Agglomerationseffekte in Deutschland

und der Einfluss von Verkehrsinfrastruktur auf Produktivität

Maximilian von Mylius

Agglomerationseffekte als Teil der KNA von Verkehrsinvestitionen?

- u.a. in England standardmäßig
- **Wieso nicht auch in Deutschland?**

Quelle: (Grundsätzliche Überprüfung und Weiterentwicklung der Nutzen-Kosten-Analyse im Bewertungsverfahren der Bundesverkehrswegeplanung, 2015)

Warum spielt sich ökonomische Aktivität noch in Städten ab?

- Räumliche Nähe erzeugt positive ökonomische Externalität (Fujita, Krugman & Venables, 1999)
  - ➔ Steigerung der Produktivität
  - ➔ **Agglomerationseffekt**
- „Treibende Kraft hinter der geographischen Konzentration von ökonomischer Aktivität und Bevölkerung“ (Richardson, 2012)

Ursachen des Agglomerationseffekts

Sharing	öffentliche Güter, Zulieferer, Kunden werden geteilt
Matching	Jobs und Produkte werden passender und schneller verteilt
Learning	Austausch und Beobachtung ermöglichen Wissenstransfer

Quelle: (Duranton & Puga, 2004)

Einbezug Verkehrsdimension

- Findet Interaktion zwischen Akteuren statt?
  - hängt nicht nur von Distanz…
  - … sondern v.a. von Reisekosten (Zeit) ab

Quelle: (Melo, Graham, & Brage-Ardao, 2013)

Schätzung des Agglomerationseffekts

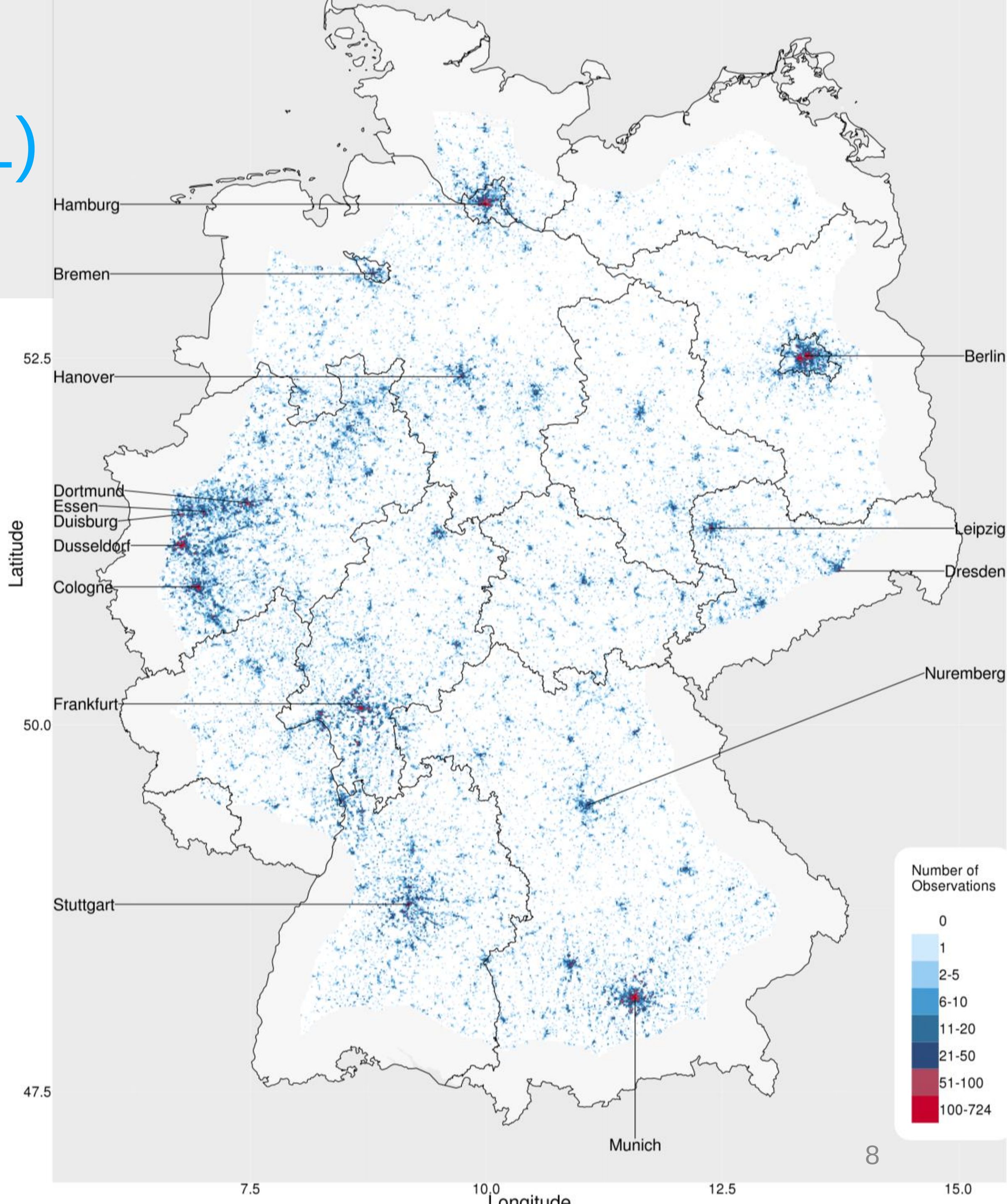
I. Forschungsansatz
II. Datenquellen
III. Effektive Bevölkerungsdichte
IV. Regressionsgleichung
V. Ergebnisse & Interpretation
VI. Limitationen
VII. Offener Teil mit Diskussion & Anhängen

I. Forschungsansatz

- Aufstellen einer Produktionsfunktion:
  - Umsatz eines Unternehmens, abhängig von:
    - Mitarbeiteranzahl,
    - eingesetztem Kapital,
    - Branchenzugehörigkeit…
    - … und Agglomeration am Unternehmensstandort

II. Datenquellen (1)

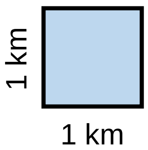
Nominatim



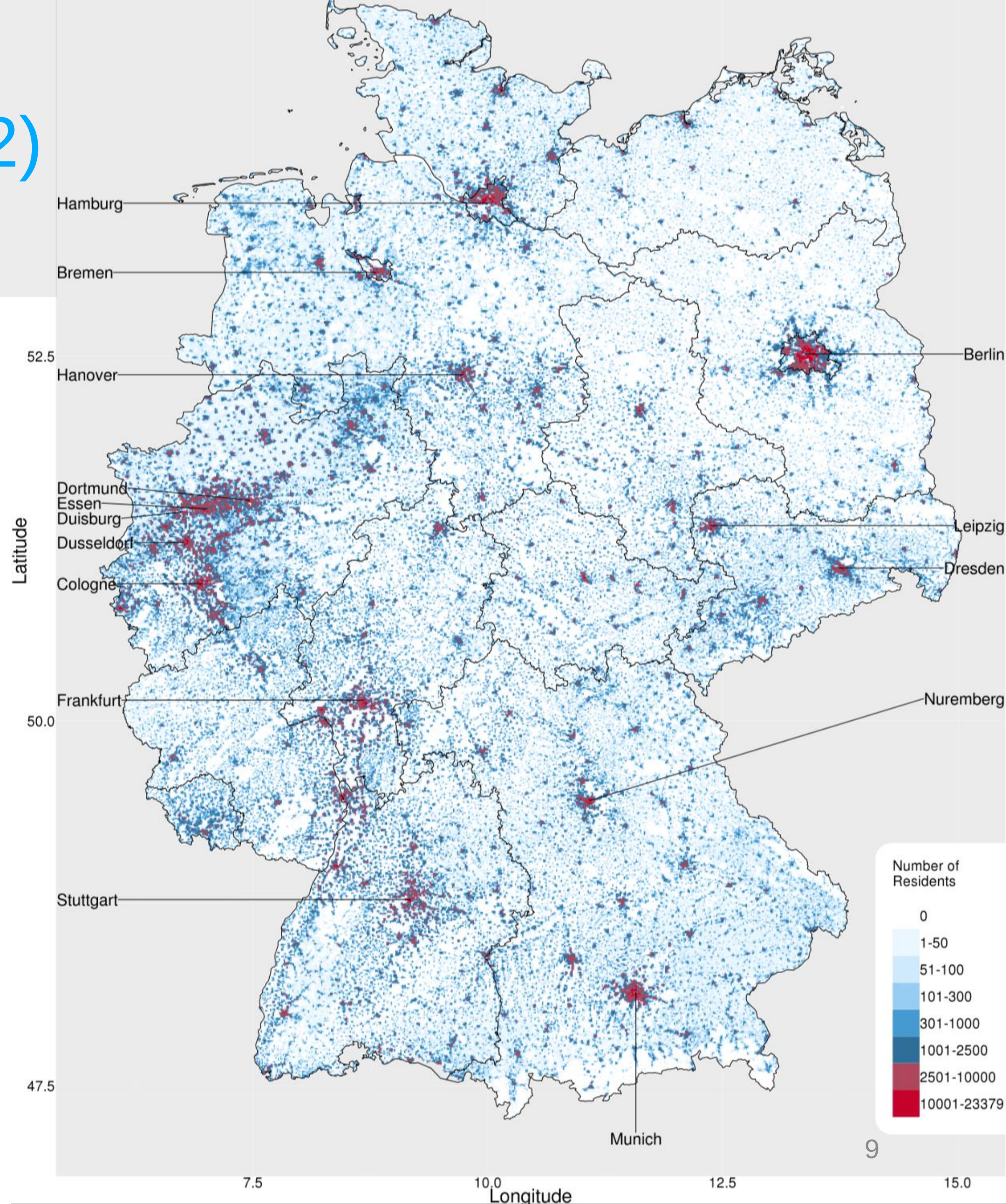
II. Datenquellen (2)

zensus2011
Wissen, was morgen zählt

- auf Basis von



-Kacheln

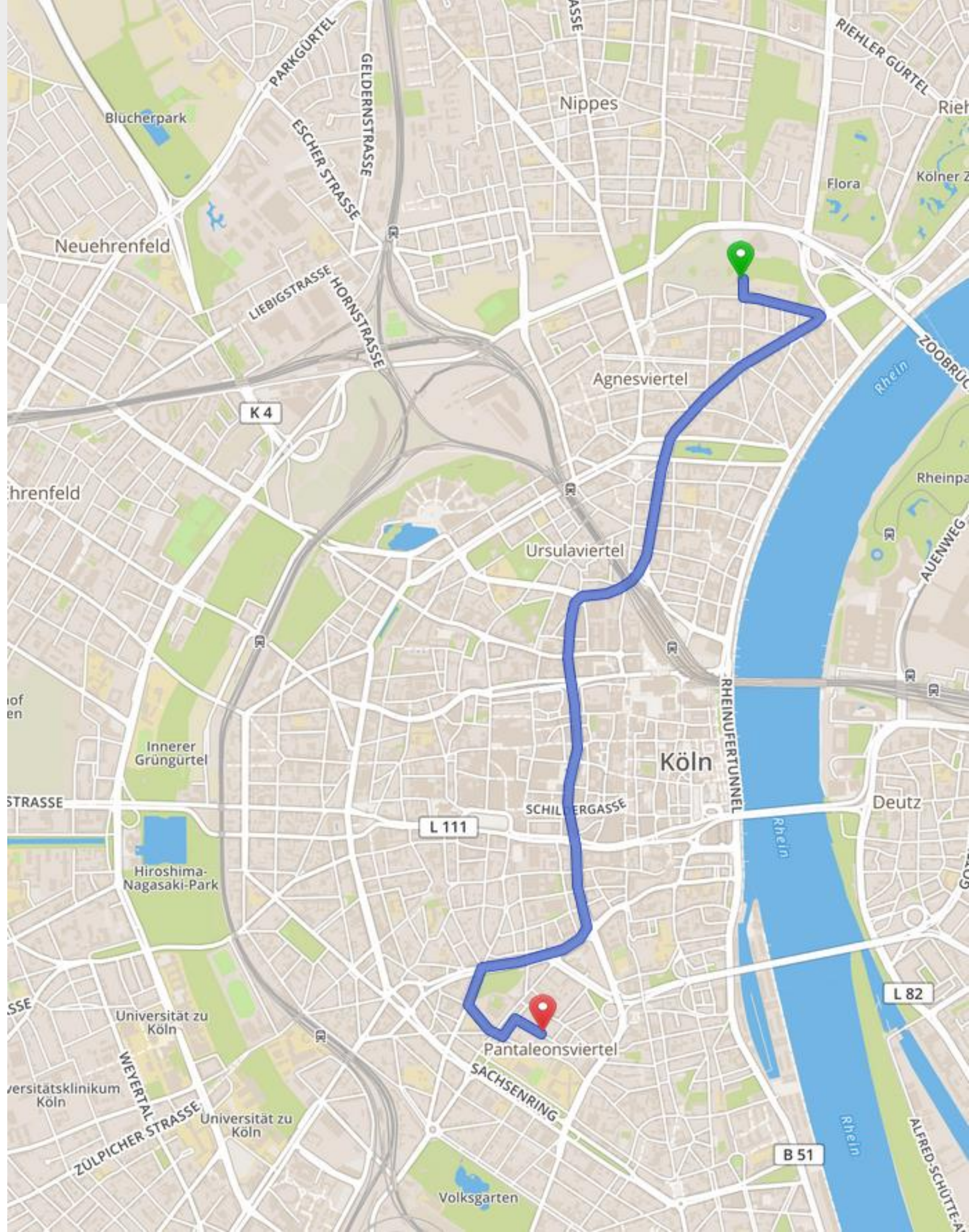


II. Datenquellen (3)

OSRM

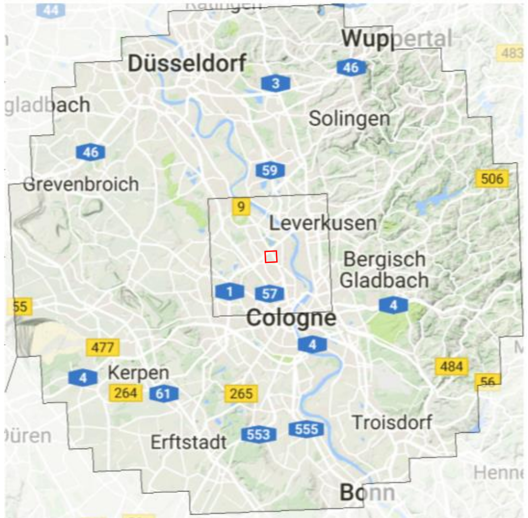
OPEN SOURCE ROUTING MACHINE

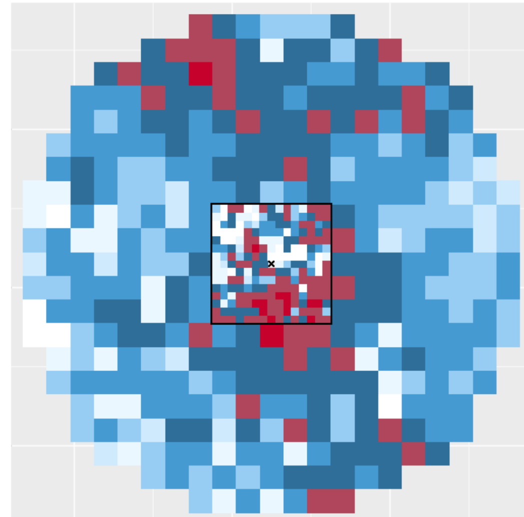
OpenStreetMap



III. Effektive Bevölkerungsdichte (1)

- Berechnung für eine 1 km^2 Ausgangsregion
- Bev. der umliegenden Regionen ein
- Gewichtet nach Erreichbarkeit
- = Marktpotential



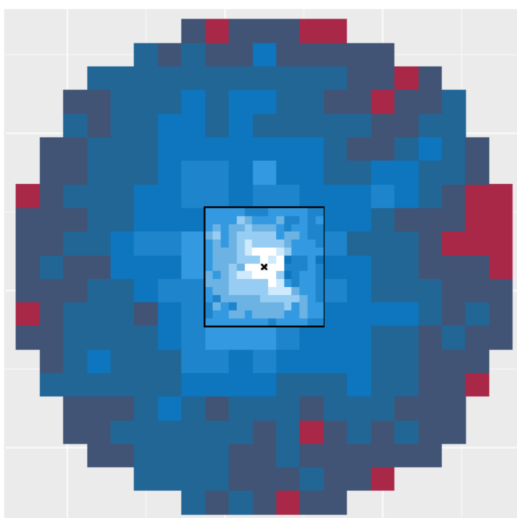


zensus2011
Wissen, was morgen zählt

- Bevölkerungs-anzahl auf Basis:
- 1 x 1 km
- 3 x 3 km für entferntere Regionen

OSRM
OPEN SOURCE ROUTING MACHINE

- PKW-Reisezeiten
- zu allen Nachbarregionen
- Umkreis von 32 Kilometer
- 556 Routen je Ausgangsregion

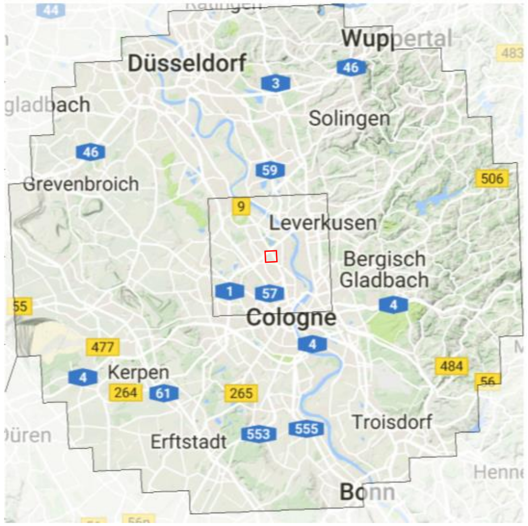


$$ePD = \sum_{n_r=1}^{n_r=556} \frac{Bevölkerungszahl_{n_r}}{Reisezeit\ zwischen\ den\ Regionen_{r,\,n_r}{}^{\alpha}} + \frac{Bevölkerungszahl_r}{Ø\ Reisezeit\ innerhalb\ der\ Region_r{}^{\alpha}}$$

ePD = effektive Bevölkerungsdichte
r = Ausgangsregion
n_r = Eine der Nachbarregionen zu Region r
α = distance decay parameter = 1,655 (Graham 2009)

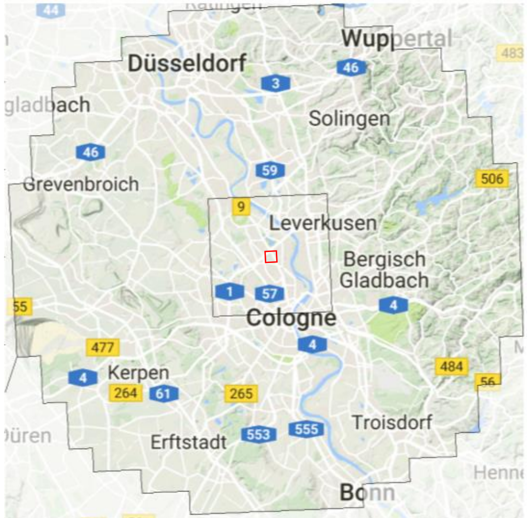
III. Effektive Bevölkerungsdichte (1)

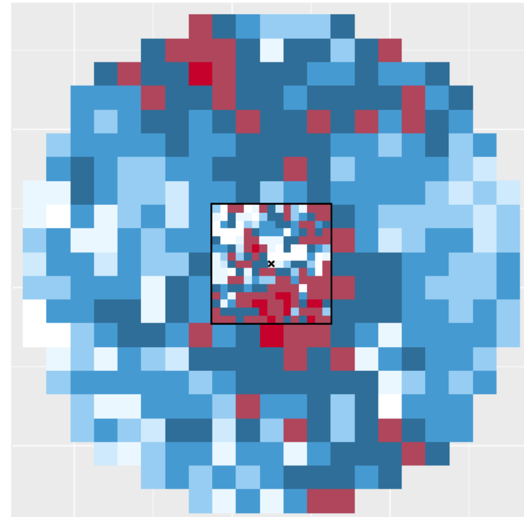
- Berechnung für eine 1 km^2 Ausgangsregion
- Bev. der umliegenden Regionen ein
- Gewichtet nach Erreichbarkeit
- = Marktpotential



III. Effektive Bevölkerungsdichte (1)

- Berechnung für eine 1 km^2 Ausgangsregion
- Bev. der umliegenden Regionen ein
- Gewichtet nach Erreichbarkeit
- = Marktpotential



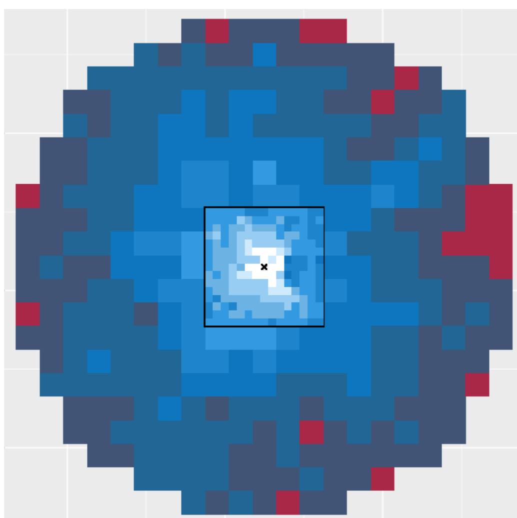


zensus 2011 Wissen, was morgen zählt

- Bevölkerungs-anzahl auf Basis:
- 1 x 1 km
- 3 x 3 km für entferntere Regionen

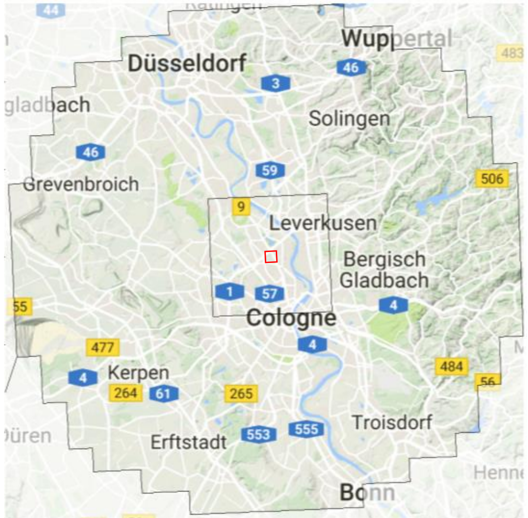
OSRM OPEN SOURCE ROUTING MACHINE

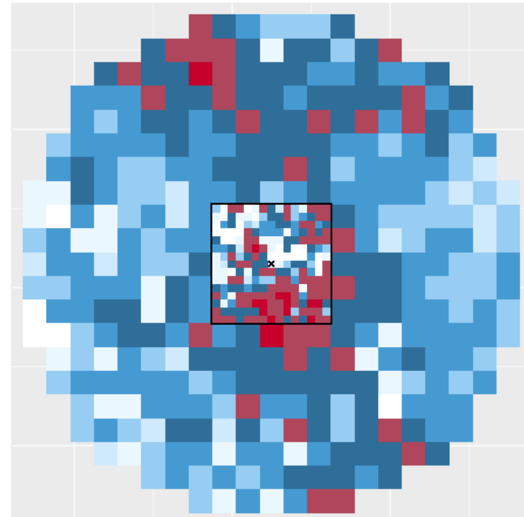
- PKW-Reisezeiten
- zu allen Nachbarregionen
- Umkreis von 32 Kilometer
- 556 Routen je Ausgangsregion



III. Effektive Bevölkerungsdichte (1)

- Berechnung für eine 1 km^2 Ausgangsregion
- Bev. der umliegenden Regionen ein
- Gewichtet nach Erreichbarkeit
- = Marktpotential



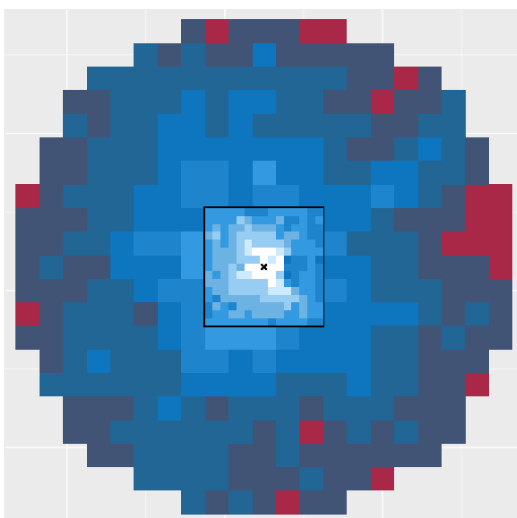


zensus2011 Wissen, was morgen zählt

- Bevölkerungs-anzahl auf Basis:
- 1 x 1 km
- 3 x 3 km für entferntere Regionen

OSRM OPEN SOURCE ROUTING MACHINE

- PKW-Reisezeiten
- zu allen Nachbarregionen
- Umkreis von 32 Kilometer
- 556 Routen je Ausgangsregion

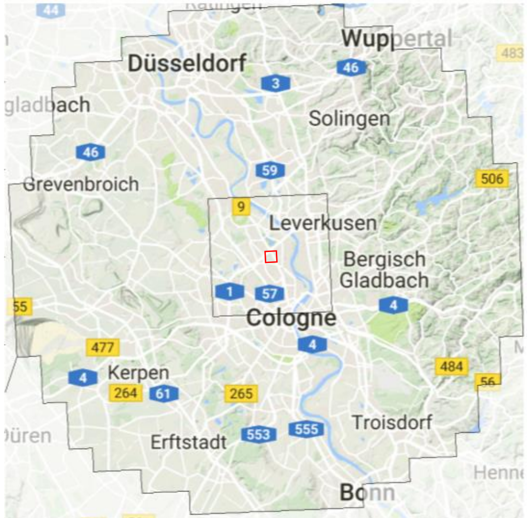


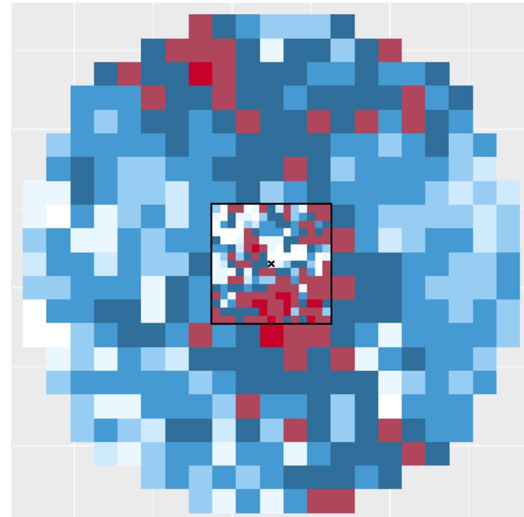
$$ePD = \sum_{n_r=1}^{n_r=556} \frac{Bevölkerungszahl_{n_r}}{Reisezeit\ zwischen\ den\ Regionen_{r,\,n_r}{}^{\alpha}} + \frac{Bevölkerungszahl_r}{Ø\ Reisezeit\ innerhalb\ der\ Region_r{}^{\alpha}}$$

ePD = effektive Bevölkerungsdichte
r = Ausgangsregion
n_r = Eine der Nachbarregionen zu Region r
α = distance decay parameter = 1,655 (Graham 2009)

III. Effektive Bevölkerungsdichte (1)

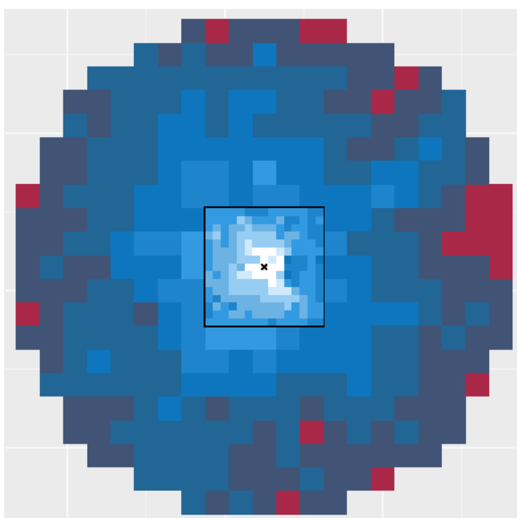
- Berechnung für eine 1 km^2 Ausgangsregion
- Bev. der umliegenden Regionen ein
- Gewichtet nach Erreichbarkeit
- = Marktpotential

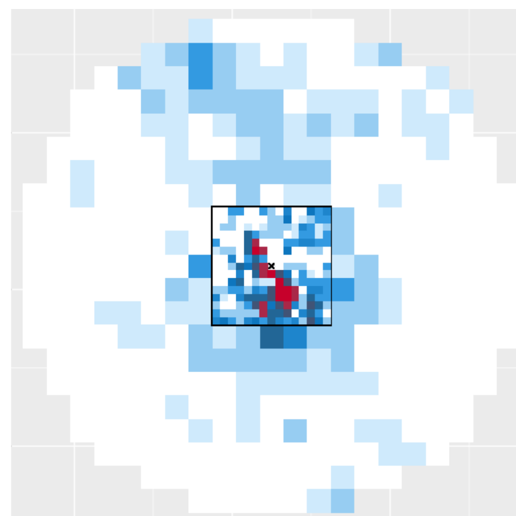




- Bevölkerungs-anzahl auf Basis:
- 1 x 1 km
- 3 x 3 km für entferntere Regionen

- PKW-Reisezeiten
- zu allen Nachbarregionen
- Umkreis von 32 Kilometer
- 556 Routen je Ausgangsregion



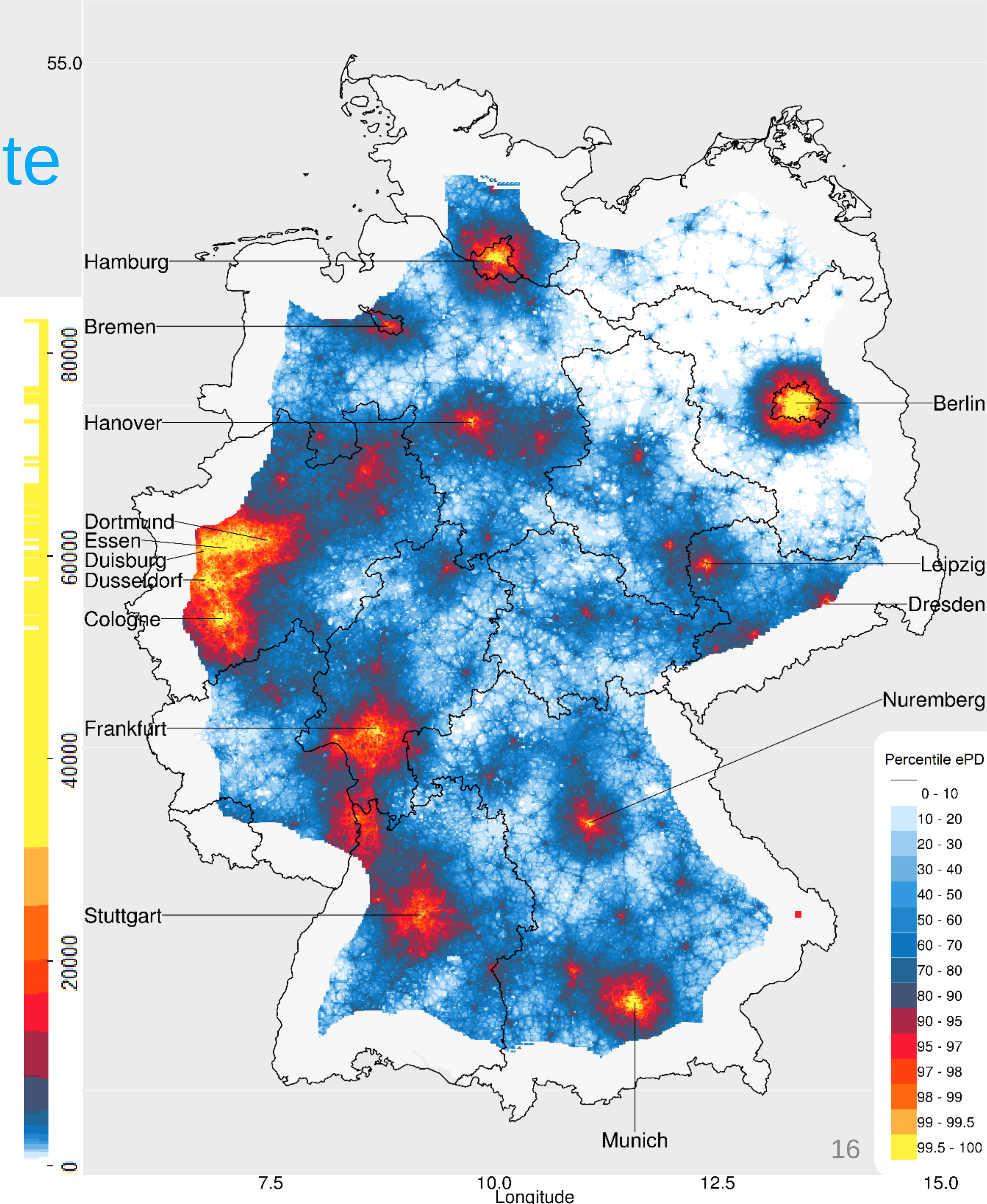


Beitrag der Kacheln zur effektiven Dichte der Ausgangsregion

Effektive Dichte der Region r

III. Effektive Bevölkerungsdichte (2)

- 255.131 Regionen
- Hohe Werte in Ballungszentren
- Ausstrahlung ins Umland
- Verkehrsadern
- Starke räumliche Korrelation
- Große Spreizung der Werte in Top-Quantilen



IV. Regressionsgleichung

Translog-Produktionsfunktion (Kim, 1992)

$$
\begin{aligned}
\ln Umsatz = {} & \\
& \beta_L \ln Mitarbeiteranzahl + \beta_K \ln Bilanzsumme \\
& + \tfrac{1}{2}\beta_{LL}(\ln Mitarbeiteranzahl)^2 \\
& + \tfrac{1}{2}\beta_{KK}(\ln Bilanzsumme)^2 \\
& + \beta_{KL}(\ln Bilanzsumme * \ln Mitarbeiteranzahl) \\
& + \beta_{QP} Anteil\ Arbeitnehmer\ mit\ abg.\ Berufsausbildung \\
& + \beta_{QA} Anteil\ Arbeitnehmer\ mit\ abg.\ Hochschulstudium \\
& + \beta_{ePD} \ln effektive\ Bevölkerungsdichte \\
& + \mu_{Industrie\ FE} + \mu_{Jahr\ FE} + \mu_{Regierungsbezirk} + \varepsilon
\end{aligned}
$$

V. Ergebnisse

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.8701***	1.6748***	2.0648***	1.9723***	1.8274***	1.4719**	2.0400***	2.1136***
	(0.1908)	(0.3272)	(0.1750)	(0.1758)	(0.2756)	(0.5937)	(0.2107)	(0.2281)
β_L	0.6861***	0.6861***	0.6865***	0.6867***	0.6859***	0.6858***	0.6863***	0.6862***
	(0.0280)	(0.0279)	(0.0280)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)
β_K	0.4908***	0.4908***	0.4900***	0.4902***	0.4910***	0.4912***	0.4901***	0.4901***
	(0.0313)	(0.0313)	(0.0313)	(0.0313)	(0.0312)	(0.0312)	(0.0312)	(0.0312)
β_{LL}	-0.1006***	-0.1006***	-0.1009***	-0.1009***	-0.1006***	-0.1005***	-0.1009***	-0.1009***
	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)
β_{KK}	-0.0003	-0.0003	-0.0003	-0.0002	-0.0003	-0.0003	-0.0003	-0.0003
	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
β_{KL}	0.0260*	0.0260*	0.0262**	0.0260**	0.0260*	0.0260*	0.0262**	0.0263**
	(0.0129)	(0.0129)	(0.0128)	(0.0128)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
β_{QP}	-0.0539	-0.0562	-0.0759	-0.0682	-0.0359	-0.0186	-0.0562	-0.0747
	(0.1010)	(0.1019)	(0.1046)	(0.1036)	(0.1690)	(0.1726)	(0.1643)	(0.1729)
β_{QA}	0.0635	0.0718	0.0481	0.0739	0.0520	0.0488	0.0309	0.0296
	(0.1329)	(0.1387)	(0.1338)	(0.1354)	(0.1594)	(0.1564)	(0.1608)	(0.1618)
β_{ePD}	0.0312***	0.0757			0.0350**	0.1073		
	(0.0072)	(0.0631)			(0.0162)	(0.1016)		
$\beta_{ePD*ePD}$		-0.0025				-0.0037		
		(0.0037)				(0.0049)		
β_{eFD}			0.0226***	0.0602***			0.0261**	0.0013
			(0.0057)	(0.0161)			(0.0121)	(0.0326)
$\beta_{eFD*eFD}$				-0.0038**				0.0022
				(0.0018)				(0.0023)
Observations	210,846	210,846	210,846	210,846	210,846	210,846	210,846	210,846
R-squared	0.7111	0.7111	0.7110	0.7111	0.7110	0.7110	0.7110	0.7110

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

V. Interpretation

- Für KNA von Verkehrsinvestitionen Veränderung der effektiven Dichte berrechnen

- Für Benchmark:

  - Gleichmäßige Reduktion der Reisezeiten um 10%

    ➔ erhöht die effektive Dichte um 19%

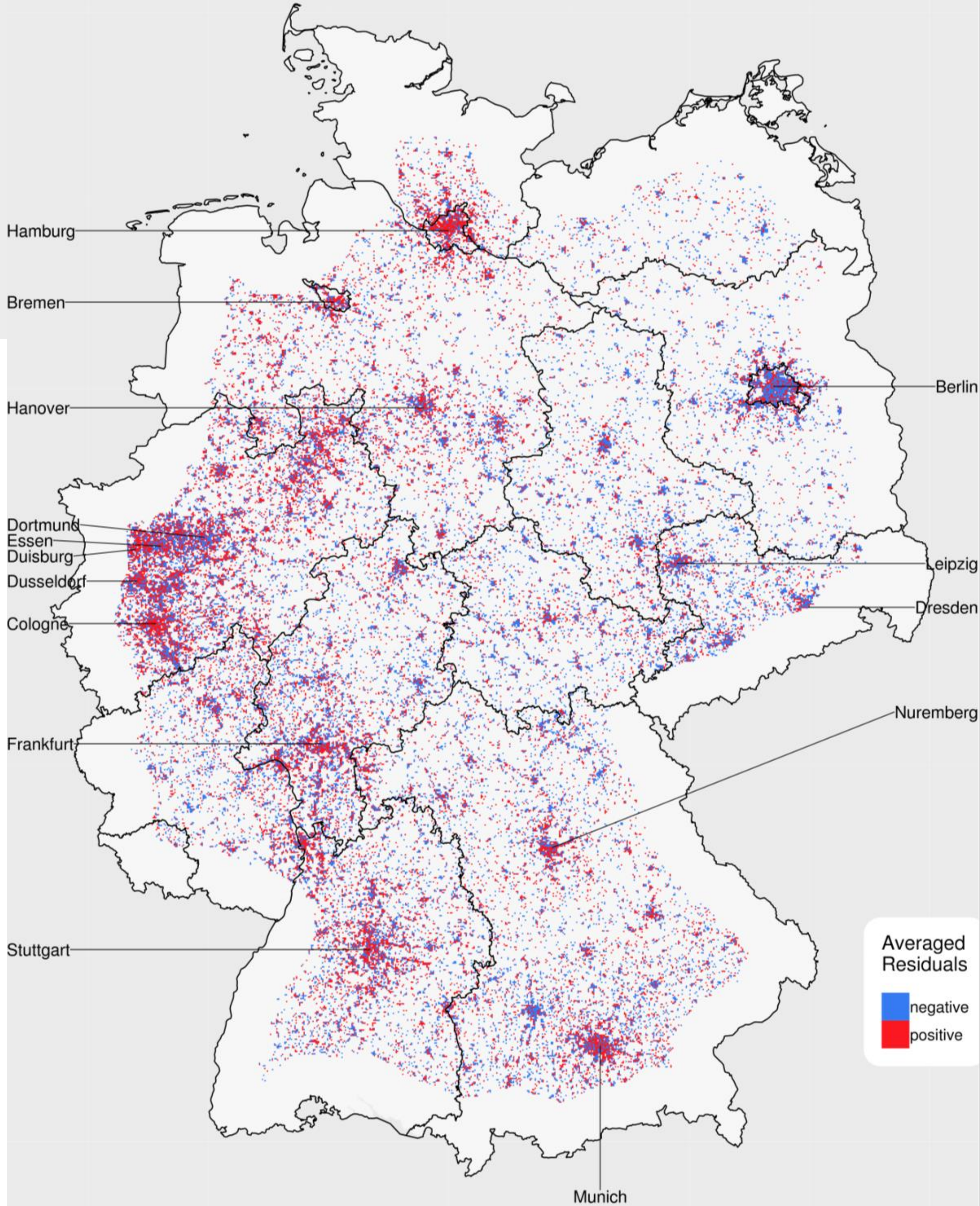
    ➔ dadurch Produktivitätssteigerung um 0,54% bzw. 0,61%

VI. Limitationen

- Einbeziehen der Reisekosten
- Nur PKW-Reisezeiten berücksichtigt
- Keine wirksamen Kontrollen für Unterschiede in Mitarbeiterqualifikationen
- Nur Adresse des Firmenhauptsitzes
- Kein Einbezug von räumlichen Variationen der Input- und Output-Preise
- Beobachten von Veränderungen der Erreichbarkeit
- Endogenität: ziehen produktive Unternehmen in große Städte?

Vielen Dank!

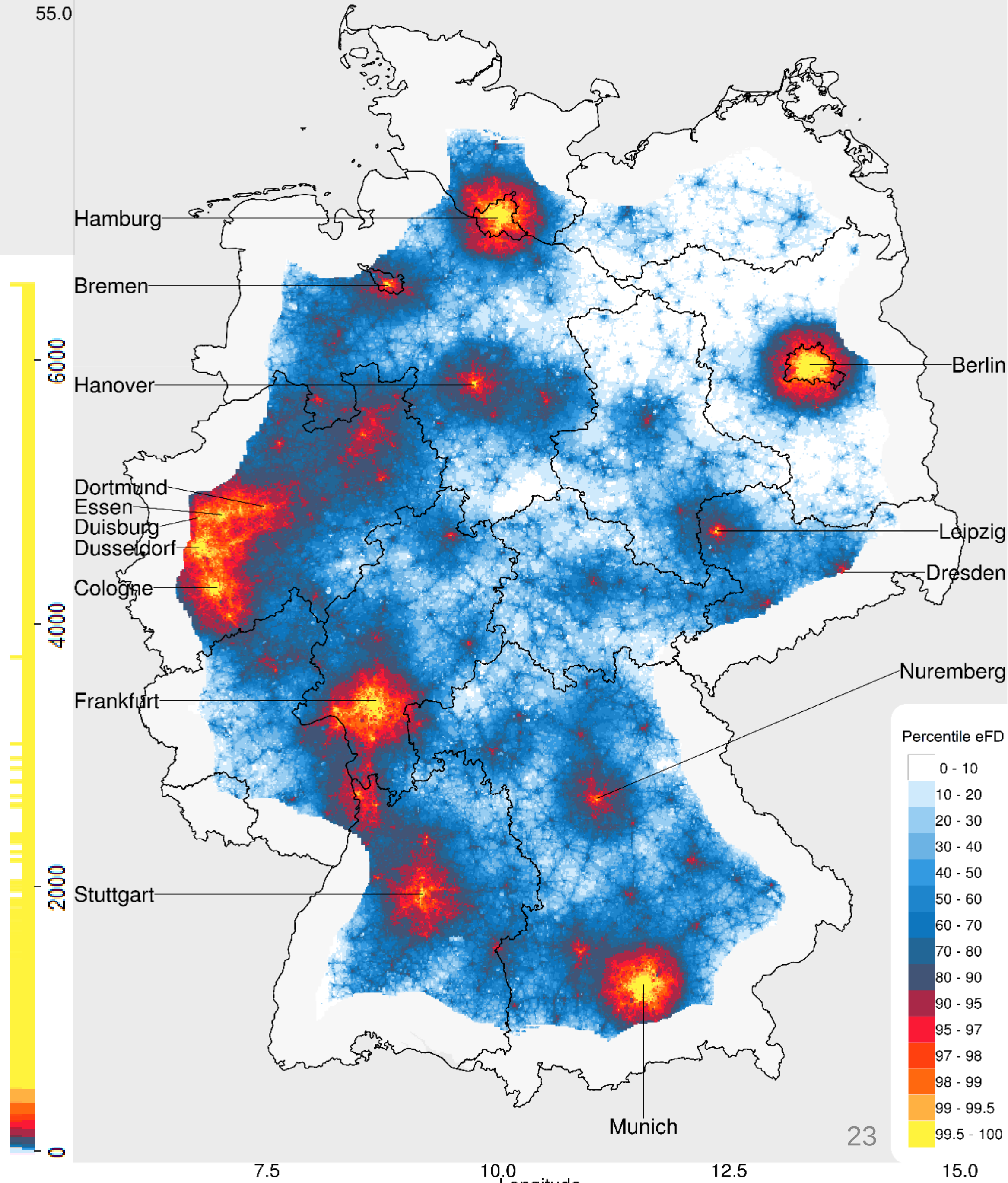
- Kontakt:
  m.mylius@zeppelin-university.net
- Ich freue mich auf den Austausch!
- Weitere Inhalte u.a.:
  - Berechnungen im Bezug auf effektive Firmendichte
  - Endogenität
  - Instrumentvariablen-schätzung
  - Untersuchung für nicht-Linearitäten
  - Schätzungen für Industriegruppen



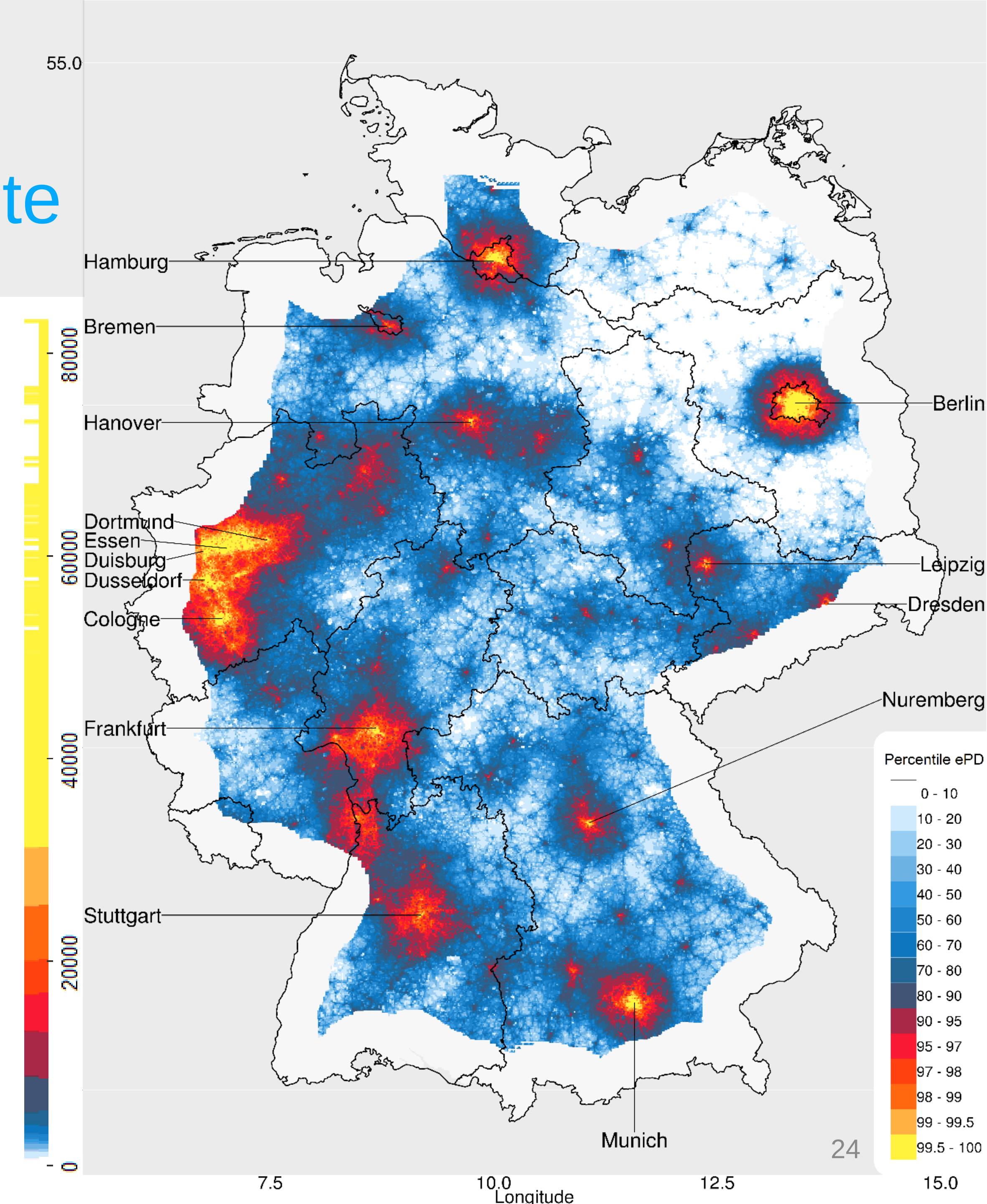
VII. Referenzen

- Bureau van Dijk. (15. 01 2018b). Dafne - annual accounts of German companies. Von https://dafne.bvdinfo.com abgerufen
- Duranton, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies. In Handbook of regional and urban economics (Vol. 4) (S. 2063-2117). Elsevier.
- Fujita, M., Krugman, P. R., & Venables, A. J. (1999). The spatial economy: cities, regions and international trade (Vol. 213). Cambridge, MA: MIT press.
- Graham, D. J., Gibbons, S., & Martin, R. (2009). Transport investment and the distance decay of agglomeration benefits. Report to the Department of Transport.
- Grundsätzliche Überprüfung und Weiterentwicklung der Nutzen-Kosten-Analyse im Bewertungsverfahren der Bundesverkehrswegeplanung, 2015 (Intraplan, Planco, TUBS)
- Harms, H. (1906, 06 14). *Harms Vaterländischer Erdkunde, 7. Auflage.* Braunschweig - Leipzig: Hellmuth Wollermann. Retrieved from https://www.deutsche-schutzgebiete.de/deutsche_staedte.htm
- Kim, H. Y. (1992). The translog production function and variable returns to scale. The Review of Economics and Statistics, S. 546-552.
- Melo, P. C., Graham, D. J., & Brage-Ardao, R. (2013). The productivity of transport infrastructure investment: A meta-analysis. Regional Science and Urban Economics 43, S. 695–706.
- Richardson, H. W. (2012). Economies and Diseconomies of Agglomeration. In H. Giersch, Urban agglomeration and economic growth (S. 123-155). Springer Science & Business Media.
- Weisstein, E. W. (2002). Average distance between two points in a square. In CRC concise encyclopedia of mathematics. CRC press.
- Zensus2011. (9. 12 2017). Von ergebnisse.zensus2011.de abgerufen

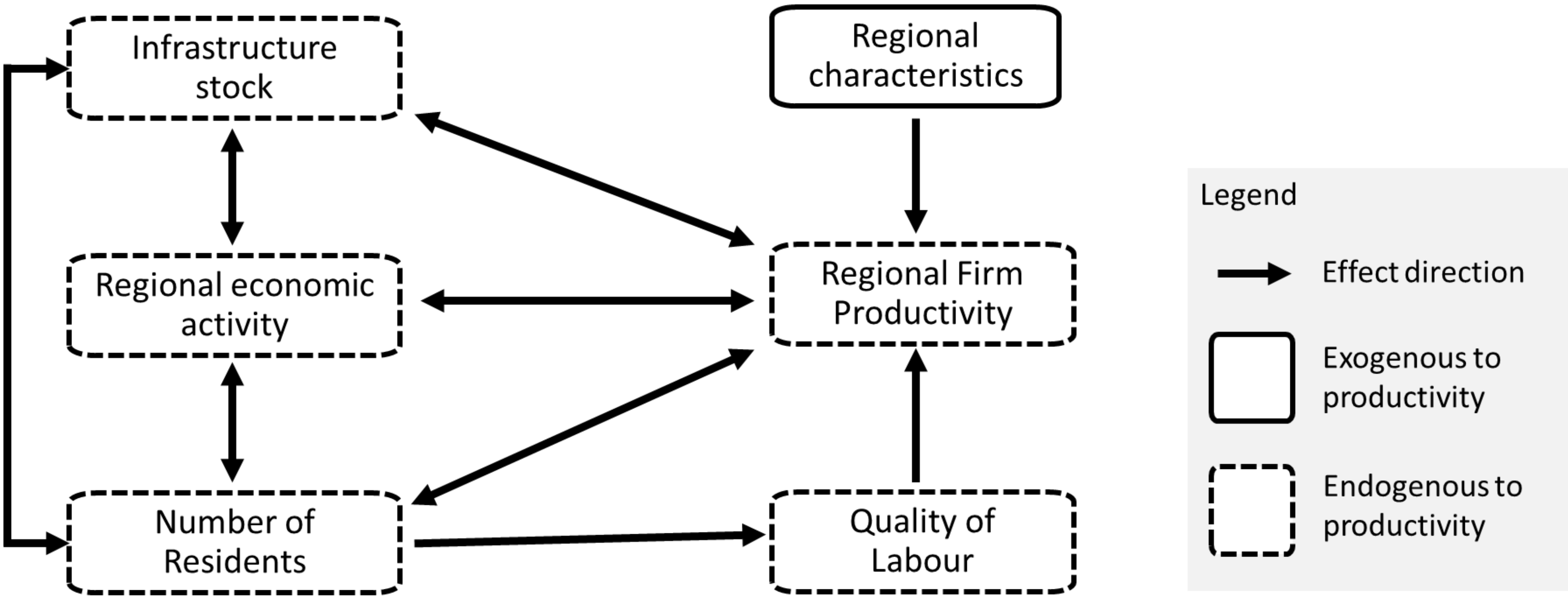
VII. Effektive Firmendichte



VII. Effektive Bevölkerungsdichte



VII. Endogenität

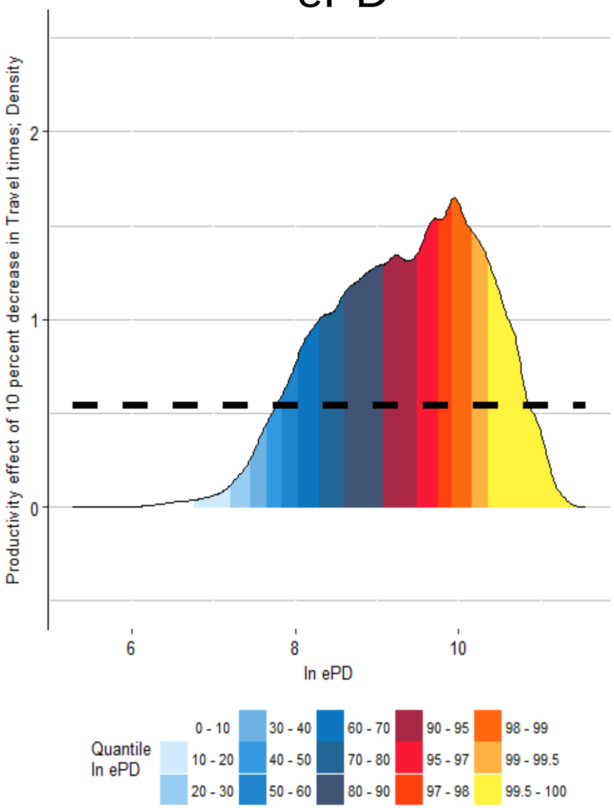


VII. Instrumentvariable

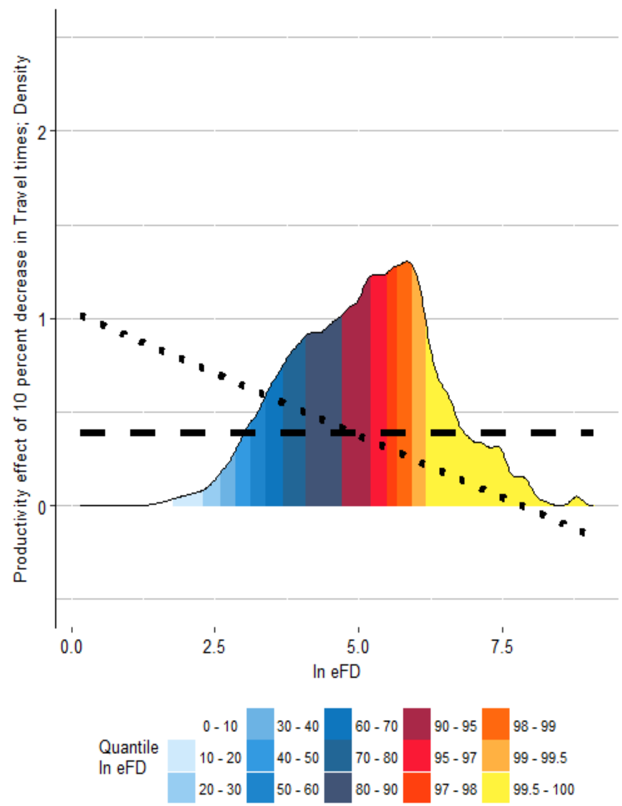
- Bevölkerung des Zensus 1905 (Harms, 1906)
- Daten für alle 375 Städte mit mehr als 20.000 Einwohnern
- Statt Reisezeiten geradlinige Distanzen

VII. Dichteverteilung & nicht-Linearitäten

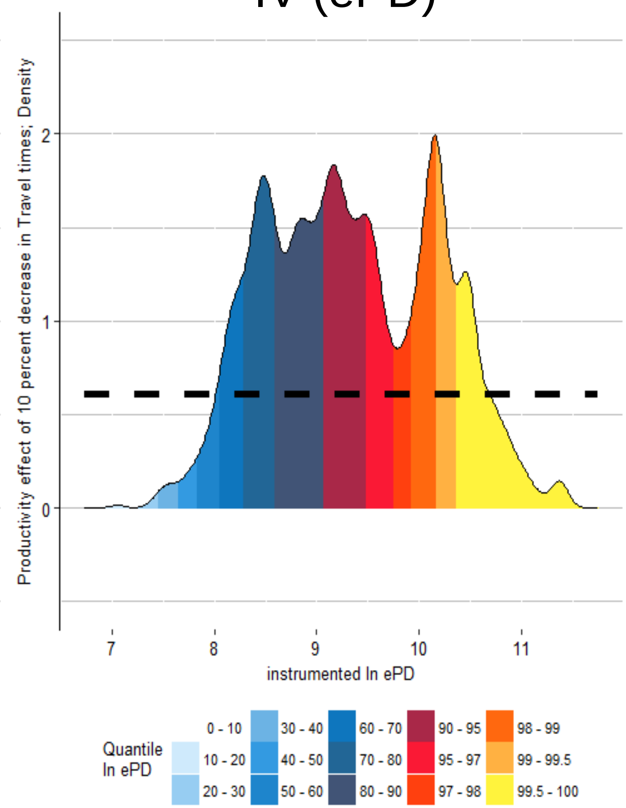
Spezifikation I
ePD



Spezifikation III & IV
eFD & eFD^2



Spezifikation V
IV (ePD)



VII. Dichteverteilung & nicht-Linearitäten

$$ePD = \sum_{n_r=1}^{n_r=556} \frac{Bevölkerungszahl_{n_r}}{Reisezeit\ zwischen\ den\ Regionen_{r,\,n_r}{}^{\alpha}}$$

$$+ \frac{Bevölkerungszahl_r}{Ø\ Reisezeit\ innerhalb\ der\ Region_r{}^{\alpha}}$$

ePD = effektive Bevölkerungsdichte

r = Ausgangsregion

n_r = Eine der Nachbarregionen zu Region r

α = distance decay parameter = 1,655 (Graham 2009)

VII. Distance decay parameter = 1

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.7052***	1.1929	1.9363***	1.8314***	1.6092***	0.7669	1.8782***	1.9105***
	(0.2158)	(0.8132)	(0.1756)	(0.1818)	(0.3584)	(0.9764)	(0.2582)	(0.3210)
β_L	0.6870***	0.6870***	0.6872***	0.6873***	0.6868***	0.6868***	0.6871***	0.6871***
	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)
β_K	0.4905***	0.4906***	0.4902***	0.4902***	0.4908***	0.4910***	0.4904***	0.4904***
	(0.0313)	(0.0313)	(0.0313)	(0.0313)	(0.0312)	(0.0312)	(0.0312)	(0.0312)
β_{LL}	-0.1006***	-0.1006***	-0.1007***	-0.1007***	-0.1005***	-0.1005***	-0.1007***	-0.1007***
	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)
β_{KK}	-0.0002	-0.0002	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003	-0.0003
	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
β_{KL}	0.0258*	0.0258*	0.0259*	0.0258*	0.0259*	0.0258*	0.0259*	0.0259*
	(0.0129)	(0.0129)	(0.0128)	(0.0129)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
β_{QP}	-0.0213	-0.0253	-0.0275	-0.0295	0.0123	0.0344	0.0079	0.0045
	(0.0927)	(0.0948)	(0.0898)	(0.0910)	(0.1816)	(0.1821)	(0.1804)	(0.1870)
β_{QA}	0.0911	0.1021	0.0747	0.0931	0.0786	0.0778	0.0578	0.0567
	(0.1237)	(0.1307)	(0.1226)	(0.1276)	(0.1585)	(0.1526)	(0.1591)	(0.1601)
β_{ePD}	0.0386***	0.1362			0.0457**	0.1926		
	(0.0094)	(0.1613)			(0.0211)	(0.1548)		
$\beta_{ePD*ePD}$		-0.0046				-0.0064		
		(0.0078)				(0.0066)		
β_{eFD}			0.0304***	0.0651*			0.0365**	0.0276
			(0.0061)	(0.0359)			(0.0169)	(0.0505)
$\beta_{eFD*eFD}$				-0.0028				0.0006
				(0.0031)				(0.0030)
Observations	210,846	210,846	210,846	210,846	210,846	210,846	210,846	210,846
R-squared	0.7111	0.7111	0.7111	0.7111	0.7110	0.7110	0.7110	0.7110

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VII. Distance decay parameter = 1.655

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.8701***	1.6748***	2.0648***	1.9723***	1.8274***	1.4719**	2.0400***	2.1136***
	(0.1908)	(0.3272)	(0.1750)	(0.1758)	(0.2756)	(0.5937)	(0.2107)	(0.2281)
β_L	0.6861***	0.6861***	0.6865***	0.6867***	0.6859***	0.6858***	0.6863***	0.6862***
	(0.0280)	(0.0279)	(0.0280)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)
β_K	0.4908***	0.4908***	0.4900***	0.4902***	0.4910***	0.4912***	0.4901***	0.4901***
	(0.0313)	(0.0313)	(0.0313)	(0.0313)	(0.0312)	(0.0312)	(0.0312)	(0.0312)
β_{LL}	-0.1006***	-0.1006***	-0.1009***	-0.1009***	-0.1006***	-0.1005***	-0.1009***	-0.1009***
	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)
β_{KK}	-0.0003	-0.0003	-0.0003	-0.0002	-0.0003	-0.0003	-0.0003	-0.0003
	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
β_{KL}	0.0260*	0.0260*	0.0262**	0.0260**	0.0260*	0.0260*	0.0262**	0.0263**
	(0.0129)	(0.0129)	(0.0128)	(0.0128)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
β_{QP}	-0.0539	-0.0562	-0.0759	-0.0682	-0.0359	-0.0186	-0.0562	-0.0747
	(0.1010)	(0.1019)	(0.1046)	(0.1036)	(0.1690)	(0.1726)	(0.1643)	(0.1729)
β_{QA}	0.0635	0.0718	0.0481	0.0739	0.0520	0.0488	0.0309	0.0296
	(0.1329)	(0.1387)	(0.1338)	(0.1354)	(0.1594)	(0.1564)	(0.1608)	(0.1618)
β_{ePD}	0.0312***	0.0757			0.0350**	0.1073		
	(0.0072)	(0.0631)			(0.0162)	(0.1016)		
$\beta_{ePD*ePD}$		-0.0025				-0.0037		
		(0.0037)				(0.0049)		
β_{eFD}			0.0226***	0.0602***			0.0261**	0.0013
			(0.0057)	(0.0161)			(0.0121)	(0.0326)
$\beta_{eFD*eFD}$				-0.0038**				0.0022
				(0.0018)				(0.0023)
Observations	210,846	210,846	210,846	210,846	210,846	210,846	210,846	210,846
R-squared	0.7111	0.7111	0.7110	0.7111	0.7110	0.7110	0.7110	0.7110

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VII. Distance decay parameter = 2

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.9892***	1.8716***	2.1281***	2.0597***	1.8951***	1.7062***	2.0879***	2.1701***
	(0.1862)	(0.2570)	(0.1780)	(0.1781)	(0.2526)	(0.5167)	(0.1998)	(0.2071)
β_L	0.6860***	0.6860***	0.6864***	0.6866***	0.6854***	0.6853***	0.6859***	0.6856***
	(0.0280)	(0.0280)	(0.0280)	(0.0279)	(0.0279)	(0.0279)	(0.0279)	(0.0279)
β_K	0.4906***	0.4907***	0.4896***	0.4898***	0.4912***	0.4914***	0.4899***	0.4899***
	(0.0312)	(0.0313)	(0.0313)	(0.0313)	(0.0312)	(0.0312)	(0.0312)	(0.0312)
β_{LL}	-0.1006***	-0.1006***	-0.1010***	-0.1009***	-0.1005***	-0.1005***	-0.1010***	-0.1010***
	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)	(0.0133)
β_{KK}	-0.0003	-0.0003	-0.0002	-0.0002	-0.0003	-0.0004	-0.0003	-0.0004
	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
β_{KL}	0.0260*	0.0260*	0.0262**	0.0261**	0.0261*	0.0261*	0.0264**	0.0265**
	(0.0129)	(0.0129)	(0.0128)	(0.0128)	(0.0129)	(0.0129)	(0.0129)	(0.0129)
β_{QP}	-0.0978	-0.0990	-0.1158	-0.1043	-0.0558	-0.0442	-0.0796	-0.1075
	(0.1158)	(0.1163)	(0.1192)	(0.1156)	(0.1644)	(0.1698)	(0.1594)	(0.1678)
β_{QA}	0.0759	0.0821	0.0622	0.0821	0.0427	0.0396	0.0220	0.0239
	(0.1434)	(0.1472)	(0.1437)	(0.1428)	(0.1600)	(0.1587)	(0.1616)	(0.1631)
β_{ePD}	0.0228***	0.0520			0.0320**	0.0736		
	(0.0057)	(0.0388)			(0.0148)	(0.0917)		
$\beta_{ePD*ePD}$		-0.0018				-0.0023		
		(0.0024)				(0.0047)		
β_{eFD}			0.0166***	0.0471***			0.0235**	-0.0078
			(0.0050)	(0.0130)			(0.0109)	(0.0285)
$\beta_{eFD*eFD}$				-0.0035**				0.0031
				(0.0016)				(0.0022)
Observations	210,846	210,846	210,846	210,846	210,846	210,846	210,846	210,846
R-squared	0.7110	0.7110	0.7110	0.7110	0.7110	0.7110	0.7110	0.7110

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VII. Standard Cobb-Douglas

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.9535***	1.7709***	2.1558***	2.0633***	1.9033***	1.5566**	2.1227***	2.2159***
	(0.1345)	(0.3012)	(0.1232)	(0.1268)	(0.2464)	(0.6174)	(0.1714)	(0.2116)
lnL	0.5409***	0.5409***	0.5412***	0.5409***	0.5409***	0.5408***	0.5412***	0.5412***
	(0.0083)	(0.0083)	(0.0084)	(0.0083)	(0.0083)	(0.0083)	(0.0083)	(0.0083)
lnK	0.5108***	0.5108***	0.5101***	0.5104***	0.5108***	0.5108***	0.5100***	0.5099***
	(0.0073)	(0.0073)	(0.0073)	(0.0073)	(0.0073)	(0.0073)	(0.0074)	(0.0073)
educ_med	-0.0557	-0.0579	-0.0822	-0.0744	-0.0344	-0.0175	-0.0554	-0.0789
	(0.1014)	(0.1022)	(0.1067)	(0.1056)	(0.1717)	(0.1765)	(0.1668)	(0.1767)
educ_high	0.0469	0.0547	0.0347	0.0607	0.0332	0.0301	0.0114	0.0097
	(0.1350)	(0.1406)	(0.1368)	(0.1378)	(0.1630)	(0.1599)	(0.1648)	(0.1663)
lnMP1_655	0.0317***	0.0734			0.0362**	0.1068		
	(0.0071)	(0.0628)			(0.0167)	(0.1054)		
lnMP1_655_2		-0.0023				-0.0036		
		(0.0037)				(0.0051)		
lnFP1_655			0.0223***	0.0599***			0.0270**	-0.0045
			(0.0058)	(0.0164)			(0.0125)	(0.0341)
lnFP1_655_2				-0.0038**				0.0028
				(0.0018)				(0.0024)
Observations	210,846	210,846	210,846	210,846	210,846	210,846	210,846	210,846
R-squared	0.7100	0.7100	0.7100	0.7100	0.7099	0.7099	0.7099	0.7099

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VII. Alte Bundesländer

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	2.0947***	1.7115***	2.3849***	2.2262***	2.3126***	2.9890**	2.4313***	2.7547***
	(0.2732)	(0.5911)	(0.2298)	(0.2566)	(0.5021)	(1.2945)	(0.3328)	(0.4396)
β_L	0.6605***	0.6605***	0.6610***	0.6611***	0.6611***	0.6612***	0.6612***	0.6608***
	(0.0309)	(0.0308)	(0.0310)	(0.0309)	(0.0302)	(0.0309)	(0.0303)	(0.0308)
β_K	0.4970***	0.4970***	0.4963***	0.4964***	0.4964***	0.4963***	0.4962***	0.4962***
	(0.0420)	(0.0420)	(0.0420)	(0.0420)	(0.0412)	(0.0419)	(0.0412)	(0.0419)
β_{LL}	-0.1142***	-0.1142***	-0.1144***	-0.1144***	-0.1142***	-0.1142***	-0.1144***	-0.1143***
	(0.0150)	(0.0150)	(0.0150)	(0.0150)	(0.0146)	(0.0149)	(0.0147)	(0.0150)
β_{KK}	-0.0030	-0.0030	-0.0030	-0.0029	-0.0029	-0.0029	-0.0029	-0.0030
	(0.0055)	(0.0055)	(0.0055)	(0.0055)	(0.0054)	(0.0055)	(0.0054)	(0.0055)
β_{KL}	0.0420***	0.0420***	0.0421***	0.0420***	0.0419***	0.0419***	0.0420***	0.0421***
	(0.0132)	(0.0132)	(0.0132)	(0.0132)	(0.0130)	(0.0133)	(0.0131)	(0.0134)
β_{QP}	-0.0756	-0.0856	-0.2055	-0.1806	-0.2243	-0.3015	-0.2520	-0.3664
	(0.2440)	(0.2447)	(0.2197)	(0.2392)	(0.3489)	(0.3832)	(0.3186)	(0.3305)
β_{QA}	0.0301	0.0364	-0.0415	-0.0062	-0.0108	-0.0535	-0.0465	-0.1128
	(0.2510)	(0.2548)	(0.2460)	(0.2616)	(0.2511)	(0.2592)	(0.2409)	(0.2347)
β_{ePD}	0.0304***	0.1160			0.0173	-0.1106		
	(0.0095)	(0.1068)			(0.0287)	(0.2106)		
$\beta_{ePD*ePD}$		-0.0047				0.0065		
		(0.0060)				(0.0101)		
β_{eFD}			0.0171**	0.0717***			0.0134	-0.0764
			(0.0072)	(0.0257)			(0.0216)	(0.0702)
$\beta_{eFD*eFD}$				-0.0052*				0.0079
				(0.0026)				(0.0050)
Observations	156,185	156,185	156,185	156,185	156,185	156,185	156,185	156,185
R-squared	0.7057	0.7057	0.7057	0.7057	0.7057	0.7056	0.7057	0.7057

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

VII. Neue Bundesländer

	ePD		eFD		IV of ePD		IV of eFD	
VARIABLES	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	1.7050***	1.8870***	1.8213***	1.8328***	1.5378***	0.4326	1.8626***	1.6584***
	(0.1234)	(0.2805)	(0.0924)	(0.0953)	(0.1159)	(0.7372)	(0.0835)	(0.1497)
β_L	0.7723***	0.7724***	0.7729***	0.7728***	0.7709***	0.7705***	0.7726***	0.7729***
	(0.0359)	(0.0359)	(0.0358)	(0.0358)	(0.0345)	(0.0362)	(0.0343)	(0.0355)
β_K	0.4632***	0.4631***	0.4619***	0.4617***	0.4653***	0.4670***	0.4621***	0.4627***
	(0.0164)	(0.0165)	(0.0164)	(0.0165)	(0.0151)	(0.0161)	(0.0156)	(0.0166)
β_{LL}	-0.0550***	-0.0550***	-0.0554***	-0.0554***	-0.0550***	-0.0549***	-0.0555***	-0.0555***
	(0.0141)	(0.0140)	(0.0140)	(0.0139)	(0.0135)	(0.0141)	(0.0133)	(0.0139)
β_{KK}	0.0113***	0.0113***	0.0114***	0.0114***	0.0110***	0.0108***	0.0113***	0.0113***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0020)	(0.0022)	(0.0021)	(0.0022)
β_{KL}	-0.0296***	-0.0296***	-0.0294***	-0.0294***	-0.0293***	-0.0293***	-0.0293***	-0.0294***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0075)	(0.0080)	(0.0075)	(0.0080)
β_{QP}	-0.0576	-0.0576	-0.0371	-0.0387	-0.0020	0.0526	-0.0191	0.0187
	(0.0992)	(0.0990)	(0.0823)	(0.0829)	(0.0813)	(0.1102)	(0.0743)	(0.1011)
β_{QA}	0.1747	0.1681	0.1469	0.1470	0.0121	-0.1227	0.1010	0.0176
	(0.1445)	(0.1446)	(0.1560)	(0.1549)	(0.1589)	(0.1955)	(0.1449)	(0.1709)
β_{ePD}	0.0294***	-0.0155			0.0540***	0.2670*		
	(0.0068)	(0.0729)			(0.0117)	(0.1401)		
$\beta_{ePD*ePD}$		0.0026				-0.0107		
		(0.0046)				(0.0064)		
β_{eFD}			0.0303***	0.0229			0.0366***	0.0870*
			(0.0069)	(0.0153)			(0.0097)	(0.0409)
$\beta_{eFD*eFD}$				0.0009				-0.0044
				(0.0018)				(0.0029)
Observations	54,661	54,661	54,661	54,661	54,661	54,661	54,661	54,661
R-squared	0.7290	0.7290	0.7291	0.7291	0.7289	0.7290	0.7291	0.7290

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

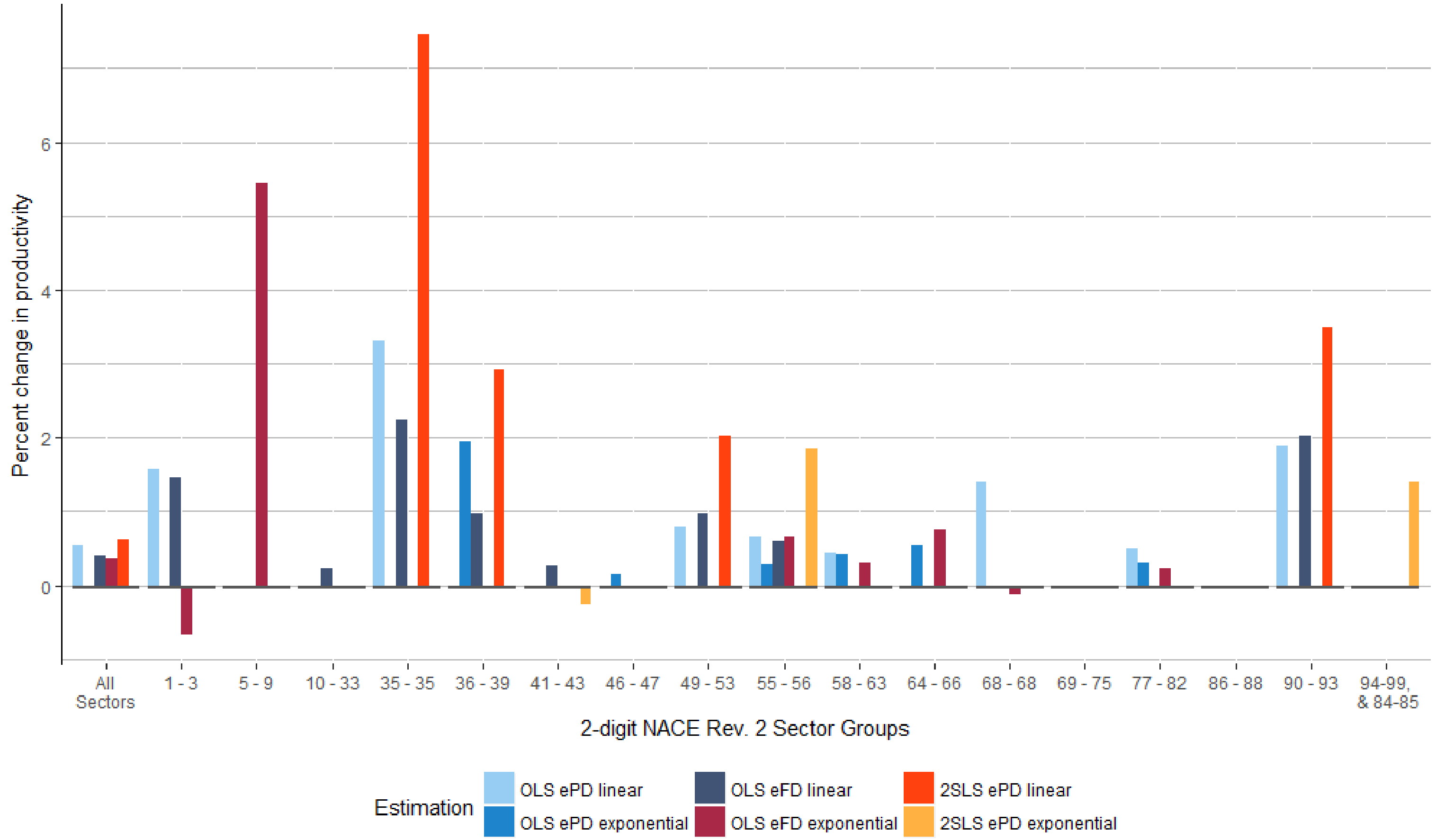
VII. Überblick Spezifikationen

Produktivitätszuwachs bei einer 10% Reduktion der Reisezeiten

	Translog Decay = 1.655 All	Standard Decay = 1.655 All	Translog Decay = 1 All	Translog Decay = 2 All	Translog Decay = 1.655 West	Translog Decay = 1.655 East
(I) constant returns to ePD	0.54%	0.37%	0.43%	0.28%	0.36%	0.35%
(II) flexible returns to ePD	-	-	-	-	-	-
(III) constant returns to eFD	0.39%	0.26%	0.34%	0.21%	0.20%	0.36%
(IV) flexible returns to eFD	0.36%	n.c.	-	n.c.	n.c.	-
(V) constant returns to IV of ePD	0.61%	0.43%	0.51%	0.40%	-	0.64%
(VI) flexible returns to IV of ePD	-	-	-	-	-	-
(V) constant returns to IV of eFD	0.31%	0.32%	0.41%	0.29%	-	0.44%
(VI) flexible returns to IV of eFD	-	-	-	-	-	-

Nur Werte auf mindestens 5% Signifikanzniveau angezeigt
n.c. = nicht berechnet

VII. Industriegruppen



Only effects significant on a 5% level plotted. 1-3 Agriculture, forestry and fishing, 5-9 Mining and quarrying, 10-33 Manufacturing, 35 Electricity, gas, steam and conditioning supply, 36-39 Water supply; sewerage, waste management and remediation activities, 41-43 Construction, 46-47 Wholesale and retail trade, repair of motorvehicles, 49-53 Transportation and storage, 55-56 Accommodation and food service activities, 58-63 Information and Communication, 64-66 Financial and insurance activities, 68 Real estate activities, 69-75 Professional, scientific and technical activities, 77-82 Administrative support service activities, 86-88 Human health and social work activities, 90-93 Arts, entertainment and recreation, 84, 85, 94-96, 97-98, 99 Other service activities, including Public administration and defence; compulsory social security; Education; Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; Activities of extraterritorial organisations and bodies