



# **The Impact of Trade Costs on Horizontal and Vertical FDI—Evidence from Taiwanese FDI in China**

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# Agenda

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1. Motivations
2. Data
3. Empirical Specifications and Results
4. Conclusions

# Motivation

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- Inconclusive Trade costs effect on patterns of FDI
  - Horizontal FDI: firms serve the foreign market by producing the final products locally to avoid trade costs, i.e. arm's-length exports and FDI are two alternative ways of supplying a foreign market (Markusen, 1984; Brainard, 1997; Markusen & Venables, 2000, etc.)
  - Vertical FDI: firms split production process in different locations to take advantage of factor cost differentials, i.e., intra-firm trade of inputs and FDI are complements (Helpman, 1984; Yeaple, 2003; Keller & Yeaple, 2009, etc.)
  - However, empirical evidence shows that the negative distance effect on horizontal FDI (Carr et. al, 2001; Fajgelbaum et. al, 2013)

# Contributions

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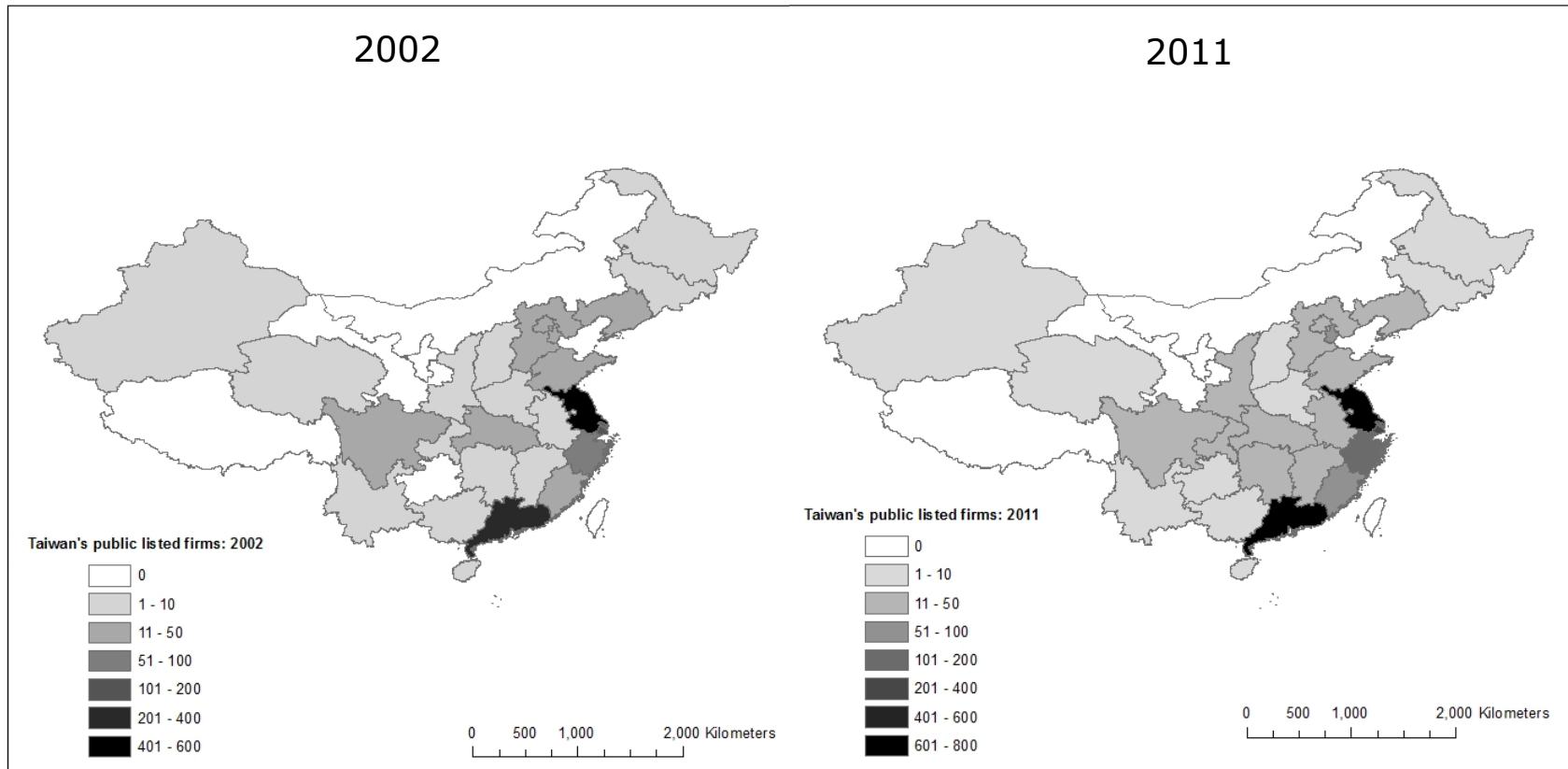
- Solid Empirical Evidence: employ Taiwanese public listed firm level panel data (2002-2011) to distinguish horizontal and vertical FDI into finer aggregated industry level (4-digit ISIC Rev.4)
  - The relative impact of trade costs on horizontal and vertical FDI across industries.
  - Within Vertical FDI, the impact of trade costs on inter-and intra-industry vertical FDI
- Innovative empirical methods to decompose trade costs effect :
  - The impact of trade costs through transaction and transport costs channels on patterns of FDI across industries.

## Data sources

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1. Taiwan Economic Journal (TEJ): Taiwanese public listed firms
  - Parent firms: primary industry code, production information
  - Affiliates: dates of establishment, address, production information, ownership, capital. Affiliates information is reported in parents' annual financial statements.
  - Panel data: 2002-2011
2. China Statistical Yearbook
  - Provincial control variables: wages, final consumption used to measure provincial market access.
3. China Industry Economy Statistical Yearbook
  - Industrial gross outputs, as the proxy for sectoral agglomeration
4. Ministry of Economic Affairs, Taiwan: Taiwanese FDI projects
  - Accumulated Taiwanese FDI amounts in Chinese provinces with 2-digit ISIC Rev.4 codes, as a proxy for Taiwanese agglomeration

# Taiwanese FDI of public listed firms in China



- Following Alfaro and Charlton (2009),

**Horizontal** if affiliate  $S$  and parent  $P$  share any element

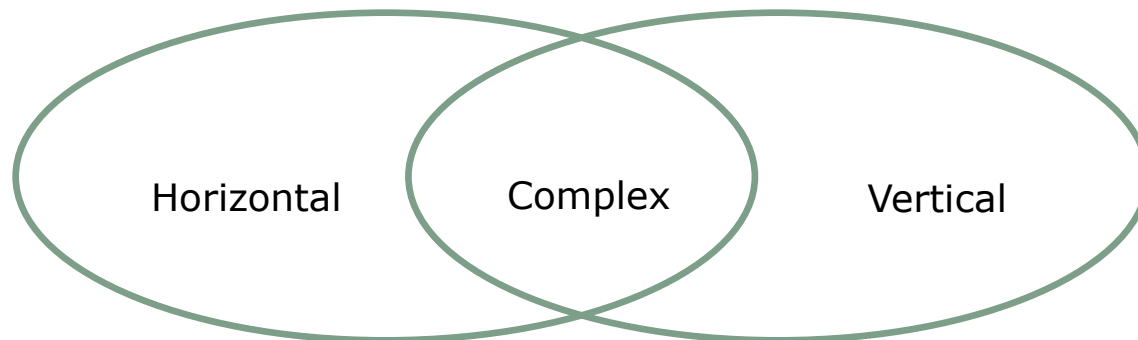
(if  $\exists x \mid x \in S \vee x \in P$ ) or if the sets are identical (if  $S = P$ );

**Vertical** if any element of  $S$  is an input to any element of  $P$

(if  $\exists x \mid x \rightarrow z$ , where  $x \in S$  and  $z \in P$ ) and

the sets are not identical (if  $S \neq P$ );

- Vertical FDI indicator,  $D\_VFDI$ , by using direct requirement table
  - Direct requirement coefficient  $d_{ij}$ : the value of inputs from industry  $i$  needed to produce one dollar of output in industry  $j$
  - $D\_VFDI$  equals one if  $d_{ij} > 0$  and parent-affiliate industry are with different industry codes, zero otherwise.



# Patterns of Taiwanese FDI



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	Four-digit	Three-digit	Two-digit
Total	2960	2960	2960
Horizontal	1599	1723	2180
Vertical	1361	1237	780
Vertical inter	780	780	780
Vertical intra	581	457	
Percentage			
Horizontal	54%	58%	74%
Vertical	46%	42%	26%
Vertical inter	26%	26%	26%
Vertical intra	20%	15%	

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In 4-digit aggregation level, vertical FDI account for 46% of total new FDI affiliates



# Taiwanese Horizontal FDI



1,599 horizontal parent-affiliate industry pair

Parent Industry	Parent ISIC code	No. of Affiliates	%
Electronic components and boards	2610	820	51.28
Computers and peripheral equipment	2620	181	11.32
Electric motors, generators, transformers, and electricity distribution and control apparatus	2710	75	4.69
Communications equipment	2630	60	3.75
Footwear	1520	37	2.31
Plastics products	2220	31	1.94
Optical instruments and photographic equipment	2670	27	1.69
Parts and accessories for motor vehicles	2930	25	1.56
Wearing apparel, except fur apparel	1410	22	1.38
Plastics and synthetic rubber in primary forms	2013	22	1.38

# Taiwanese Vertical FDI

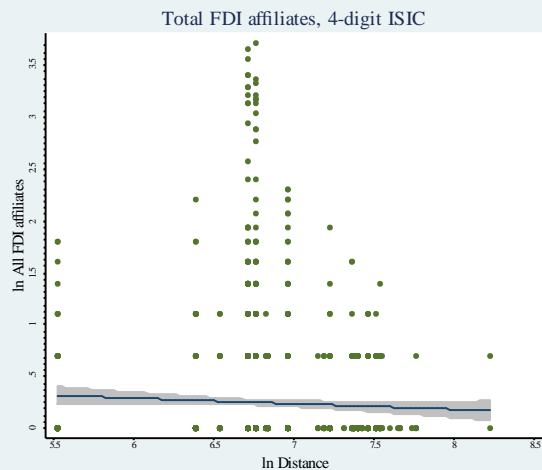


## 1,361 vertical parent-affiliate industry pair

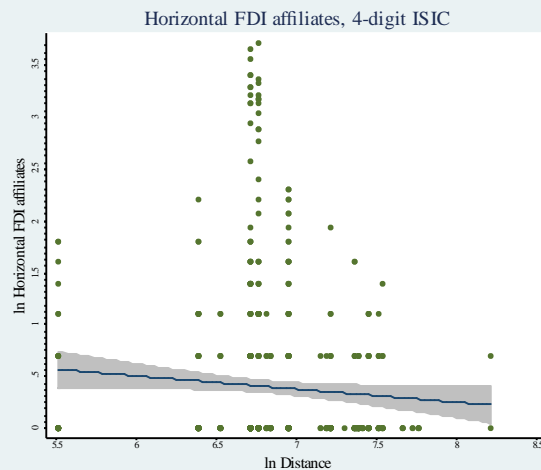
Parent Industry	Affiliate Industry	Parent ISIC code	Affiliate ISIC code	No. of pairs	%
Computers and peripheral equipment	Electronic components and boards	2620	2610	127	9.33
Electronic components and boards	Computers and peripheral equipment	2610	2620	58	4.26
Electronic components and boards	Plastics products	2610	2220	54	3.97
Cement, lime and plaster	Articles of concrete, cement and plaster	2394	2395	45	3.31
Electronic components and boards	Optical instruments and photographic equipment	2610	2670	30	2.2
Computers and peripheral equipment	Communications equipment	2620	2630	28	2.06
Computers and peripheral equipment	Plastics products	2620	2220	27	1.98
Electronic components and boards	Other fabricated metal products	2610	2599	26	1.91
Electronic components and boards	Cutlery, hand tools and general hardware	2610	2593	25	1.84
Electronic components and boards	Other electronic and electric wires and cables	2610	2732	23	1.69

# Descriptive Statistics: Distance variable

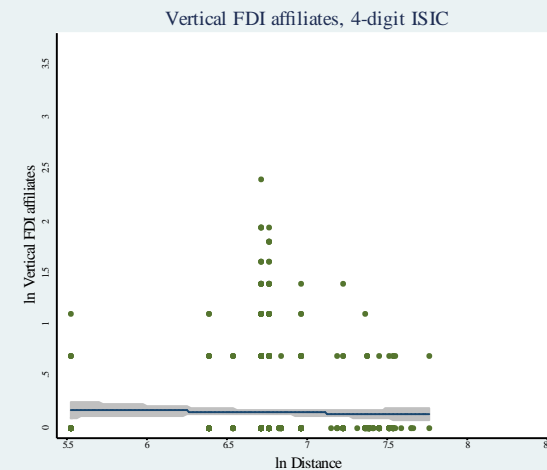
Taiwanese FDI in China, 4-digit ISIC, 2001-2011



Source: TEJ, 2012

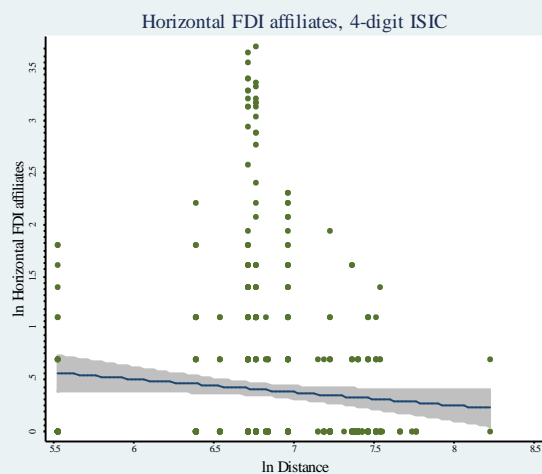


Source: TEJ, 2012

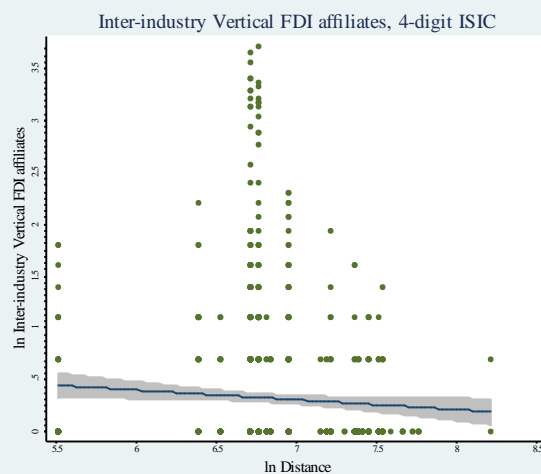


Source: TEJ, 2012

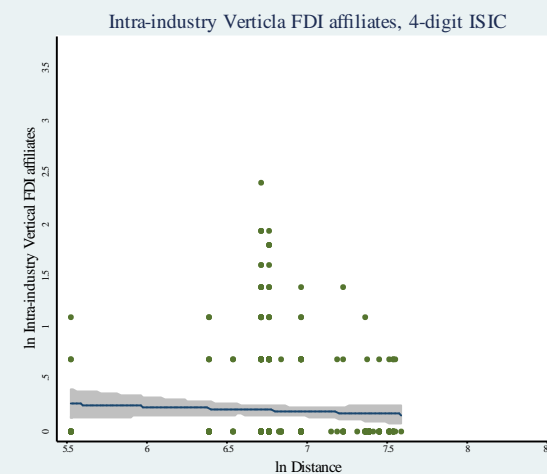
Taiwanese Horizontal and Vertical FDI in China, 4-digit ISIC, 2001-2011



Source: TEJ, 2012



Source: TEJ, 2012



Source: TEJ, 2012

# Empirical specification

$$\begin{aligned}
 FDI_{spjt} = & \beta_0 + \beta_1 Distance_j + \beta_2 D\_VFDI_{sp} + \beta_3 Distance_j \times D\_VFDI_{sp} \\
 & + \Phi X_{jt-1} + \Theta X_{jt-1} D\_VFDI_{sp} \\
 & + V_{sj} \times D\_VFDI_{sp} + V_t \times D\_VFDI_{sp} + V_{sj} + V_t + \varepsilon_{spjt}
 \end{aligned}$$

where  $s$  indexes the industry of foreign affiliate,  $p$  indexes the industry of the parent firm,  $j$  indexes the Chinese province, and  $t$  indexes the time periods, which are from 2002 to 2011.

- $FDI_{spjt}$ : logarithm of the number of new FDI affiliates
- $Distance_j$ : logarithm of bilateral distance between Taipei (Taiwan) and the capital city of Chinese province  $j$
- $D\_VFDI_{sp}$ : vertical FDI indicator, which equals one for vertical FDI affiliates, and zero for horizontal FDI
- $X_{jt-1}$ : Provincial control variables, including wage, market access, sectoral agglomeration and Taiwanese agglomeration

# Baseline Results



	Dependent Variable					
	Horizontal FDI		Vertical FDI		Total FDI	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Ln Distance<sub>j</sub></i>	-0.127*	0.0234	-0.0222	0.0520**	-0.127*	0.0234
	(0.0765)	(0.0826)	(0.0232)	(0.0221)	(0.0764)	(0.0825)
<i>Ln Distance<sub>j</sub> × D_VFDI<sub>sp</sub></i>					0.104	0.0286
					(0.0805)	(0.0864)
<i>D_VFDI<sub>sp</sub></i>					-0.960*	2.228*
					(0.577)	(1.246)
<b>Control variables</b>						
<i>Ln Wage<sub>jt-1</sub></i>		0.169		-0.108**		0.169
		(0.238)		(0.0520)		(0.238)
<i>Ln Market Access<sub>jt-1</sub></i>		-0.133		0.00781		-0.133
		(0.260)		(0.0519)		(0.259)
<i>Ln sectoral Agglomeration<sub>jt-1</sub></i>		0.0176		0.0262		0.0176
		(0.0759)		(0.0179)		(0.0757)
<i>Ln TAI FDI Agglomeration<sub>jt-1</sub></i>		0.0933***		0.0356***		0.0933***
		(0.0291)		(0.00958)		(0.0291)
<i>Ln Wage<sub>jt-1</sub> × D_VFDI<sub>sp</sub></i>						-0.278
						(0.213)
<i>Ln Market Access<sub>jt-1</sub> × D_VFDI<sub>sp</sub></i>						0.141
						(0.233)
<i>Ln Sectoral Agglomeration<sub>jt-1</sub> × D_VFDI<sub>sp</sub></i>						0.00861
						(0.0772)
<i>Ln TAI Agglomeration<sub>jt-1</sub> × D_VFDI<sub>sp</sub></i>						-0.0577**
						(0.0248)
<b>Observations</b>	651	651	1,059	1,059	1710	1710
<b>Within R-squared</b>	0.007	0.142	0.001	0.042	0.05	0.153

# The Relative Impact of Trade Costs



Dependent variable: Ln New Taiwanese FDI Affiliates<sub>spjt</sub>, 4-digit ISIC4

	(1)	(2)	(3)	(4)
<i>Ln Distance<sub>i</sub> × D_VFDI<sub>sp</sub></i>	0.0697 (0.0615)	-0.125* (0.0645)	-0.028 (0.0887)	-0.248*** (0.0917)
<i>D_VFDI<sub>sp</sub></i>	-2.376 (16.91)	-19.33 (41.83)	6.099 (20.16)	41.84 (54.52)
<b>Control variables</b>	N	Y	N	Y
<b>Time Dummy</b>	Y	Y	Y	Y
<b>Province Dummy</b>	Y	Y	N	N
<b>Fixed Effects</b>	Industry	Industry	Industry- Province	Industry- Province
<b>No. of Fixed Effects</b>	83	83	476	476
<b>Observations</b>	1,710	1,710	1,710	1,710
<b>Within R-squared</b>	0.158	0.235	0.159	0.254

# Inter- and Intra-Industry Vertical FDI



Dependent variable: Ln New Taiwanese Vertical FDI Affiliates<sub>spjt</sub>, 4-digit ISIC4

	(1)	(2)	(3)	(4)
<i>Ln Distance<sub>j</sub> × D_IntraV<sub>sp</sub></i>	-0.0148 (0.138)	0.197 (0.158)	-0.0121 (0.137)	0.208 (0.157)
<i>Ln Closeness<sub>sp</sub></i>			-0.0258 (0.0187)	-0.0215 (0.0186)
<i>Ln Closeness<sub>sp</sub> × D_IntraV<sub>sp</sub></i>			-0.0756* (0.0388)	-0.101** (0.0390)
<b>Control variables</b>	N	Y	N	Y
<b>Time Dummy</b>	Y	Y	Y	Y
<b>Fixed Effects</b>	Industry- Province	Industry- Province	Industry- Province	Industry- Province
<b>No. of Fixed Effects</b>	309	309	309	309
<b>Observations</b>	1,059	1,059	1,059	1,059
<b>Within R-squared</b>	0.031	0.059	0.046	0.077

# Transaction Costs Channel

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- Assumption: if FDI engages in more relationship-specific investments, it will incur higher transaction costs than those FDI with less relationship-specific investments.
- Channel : Firms in the industry with more relationship-specific investments will tend to invest proportionally less in the location that is further away from home.
- Create contract intensity to measure the level of relationship-specific investment across industries
- Contract Intensity is extended to 3-digit ISIC Rev. 4 from Nunn(2007) dataset.



# Transport Costs Channel

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- Assumption: when intra-firm trades incur between parent firm and foreign affiliates, the higher the product's unit value (value/weight), the smaller share of the ad-valorem transport costs.
- Channel: Firms in the industry with greater unit value will invest proportionally more than ones with low unit value in the location that is further away from home.
- Unit value intensity (UVI) is the average value of estimated individual-specific error derived from the product fixed effects estimation. The U.S. imported data, which is provided by Hummels (2007), is used to create UVI for 3-digit ISIC Rev.4 level.

# Transaction and Transport Costs Channels



Dependent variable: Ln New Taiwanese FDI Affiliates<sub>spjt</sub>, 3-digit ISIC4

	Horizontal FDI	Vertical FDI	Total FDI	
	(1)	(2)	(3)	(4)
<i>Ln Distance<sub>j</sub> × Contract Intensity<sub>s</sub></i>	-0.609** (0.250)	-0.0258 (0.190)		
<i>Ln Distance<sub>j</sub> × Unit Value Intensity<sub>s</sub></i>	0.00728 (0.0435)	0.00489 (0.0408)		
<i>Ln Distance<sub>j</sub> × CI<sub>s</sub> × D_VFDI<sub>sp</sub></i>			-0.399*** (0.0457)	-0.443*** (0.0448)
<i>Ln Distance<sub>j</sub> × UVI<sub>s</sub> × D_VFDI<sub>sp</sub></i>			0.0144** (0.00585)	0.0148** (0.00603)
<b>Control variables</b>	Y	Y	N	Y
<b>Time Dummy</b>	Y	Y	Y	Y
<b>Province Dummy</b>	Y	Y	N	N
<b>Fixed Effects</b>	Industry	Industry	Industry- Province	Industry- Province
<b>No. of Fixed Effects</b>	43	45	399	399
<b>Observations</b>	723	952	1,691	1,691
<b>Within R-squared</b>	0.33	0.068	0.173	0.239

# Robustness Check: Air Travelling Time



	Ln New Taiwanese FDI Affiliates <sub>spjt</sub> , 4-digit ISIC4		Ln New Taiwanese FDI Affiliates <sub>spjt</sub> , 3_digit ISIC4	
	(1)	(2)	(3)	(4)
<i>Ln Flight time<sub>jt</sub></i>	-0.0842 (0.118)	0.0637 (0.125)	0.265** (0.109)	0.275*** (0.101)
<i>Ln Flight time<sub>jt</sub> × D_VFDI<sub>sp</sub></i>	0.233*** (0.0877)	-0.0262 (0.100)		
<i>Ln Flight time<sub>jt</sub> × CI<sub>s</sub> × D_VFDI<sub>sp</sub></i>			-0.447*** (0.0562)	-0.456*** (0.0541)
<i>Ln Flight time<sub>jt</sub> × UVI<sub>s</sub> × D_VFDI<sub>sp</sub></i>			0.0157** (0.00723)	0.0167** (0.00749)
<b>Control variables</b>	N	Y	N	Y
<b>Time Dummy</b>	Y	Y	Y	Y
<b>Fixed Effects</b>	Industry- Province	Industry- Province	Industry- Province	Industry- Province
<b>No. of Fixed Effects</b>	476	476	399	399
<b>Observations</b>	1,710	1,710	1,675	1,675
<b>Within R-squared</b>	0.15	0.25	0.169	0.235

# Conclusions

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- Trade costs have greater negative impact on vertical FDI than horizontal FDI
- Trade costs might affect less negatively on intra-industry vertical FDI than inter-industry vertical FDI, but this difference is not significant
- Vertical FDI locations are much more sensitive to trade costs through both transaction and transport costs channels