Do acquisitions boost patents?
An empirical analysis on Chinese and Indian Emerging Market Multinationals in Europe, Japan and USA

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Motivation

- The Economist (September 12th, 2015): "*The New Silk Road. China's latest wave of globalisers will enrich their country* (– and the world)".

Is this empirically verified?

- There are a few recent studies investigating the impact of FDI on EMNEs economic performance (Cozza, Rabellotti & Sanfilippo, CER 2015; Chen and Tang, ADR 2014; Edamura et al, CER 2014 and with a focus on acquisitions Buckley et al, JWB 2014; Lebedev et al, JWB 2015; Nicholson and Salaber, IBR 2013);

- What about their innovative impact? There are just a few case studies, such as those on the white goods industry (Bonaglia et al, JWB 2007; Duysters et al, ICC 2009), the alternative energy sector (Awate et al, GSJ 2012; Hansen et al, JEG 2014) and the pharma industry (Kedron and Bagchi-Sen, JEG 2012) and a recent econometric study on China (Anderson et al, IBR 2015);

- We know very little about whether EMNEs do benefit – in terms of their innovative output – from FDI and what factors are likely to condition this impact;

- Here we focus on the **acquisitions of EU27, Japanese and US companies made by Chinese and Indian multinationals** in the period 2003-2011 and **analyze their impact on the patent portfolio of the acquirers**.

The literature on acquisitions and innovation

- The empirical literature examining the effects of acquisitions on the innovation capacity of the acquirers is not conclusive:

  - ➤ Positive impact due to complementarity of knowledge (Makri et al, SMJ 2010) and economies of scale and scope in R&D processes (Valentini, SMJ 2012);

  - ➤ Negative impact due to costs of integration and reduced motivations of R&D personnel (Colombo and Rabbiosi, RP 2014);

- Factors playing a role on the innovative outcome of acquisitions:

  - ➤ Absolute (and relative) knowledge base of the target (Ahuja and Katila, 2001; Cloodt, Hagedoorn, and Van Kranenburg, 2006);

  - ➤ Institutional distance between the target and the acquirer (Cloodt et al, 2006; Björkman, Stahl, and Vaara, 2007);

  - ➤ Past investment experience of the acquirer.

EMNEs strategic asset seeking motivations in acquisitions

- EMNEs are increasingly undertaking M&As aimed at acquiring technology, brands, marketing and R&D capabilities, distribution networks, managerial and organizational skills (Rabbiosi, Elia, and Bertoni 2012, Buckley et al. 2007);

- While we know a lot about EMNEs asset-seeking motivations for undertaking M&As, we still know little about the impact of acquisitions on EMNEs innovative outputs.

Three dimensions influence the EMNEs innovative output after an acquisition

① The previous (to the deal) patenting experience of the acquiring firm;

② The patenting portfolio of the target firm;

③ The knowledge base of the region in which the target firm is located.

Our hypotheses

- H1: The larger is the previous (to the deal) patenting experience of the *acquirer* the higher is its capacity of exploiting the knowledge resources available in the target firm;

- H2: The stronger is the knowledge base of the *target firm* the higher is the innovative impact on the acquiring EMNE;

- H3: The stronger is the knowledge base of the *target region* the higher is the innovative impact on the acquiring EMNE.

Data

- All completed majority stake cross-border acquisitions by Indian and Chinese MNEs in EU27, Japan and USA from 2003 to 2011: 466 deals;

- The data source is **EMENDATA (Emerging Multinationals Events and Networks DATAbase)** aggregating Zephyr and SDC Platinum (28% of the acquisitions are only reported in Zephyr and 31% are only in SDC Platinum);

- Medium and high-tech sectors (Ahuja and Katila, 2001; Cloodt et al, 2006; Valentini and Di Guardo, 2012**).**

Table 1 - Distribution of deals by country of origin, macro-sector, and top destinations (# and %) (2003-2011)

	Total		Manufacturing		Services		Top destinations (#)
China	95	20.39	59	28.23	36	14.01	United States (30), Germany (20), Japan (9), France (9)
India	371	79.61	150	71.77	221	85.99	United States (176), United Kingdom (78), Germany (32)
Total	466	100	209	100	257	100	

Dependent Variable

- *NUM_INPADOC_FAMILIES* measured as the cumulative number of distinct INPADOC families containing patents applications filed by the acquirer at any patent office in the three years after the deal;

- INPADOC family is a set of patent applications filed in multiple countries for protecting a single invention (Martinez, 2010);

  - The advantage of this approach over the use of EPO or USPTO patent applications is 1) to eliminate the home bias and 2) to avoid double counting;

  - Patent data are retrieved from ORBIS BvD and then checked manually with EPO-PATSTAT (version April 2014). The INPADOC families of the patents applications are retrieved from EPO-PATSTAT, as well as all the related patent information (i.e. backward citations, filing dates, technological classes).

Table 3 - Descriptive Statistics on Acquirer and Target patents pre- and after the acquisition

| | | ACQUIRER | | | | TARGET | |
| | | # INPADOC FAMILIES | | # INPADOC FAMILIES FORWARD CITATIONS | | # INPADOC FAMILIES | # INPADOC FAMILIES FORWARD CITATIONS |
		Pre-Acquisition	After-Acquisition	Pre-Acquisition	After-Acquisition	Pre-Acquisition	Pre-Acquisition
China	#	2789	3369			10335	
	Mean	29.484	36.168	34.421	44.663	108.895	191.063
	SD	131.584	123.934	140.392	154.688	1042.003	1809.751
	Min	0	0	0	0	0	0
	Max	1213	691	1254	819	10158	17644
India	#	1517	1924			365	
	Mean	7.943	8.604	31.275	26.752	1.005	3.315
	SD	33.779	31.678	135.784	100.448	6.280	16.376
	Min	0	0	0	0	0	0
	Max	343	347	1323	1300	99	189

Note: INPADOC FAMILIES FORWARD CITATIONS are calculated as number of distinct INPADOC families citing the focal INPADOC family in the 5 years after its priority date

Independent Variables

- *ACQUIRER_KNOW_BASE:* sum of INPADOC families with patents filed by the acquirer in the 5 years before the deal and their citations;

- *TARGET_KNOW_BASE* : sum of INPADOC families with patents filed by the target in the 5 years before the deal and their citations;

- *REGIONAL_KNOW_BASE:* log of cumulative number of per capita patent applications in the 5 years before the deal in the TL2 (e.g. NUTS2) region where the target firm is located (OECD Regional Database).

Control variables

- *MA_EXPERIENCE:* cumulative number of acquirer's majority acquisitions and greenfield investments up to the year of the deal;

- *HORIZONTAL_MA:* dummy equal to 1 when both the target and the acquirer belong to the same SIC2 digit;

- *ISTITUTIONAL_DIST:* institutional distance between the countries of the target and the acquirer (Berry, Guillén and Zhou, JIBS 2010);

- *NO_BIG_ACQ:* dummy equal to 1 if the acquirer does not belong to the "Large" and "Very Large" categories, as defined in ORBIS;

- *CHINA_DUMMY*; *JAPAN_DUMMY* and *US_DUMMY*;

- Year dummies.

Econometric methodology

- Poisson Quasi Maximum Likelihood estimation with industry fixed effects at NACE Main Section level;

- Robustness checks:

  - Control for the possibility that patenting & acquiring might not be not independent (Valentini and Di Guardo, 2012) with a two-stage count model with sample selection adding an auxiliary equation controlling for the probability to carry out an international acquisition (Bratti and Miranda, 2011);

  - Zero-inflated Poisson regressions due to the high number of zeros (Hu and Jefferson, 2009).

H1

H2

H3

	Controls		Independent variables			Full		Full with interactions		Dep. Var.: N USPTO PATENTS
				Dep. Var.: NUMBER OF INPADOC PATENTS						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TARGET_KNOW_BASE		-0.0031***			-0.0022***	-0.0010*	0.0377***	-0.0010**	-0.0046***	-0.0016***
		(0.0004)			(0.0000)	(0.0005)	(0.0096)	(0.0004)	(0.0012)	(0.0001)
ACQUIRER_KNOW_BASE			0.0018***		0.0020***	0.0030***	0.0030***	-0.0048	0.0030***	0.0027***
			(0.0003)		(0.0004)	(0.0003)	(0.0003)	(0.0027)	(0.0003)	(0.0005)
REGION_KNOW_BASE				-0.0281	0.0659	-0.0195	-0.0072	-0.0850**	-0.0162	0.0655
				(0.1156)	(0.1468)	(0.0371)	(0.0382)	(0.0310)	(0.0387)	(0.1719)
CHINA	1.8317***					2.2392***	2.2503***	2.3137***	2.2551***	-2.1254***
	(0.1391)					(0.5985)	(0.6010)	(0.6731)	(0.5997)	(0.4429)
JP	-1.1883**					-0.5467	-0.4236	-0.5211	-0.4781	1.4543***
	(0.4146)					(0.3002)	(0.3720)	(0.3381)	(0.3476)	(0.1954)
US	-0.0756					0.1648	0.2065	0.1186	0.1347	0.6700
	(0.5768)					(0.2118)	(0.2160)	(0.2270)	(0.2503)	(0.4520)
TOT_EXP	0.2573***					0.0558*	0.0523*	0.0753**	0.0653***	-0.0883***
	(0.0301)					(0.0228)	(0.0251)	(0.0279)	(0.0189)	(0.0099)
INSTITUTIONAL_DIST	-0.0466					-0.0234***	-0.0264***	-0.0186***	-0.0252***	-0.0306
	(0.0297)					(0.0021)	(0.0026)	(0.0025)	(0.0023)	(0.0304)
HORIZONTAL_MA	0.9806					0.7987*	0.8165*	0.8742**	0.8068*	0.0844
	(0.5664)					(0.3452)	(0.3510)	(0.3299)	(0.3506)	(0.4238)
NO_BIG_ACQ	-2.9471**					-2.9555**	-3.3865*	-2.9348**	-2.9525**	-1.5762
	(0.9592)					(0.9394)	(1.4048)	(0.9666)	(0.9465)	(1.0476)
TARGET_REGIONAL							-0.0052***			
							(0.0013)			
ACQUIRER_REGIONAL								0.0010**		
								(0.0004)		
TARGET_ACQUIRER									0.0001***	
									(0.0001)	
YEAR DUMMY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	428	428	428	414	414	414	414	414	414	409
ll	-9.0e+03	-1.5e+04	-1.1e+04	-1.5e+04	-1.1e+04	-5.8e+03	-5.7e+03	-5.4e+03	-5.7e+03	-1.5e+03

LEGEND: Legend: *<0.05, **<0.01, ***<0.001. Models are estimated using Poisson Quasi-Maximum Likelihood. Robust Standard errors are reported below coefficients.

Main findings

① The stronger the acquirer knowledge base, the more the acquirer patents after the deal;

② The stronger the target knowledge base, the lower the acquirers patent after the deal;

③ There is a general neutral effect (non significant) of the regional innovative context.

	Controls		Independent variables			Full	Full with interactions			Dep. Var.: N USPTO PATENTS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TARGET_KNOW_BASE		-0.0031***			-0.0022***	-0.0010*	0.0377***	-0.0010**	-0.0046***	-0.0016***
		(0.0004)			(0.0000)	(0.0005)	(0.0096)	(0.0004)	(0.0012)	(0.0001)
ACQUIRER_KNOW_BASE			0.0018***		0.0020***	0.0030***	0.0030***	-0.0048	0.0030***	0.0027***
			(0.0003)		(0.0004)	(0.0003)	(0.0003)	(0.0027)	(0.0003)	(0.0005)
REGION_KNOW_BASE				-0.0281	0.0659	-0.0195	-0.0072	-0.0850**	-0.0162	0.0655
				(0.1156)	(0.1468)	(0.0371)	(0.0382)	(0.0310)	(0.0387)	(0.1719)
CHINA	1.8317***					2.2392***	2.2503***	2.3137***	2.2551***	-2.1254***
	(0.1391)					(0.5985)	(0.6010)	(0.6731)	(0.5997)	(0.4429)
JP	-1.1883**					-0.5467	-0.4236	-0.5211	-0.4781	1.4543***
	(0.4146)					(0.3002)	(0.3720)	(0.3381)	(0.3476)	(0.1954)
US	-0.0756					0.1648	0.2065	0.1186	0.1347	0.6700
	(0.5768)					(0.2118)	(0.2160)	(0.2270)	(0.2503)	(0.4520)
TOT_EXP	0.2573***					0.0558*	0.0523*	0.0753**	0.0653***	-0.0883***
	(0.0301)					(0.0228)	(0.0251)	(0.0279)	(0.0189)	(0.0099)
INSTITUTIONAL_DIST	-0.0466					-0.0234***	-0.0264***	-0.0186***	-0.0252***	-0.0306
	(0.0297)					(0.0021)	(0.0026)	(0.0025)	(0.0023)	(0.0304)
HORIZONTAL_MA	0.9806					0.7987*	0.8165*	0.8742**	0.8068*	0.0844
	(0.5664)					(0.3452)	(0.3510)	(0.3299)	(0.3506)	(0.4238)
NO_BIG_ACQ	-2.9471**					-2.9555**	-3.3865*	-2.9348**	-2.9525**	-1.5762
	(0.9592)					(0.9394)	(1.4048)	(0.9666)	(0.9465)	(1.0476)
TARGET_REGIONAL							-0.0052***			
							(0.0013)			
ACQUIRER_REGIONAL								0.0010**		
								(0.0004)		
TARGET_ACQUIRER									0.0001***	
									(0.0001)	
YEAR DUMMY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	428	428	428	414	414	414	414	414	414	409
ll	-9.0e+03	-1.5e+04	-1.1e+04	-1.5e+04	-1.1e+04	-5.8e+03	-5.7e+03	-5.4e+03	-5.7e+03	-1.5e+03

Dep. Var.: NUMBER OF INPADOC PATENTS (columns 1–9); Dep. Var.: N USPTO PATENTS (column 10)

LEGEND: Legend: *<0.05, **<0.01, ***<0.001. Models are estimated using Poisson Quasi-Maximum Likelihood. Robust Standard errors are reported below coefficients.
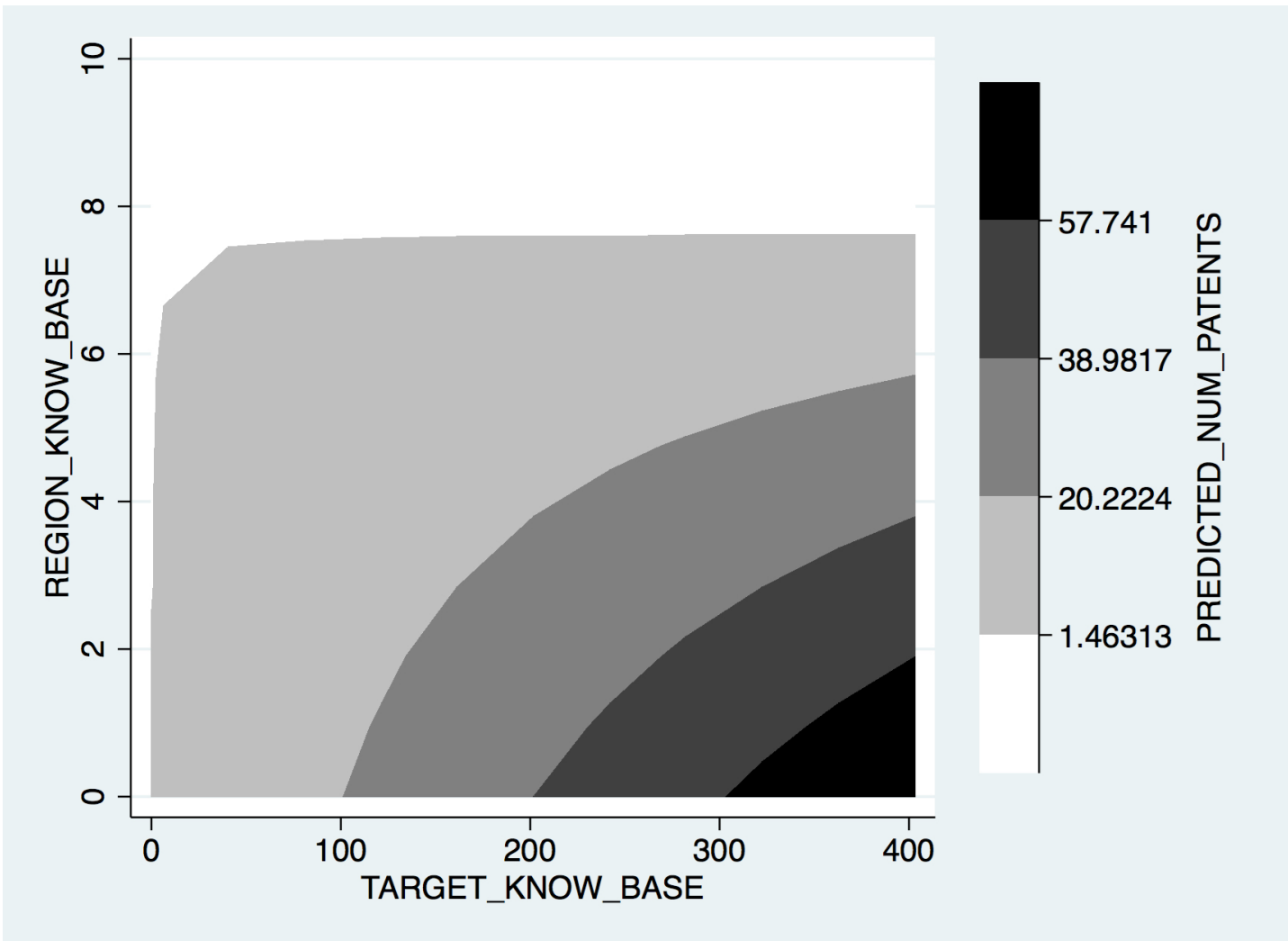
Regional and Acquirer Knowledge Base
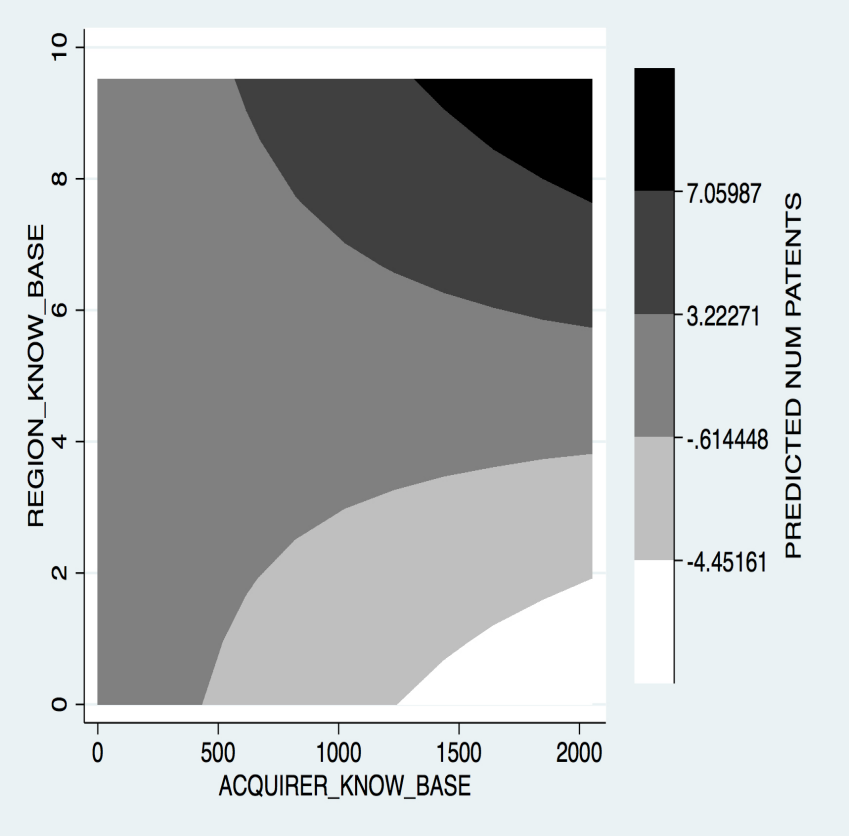
Acquirer and Target Knowledge Base
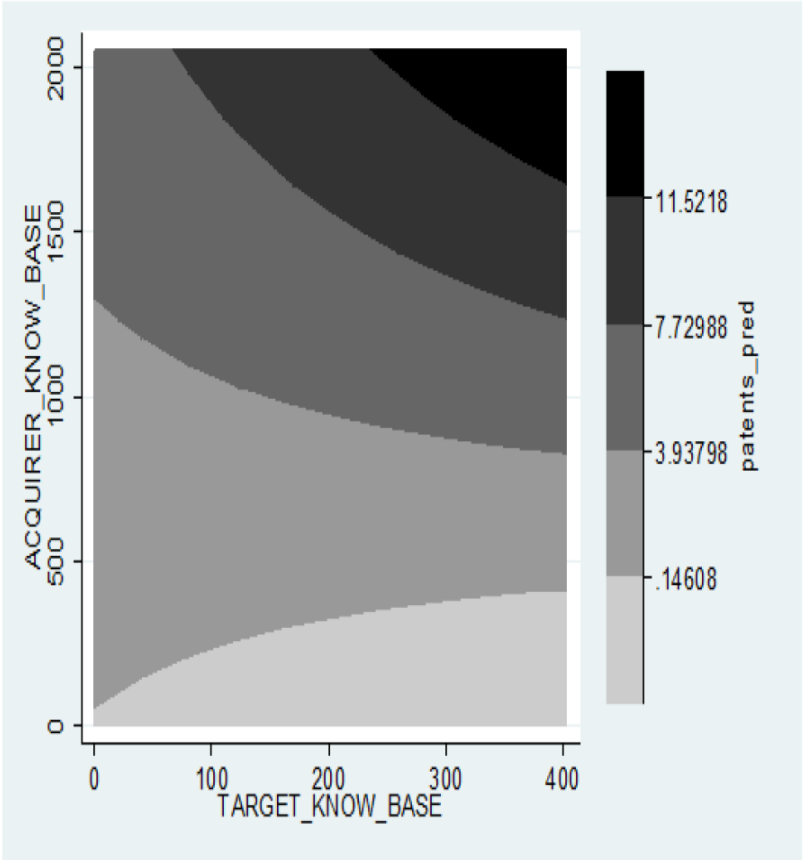
Regional and Target Knowledge Base

Concluding remarks

- The more innovative EMNEs take advantage of their acquisitions (and of the knowledge available in the local context) in EU27, Japan and US for further improving their patenting activity;

- Nonetheless, on average EMNEs are still unable to take advantage of their acquisitions to increase their innovativeness because of the existing technological gap;

- With regard to the knowledge context in which the acquired companies are located, it doesn't play a significant role;

- Can we expect that with EMNEs increasing their innovation capacity their ability to take advantage from acquisition will also increase?
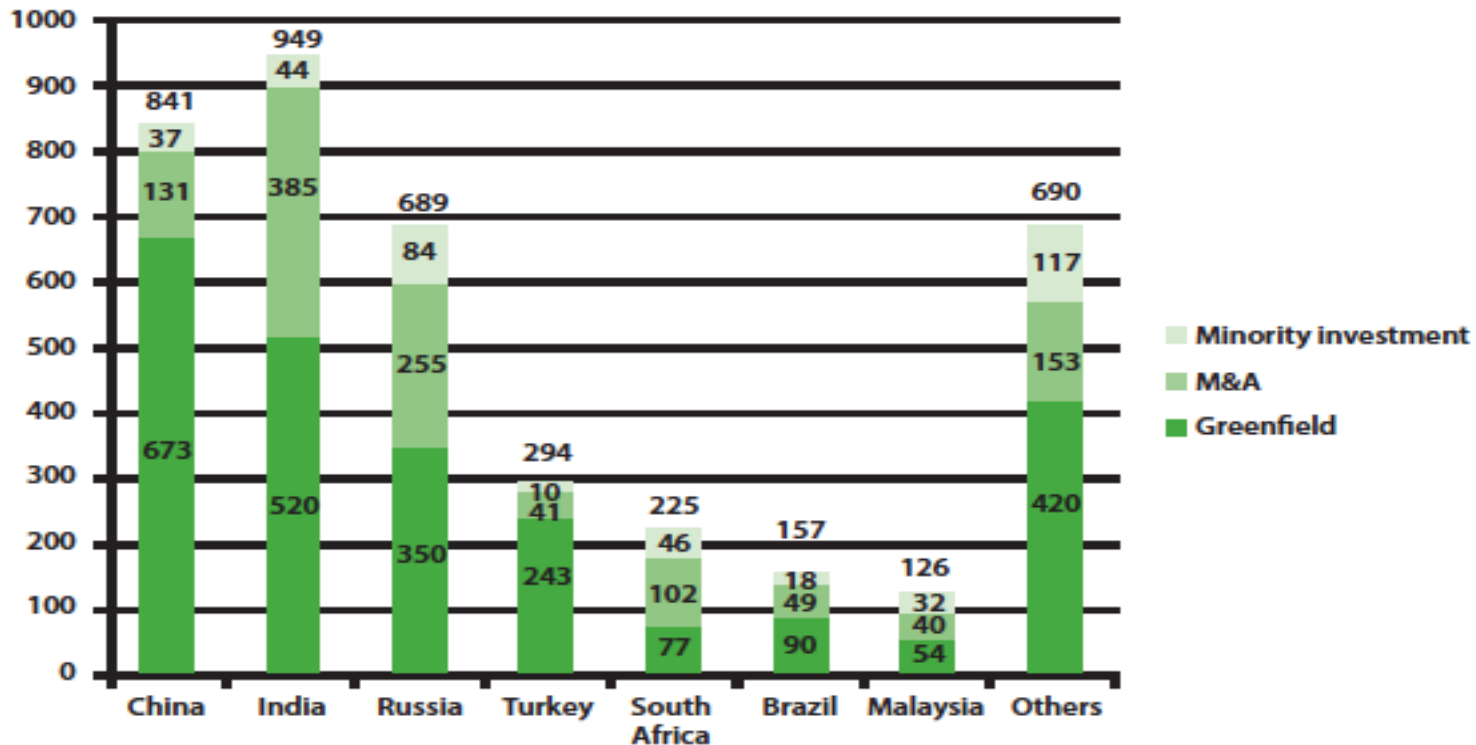
EMENDATA

Emerging Multinationals Events and Networks DATAbase

- **Greenfield investments** (*fDiMarket*s - FT) + **M&As** (*Zephyr* - BvD and *SDC Platinum* – Thomson Reuters) (+ minority investments) from EMNEs;

- EMENDATA provides information at the level of the a) **single deal**, b) the **investing company** and c) the **global ultimate owner (GUO)**;

- Information include: a) entry mode; b) sector of specialization of the investing company and of the subsidiaries; c) activities undertaken by the subsidiaries; d) location of the subsidiaries; e) number of jobs created; f) financial information about the investors and the subsidiaries; g) patents of the investors and the subsidiaries;

- Period: 2003-2011 (updating at 2013);
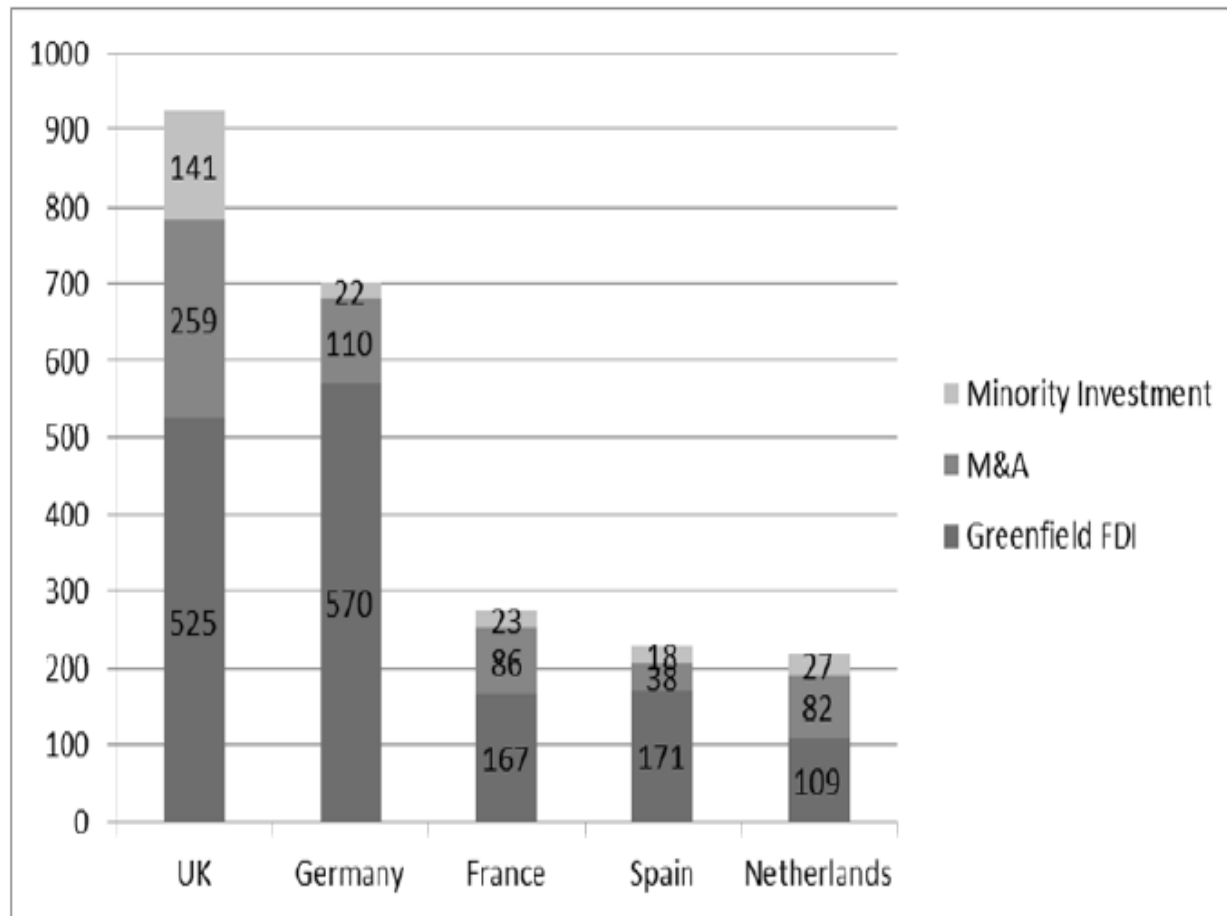
- Focus on EU-27: 3,971 deals.

EMNEs in Europe:
From where do they come from?

Figure 1 - Emerging countries FDI to Europe by entry mode (2003-2001) (# deals)
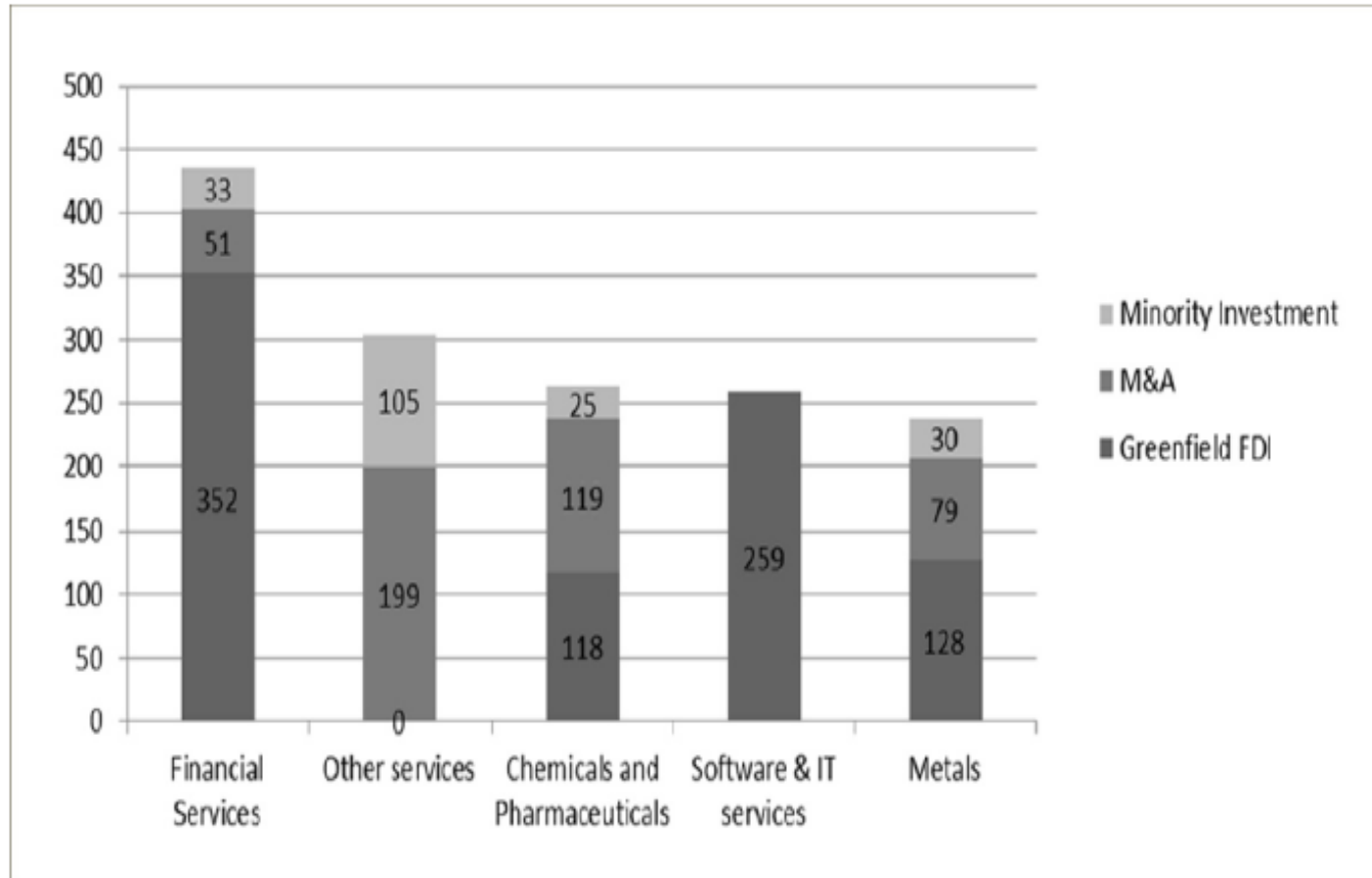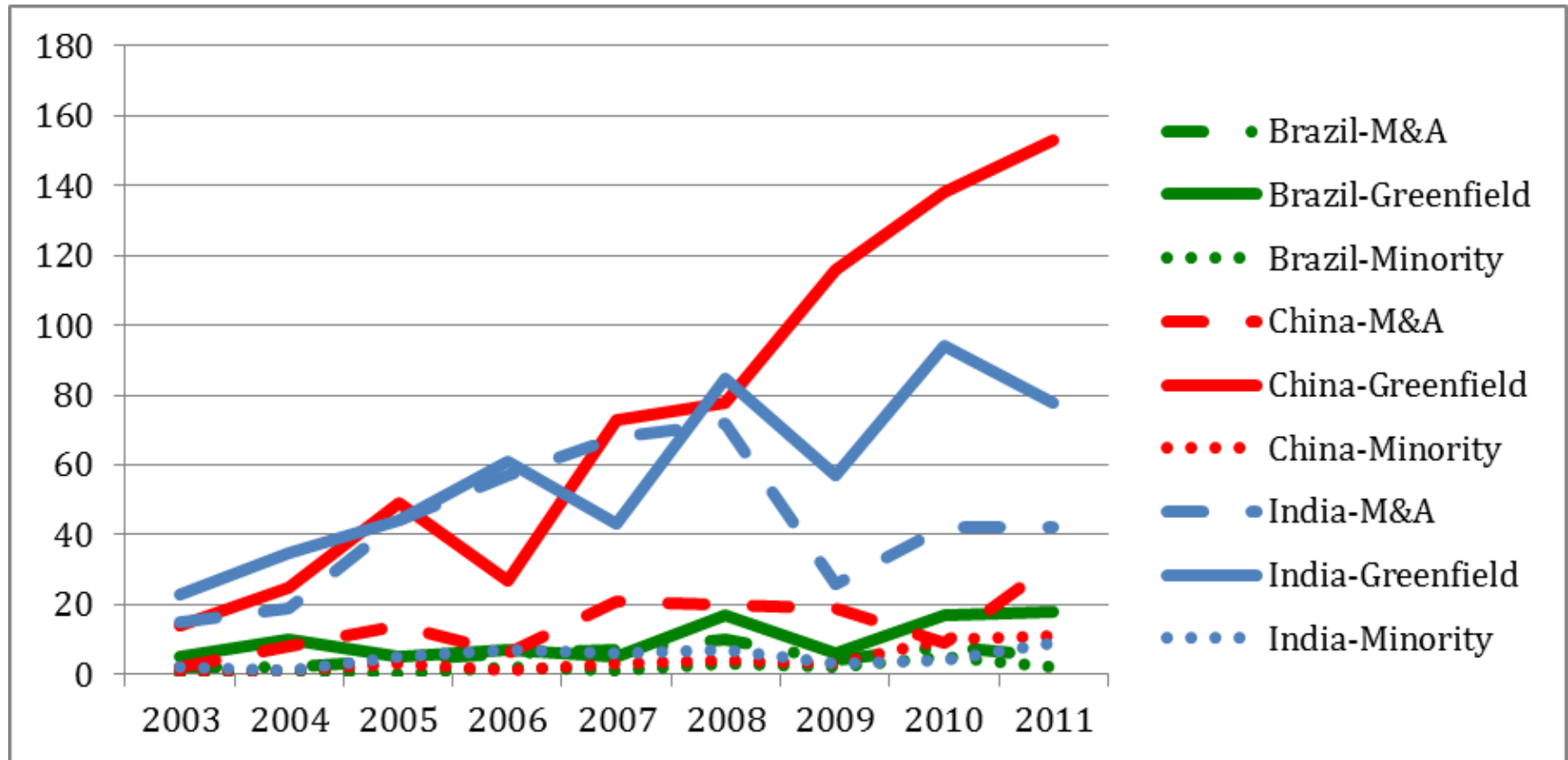
Source: EMENDATA

Where do they go?

Source: EMENDATA (based on Table A3.3, Annex 2)
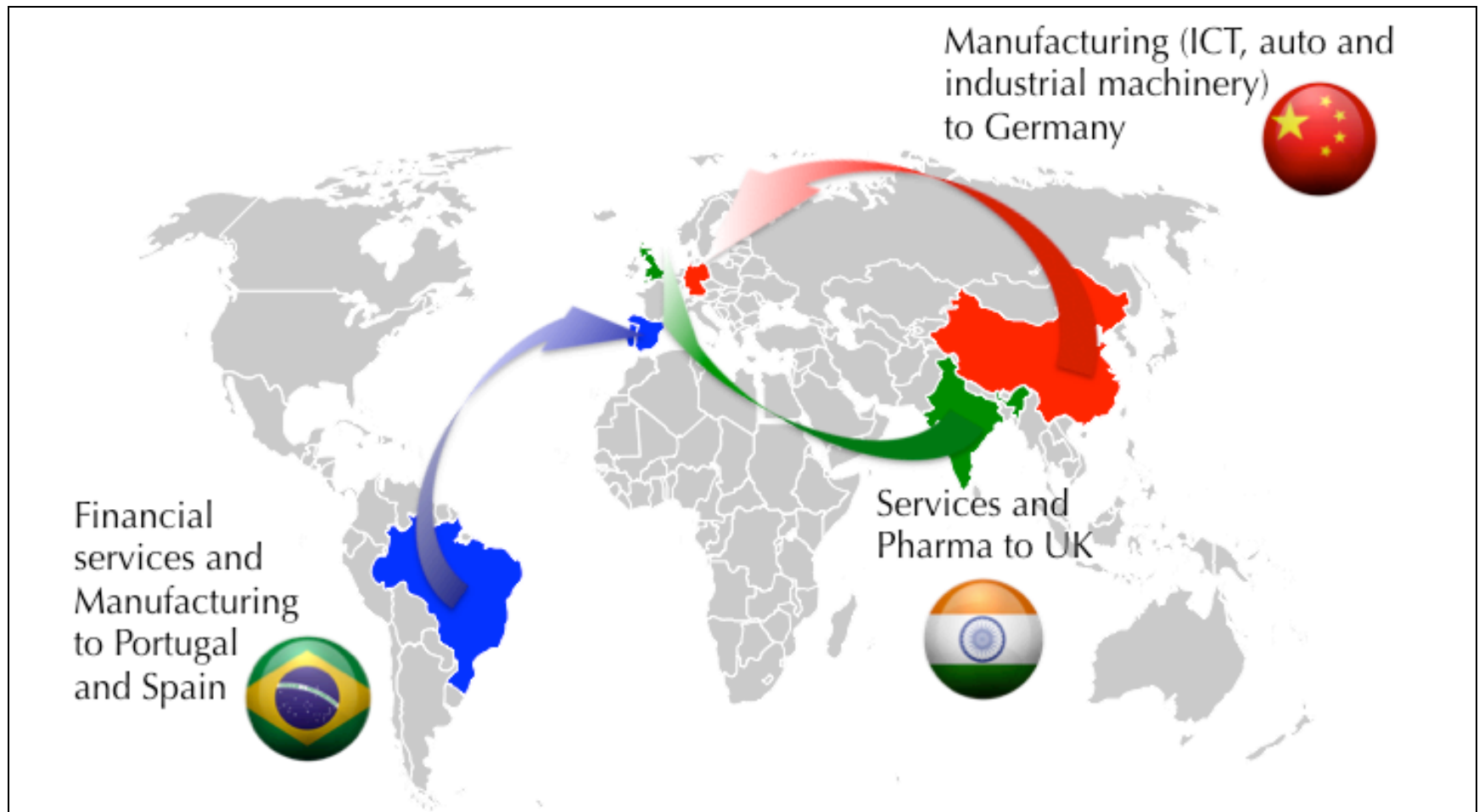
In which industries they do specialize in?

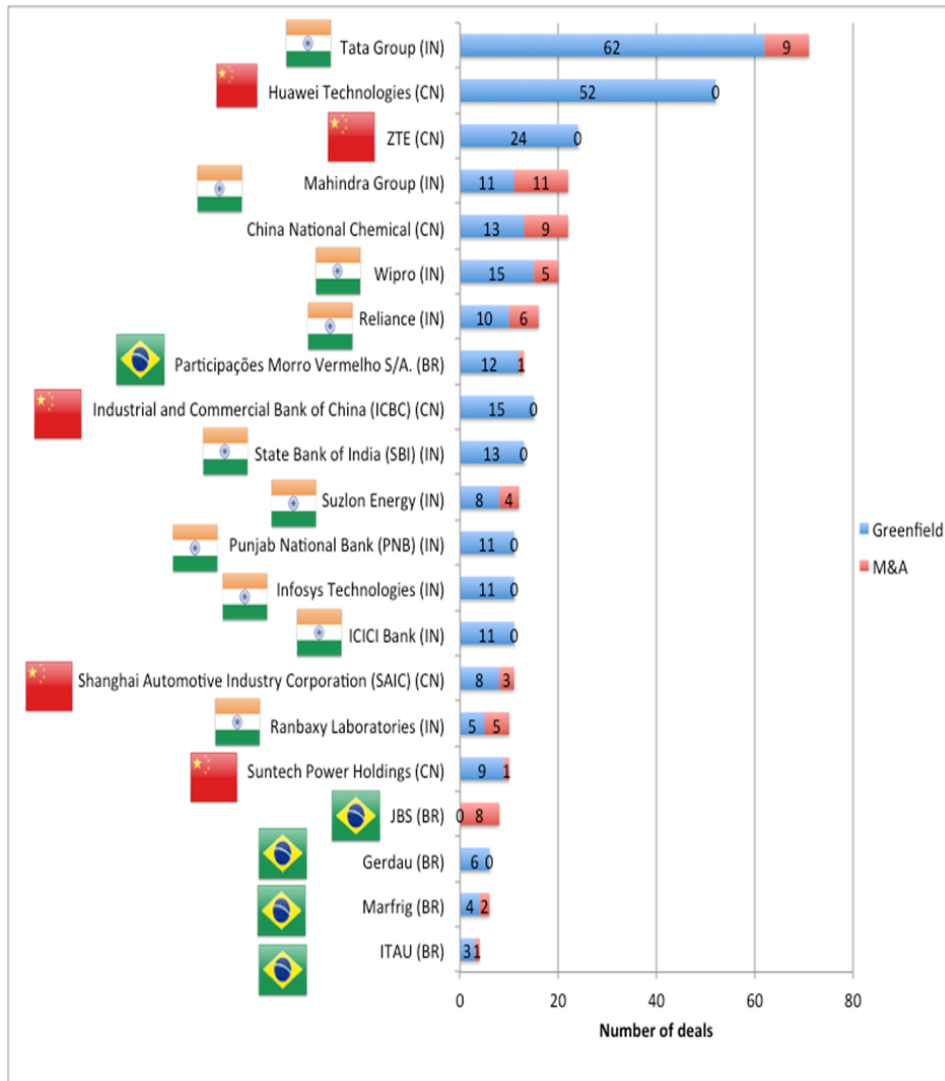Source: EMENDATA (based on Table A3.4, Annex 2)
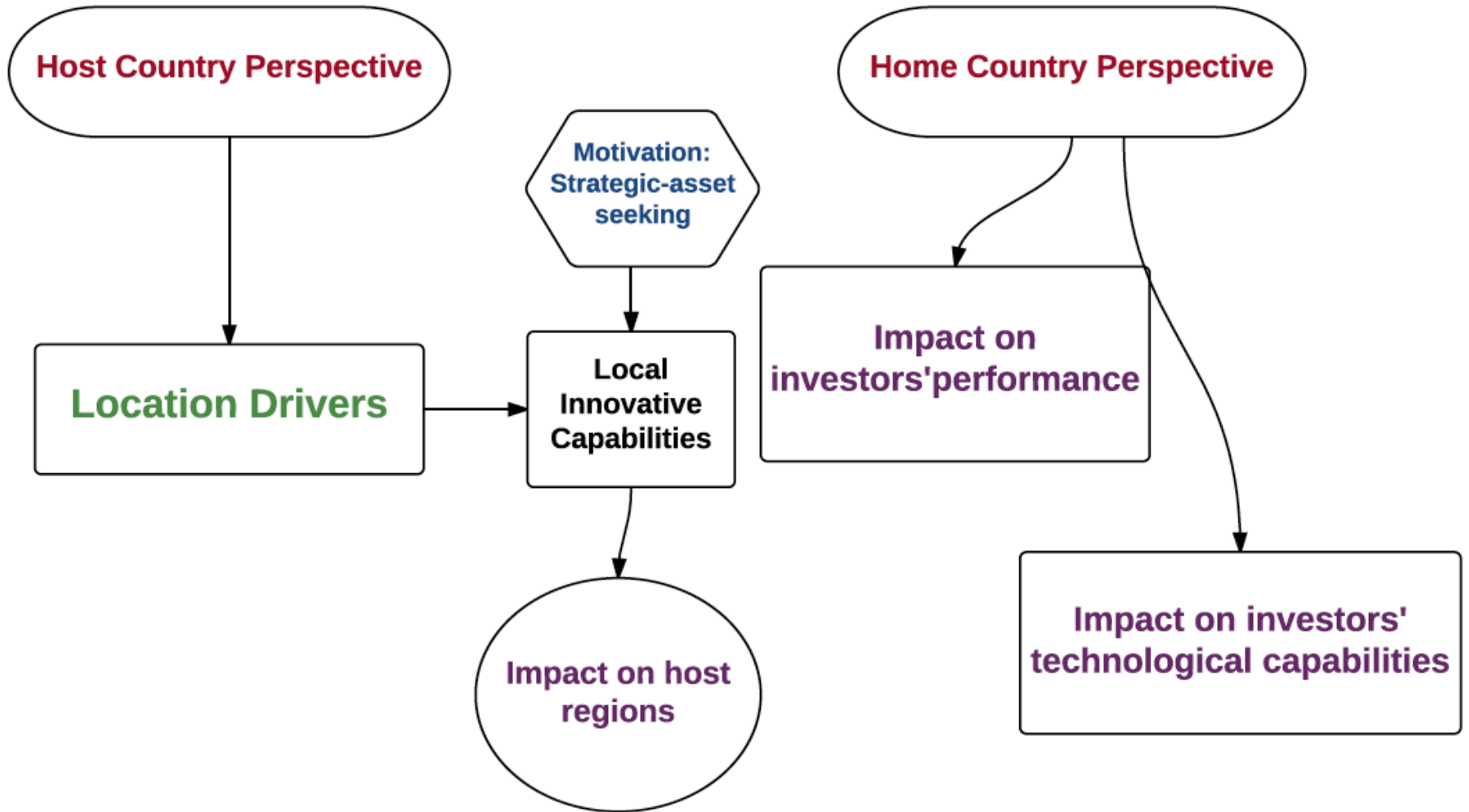
Focus on Brazilian, Chinese and Indian investments

Main country destinations and sectorial specialization of BIC MNE investments in the EU-27

Who are the top investors?

Some findings

① **On location drivers:** Crescenzi R., Pietrobelli C., Rabellotti R., 2015, The location strategy of multinationals from emerging countries in the EU regions, *LEQS Papers* 93-2015 London School of Economics forthcoming in *European and Planning Studies*;

② **On the impact on host regions**: Giuliani E., Gorgoni S. and Guenther C.,Rabellotti R., 2014, "Emerging-market MNEs investing in Europe. A typology of subsidiary global–local connections", *International Business Review,* 23: 680-691;

③ **On the impact on investors' technological capabilities**: Giuliani E., Martinelli A. and Rabellotti R., 2015, Is Co-Invention Expediting Technological Catch Up? A Study of Collaboration between Emerging Country Firms and EU inventors, forthcoming in *World Development*;

④ **On the impact on investors 'performance**: Cozza C., Sanfilippo M.and Rabellotti R., 2015, The Impact of Outward FDI on the Performance of Chinese Multinationals, forthcoming in *China Economic Review*.

Thank you

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Table 6 – 'Robustness check – Two-stage estimation

	Full model	Full model with interactions		
	Dep. Var.: N. of INPADOC PATENTS			
	(1)	(2)	(3)	(4)
ACQUIRER_KNOW_BASE	0.0038***	0.0034***	-0.0033***	0.0030***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
TARGET_KNOW_BASE	-0.0025***	0.0288**	-0.0021***	-0.0035***
	(0.0002)	(0.0088)	(0.0002)	(0.0004)
CHINA	2.3956***	1.9964***	1.2520***	1.3943***
	(0.0529)	(0.0529)	(0.0524)	(0.0631)
ISTITUTIONAL_DIST	0.0059	-0.0727***	-0.0903***	-0.0841***
	(0.0047)	(0.0047)	(0.0049)	(0.0049)
TOT_EXP	-0.1187***	-0.0289***	-0.1026***	-0.0936***
	(0.0066)	(0.0067)	(0.0070)	(0.0083)
PRE_2008	0.6575***	0.3344***	0.2052***	0.2664***
	(0.0385)	(0.0387)	(0.0395)	(0.0387)
MANUFACTURING	0.1207**	-0.3185***	-0.0163	-1.1806***
	(0.0464)	(0.0508)	(0.0494)	(0.0655)
JP	-1.3929***	-0.6954***	-0.1688	-0.0768
	(0.0908)	(0.0875)	(0.0910)	(0.0918)
US	0.0369	0.3254***	0.3658***	-0.0402
	(0.0720)	(0.0797)	(0.0755)	(0.1001)
MA_HORIZONTAL	0.1629*	0.3597***	0.2502**	0.2658**
	(0.0780)	(0.0823)	(0.0905)	(0.1008)
REGION_KNOW_BASE	-0.3503***	-0.2350***	-0.1955***	-0.2236***
	(0.0147)	(0.0142)	(0.0154)	(0.0159)
OPERATING_REVENUES	0.4710***	0.6279***	0.5587***	0.6420***
	(0.0093)	(0.0112)	(0.0111)	(0.0134)
TARGET*REGION		-0.0037**		
		(0.0012)		
ACQUIRER*REGION			0.0009***	
			(0.0000)	
ACQUIRER*TARGET				0.0001***
				(0.0001)
CONSTANT	-3.4152***	-5.2491***	-3.6402***	-3.8971***
	(0.1791)	(0.1931)	(0.1951)	(0.1927)
OBSERVATIONS	2438	2438	2438	2438
LOG LIKELIHOOD	-1.3e+03	-1.3e+03	-1.3e+03	-1.3e+03

Legend: *<0.05, **<0.01, ***<0.001. Standard errors are reported below coefficients. In the two-stage test, the selection equation includes revenues, solvency ratio, acquirer knowledge base, manufacturing sector dummy and origin country dummy.

Table 5 – Robustness check – Zero-inflated models

	Dep. Var.: N. of INPADOC PATENTS			
	Full model	*Full model with interactions*		
	[1]	[2]	[3]	[4]
TARGET_KNOW_BASE	-0.0038***	0.1867***	-0.0037***	-0.0071***
	(0.0003)	(0.0114)	(0.0003)	(0.0007)
ACQUIRER_KNOW_BASE	0.0018***	0.0019***	-0.0000	0.0018***
	(0.0001)	(0.0001)	(0.0002)	(0.0001)
CHINA	1.7217***	1.7795***	1.6582***	1.7493***
	(0.0373)	(0.0375)	(0.0376)	(0.0376)
PRE_2008	-0.3573***	-0.3276***	-0.3371***	-0.3750***
	(0.0330)	(0.0332)	(0.0331)	(0.0330)
JP	0.1192	0.3026***	0.1612	0.1875*
	(0.0878)	(0.0887)	(0.0881)	(0.0886)
US	0.0810	0.3113***	0.0280	0.0873
	(0.0514)	(0.0530)	(0.0512)	(0.0518)
TOT_EXP	-0.0498***	-0.0585***	-0.0482***	-0.0475***
	(0.0060)	(0.0060)	(0.0060)	(0.0059)
ISTITUTIONAL_DIST	0.0199***	0.0119***	0.0287***	0.0206***
	(0.0033)	(0.0033)	(0.0034)	(0.0033)
MA_HORIZONTAL	0.1592*	0.2158**	0.2136**	0.1816**
	(0.0668)	(0.0670)	(0.0669)	(0.0670)
REGION_KNOW_BASE	-0.0867***	-0.0490***	-0.1373***	-0.0864***
	(0.0096)	(0.0099)	(0.0101)	(0.0096)
MANUFACTURING	0.1448***	0.2730***	0.3173***	0.1531***
	(0.0316)	(0.0328)	(0.0357)	(0.0317)
NO_BIG_ACQ	-1.4826***	-1.4226***	-1.3795***	-1.4918***
	(0.1432)	(0.1430)	(0.1434)	(0.1433)
TARGET*REGION		-0.0252***		
		(0.0015)		
ACQUIRER*REGION			0.0003***	
			(0.0000)	
ACQUIRER*TARGET				0.0001***
				(0.0001)
CONSTANT	3.1296***	2.7370***	3.2124***	3.0972***
	(0.1161)	(0.1195)	(0.1139)	(0.1165)
OBSERVATIONS	452	452	452	452
LOG LIKELIHOOD	-4.2e+03	-4.0e+03	-4.1e+03	-4.1e+03

Legend: *<0.05, **<0.01, ***<0.001. Standard errors are reported below coefficients.
In the Zero-inflated Poisson_test, the inflate equation includes origin country dummy,
manufacturing sector dummy, acquirer knowledge base and acquirer size.