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Dunning 1977

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$CorDist_{ij,t}$ Qian & Sandoval 2016

$$CorDist_{ij,t} = \log(\left|Cor_{i,t} - Cor_{j,t}\right| + 2)$$

$Cor_{i,t}$ $Cor_{j,t}$ j

RC_j 2014

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$$\mathrm{RC}_j = 1 - (\mathrm{Trb}_j - \mathrm{Trb}_{globe})$$

Trb_j Trb_{globe} j j

CD_j 2012 KSI

$$CD_j = \left\{\sum_{i=1}^{4}[(\mathrm{I}_{ij} - \mathrm{I}_{iCH})^2 / \mathrm{V}_i] / 4\right\} + (1/T_j)$$

I_{ij} I_{iCH} j i V_i i

T_j j $1/T_j$ j

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2014 2019 “

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1	8	15	4	1	6	14

PLS-PM 36 Wold 1973

$$\xi_j = \sum_{h=1}^{n} \omega_{jh} x_{jh} + \mu_j$$

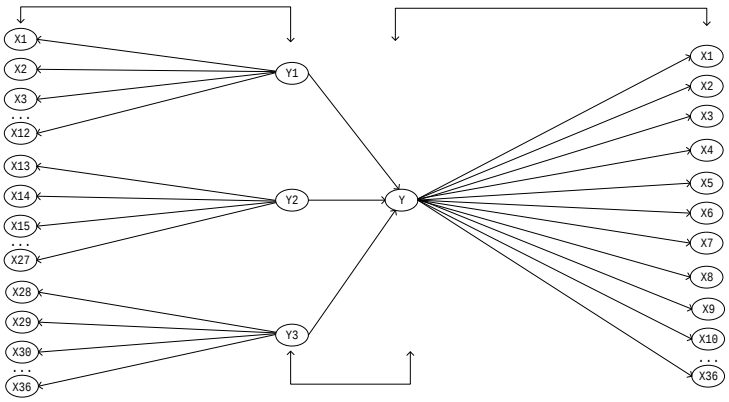
“ ” PLS-PM 1

Y_1 Y_2 Y_3

$X_1 \sim X_{12}$ $X_{13} \sim X_{27}$ $X_{28} \sim X_{36}$

Y Y_1 Y_2 Y_3

2014 Y



PLS-PM Y_j X_{j1} $\omega_j = \frac{1}{n} \mathrm{X}_j^{\,T} Z_j$

$$Z_j = \sum e_{ji} Y_i \qquad e_{ji} = \mathrm{sign}(\mathrm{corr}(\mathrm{Y}_{j,} \mathrm{Y}_i)) = \begin{cases} -1, corr(\mathrm{Y}_{j,} \mathrm{Y}_i) > 0 \\ 0, corr(\mathrm{Y}_{j,} \mathrm{Y}_i) = 0 \\ 1, corr(\mathrm{Y}_{j,} \mathrm{Y}_i) < 0 \end{cases}$$

$\omega_j = (\mathrm{X}_j{}^T \mathrm{X}_j)^{-1} \mathrm{X}_j{}^T Z_j$ ω_j $Y_j = \sum_{h=1}^{P_j} \omega_{jh} x_{jh} = X_j \omega_j$

R plspm

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0.124	0.126	0.113	0.123	0.121	0.118
0.107	0.106	0.112	0.114	0.119	0.111
0.091	0.089	0.087	0.095	0.096	0.095
0.108	0.107	0.122	0.108	0.109	0.112
0.095	0.093	0.094	0.096	0.090	0.082
0.106	0.103	0.105	0.107	0.108	0.106
0.129	0.132	0.133	0.134	0.135	0.136
0.087	0.089	0.081	0.077	0.072	0.073

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2014-2019

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PSL-PM 0.2 0.4 0.6 0.8 1.0

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2014		**2015**		**2016**		**2017**		**2018**		**2019**	
0.486	C	0.474	C	0.486	C	0.494	C	0.405	C	0.368	C
0.418	D	0.413	E	0.423	E	0.427	D	0.366	E	0.381	C
0.450	D	0.434	D	0.433	D	0.420	E	0.359	E	0.358	D
0.493	B	0.490	B	0.502	C	0.492	C	0.380	D	0.366	D
0.386	E	0.382	E	0.391	E	0.404	E	0.370	D	0.352	D
0.417	D	0.429	D	0.458							

0.530	B	0.516	B	0.522	B	0.494	B	0.381	D	0.374	C
0.525	B	0.522	B	0.542	B	0.534	B	0.407	C	0.392	B
0.424	D	0.432	D	0.434	D	0.422	E	0.346	E	0.333	E
0.538	A	0.526	A	0.545	B	0.535	B	0.414	B	0.390	B
0.525	B	0.518	B	0.525	B	0.518	B	0.434	A	0.401	A
0.428	D	0.422	D	0.433	D	0.434	D	0.363	E	0.342	E
0.491	C	0.489	B	0.502	B	0.515	B	0.417	B	0.398	B
0.403	E	0.400	E	0.410	E	0.403	E	0.350	E	0.329	E
0.526	B	0.505	B	0.539	B	0.529	B	0.423	B	0.398	B
0.387	E	0.382	E	0.395	E	0.393	E	0.353	E	0.319	E
0.463	C	0.456	C	0.482	C	0.475	C	0.432	C	0.380	C
0.536	A	0.540	A	0.561	A	0.549	A	0.442	A	0.411	A
0.621	A	0.597	A	0.621	A	0.608	A	0.427	B	0.409	A
0.466	C	0.466	C	0.480	C	0.474	C	0.390	C	0.357	D
0.436	D	0.426	D	0.448	D	0.443	D	0.410	C	0.385	C
0.491	C	0.483	C	0.504	B	0.485	C	0.404	C	0.387	C
0.459	C	0.460	C	0.474	C	0.473	C	0.390	D	0.369	C
0.652	A	0.635	A	0.643	A	0.653	A	0.484	A	0.470	A
0.542	A	0.531	A	0.551	A	0.552	A	0.423	B	0.392	B
0.533	A	0.531	A	0.555	A	0.550	A	0.423	B	0.388	B
0.416	E	0.427	D	0.444	D	0.430	D	0.374	D	0.345	E
0.378	E	0.388	E	0.388	E	0.399	E	0.362	E	0.348	E
0.427	D	0.433	D	0.450	D	0.452	D	0.390	C	0.367	D
0.435	D	0.431	D	0.441	D	0.439	D	0.389	D	0.352	D
0.405	E	0.419	E	0.426	E	0.414	E	0.355	E	0.350	E
0.461	C	0.472	C	0.485	C	0.484	C	0.406	C	0.388	B
0.368	E	0.338	E	0.341	E	0.331	E	0.309	E	0.316	E

2014-2019 “ ” 49

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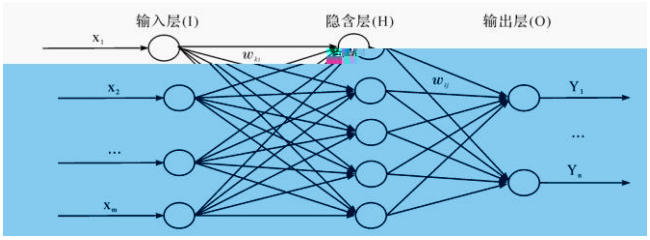

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BP

X Y I m H

O n h ω_{ki}

ω_{ij} a_i b_j

$$H_i = f(\sum_{k=1}^{n} \omega_{ki} x_k - a_i) \quad \mathrm{i} = 1, 2..., \mathrm{h}$$

$$f(x) = \frac{1}{1 - e^{-x}}$$ Sigmoid 0 1

$$f'(x) = f(x)[1 - f(x)]$$

$$O_j = \sum_{i=1}^{h} H_i \omega_{ij} - b_j, \; j = 1, 2, ..., n$$

O_j Y_k

$E(\omega, b)$

$$E(\omega, b) = \frac{1}{2} \sum_{j=1}^{n} (O_j - Y_j)^2$$

ω'_{ki} a'_i

$$\omega'_{ki} = \omega_{ki} - \eta_1 \cdot \frac{\partial E(\omega, b)}{\partial \omega_{ki}} = \omega_{ki} - \eta_1 \cdot \delta_{ki} \cdot x_k$$

$$a'_i = a_i - \eta_2 \cdot \frac{\partial E(\omega, a)}{\partial a_i} = a_i - \eta_2 \cdot \delta_{ki}$$

ω'_{ij} b'_j

$$\omega'_{ij} = \omega_{ij} - \eta_1 \cdot \frac{\partial E(\omega, b)}{\partial \omega_{ij}} = \omega_{ij} - \eta_1 \cdot \delta_{ij} \cdot x_i$$

$$b'_j = b_j - \eta_2 \cdot \frac{\partial E(\omega, \mathrm{b})}{\partial b_j} = b_j - \eta_2 \cdot \delta_{ij}$$

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$M = \sqrt{m+n} + a$ m n a

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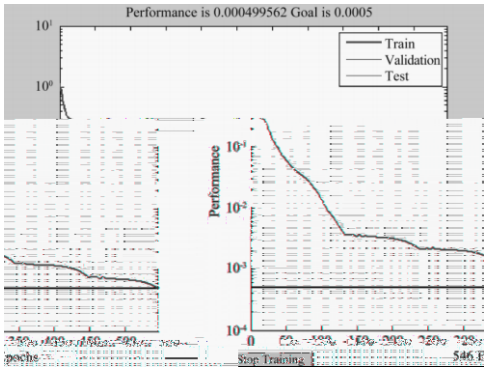

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	0.466	0.470	99.11%	A
	0.381	0.392	97.15%	B

2014-2019 “ ” 49 OFDI

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Tax_{it} WDI

2019

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ln*OFDI*	294	7.953	3.144	15.261	0.000
ln*Risk*	294	0.449	0.270	0.653	0.309
ln*Risk_pol*	294	0.371	0.585	0.366	0.174
ln*Risk_eco*	294	0.478	0.506	0.694	0.232
ln*Risk_soc*	294	0.521	0.634	0.861	0.335
ln*GDP*	294	9.351	2.096	15.247	3.198
ln*Distcap*	294	8.593	0.498	8.841	7.152
ln*Resource*	294	2.536	2.372	4.695	0.000
ln*Labor*	294	12.474	1.528	14.788	7.069
ln*Patent*	294	6.035	2.612	9.859	0.000
ln*Tax*	294	4.392	2.785	10.525	1.074

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Risk OFDI

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lnRisk_soc					-1.057**
					(-2.41)
BIT	0.629***	0.627***	0.781***	0.743***	0.916***
	(1.813)	(1.823)	(1.302)	(1.554)	(1.336)
lnGDP		2.129***	1.998***	1.975***	1.988***
		(0.372)	(0.390)	(0.366)	(0.373)
lnDistcap		-4.131**	-0.605	0.113	-1.527
		(-2.18)	(-0.57)	(0.04)	(-1.26)
lnResource		1.207***	1.328***	1.251***	1.415***
		4.53	(5.26)	4.77	6.46
lnLabor		0.307*	0.314*	0.452**	0.375**
		(1.46)	(1.57)	(2.29)	(2.12)
lnPatent		0.071	-0.082	-0.239**	-0.144
		(0.69)	(-0.76)	(-3.13)	(-1.35)
lnTax		-0.043**	-0.029*	-0.032*	-0.033**
		(-2.11)	(-1.84)	(-1.68)	(-1.95)
L.lnOFDI		0.236**	0.385***	0.412***	0.208***
		(2.12)	(6.45)	(5.18)	(2.94)
	6.357***	18.528	-16.355**	-18.361	-0.061
	(20.24)	(1.36)	-2.12	(-1.83)	(-0.05)
	294	294	294	294	294
	0.046	-	-	-	-
AR 2	-	0.8055	0.2791	0.6163	0.2238
Sargan Test	-	0.3372	0.5158	0.4429	0.3462

*** ** * 1% 5% 10% 1 T 2 - 5 Z

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“ ” OFDI OFDI Quer 2012 2019 2021 “ ” OFDI $\ln GDP_{it}$ “ ” OFDI “ ” “ ” OFDI 2 $\ln Distcap_{cit}$ 5%

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OFDI 2 - 5 $\ln Resource_{it}$ 1%

OFDI

2018 2020 “

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	1	2	3	4	1	2	3	4
lnRisk	-1.326***				-2.755***			
	(-3.17)				(-3.28)			
lnRisk_pol		0.951***				-3.724***		
		(0.29)				(-6.35)		
lnRisk_eco			-0.742				-0.748	
			(-0.76)				(-0.79)	
lnRisk_soc				-1.172***				-1.233***
				(-2.87)				(-2.91)
BIT	0.380*	0.244**	0.531***	0.395**	0.396**	0.399***	0.564***	0.474***
	(0.289)	(0.677)	(0.231)	(0.357)	(0.392)	(0.261)	(0.486)	(0.273)
lnGDP	-0.597***	-0.613***	-0.503***	-0.798***	1.677***	2.228***	1.505***	1.837***
	(-0.655)	(-0.461)	(-0.624)	(-0.705)	(0.530)	(0.352)	(0.678)	(0.714)
lnDistcap	-3.048*	-0.596	-0.671	-1.209	-1.526*	-0.484	-0.482*	-0.883
	(-3.93)	(-2.79)	(-2.18)	(-1.56)	(-1.99)	(-2.25)	(-1.97)	(-1.82)
lnResource	0.913	1.101	1.155	1.120	1.428***	1.557***	1.424***	1.286***

	2.75	(3.46)	4.38	4.29	(2.245)	(3.228)	(4.13)	(4.05)
lnLabor	0.196**	0.216*	0.322**	0.324**	0.299**	0.251**	0.518**	0.445*
	(1.21)	(1.52)	(1.94)	(1.97)	1.28	1.83	1.67	1.98
lnPatent	0.085*	0.065**	0.132*	0.181	0.082	-0.055	-0.229**	-0.128
	(0.72)	(0.66)	(0.61)	(1.49)	(0.67)	(-0.55)	(-3.29)	-1.46
lnTax	-0.031**	-0.044*	-0.038*	-0.042**	-0.020*	-0.019*	-0.016**	-0.018**
	(-1.96)	(-1.99)	(-1.72)	(-2.01)	(-1.97)	(-1.93)	(-1.83)	(-1.99)
L.lnOFDI	0.217***	0.267***	0.186**	0.351***	0.205***	0.253***	0.190***	0.348***
	(2.32)	(3.71)	(3.26)	(2.94)	(2.16)	(3.47)	(3.13)	(2.82)
	16.710	-16.219**	-16.245	-1.813	15.677	-14.051*	-13.545	-1.948
	(0.97)	-2.01	(-0.98)	(-0.31)	(0.93)	(-1.98)	(-0.92)	(-0.33)
	78	78	78	78	216	216	216	216
AR 2	0.8405	0.2907	0.6277	0.2274	0.8372	0.2898	0.6285	0.2335
Sargan Test	0.3547	0.4313	0.4469	0.3592	0.3387	0.4006	0.4514	0.3497

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	1	2	3	4 2SLS
lnRisk	-1.292**	-1.497***	-1.355***	-1.807**
	(-			

	(1.14)	(2.27)	(2.34)	(0.85)
lnTax	-0.020*	-0.021*	-0.019**	-0.022*
	(-1.95)	(-1.93)	-1.99	-2.01
	11.623	4.758	5.388	-0.038
	0.51	(0.62)	(0.59)	(-0.02)
	294	294	294	294
	-	0.3772	0.3948	0.3764

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Country Risks along the Belt and Road, Bilateral Investment Treaties and China's OFDI Location Choice —— Empirical Study based on PLS-PM and BP Neural Network Model

ZHU Jie-xi, LI Jun-jiang

Abstract: It is of great significance to effectively prevent and defuse investment risks and optimize the spatial distribution of OFDI for the steady and long-term development of high-quality belt and Road Cooperation. A risk measurement system for countries along the Belt and Road including political and military risks, economic and financial risks, and social and cultural risks was constructed, and the partial least squares path model was used to measure the comprehensive risks and risks in all dimensions of 49 countries along the Belt and Road from 2014 to 2019. BP neural network is used to establish a risk warning model, which is proved to have good generalization ability after training and simulation. Through systematic GMM dynamic panel regression analysis, the influence of host country risk and BIT on the flow of China's OFDI is analyzed. The results show that the risk level of countries along the belt and Road has a great difference, and the comprehensive investment risk of host country has a significant positive impact on China's OFDI location choice. Signing BIT can promote China's direct investment in countries along the Belt and Road, especially in developing countries with higher risks. There is "heterogeneity preference" in the location choice of China's OFDI. The comprehensive investment risk, political and military risk and social and cultural risk in developing countries have a significantly higher impact on China's OFDI than that in developed countries. The effect of host country market size on China's OFDI to developed and developing countries is asymmetric. For different investment motives, China's OFDI of developing countries is significantly affected by the host country's natural resource endowment and labor market size, while China's OFDI of developed countries is significantly affected by the host country's technological level. The non-commercial trend makes China more tolerant of country risk, geographical distance and high tax burden for developing country OFDI.

Keywords: BP neural network; Foreign direct investment; The Belt and Road Initiative; Host country risk; Bilateral investment treaty