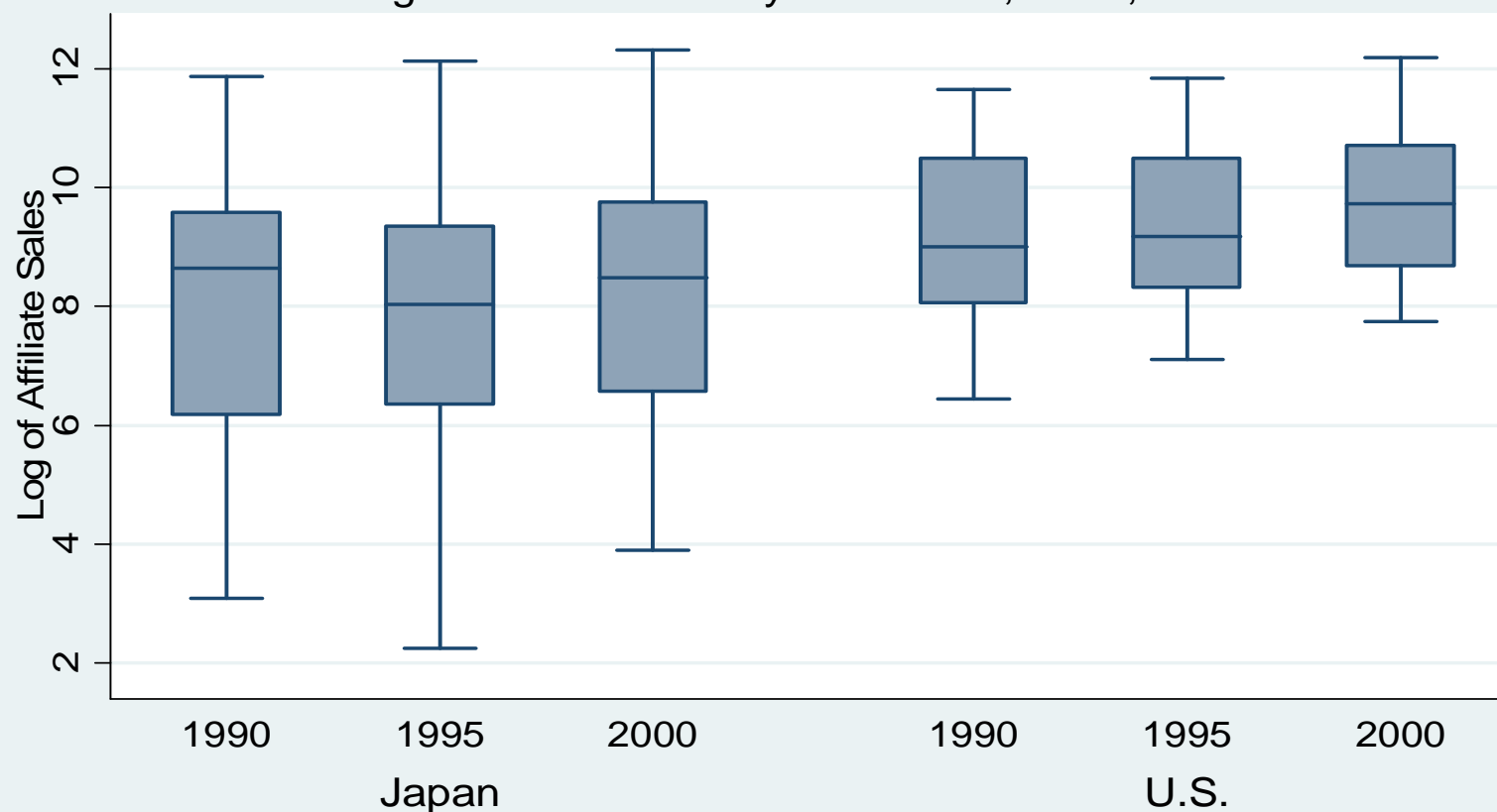
Descriptive Statistics (3)

- Data sources on host-country characteristics
  - Barro and Lee (2000) → <u>1990, 1995, 2000 years</u>
  - World Development Indicator
  - Raymond Robertson's International Trade Data
  - World Competitiveness Report
  - Euromoney

- Sample country
  - 41 and 39 host markets for Japanese and U.S. MNEs
  - Western and Eastern Europe, North America, Latin America, East Asia, Middle East, and Africa

Descriptive Statistics (4)

| Variables	No. of observations		Mean		Std. Dev.		Min		Max	
	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan	U.S.	Japan	U.S.
ASALE	110	98	7.90	9.50	2.14	1.40	1.32	6.45	12.3	12.2
SKILL	110	98	7.99	7.85	2.24	2.14	3.30	3.30	12.2	11.5
PSCHOOL	110	98	4.52	4.40	1.40	1.30	1.92	1.92	7.66	7.66
SSCHOOL	110	98	2.20	2.14	1.24	1.15	0.45	0.45	5.09	5.08
GDP	110	98	5.44	5.53	1.13	1.08	3.65	3.78	9.19	8.47
MKP	110	98	1.86	1.83	0.66	0.67	0.61	0.61	3.32	3.32
DIST	110	98	8.96	8.97	0.58	0.61	7.05	6.60	9.82	9.70
TC	110	98	31.4	32.7	12.1	12.5	10.0	10.0	64.4	64.8
IC	110	98	23.1	23.0	15.5	15.6	2.17	2.17	61.5	61.5

Descriptive Statistics (5)

Figure 1. Pattern of Japanese and U.S. Multinational Sales

Foreign-Affiliate Sales by Year 1990, 1995, and 2000

Source: RIETI and BEA

Descriptive Statistics (6)

Figure 2. Affiliate Sales and Relative Skill Endowments for Year 1990
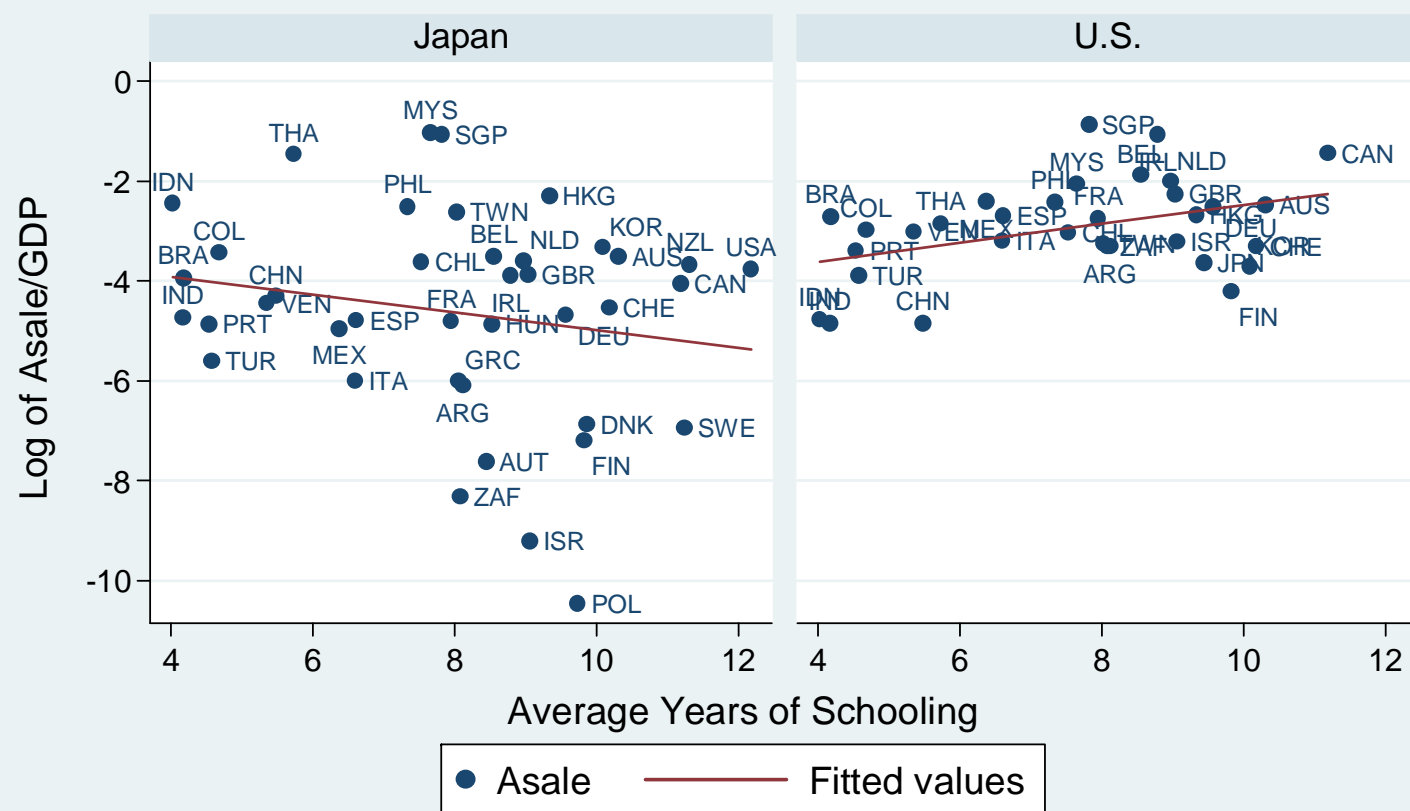By Home Country
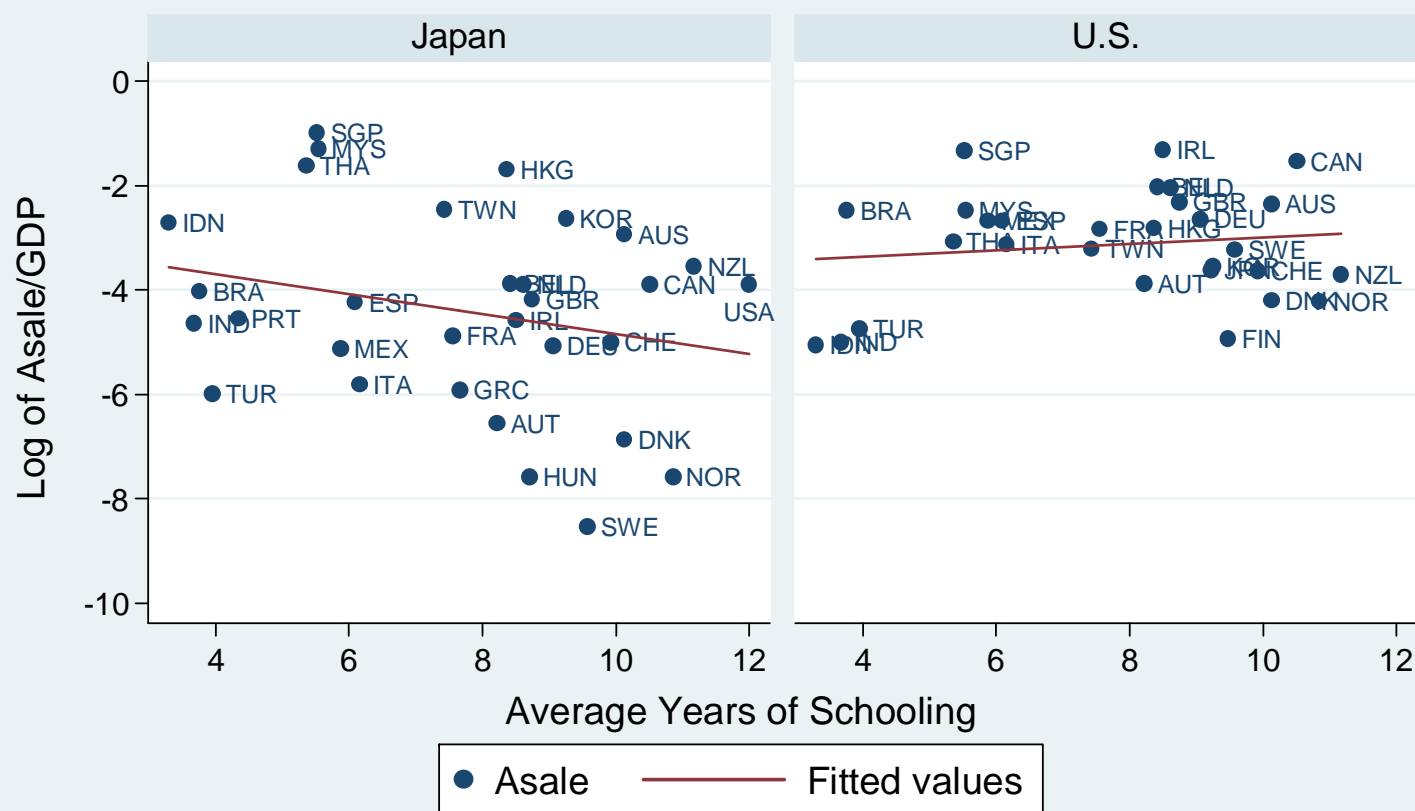
Source: RIETI, BEA, and Barro and Lee(2000)
Note: Asale and GDP are measured in billions of U.S. dollars.

Descriptive Statistics (7)

Figure 3. Affiliate Sales and Relative Skill Endowments for Year 1995
By Home Country

Source: RIETI, BEA, and Barro and Lee(2000)
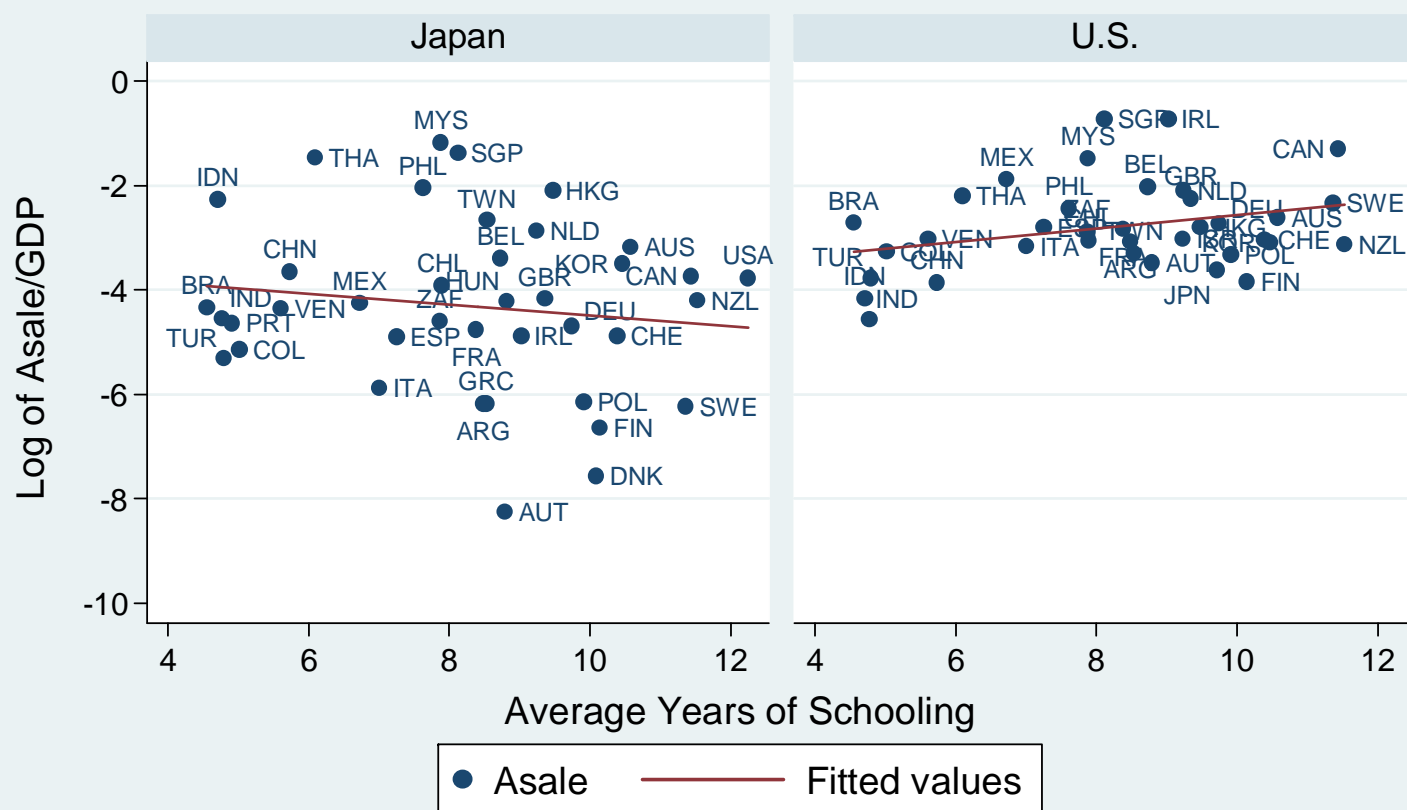Note: Asale and GDP are measured in billions of U.S. dollars.

Descriptive Statistics (8)

Figure 4. Affiliate Sales and Relative Skill Endowments for Year 2000
By Home Country

Source: RIETI, BEA, and Barro and Lee(2000)
Note: Asale and GDP are measured in billions of U.S. dollars.

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   - **<u>OLS Regression</u>**
   - IV Regression
   - Sensitivity Analysis

Estimation Result (1): OLS

Dependent: Log of foreign affiliate sales

	Japanese Sample	U.S. Sample	Coefficient Difference
Skill Endowments	-0.284***	0.013	-0.297**
	(0.084)	(0.061)	(0.103)
Log of GDP	1.097***	0.899***	0.198
	(0.127)	(0.099)	(0.161)
Log of Market Potential	-1.102***	-0.121	-0.981**
	(0.247)	(0.170)	(0.301)
Log of Distance	-1.370***	-0.462***	-0.908***
	(0.207)	(0.125)	(0.242)
Trade Cost	-0.020	-0.022**	0.002
	(0.017)	(0.008)	(0.019)
Investment Cost	-0.037*	-0.013	-0.024
	(0.014)	(0.011)	(0.018)
Year 1995 Dummy	-0.215	0.153	-0.368
	(0.372)	(0.223)	(0.434)
Year 2000 Dummy	0.344	0.216	0.128
	(0.386)	(0.261)	(0.467)
No. of Observations	110	98	208
R^2	0.525	0.667	0.635

Estimation Result (2): OLS

- Marginal effects of SKILL on Japanese affiliate sales
  - Additional one-year schooling reduces ASALE by 25 %

Thought experiment

- Average years of schooling in 2000
  - 6 years in China
  - 12 years in the U.S.

- IF Chinese workers had the U.S. level of education,
  - Japanese affiliate sales would decline by 150 %!!!
  - About 28 billion dollars of sales would disappear…

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   - Sensitivity Analysis

Estimation Result (3): IV

Dependent: Log of foreign affiliate sales

	Japanese Sample		U.S. Sample	
	2nd stage	1st stage	2nd stage	1st stage
Skill Endowments	**-0.299*****		**-0.035**	
	(0.082)		(0.064)	
Primary School (t-10)		0.947***		0.923***
		(0.042)		(0.053)
Secondary School (t-10)		0.901***		0.885***
		(0.068)		(0.078)
Control Variables	Yes	Yes	Yes	Yes
No. of Observations	110	110	98	98
R^2		0.931		0.924
Partial R^2		0.886		0.846
F statistics for IV Relevance Test		432.5 (0.000)		228.5 (0.000)
Hansen's J statistics for Overidentification Test	2.004 (0.157)		6.199 (0.013)	

Estimation Result (4): IV

- Marginal effects of SKILL in Japanese sample
  - Additional one-year schooling reduces ASALE by 35%
  - IV estimates < OLS estimates
  - Endogeneity bias works to move OLS estimates **upward**.

- Instrument validity for causality
  - Strong correlation with SKILL: partial R2, F test

  - No evidence for correlation with error in Japanese sample: Small Hansen's J statistics

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Estimation Result (5)
Sensitivity to Alternative Variables

Japanese Sample						
	OLS	IV	OLS	IV	OLS	IV
Log of Skill Endowment	**-1.94****	**-2.16*****				
	(0.60)	(0.61)				
Absolute Skill Difference			**0.36****	**0.48*****		
			(0.12)	(0.14)		
College Graduates					**-0.04**	**-0.51****
					(0.03)	(0.19)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	110	110	110	110	110	110
R^2	0.52		0.51		0.47	
Hansen's J statistics for Overidentification Test		2.43 (0.11)		3.29 (0.06)		2.04 (0.15)

Estimation Result (6)
Sensitivity to Alternative Variables

	U.S. Sample					
	OLS	IV	OLS	IV	OLS	IV
Log of Skill Endowment	0.38	-0.22				
	(0.43)	(0.46)				
Absolute Skill Difference			-0.01	0.03		
			(0.06)	(0.06)		
College Graduates					0.02	-0.29
					(0.03)	(0.18)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	98	98	98	98	98	98
R^2	0.67		0.66		0.67	
Hansen's J statistics for Overidentification Test		6.44 (0.01)		6.19 (0.01)		0.03 (0.85)

Estimation Result (7)
Sensitivity to Additional Control Variables

Sample	OLS		IV	
	Japan	**U.S.**	**Japan**	**U.S.**
Skill Endowment	**-0.307*****	**-0.037**	**-0.319*****	**-0.073**
	(0.083)	**(0.080)**	**(0.077)**	**(0.073)**
Previous Control Variables	Yes	Yes	Yes	Yes
Corporate Tax Rate	-0.023	0.004	-0.023	0.004
	(0.021)	(0.016)	(0.020)	(0.015)
ASEAN Free Trade Area	2.194***	1.307**	2.180***	1.282***
	(0.398)	(0.384)	(0.370)	(0.359)
Mercosur	0.170	0.758	0.172	0.795
	(0.485)	(0.470)	(0.446)	(0.419)
EU Single Market	-1.203*	-0.221	-1.231*	-0.287
	(0.511)	(0.380)	(0.479)	(0.347)
Geographic Contiguity		0.563		0.592
		(0.658)		(0.588)
Common Language		0.397		0.438
		(0.261)		(0.246)
No. of Observations	94	83	94	83
R^2	0.661	0.725		
Hansen's J statistics for Overidentification Test			1.151 (0.283)	3.849 (0.049)

Estimation Result (8)

- Summary of Results

1. Highly significant and economically large negative impact of SKILL on Japanese affiliate sales

2. No effects of SKILL on U.S. affiliate sales

3. Robust to endogeneity bias

4. Robust to alternative variable definitions of SKILL

5. Robust to a number of additional control variables

Possible Explanations

- Why is a vertical motive of FDI stronger for Japanese MNEs?

1. China as a "world factory" ?
   - No change by dropping China from sample

2. East Asia with vast human resources ?
   - No change by controlling for ASEAN FTA

3. Proximity of foreign resource of unskilled labor ?
   - No change by including interaction between SKILL and DIST

4. U.S. MNEs tend to choose outsourcing in low-skill countries ?
   - Little reason for stronger sourcing motives than Japanese firms

5. International logistics and business networks of Japanese firms

Conclusion

- Weak evidence for vertical FDI in prior research

- Strong evidence of vertical FDI for Japanese MNEs
  - Robust to a variety of sensitivity checks

- Widely available U.S. data in favor of horizontal FDI

- Implications for effects of FDI on home and host countries

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Country List and Code

Argentina	ARG	(JP, US)	Japan	JPN	(, US)
Australia	AUS	(JP, US)	South Korea	KOR	(JP, US)
Austria	AUT	(JP, US)	Malaysia	MYS	(JP, US)
Belgium	BEL	(JP, US)	Mexico	MEX	(JP, US)
Brazil	BRA	(JP, US)	Netherlands	NLD	(JP, US)
Canada	CAN	(JP, US)	New Zealand	NZL	(JP, US)
Chile	CHL	(JP, US)	Norway	NOR	(JP, US)
China	CHN	(JP, US)	Philippines	PHL	(JP, US)
Colombia	COL	(JP, US)	Poland	POL	(JP, US)
Denmark	DNK	(JP, US)	Portugal	PRT	(JP, US)
Finland	FIN	(JP, US)	Singapore	SGP	(JP, US)
France	FRA	(JP, US)	South Africa	ZAF	(JP, US)
Germany	DEU	(JP, US)	Spain	ESP	(JP, US)
Greece	GRC	(JP,)	Sweden	SWE	(JP, US)
Hong Kong	HKG	(JP, US)	Switzerland	CHE	(JP, US)
Hungary	HUN	(JP,)	Taiwan	TWN	(JP, US)
India	IND	(JP, US)	Thailand	THA	(JP, US)
Indonesia	IDN	(JP, US)	Turkey	TUR	(JP, US)
Ireland	IRL	(JP, US)	United Kingdom	GBR	(JP, US)
Israel	ISR	(JP, US)	United States	USA	(JP,)
Italy	ITA	(JP, US)	Venezuela	VEN	(JP, US)