International collaboration and spatial dynamics of US patenting in Central and Eastern Europe 1981-2010

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Research Problem

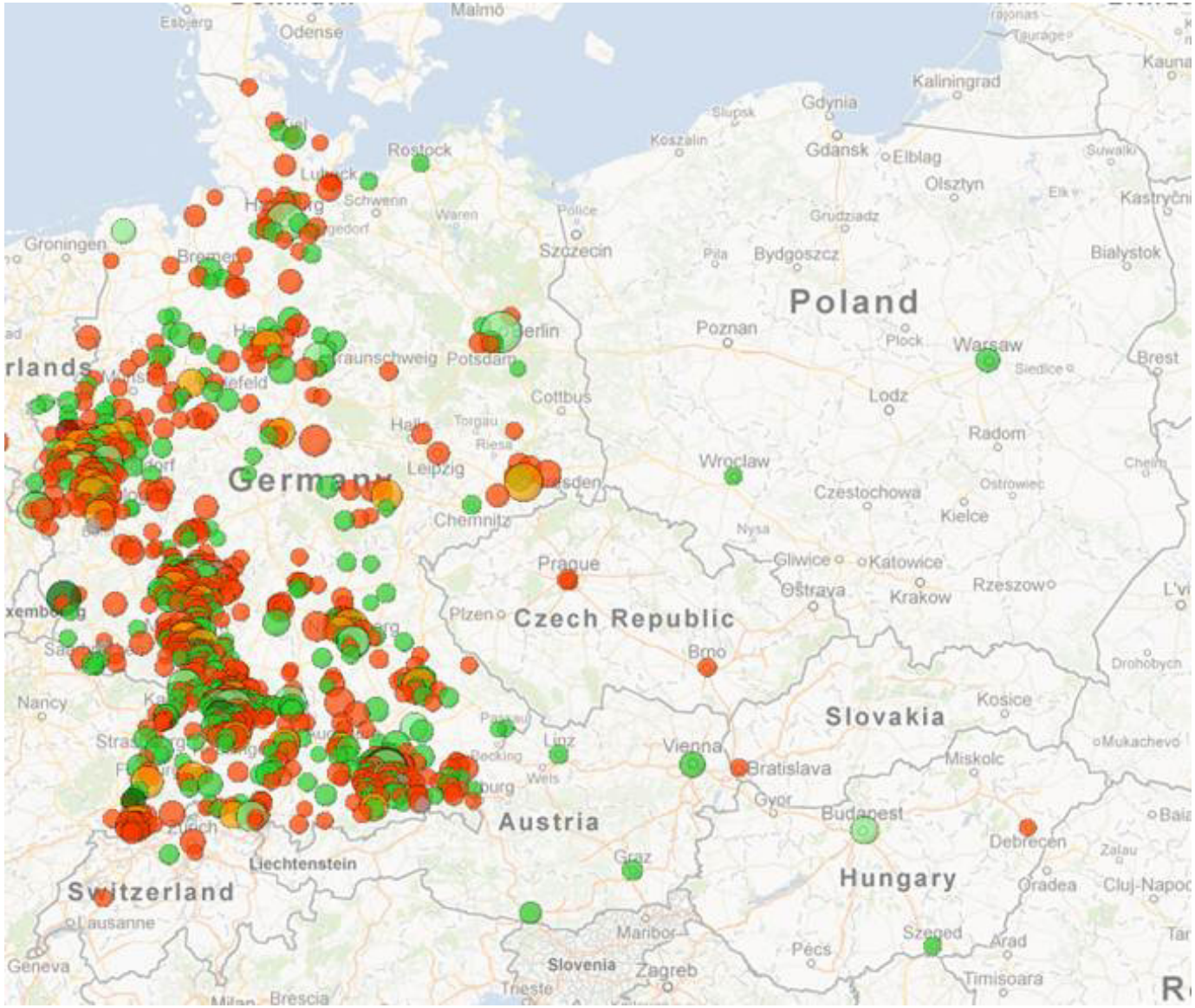
We experience an increasing scale of international collaboration in science and patenting (Wagner et al. 2015).

International co-operation in patenting is important, because:

1. it produces better patents (Beaudry and Schiffaeurova 2011)
2. international knowledge flows might spill over to co-located firms and inventors (Breschi and Lissoni 2001; Guan and Chen 2012; Jaffe *et al.* 1993; Varga and Schalk 2004).

This latter aspect is especially important for less developed countries that can benefit from international collaborations in their knowledge production (Goldfinch *et al.* 2003; Penrose 1973; Varga and Sebestyén 2013).

Research Problem



Research Problem

Economic transition and globalization gathered speed simultaneously, so that foreign-owned companies and international collaboration became the dominant engine in spatial development of innovation (Lengyel *et al.* 2015; Radosevic 2002).

Despite the large efforts devoted to regional and national innovation systems in CEE, here is a common agreement that innovation policy could not cope with the above challenges due to weak local institutions and innovation links (Havas 2002; Inzelt 2004; Radosevic 2011; Radosevic and Reid 2006; von Tunzelmann and Nassehi 2004; Varblane *et al.* 2007).

Question: how did international collaboration influence spatial dynamics of patenting in CEE over the 1981-2010 period?

Data

We have downloaded the full set of patents filed by the United States Patent and Trademark Office (USPTO), in which at least one inventor from the CEE countries participated.

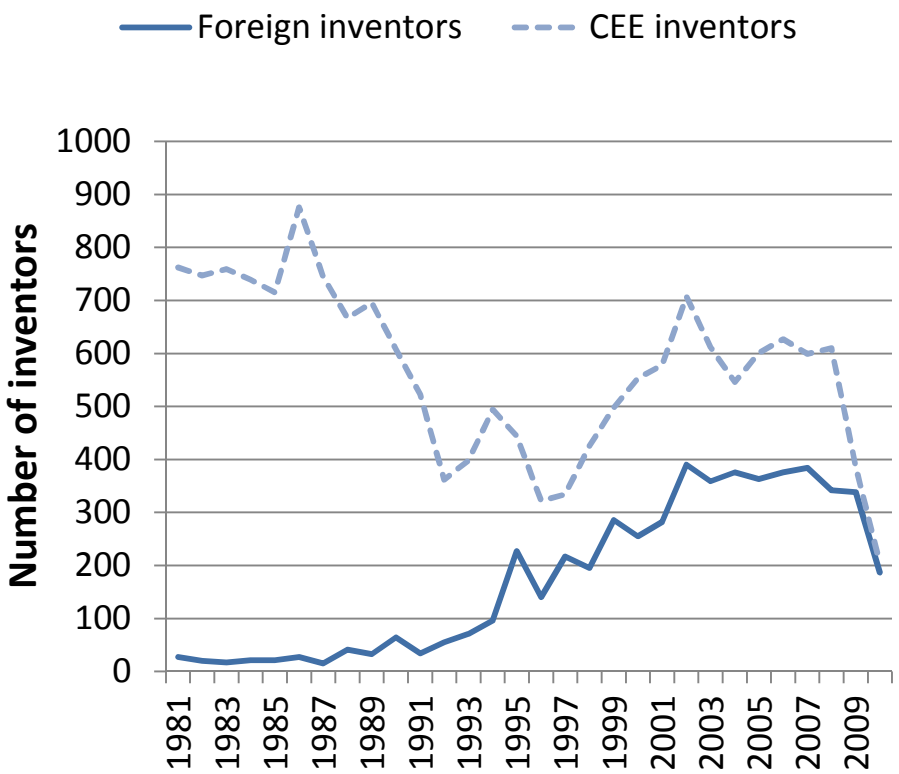
USPTO data is used instead of EPO data because

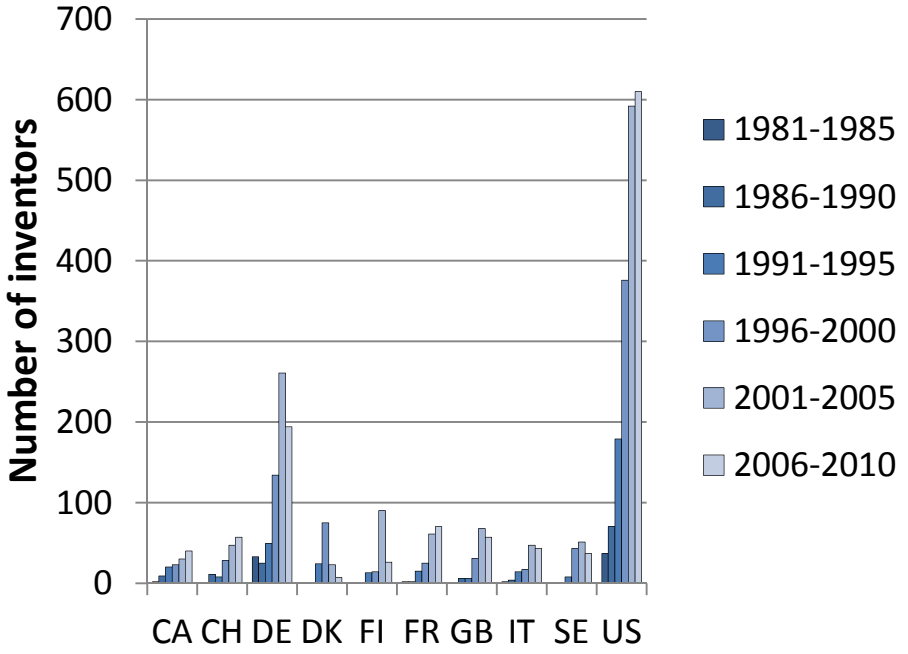
1. the accession of CEE countries to the common EU market have affected the number of EPO patent applications for reasons other than inventions (Hall and Helmers 2012);

2. USPTO patents can be expected to capture globally competitive innovation output better than EPO data (Ginarte and Park 1997, Martinez and Guellec, 2003).

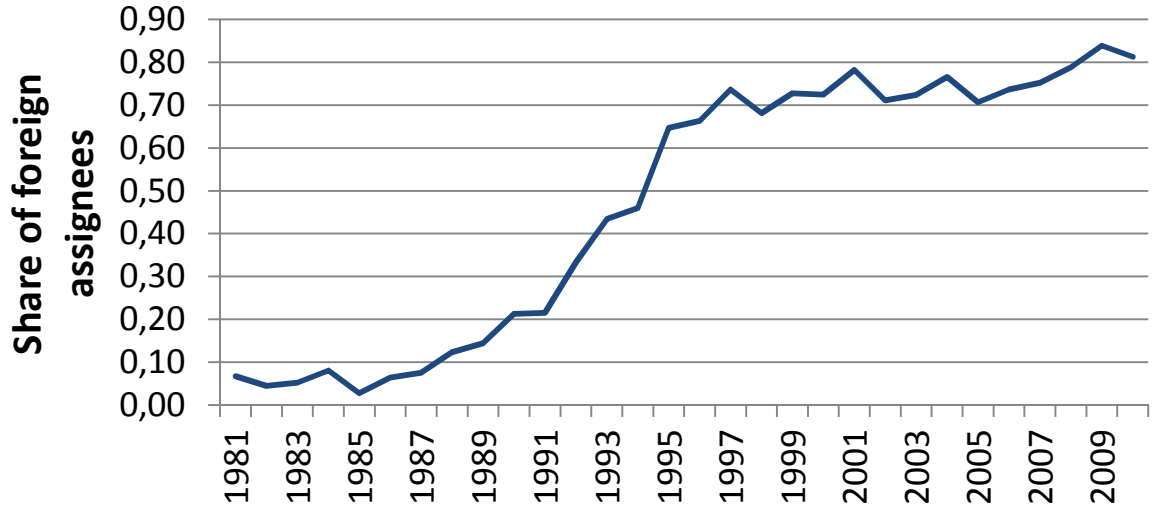
USPTO patents with at least one inventor in the Czech Republic, Poland, Slovakia, and Hungary for the 1980-2010 period → **7601 patents**.

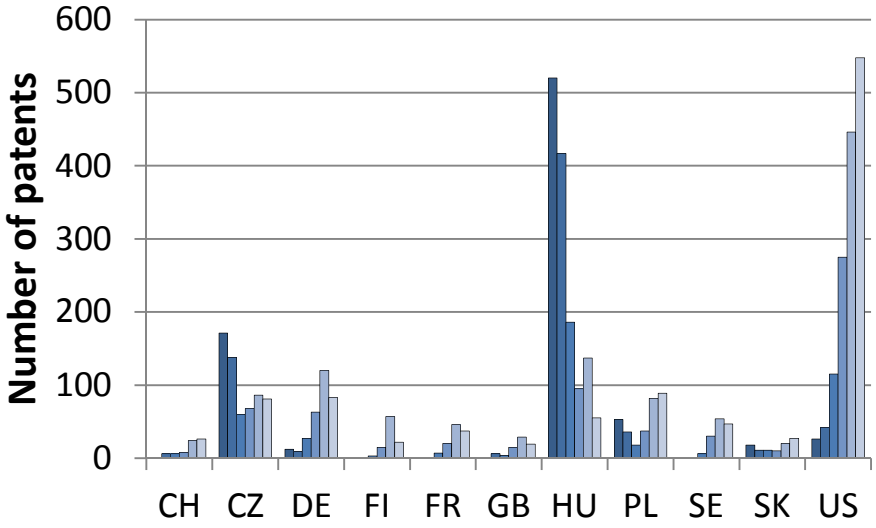
Inventors

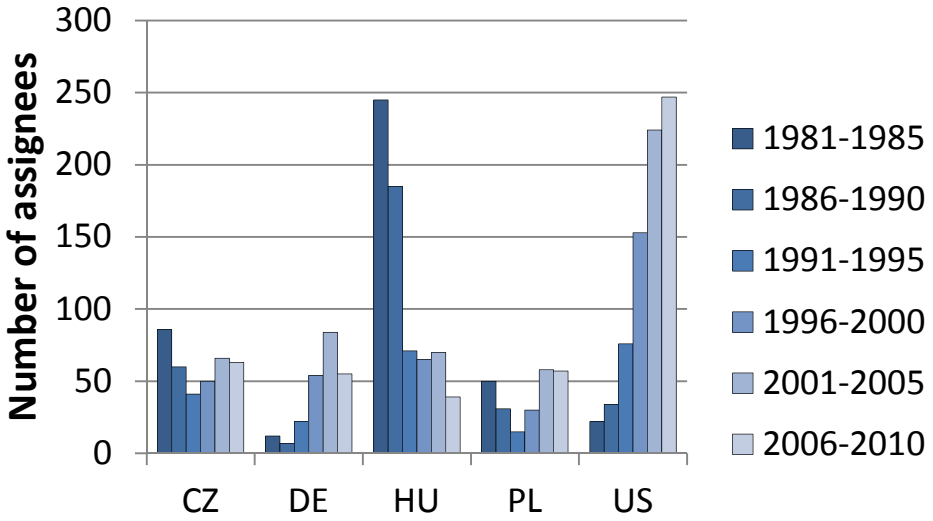

Foreign inventors
CEE inventors
Number of inventors
1000
900
800
700
600
500
400
300
200
100
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Number of inventors
700
600
500
400
300
200
100
0
CA CH DE DK FI FR GB IT SE US
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
2006-2010

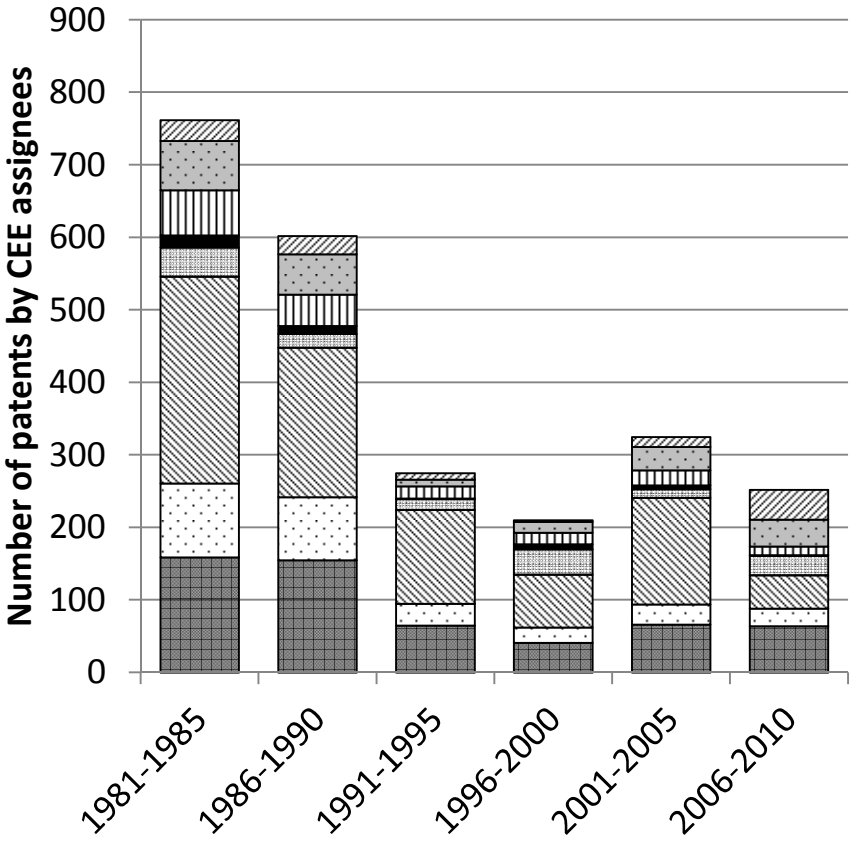
Assignees

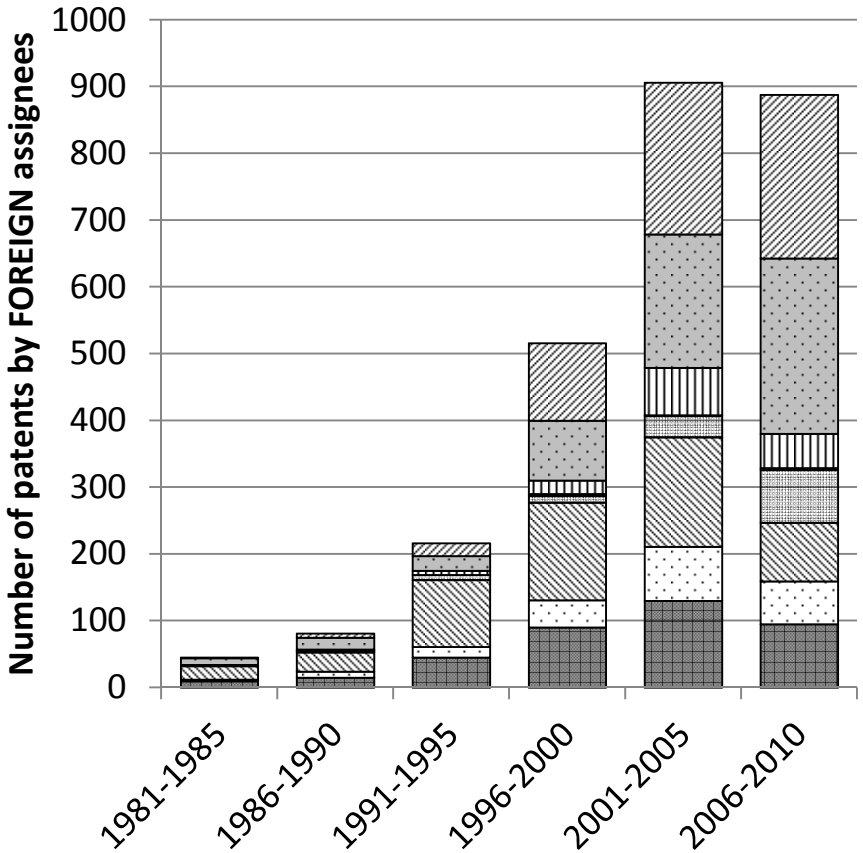

Share of foreign assignees
0,90
0,80
0,70
0,60
0,50
0,40
0,30
0,20
0,10
0,00
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009


Number of patents
600
500
400
300
200
100
0
CH
CZ
DE
FI
FR
GB
HU
PL
SE
SK
US


Number of assignees
300
250
200
150
100
50
0
CZ
DE
HU
PL
US
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
2006-2010

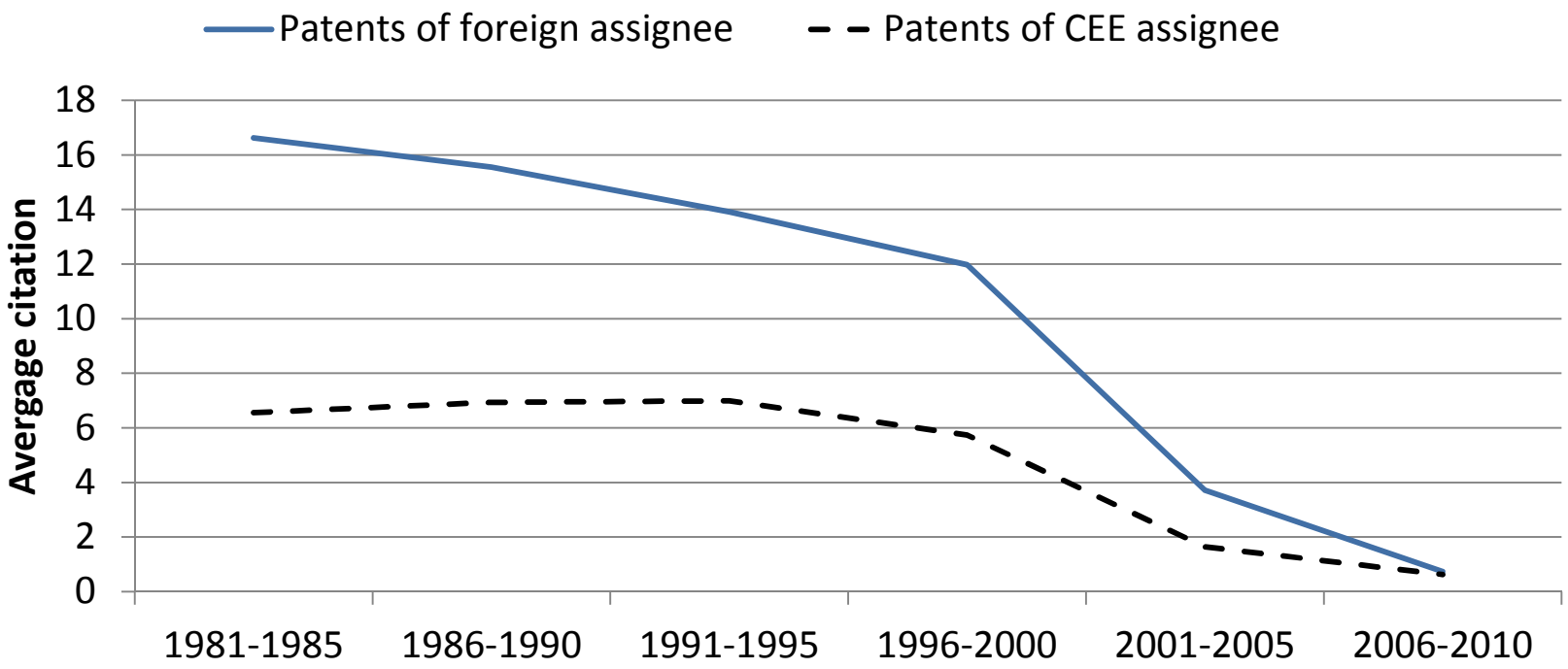
Technology



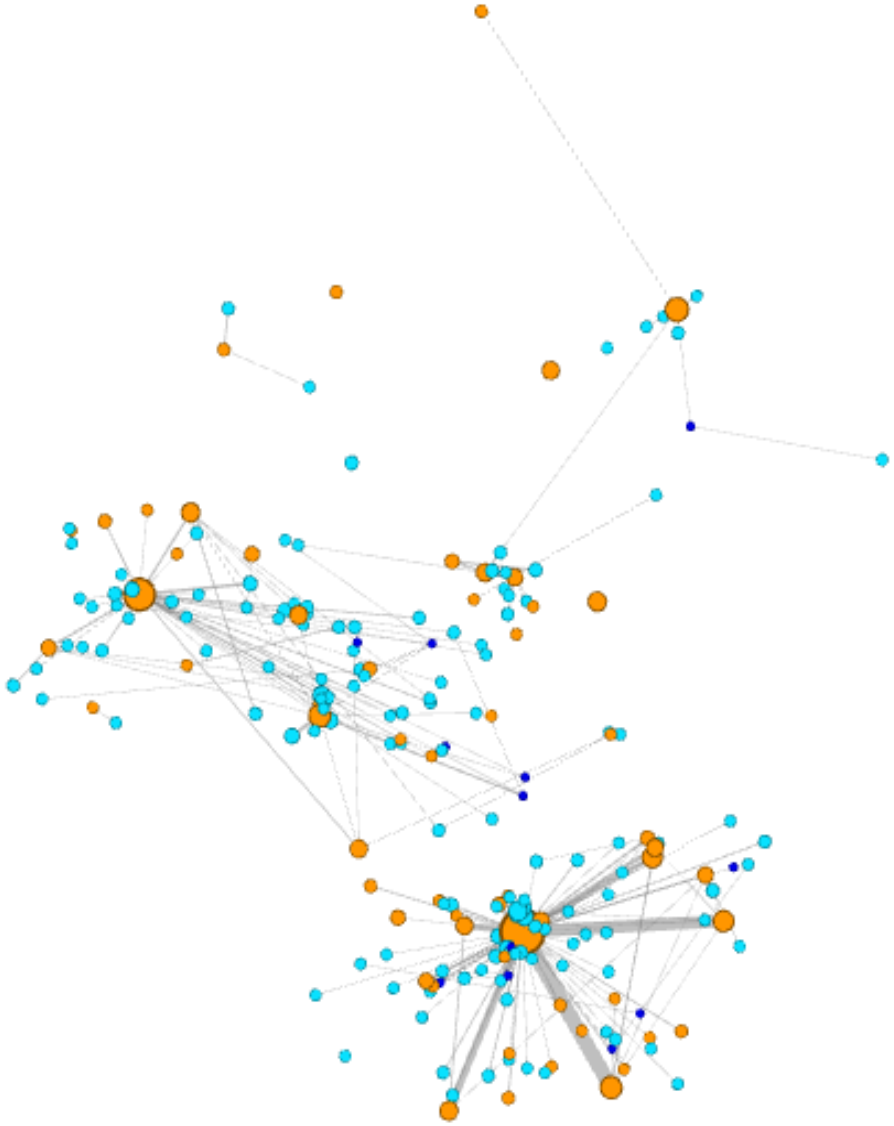


Electricity
Physics
Mechanical engineering
Fixed constructions
Textiles; paper
Chemistry; metallurgy
Performing operations; transporting
Human necessities

Quality


Patents of foreign assignee
Patents of CEE assignee
Avergage citation
18
16
14
12
10
8
6
4
2
0
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
2006-2010

Spatial collaboration, 1981-1985



Node size: number of patents

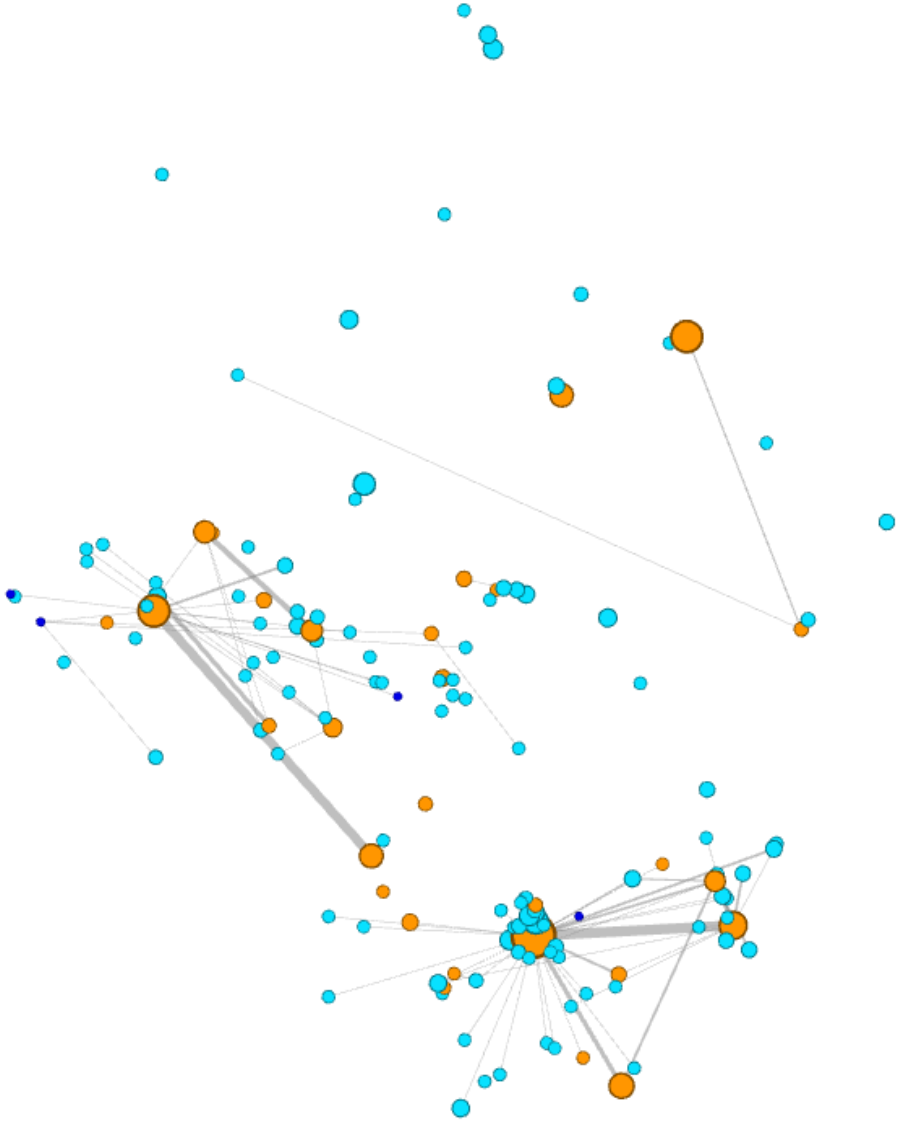
Edge size: number of patents in collaboration

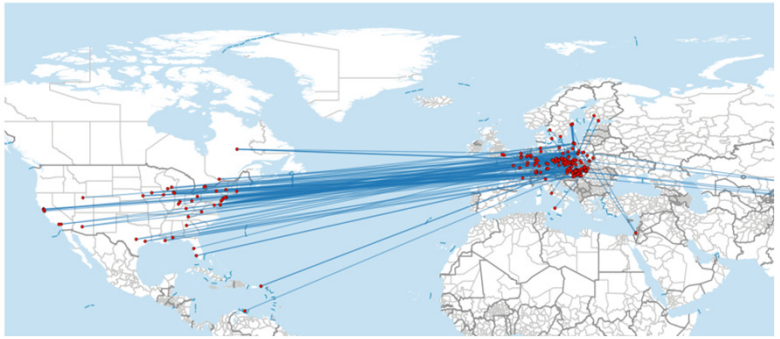
Orange: assignee and inventor

Light blue: only inventor

Dark blue: only assignee

Spatial collaboration, 1991-1995





Node size: number of patents

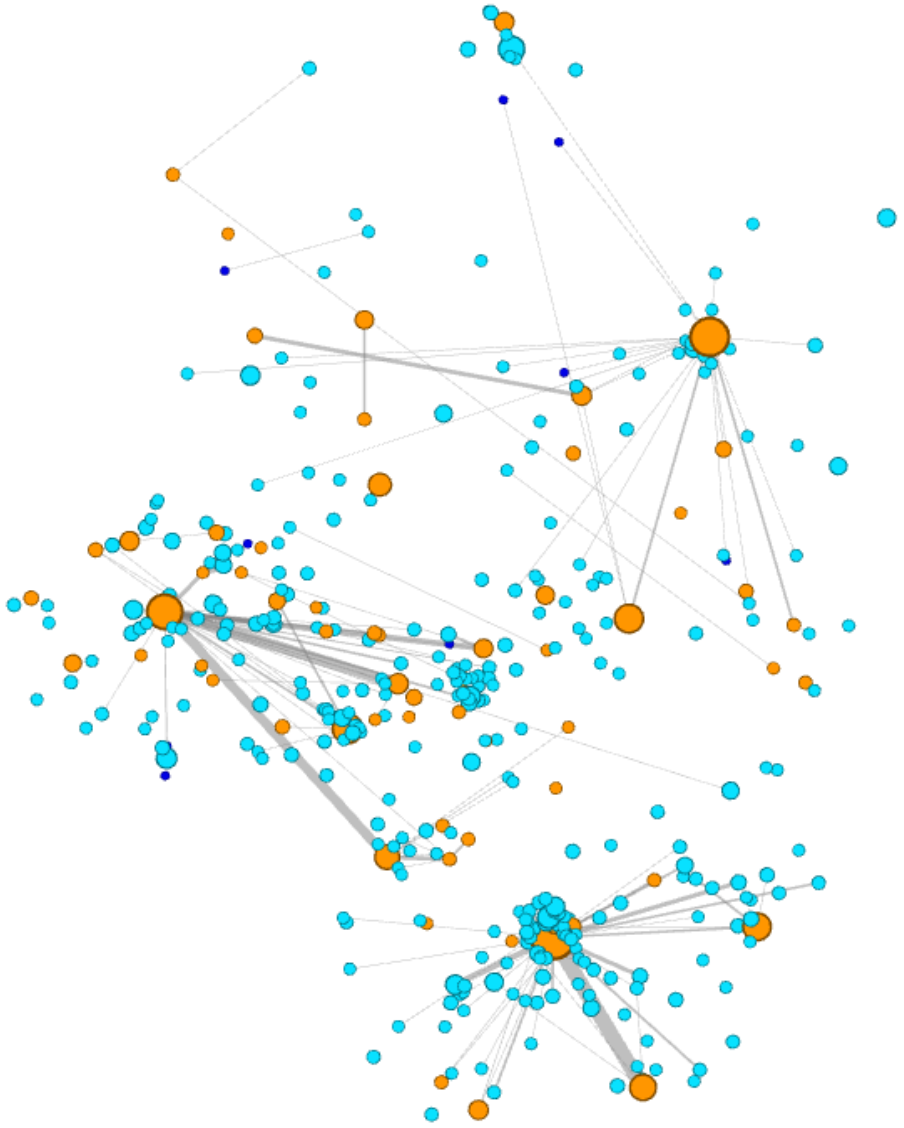
Edge size: number of patents in collaboration

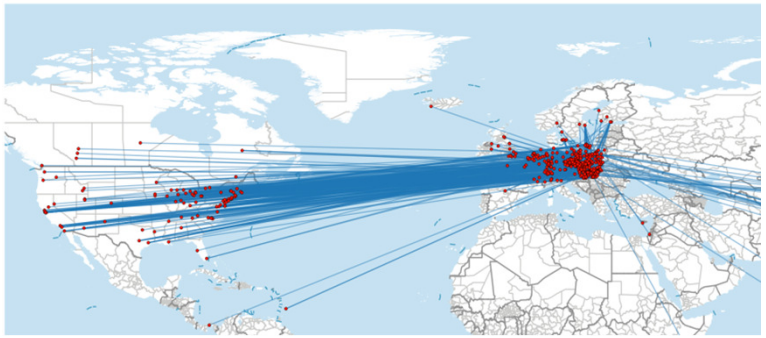
Orange: assignee and inventor

Light blue: only inventor

Dark blue: only assignee

Spatial collaboration, 2001-2005





Node size: number of patents

Edge size: number of patents in collaboration

Orange: assignee and inventor

Light blue: only inventor

Dark blue: only assignee

Spatial collaboration, 1981-2010

Period	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010
EDGES	277	315	279	442	809	770
in CEE	242	249	111	121	195	172
NODES						
CEE INV	154	165	112	170	338	367
CEE ASS	12	11	4	3	11	11
CEE INV-ASS	60	50	29	44	64	64
FOR ASS	25	52	98	178	237	199
TOP 5 TOWNS (number of patents by inventor location)	Budapest (475)	Budapest (397)	Budapest (214)	Budapest (210)	Budapest (324)	Budapest (243)
	Prague (100)	Prague (87)	Prague (59)	Prague (97)	Warsaw (141)	Prague (141)
	Warsaw (33)	Warsaw (41)	Warsaw (46)	Warsaw (76)	Prague (127)	Warsaw (96)
	Brno (26)	Dunakeszi (22)	Debrecen (29)	Liberec (29)	Brno (55)	Hroznetin (60)
	Szeged (26)	Debrecen (21)	Dunakeszi (20)	Bratislava (25)	Cracow (47)	Brno (56)

The probability of town entry and exit

Period	**1986-1990**	**1991-1995**	**1996-2000**	**2001-2005**	**2006-2010**
ENTRY at *t*	**116**	**67**	**145**	**279**	**236**
P(CEE) at *t*	95%	61%	53%	36%	37%
P(Foreign) at *t*	3%	37%	42%	54%	60%
P(CEE and Foreign) at *t*	2%	1%	5%	10%	3%

Period	**1981-1985**	**1985-1990**	**1991-1995**	**1996-2000**	**2001-2005**
CEE at *t*	**199**	**191**	**80**	**101**	**129**
P(INCUMBENT) at *t*+1	43.2%	30.4%	37.5%	47.5%	37.2%
P(EXIT) at *t*+1	56.8%	69.6%	62.5%	52.5%	62.8%
FOREIGN at *t*	**5**	**6**	**37**	**74**	**202**
P(INCUMBENT) at *t*+1	60%	16.7%	48.6%	54.1%	36.6%
P(EXIT) at *t*+1	40%	83.3%	51.4%	45.9%	63.4%
CEE and FOREIGN at *t*	**10**	**18**	**24**	**39**	**71**
P(INCUMBENT) at *t*+1	100%	83.3%	87.5%	89.7%	80.3%
P(EXIT) at *t*+1	0%	16.7%	12.5%	10.3%	19.7%

Entry and Exit of towns, pooled OLS with period FE

	ENTRY				EXIT			
	1981-2010	1981-1990	1991-2000	2001-2010	1981-2010	1981-1990	1991-2000	2001-2010
CEE firm	0.518***	0.770***	0.396***	0.355***	0.450***	0.565***	0.582***	0.287***
	(0.017)	(0.020)	(0.038)	(0.032)	(0.019)	(0.034)	(0.030)	(0.032)
FOR firm	0.371***	-0.004	0.360***	0.416***	0.241***	-0.233*	0.055	0.320***
	(0.023)	(0.110)	(0.048)	(0.025)	(0.029)	(0.140)	(0.074)	(0.030)
SK	0.057***	0.039**	0.060***	0.118***	0.042***	0.099***	0.002	0.089***
	(0.015)	(0.016)	(0.023)	(0.033)	(0.016)	(0.027)	(0.018)	(0.031)
CZ	0.044***	0.038***	0.050***	0.069***	0.031***	0.089***	0.023	0.029
	(0.011)	(0.014)	(0.016)	(0.022)	(0.011)	(0.023)	(0.016)	(0.019)
PL	0.039***	0.035**	0.038**	0.098***	0.018	0.097***	0.001	0.041*
	(0.012)	(0.014)	(0.018)	(0.025)	(0.012)	(0.023)	(0.016)	(0.022)
Constant	0.080***	0.032***	-0.030**	0.043**	-0.001	-0.068***	0.011	-0.013
	(0.011)	(0.011)	(0.013)	(0.018)	(0.011)	(0.016)	(0.013)	(0.014)
adj. R-sq	0.425	0.711	0.357	0.303	0.343	0.482	0.476	0.259
N	5376	1792	1792	1792	4480	896	1792	1792

Note: standard errors in parantheses. * p<0.10, ** p <0.05, *** p<0.01. The EXIT models contain the lagged values of the independent variables.

Conclusions

International collaboration boomed in CEE patenting after 1990, which resulted in better patents and a technological shift towards mechanical engineering and phisics.

International collaborations have had a positive effect of spatial dynamics, because more and more towns have entered the arena of patenting by those inventors who worked for foreign assignees.

However, the spatial effect of international collaborations doesn't seem to last long; innovation is not automatically maintained in the towns after working for a foreign company.

Therefore, the balance between international collaboration and domestic co-operation shall be an important aim of national and regional innovation policies in CEE countries.

Further steps

1. Better regression models

- Spatial trend: introducing co-ordinates
- Regional variables: number of inventors and assignees, R&D

2. Better maps

3. Trace CEE inventors over time to sort out the effect of movements.

Thank you for your attention!

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