Move a Little Closer? Information Sharing and the Spatial Clustering of Bank Branches

Shusen Qi (Xiamen University)

Ralph De Haas (EBRD; Tilburg University)

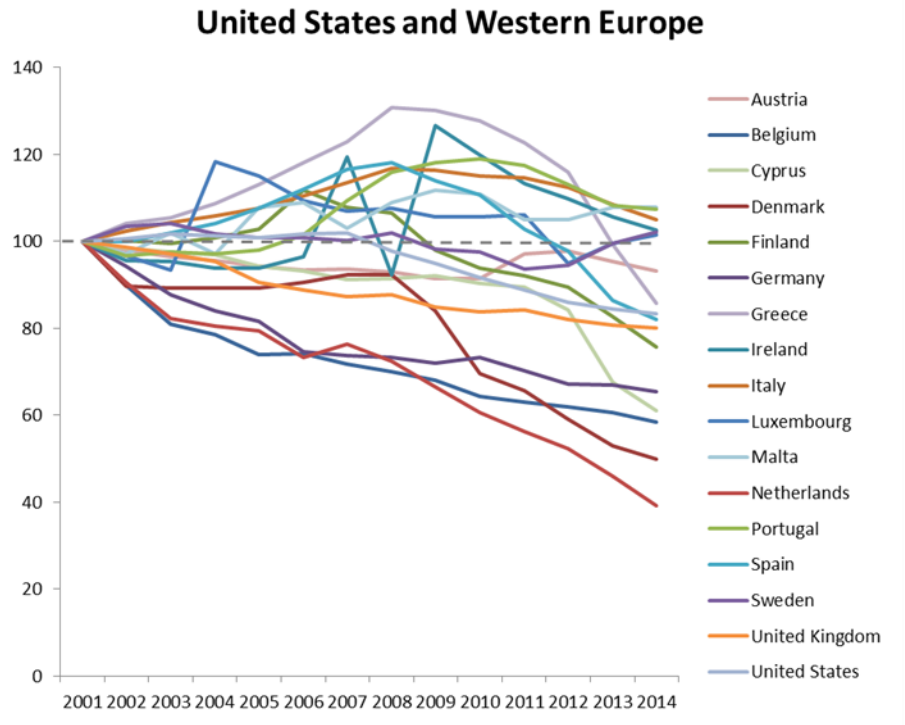
Steven Ongena (University of Zurich; SFI; KU Leuven; CEPR)

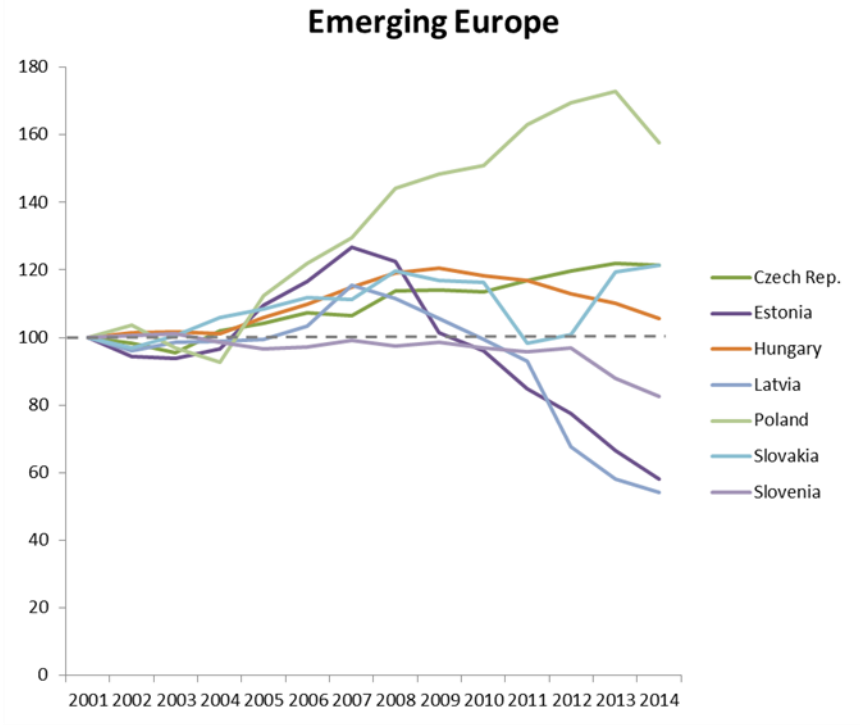
Stefan Straetmans (Maastricht University)

厦門大學
XIAMEN UNIVERSITY

* The views expressed are those of the authors and not necessarily those of the EBRD

Bank Branch Dynamics





Bank Branching Geography

A closed Britannia Bank branch in Northern England

A HSBC branch in Canary Wharf financial district in London

厦門大學
XIAMEN UNIVERSITY

Literature

- Rich literature exploits the impact of bank density on real outcomes (Jayaratne & Strahan, 1996; Guiso et al., 2004; Herrera & Minetti, 2007; Benfratello et al., 2008; Beck et al., 2010; Rice & Strahan, 2010; Favara & Imbs, 2015)

- Limited literature that investigate banks' decisions on the size of their branch networks (Cerasi et al., 2002; Cohen & Mazzeo, 2010; Coccorese, 2012; Temesvary, 2014)

- There is a clear lack of research that theoretically explains and empirically identifies the fundamental factors that drive the physical location of bank branches

Why do bank branches cluster?

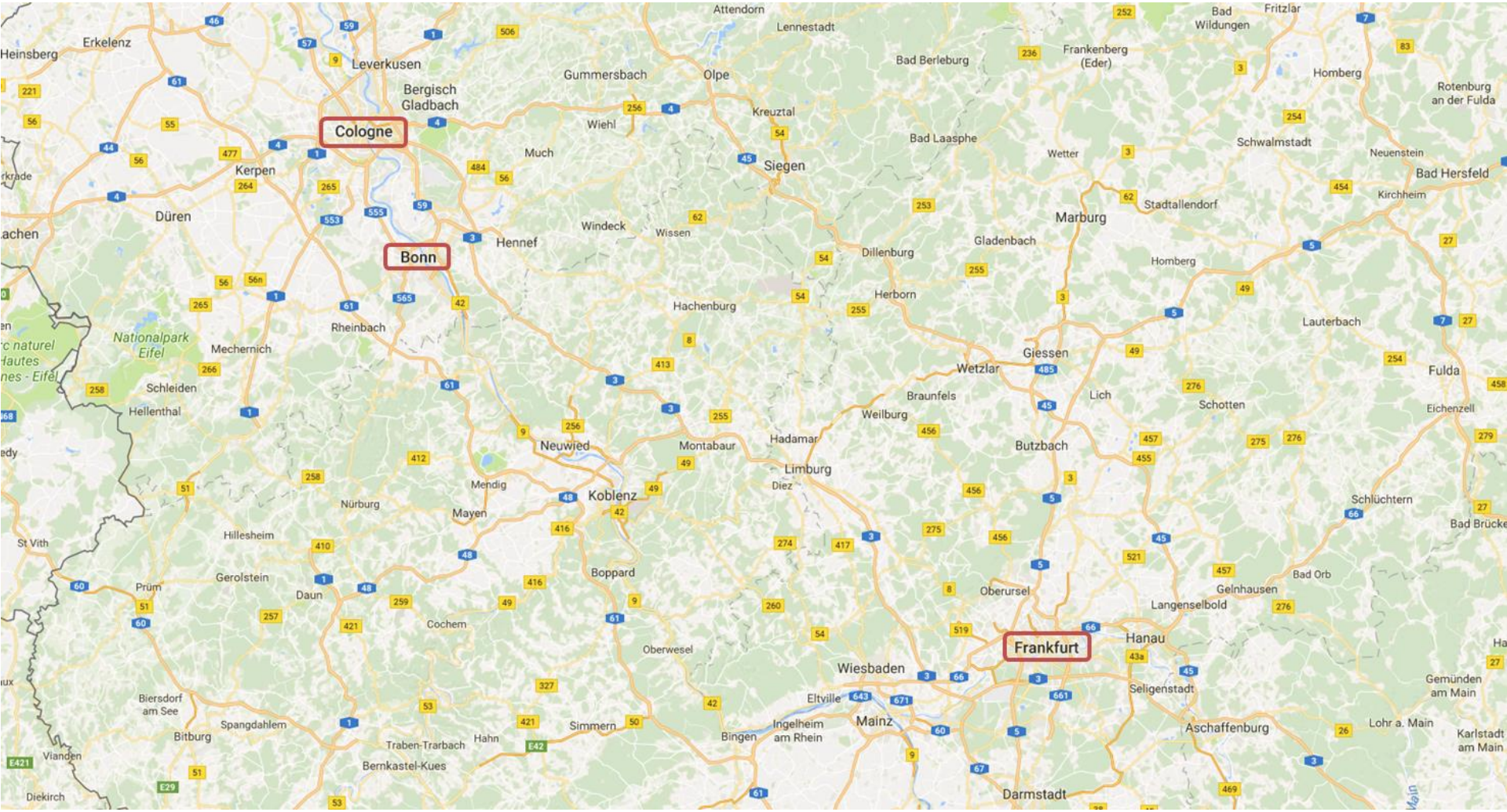
This Paper

- Build a spatial oligopoly model to explain bank branch clustering, which is broader than the hoteling and Salop model
- Use the introduction of information sharing, either a public credit registry or a private credit bureau, as a shock to our model to make predictions about the impact of information sharing on branch clustering
- Empirically test the model by using detailed bank branch data (geographical coordinates and the dates of establishment or closure)
- Information sharing reduces spatial credit rationing and increases bank branch clustering

Theoretical Model: Assumptions

- Two nearby bank localities ***d*** (***k*** bank branches) and ***s*** (***j*** bank branches) (distance equal to ***m***) and a more distant bank locality ***w*** (***n*** bank branches)

- Entrepreneurs are uniformly distributed across a two-dimensional plane. Each entrepreneur has identical project returns ***r*** and visits at most one locality to apply for a loan



厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Three Stages

- Stage I: banks open a finite number of branches across localities on the two-dimensional plane
    - Banks cluster these branches based on expected profits

Theoretical Model: Three Stages

- Stage II: entrepreneurs observe the locations of branches and receive a signal about the loan rate in each locality. They now decide, based on the expected return of borrowing in each locality, which locality to visit
  - Expected return depends on the distance to the locality ***R***, the positive transportation cost coefficient ***t***, the probability of successfully applying for a loan $\boldsymbol{1-Prob(k)}$, and the expected interest rate $\boldsymbol{i_d}$
  - Without information sharing among banks, information asymmetries between banks and entrepreneurs cause a discrete distance threshold beyond which the loan application will be rejected for sure. So the entrepreneur cannot obtain a loan in distant bank locality ***w***

厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Three Stages

- Stage III: bank branches in the same locality compete the loan rate down to a local equilibrium level i_d
  - Equilibrium lending rate is determined by within-locality competition and is not affected by banks in other localities (Ho & Ishii, 2011)
  - Bank branches grant loans at zero marginal cost

Theoretical Model: Summary

- Formalize the trade-off between the market-size effect and price-cutting effect of bank branch clustering when banks maximize their expected profit

- Market-size effect: more bank branch clustering induces higher probability of receiving a loan at a relatively low cost, which will attract a larger number of borrowers to visit this locality

- Price-cutting effect: more bank branch clustering increases competition among banks, which will decrease the equilibrium loan rate in that locality

Theoretical Model: Backward Induction

- Stage III: In locality ***d*** the equilibrium loan rate is:

$$i_d = i_0 + i_1/k$$

- Joint probability of rejection in locality ***d*** (Gupta & Tao, 2010) is:

$$Prob(k) = p * Prob(k-1) +$$

$$\varphi * \sqrt{p * Prob(k-1) * (1-p) * (1-Prob(k-1))}$$

- Where ***p*** is the probability of not obtaining a loan in a bank branch and this probability is correlated across branches with correlation ***φ*** in the same locality

Theoretical Model: Backward Induction

- Stage II: Given the expected loan rates at each bank locality, an entrepreneur decides which locality to visit by maximizing the expected profit:

$$EP_d = (1 - Prob(k))(r - i_d) - t * R$$

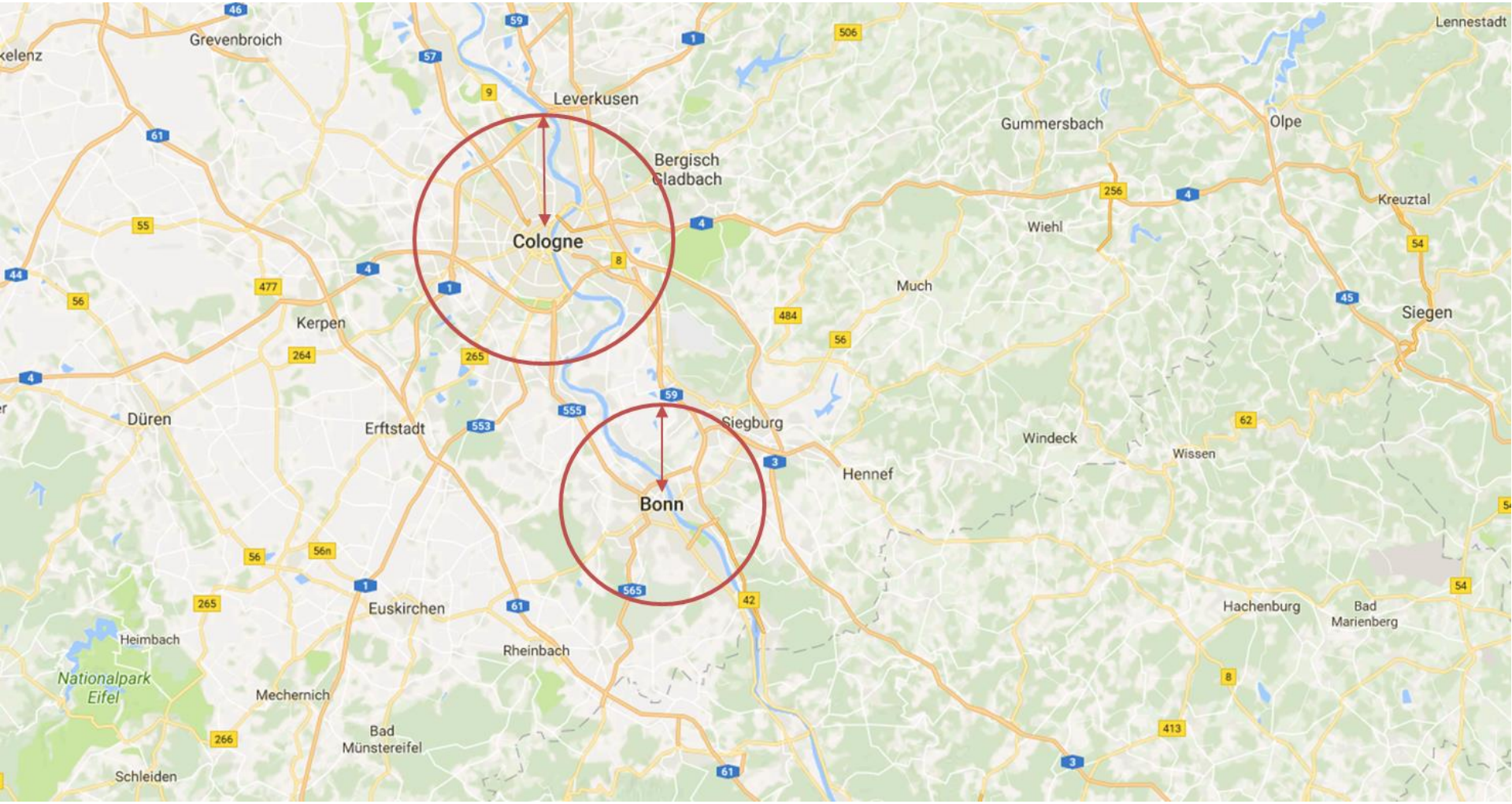
Theoretical Model: Backward Induction

- Stage II: If we assume there is no overlap between localities ***d*** and ***s***, then the marginal entrepreneur should satisfy:

$$EP_d = 0$$

- So we have:

$$R_{no\ overlap} = (1 - Prob(k))(r - i_d)/t$$



厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Backward Induction

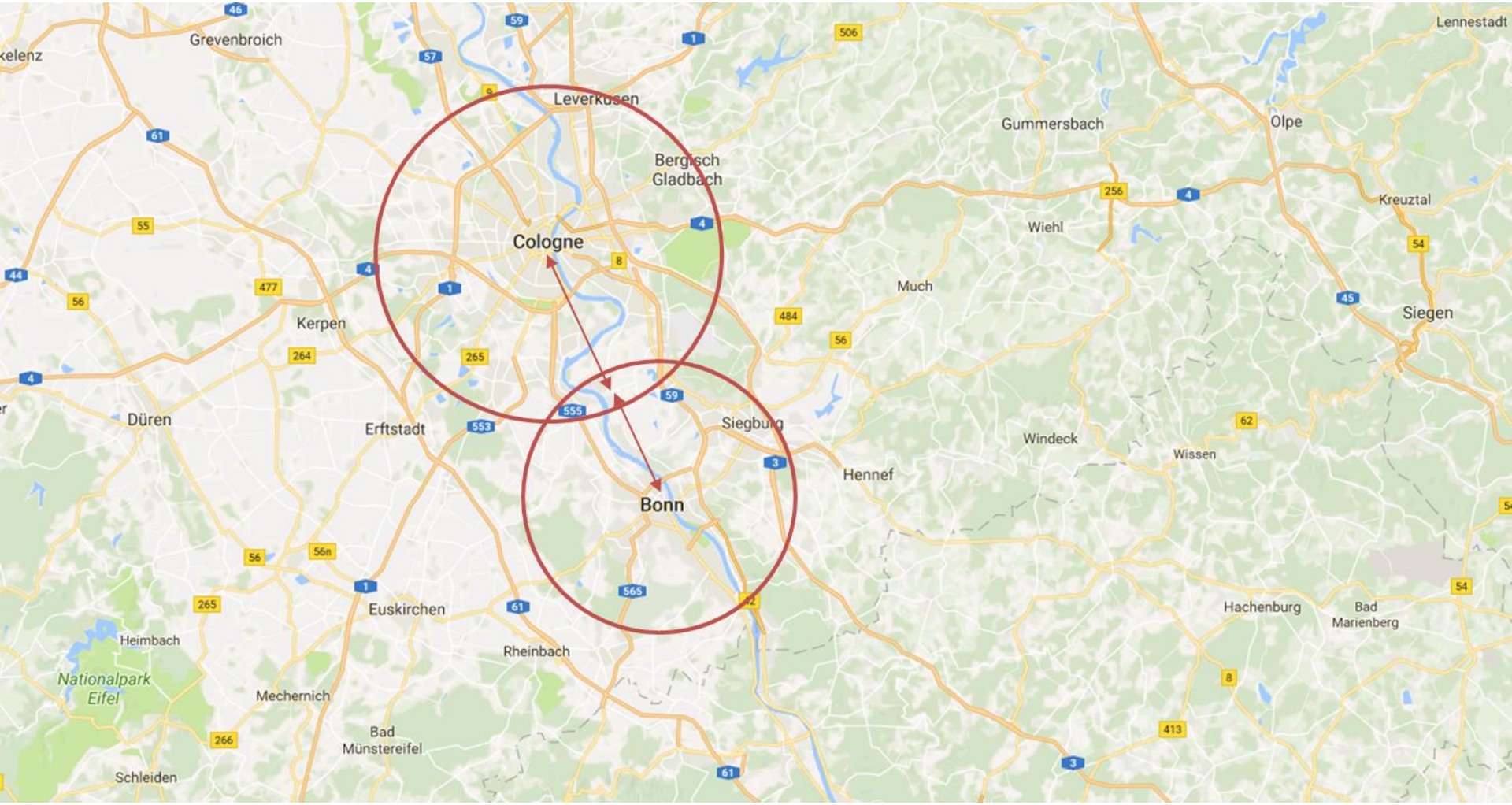
- Stage II: if we assume the market areas of localities ***d*** and ***s*** overlap and around locality ***d*** there is an infinite number of localities ***s***, then the marginal entrepreneur should satisfy:

$$EP_d = EP_s$$

- So we have:

$$R_{overlap} =$$

$$[(1 - Prob(k))(r - i_d) - (1 - Prob(j))(r - i_s)]/2t + m/2$$



厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Backward Induction

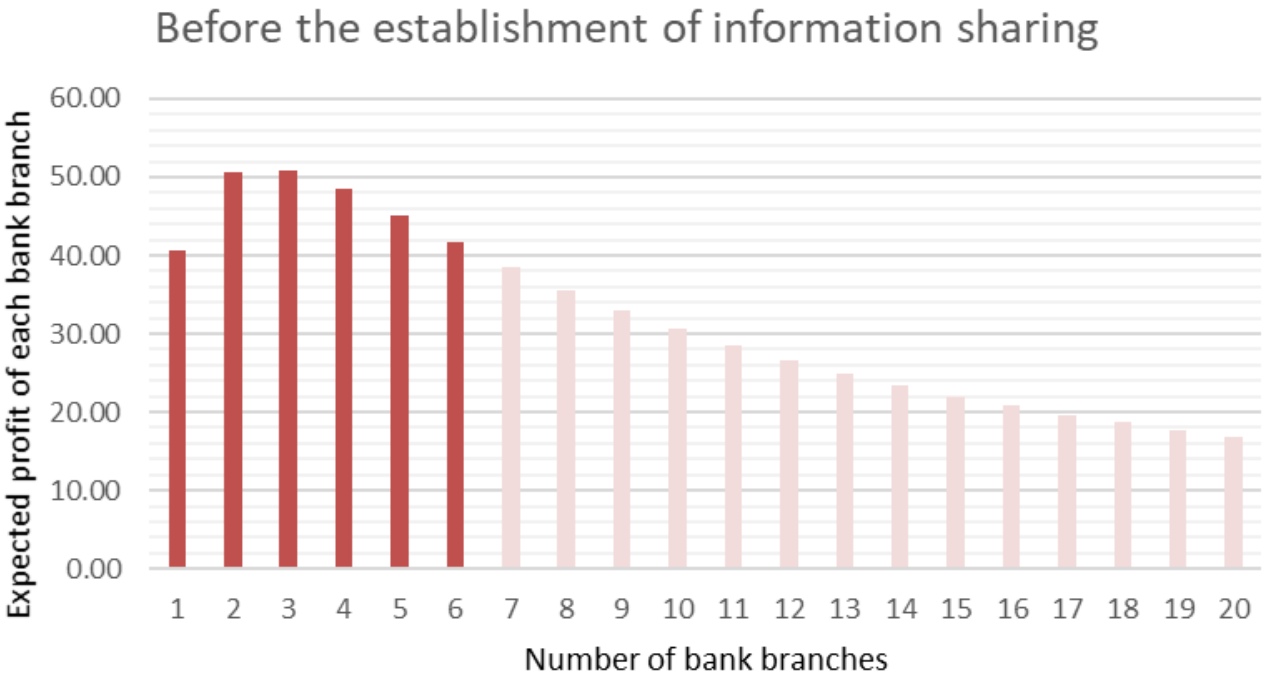
- Stage I: market area for locality ***d*** is a circle around locality ***d*** with a radius of ***R***. If all bank branches equally share the total market, then the market size of each branch is:

$$S_d = (\pi * R^2)/k$$

- Expected profit of each branch in locality ***d*** is then:

$$E_d = S_d * i_d$$

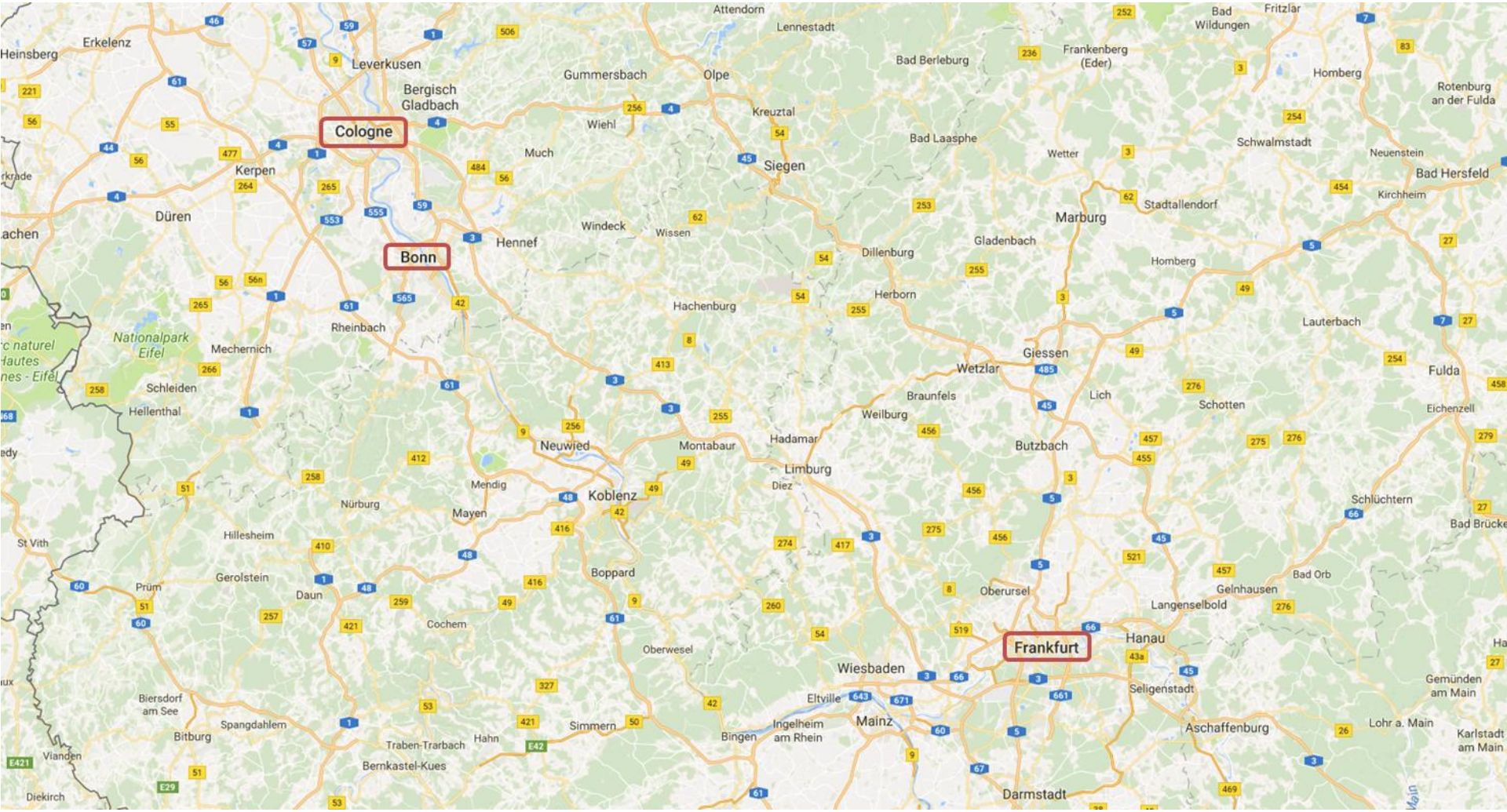
- Banks determine the clustering of their branches based on expected profits, until the expected profit of opening a new branch in locality ***d*** is below that of opening a stand-alone branch in a new locality



厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Information Sharing

- Without information sharing, entrepreneurs can only apply for a loan in nearby localities ***d*** and ***s*** due to geographical credit rationing
- When information sharing is introduced the entrepreneur can also choose to apply for a loan in locality ***w*** with a positive cost component ***c***
- Banks in nearby localities now have more incentives to cluster their branches in order to attract (or retain) borrowers who may be tempted to travel to a distant locality and apply there



厦門大學
XIAMEN UNIVERSITY

Theoretical Model: Information Sharing

- Stage II: the marginal entrepreneur who is indifferent between going to locality ***d*** and locality ***w*** should satisfy:

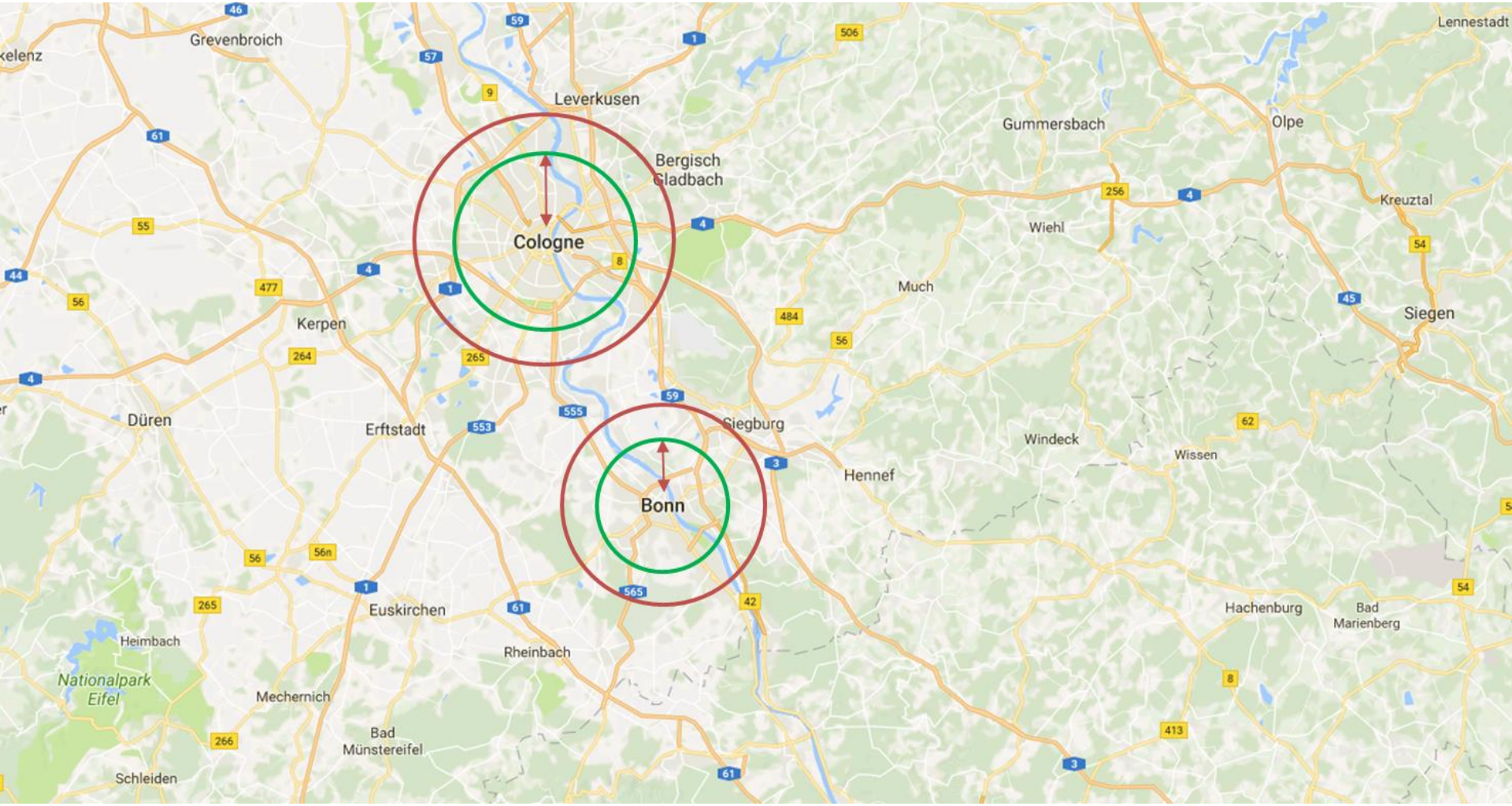
$$EP_d = EP_w$$

- So we have:

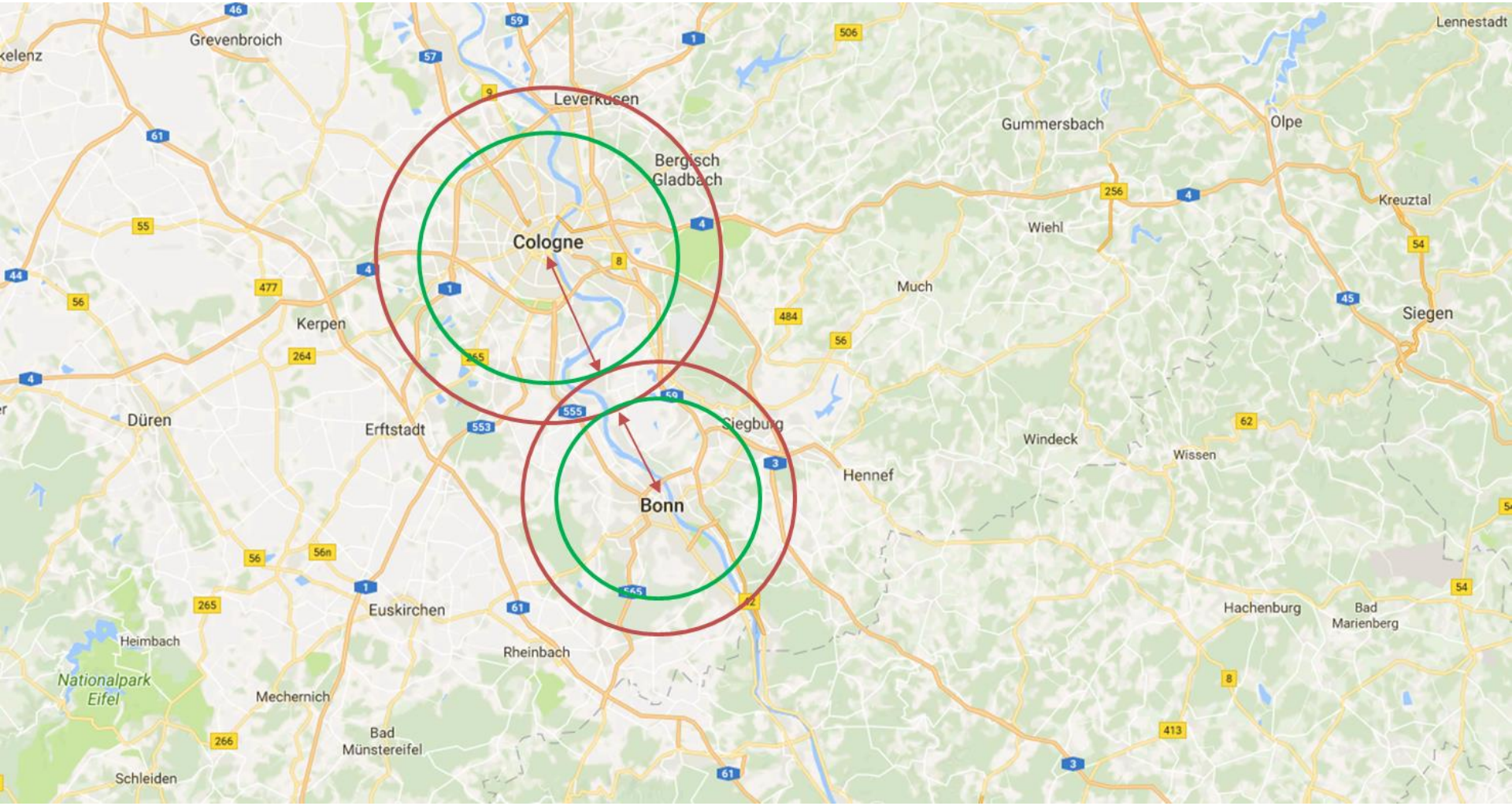
$$R_{info\ sharing} =$$

$$[(1 - Prob(k))(r - i_d) - (1 - Prob(n))(r - i_n) + c]/t$$

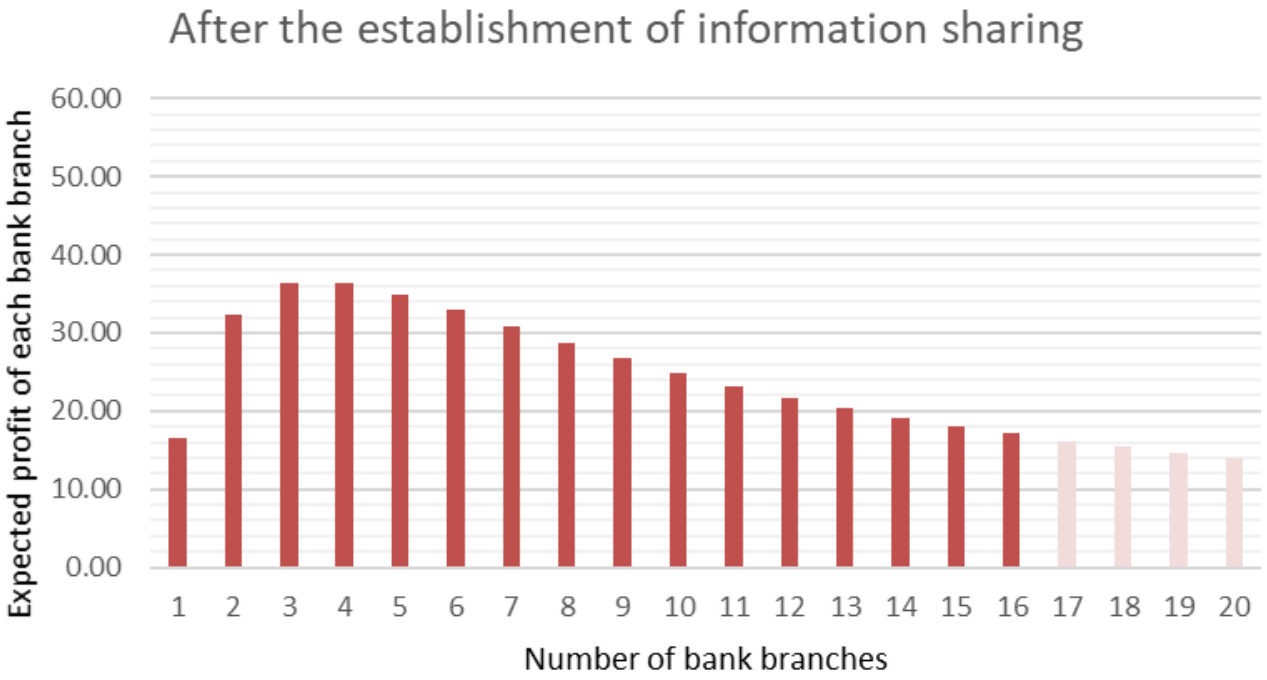
- Loan rejection correlation across branches ***φ*** also increases



厦門大學
XIAMEN UNIVERSITY



厦門大學
XIAMEN UNIVERSITY

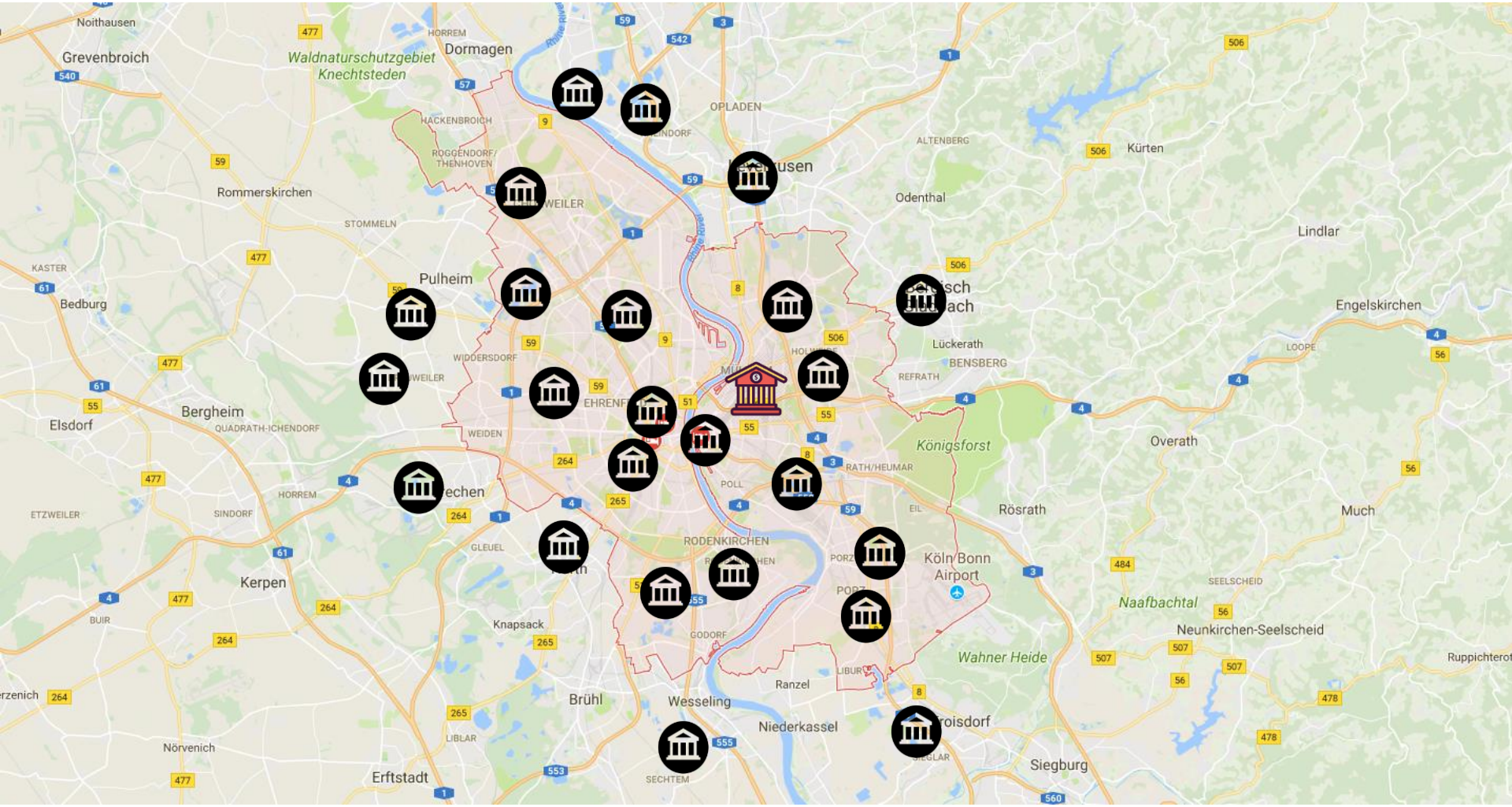

After the establishment of information sharing
Expected profit of each bank branch
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Number of bank branches

Hypothesis 1 & 2

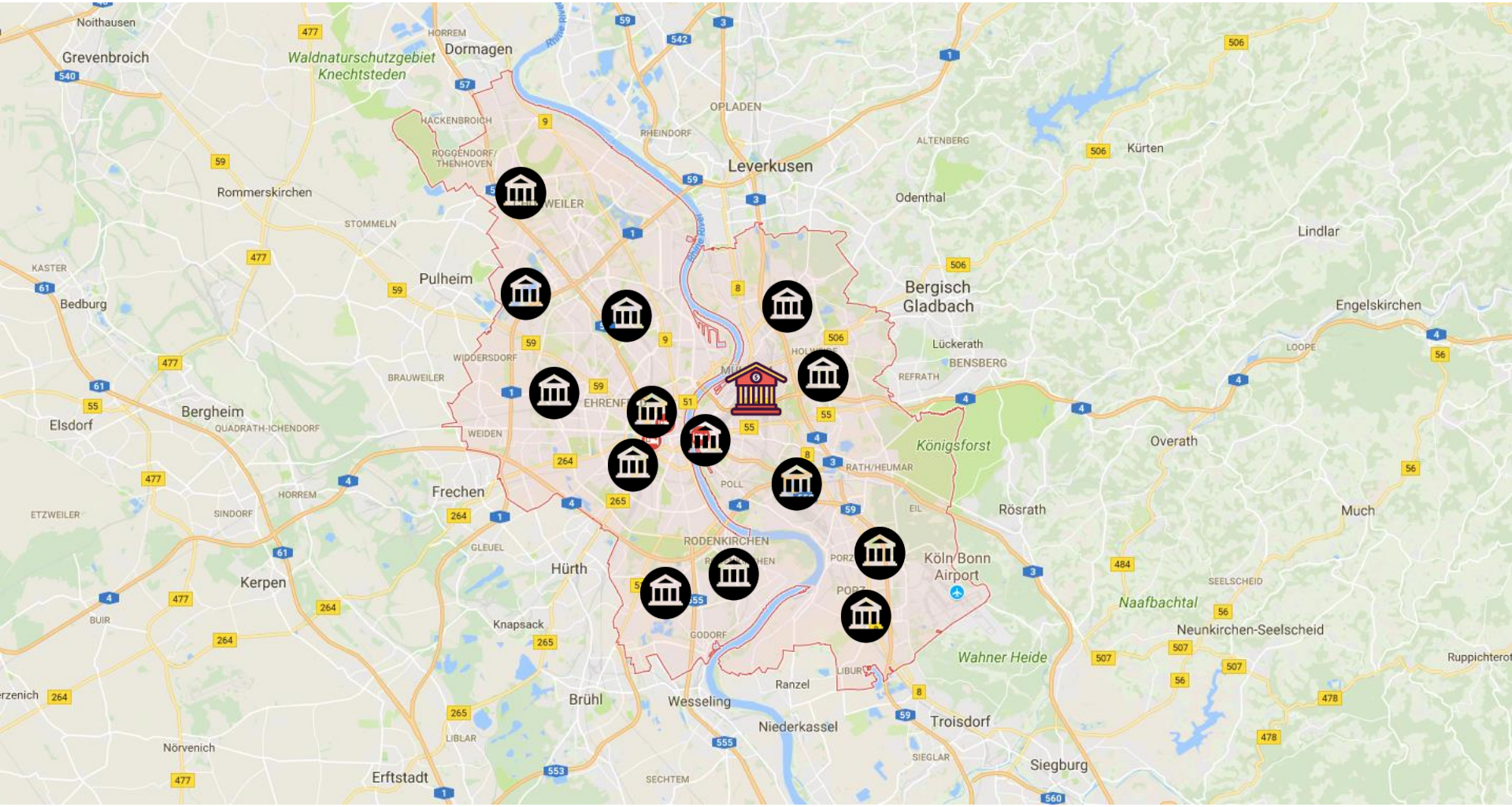
- Hypothesis 1: after the introduction of information sharing, different banks increasingly cluster their branches in the same localities
- Hypothesis 2: after the introduction of information sharing, banks are more likely to open new branches in localities with no (or few) pre-existing own branches

Empirical Data: Bank Branch

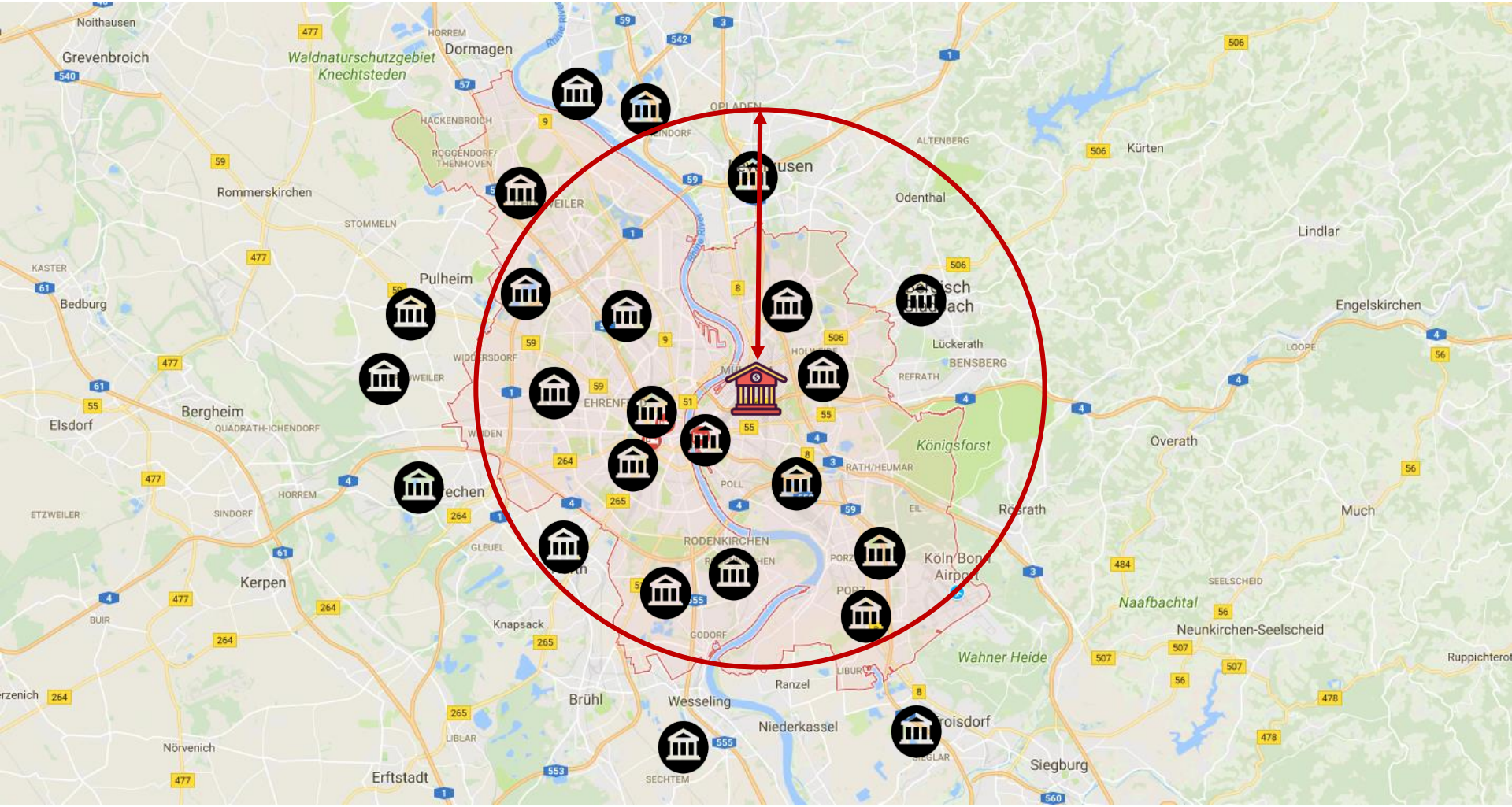
- Banking Environment and Performance Survey (BEPS II): geographical coordinates and dates of establishments (and possible closures) of 59,333 branches operated by 676 banks across 22 emerging European countries during 1995-2012
- To empirically assess the impact of information sharing on bank branch clustering, we focus on the 33,716 branch openings (owned by 532 banks) during 1995-2012
- Match each newly opening bank branch with existing bank branches in two ways either by locality (city or town) or by circle with a radius of 2 or 5 kilometers



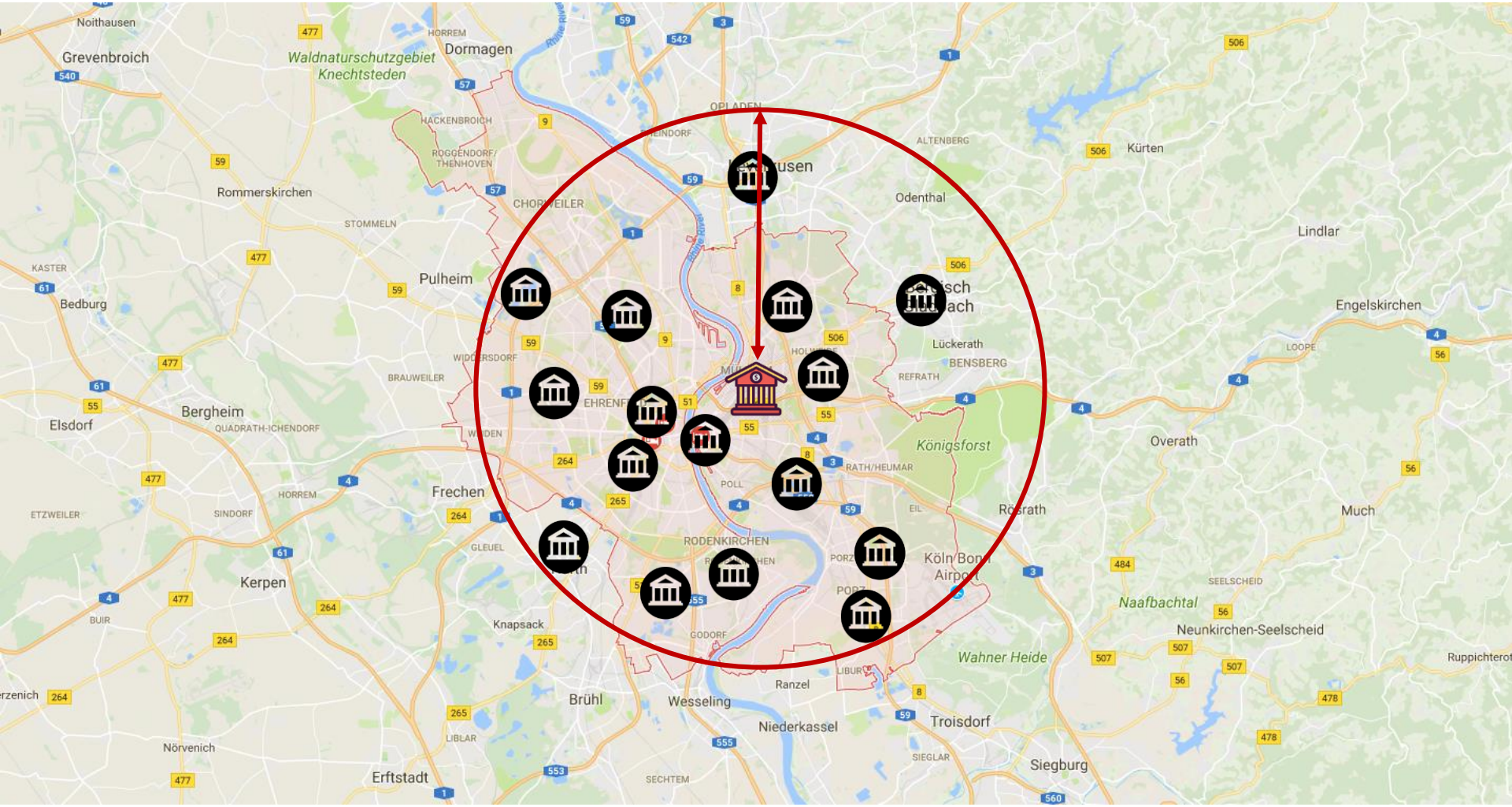
厦門大學
XIAMEN UNIVERSITY



厦門大學
XIAMEN UNIVERSITY



厦門大學
XIAMEN UNIVERSITY



厦門大學
XIAMEN UNIVERSITY

Information Sharing and Bank Branching

Dependent variable →	No. branches all banks w/i			Branch same bank w/i		
	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)
Information sharing	84.32***	69.91***	55.45***	-0.08***	-0.10***	-0.11***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
(Adjusted) R-squared	0.212	0.177	0.147	0.111	0.115	0.118
Observations	33,716	33,716	33,716	33,716	33,716	33,716

Instrumental Variable

Dependent variable →	First stage	Second stage					
	Information sharing	No. branches all banks w/i			Branch same bank w/i		
		2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% neighboring countries that introduced information sharing in the past 5 years	0.28***	-	-	-	-	-	-
	(0.000)	-	-	-	-	-	-
Information sharing	-	139.84***	67.66***	9.79	-0.37***	-0.21**	-0.31***
	-	(0.000)	(0.000)	(0.745)	(0.000)	(0.012)	(0.000)
Cragg-Donald Wald F statistic	511.52	-	-	-	-	-	-
Kleibergen-Paap rk Wald F statistic	317.05	-	-	-	-	-	-
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Adjusted) R-squared	0.771	0.207	0.177	0.145	0.0889	0.1119	0.1079
Observations	33,716	33,716	33,716	33,716	33,716	33,716	33,716

Placebo Test

- For each year we keep the same number of new credit registry introductions but instead of using the actual countries, we use a random (false) country (out of the total set of countries that at that point in time had not (yet) introduced information sharing

- Repeat for 500 times and report the average estimates

Placebo Test

Dependent variable →	No. branches all banks w/i			Branch same bank w/i		
	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)
Information sharing	-4.40	-3.57	-2.71	0.00	0.00	0.00
	(0.177)	(0.357)	(0.592)	(0.779)	(0.738)	(0.712)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
(Adjusted) R-squared	0.202	0.171	0.144	0.111	0.115	0.118
Observations	33,716	33,716	33,716	33,716	33,716	33,716

Clustering Standard Errors

Dependent variable →	No. branches all banks w/i								
	2 km	5 km	Locality	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Information sharing	84.32***	69.91***	55.45***	84.32***	69.91**	55.45*	84.32**	69.91**	55.45*
	(0.000)	(0.000)	(0.005)	(0.009)	(0.027)	(0.062)	(0.015)	(0.032)	(0.064)
Clustering Standard Errors	Bank	Bank	Bank	Country	Country	Country	Year	Year	Year
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.212	0.178	0.148	0.053	0.054	0.076	0.065	0.059	0.057
Observations	33,716	33,716	33,716	33,716	33,716	33,716	33,716	33,716	33,716

Dependent variable →	No. branches all banks w/i								
	2 km	5 km	Locality	2 km	5 km	Locality	2 km	5 km	Locality
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Information sharing	84.32***	69.91***	55.45***	84.32***	69.91***	55.45***	84.32***	69.91***	55.45***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.003)
Clustering Standard Errors	Bank*Locality	Bank*Locality	Bank*Locality	Country*Year	Country*Year	Country*Year	Bank*Year	Bank*Year	Bank*Year
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.212	0.177	0.147	0.212	0.177	0.147	0.212	0.177	0.147
Observations	33,716	33,716	33,716	33,716	33,716	33,716	33,716	33,716	33,716

Information Sharing and Spatial Credit Rationing

- Information sharing reduces spatial credit rationing and enabling firms to borrower from further away bank localities

- Tested by matching our data with the Kompass firm-bank relationship data in 2000 and 2005 for four different countries:

  - Czech Republic (introduced both PCR & PCB in 2002)
  - Poland (introduced PCB in 2001)
  - Croatia (introduced PCB in 2007)
  - Hungary (introduced PCB in 1995)

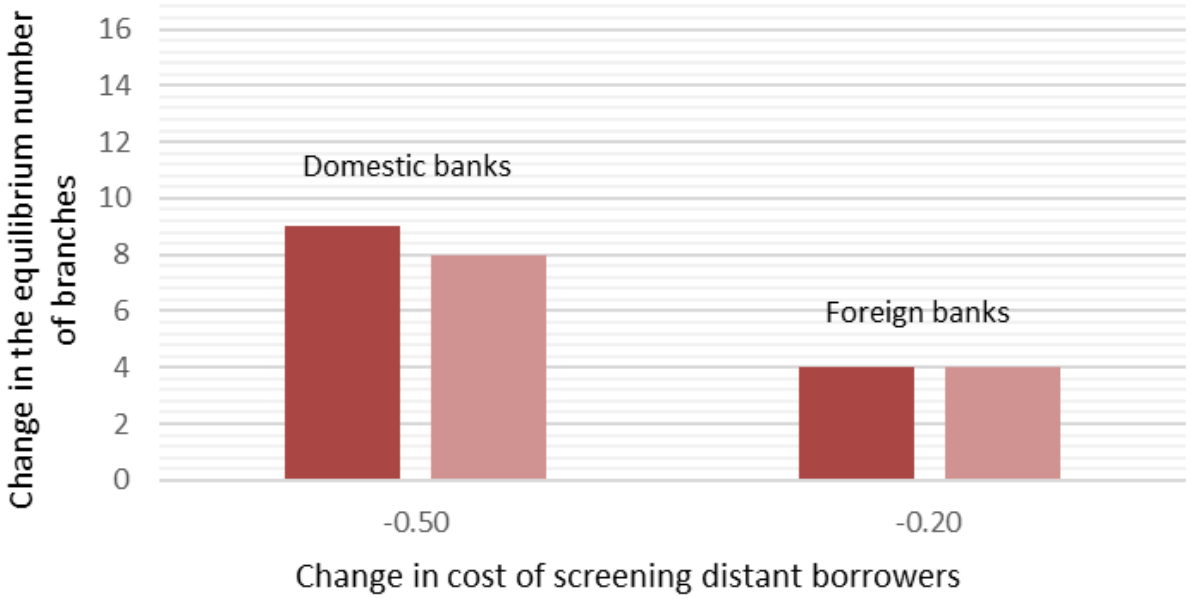
Information Sharing and Spatial Credit Rationing

Dependent variable → Firm-branch distance (in km)

Czech Republic (Introduced information sharing in 2002)					
	Obs.	Mean	St. Dev.	Min.	Max.
2000	1,697	2.96	5.11	0.00	76.80
2005	1,902	4.98	13.99	0.00	272.39
2005-2000	2.02***				
Poland (Introduced information sharing in 2001)					
	Obs.	Mean	St. Dev.	Min.	Max.
2000	5,394	19.09	56.49	0.00	440.70
2005	1,252	27.00	68.65	0.00	443.52
2005-2000	7.91***				
Croatia (Introduced information sharing in 2007)					
	Obs.	Mean	St. Dev.	Min.	Max.
2000	954	16.64	48.95	0.01	401.56
2005	409	20.92	47.43	0.02	365.15
2005-2000	4.28				
Hungary (Introduced information sharing in 1995)					
	Obs.	Mean	St. Dev.	Min.	Max.
2000	1,459	24.08	34.51	0.02	223.78
2005	1,417	8.54	13.65	0.03	193.03

Difference-in-Difference regression	
Information sharing	2.66**
	(0.046)
Year Fixed Effects	Yes
Country Fixed Effects	Yes
(Adjusted) R-squared	0.022
Observations	14,484

厦門大學
XIAMEN UNIVERSITY



厦門大學
XIAMEN UNIVERSITY

Hypothesis 3

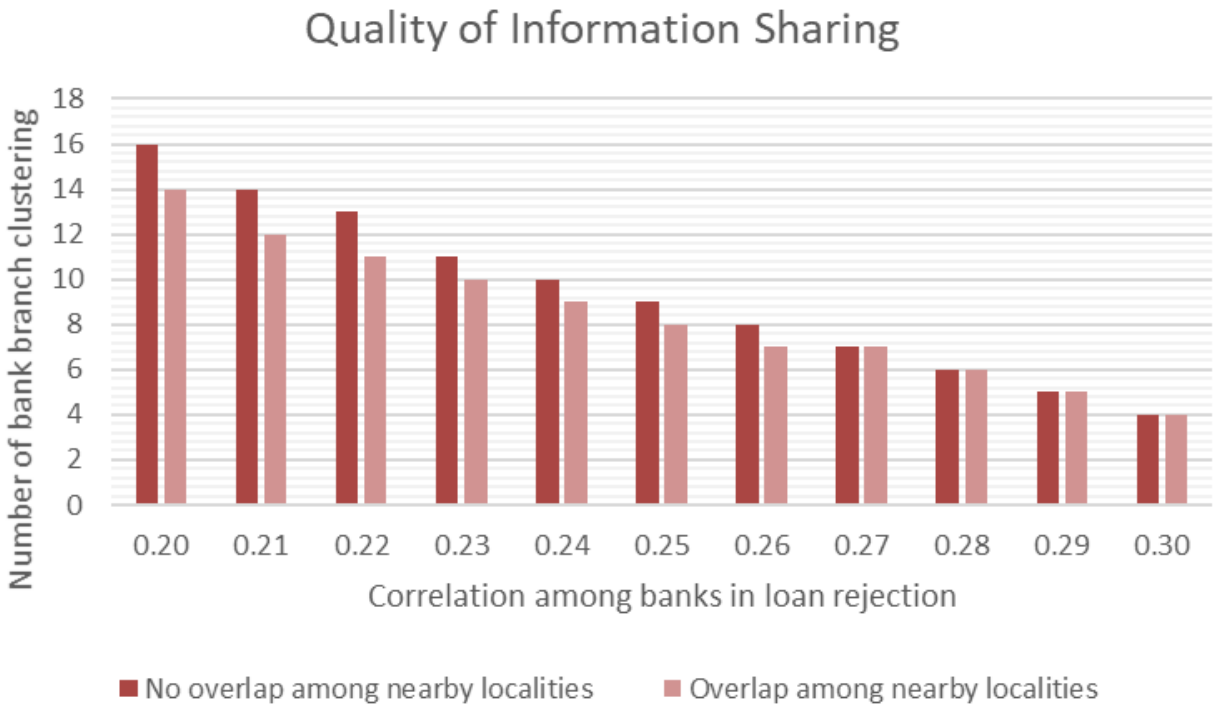
- Hypothesis 3: the impact of information sharing on bank clustering is stronger for domestic banks

Domestic vs Foreign Banks

Dependent variable →	No. branches all banks w/i			Branch same bank w/i		
	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)
Information sharing	112.51***	95.18***	74.39***	-0.05***	-0.07***	-0.09***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Branch by foreign banks	79.38***	83.68***	84.30***	0.06***	0.05***	0.03***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Information sharing * Branch by foreign bank	-60.29***	-54.19***	-40.88**	-0.06***	-0.06***	-0.04***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)
(Adjusted) R-squared	0.223	0.190	0.160	0.112	0.116	0.118
Observations	33,716	33,716	33,716	33,716	33,716	33,716
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Domestic vs Foreign Banks

Dependent variable →	No. branches all banks w/i			Branch same bank w/i		
	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)
Information sharing	105.85***	87.99***	68.01***	-0.03***	-0.05***	-0.06***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
Branch by greenfield foreign bank	73.81***	84.76***	94.00***	-0.02**	-0.03***	-0.03***
	(0.000)	(0.000)	(0.000)	(0.017)	(0.001)	(0.001)
Branch by M&A foreign bank	68.93***	69.51***	67.00***	0.11***	0.11***	0.09***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Information sharing * Branch by greenfield foreign bank	-50.92***	-47.72***	-40.17***	-0.10***	-0.11***	-0.10***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Information sharing * Branch by M&A foreign bank	-54.51***	-45.30***	-30.72***	-0.08***	-0.07***	-0.06***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
(Adjusted) R-squared	0.2240	0.1911	0.1609	0.1206	0.1273	0.1262
Observations	33,716	33,716	33,716	33,716	33,716	33,716



厦門大學
XIAMEN UNIVERSITY

Hypothesis 4

- Hypothesis 4: very effective information sharing, characterized by a sufficiently high correlation among banks' loan-approval decisions, will reduce branch clustering

Quality of Information Sharing

Dependent variable →	No. branches all banks w/i					
	2 km	5 km	Locality	2 km	5 km	Locality
	(1)	(2)	(3)	(4)	(5)	(6)
Information sharing	75.30***	64.90***	51.48***	65.36***	49.55***	35.11***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Information sharing * Quality information sharing	-5.17***	-5.72***	-6.55***			
	(0.000)	(0.000)	(0.000)			
Information sharing * Better information sharing				-50.39***	-54.13***	-54.07***
				(0.000)	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.195	0.151	0.109	0.214	0.180	0.150
Observations	17,807	17,807	17,807	17,807	17,807	17,807

Conclusions

- Develop a simple and intuitive framework in which banks rationally trade off the market-size and price-cutting effects of geographical bank clustering
- Test our model predictions in an international context, using the introduction of information sharing as country-level exogenous shocks that move banks towards a new clustering equilibrium
- Uncovers an important mechanism: the central availability of borrower information leads to different equilibrium levels of branch clustering which is associated with a reduction in spatial credit rationing