Influence of IT Employees on GDP

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Agenda

- Motivation
- Data
- Modelling
- Results

Motivation

Based on the particular functional form of the production function, Cobb-Douglas production function, we usually study the relationship between production and two components, *labor and physical capital*. But, there is a third factor and that is technology, sometimes it is difficult to measure because the data is not available or there is no specific definition on how to measure this component.

Some research papers discuss the positive effects between the third component and economic growth. Furthermore, some of these studies attempted to estimate the relationship between various economics variables and the technology diffusion, *The Gompertz model of technology diffusion*. (Baliamoune-Lutz, 2003) (Avgerou, 1998)

In this project, technology investment was not disaggregated at the city level and for several years, so a proxy variable was used to analyze the third component (% of IT employees). In addition, some control variables were considered to mitigate potential problems of omitted variables bias.

Data

Inkar database was used for this project and then a data set was constructed using data from 2016 to 2020. It includes the following variables:

- ln_gdp : Logarithm of Gross Domestic Product (GDP) absolute in million euros.
- ln_physical_investment : Logarithm of expenditure on physical investments in € per inhabitant.
- perctg_it_employees : Share of employees subject to social security contributions in IT and scientific service occupations to SV employees in %.
- employment_rate : SV employees at place of residence per 100 inhabitants of working age in %
- perctg_inhab_working_age : Percentage of residents aged 18 to under 50
- settlement_density : Inhabitants per km^2 settlement and transport area in 1K

Modelling - Tests

Name	Test Statistic	p-value
RLMerr	0.43639	0.5089
RLMlag	6.8278	0.00898

Table: Test results - Data 2020

Modelling

Spatial Durbin Model

$$ln\_gdp_{it} = \alpha_n + \rho W ln\_gdp_{it} + \beta_1 ln\_physical\_investment_{it} + \beta_2 perctg\_it\_employees_{it} + \beta_3 employment\_rate_{it} + \beta_4 perctg\_inhab\_working\_age_{it} + \beta_5 settlement\_density_{it} + \varepsilon_{it}$$

where i refers to the cities, and t is the time period (2016-2020)

Results - Correlation

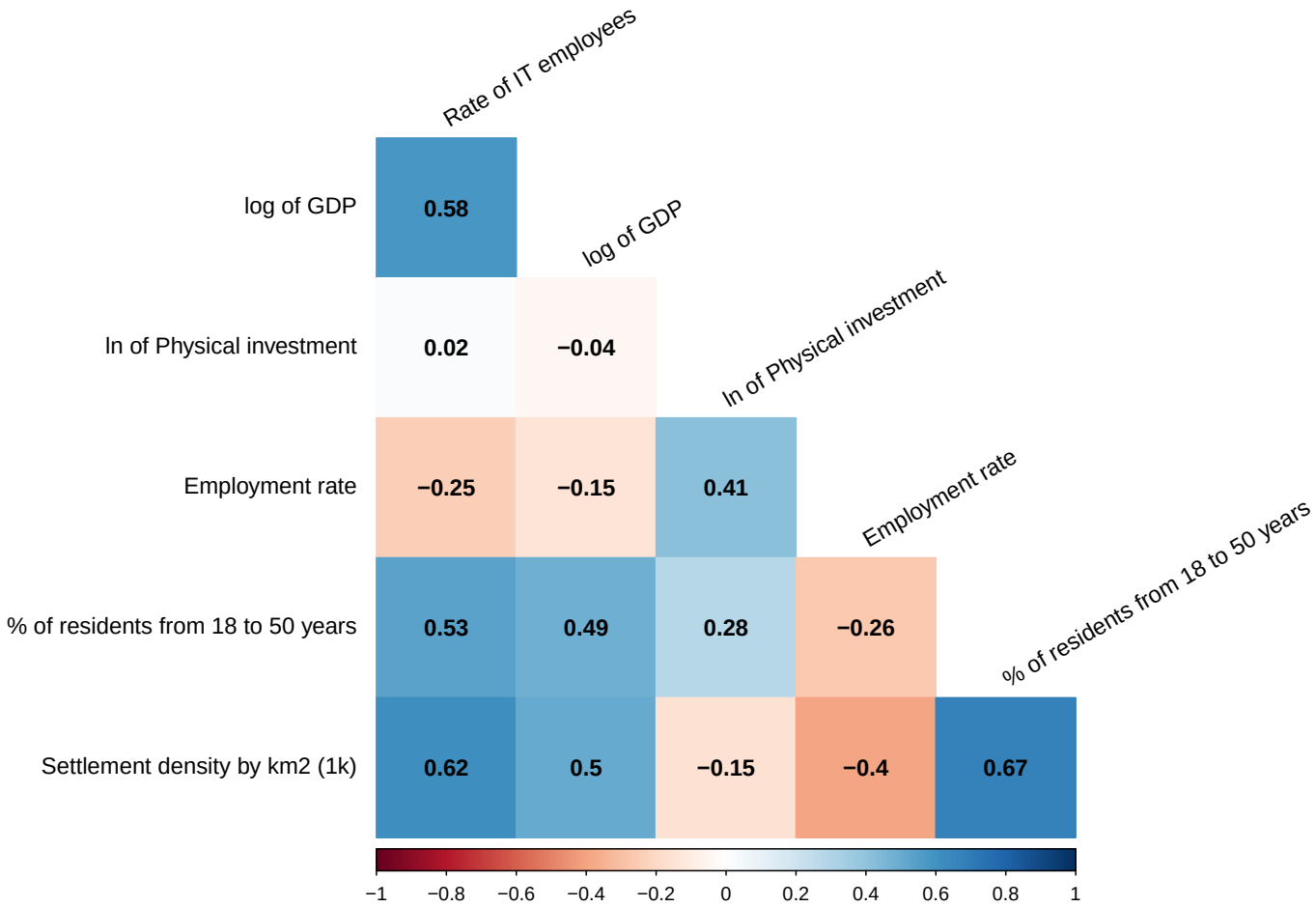

Figure: Correlation Matrix - Data 2020

Results - Maps

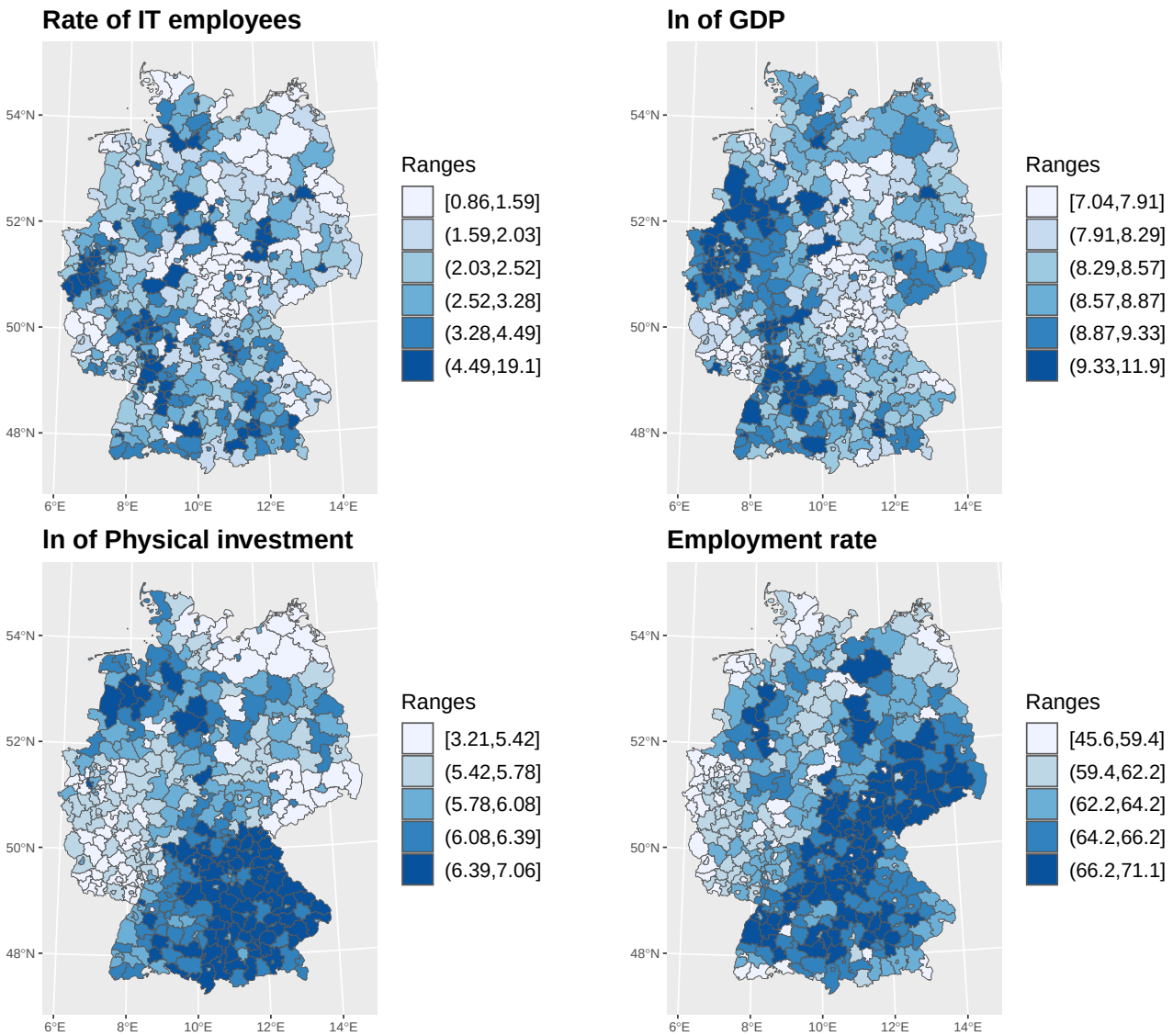

Figure: Heatmap - Data 2020

Results - OLS Model

	Dependent variable:
	ln_gdp
Rate of IT employees	0.099^{***}
	(0.017)
ln of Physical investment	-0.119^{**}
	(0.053)
Employment rate	0.029^{***}
	(0.008)
% of residents from 18 to 50 years	0.050^{***}
	(0.012)
Settlement density by km2 (1k)	0.216^{***}
	(0.045)
Constant	4.991^{***}
	(0.646)
Observations	401
R^2	0.430
Adjusted R^2	0.423
Residual Std. Error	0.582 (df = 395)
F Statistic	59.637^{***} (df = 5; 395)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table: OLS Results - Data 2020

Results - Spatial Regression Model

	ln_gdp(1)	ln_gdp(2)
lambda	0.247***	0.251***
	(0.030)	(0.030)
Rate of IT employees	0.010**	0.010**
	(0.004)	(0.004)
ln of Physical investment	-0.001	-0.001
	(0.001)	(0.001)
Employment rate	0.005***	0.005***
	(0.001)	(0.001)
Rate of IT employees-lag	-0.040***	-0.039***
	(0.009)	(0.008)
ln of Physical investment-lag	0.001	0.0005
	(0.002)	(0.002)
Employment rate-lag	0.014***	0.015***
	(0.002)	(0.002)
% of residents from 18 to 50 years	0.002	
	(0.003)	
Settlement density by km2 (1k)	0.026+	
	(0.015)	
Observations	2005	
Model	Spatial Durbin Model	

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table: SDM results

Results - Impact Measures

	Features	Direct	Indirect	Total	p.value(Total)
1	Rate of IT employees	0.0105	0.0031	0.0136	0.0044
2	ln of Physical investment	-0.0013	-0.0004	-0.0016	0.3329
3	Employment rate	0.0047	0.0014	0.0060	0.0015
4	Rate of IT employees-lag	-0.0411	-0.0120	-0.0531	0.0000
5	ln of Physical investment-lag	0.0006	0.0002	0.0008	0.7006
6	Employment rate-lag	0.0145	0.0042	0.0187	0.0000
7	% of residents from 18 to 50 years	0.0016	0.0005	0.0020	0.6707
8	Settlement density by km2 (1k)	0.0266	0.0078	0.0344	0.0776

Table: Impact results

Results - Clustering Analysis

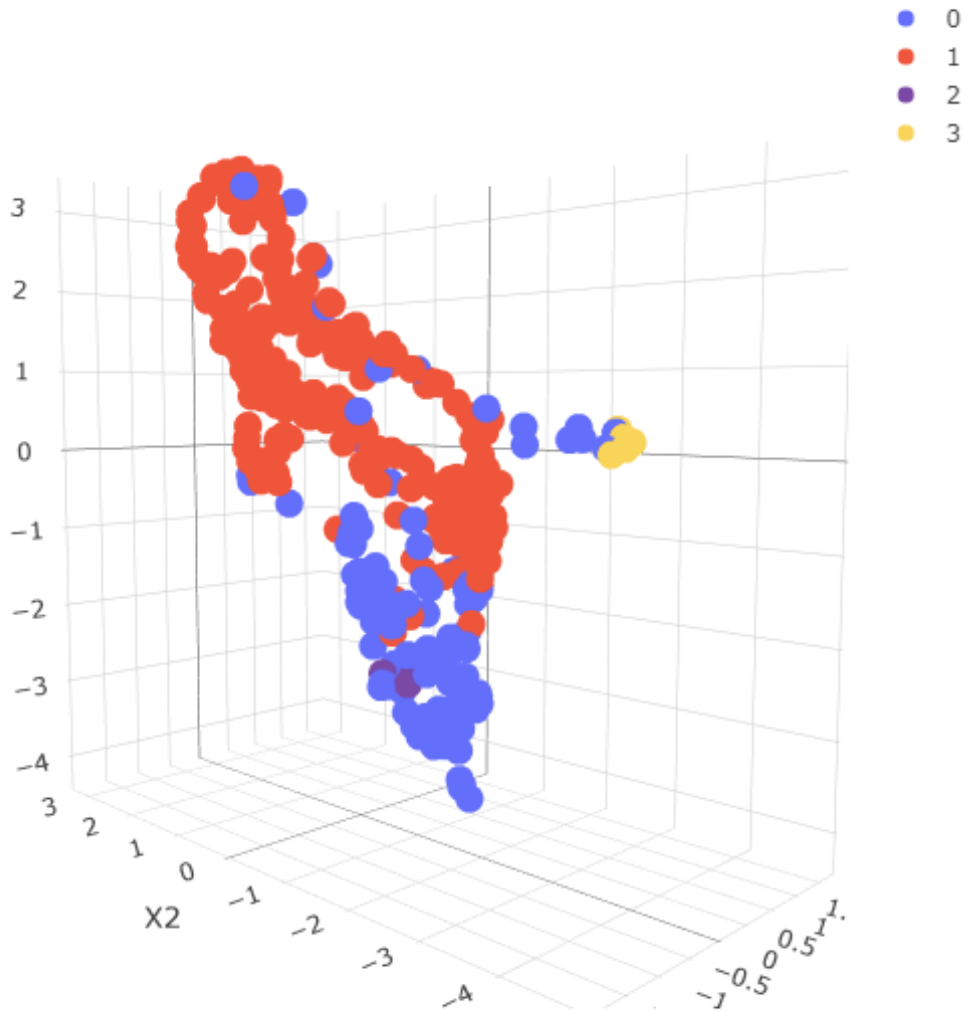

Figure: DBSCAN - Data 2020

Results - Clustering Analysis

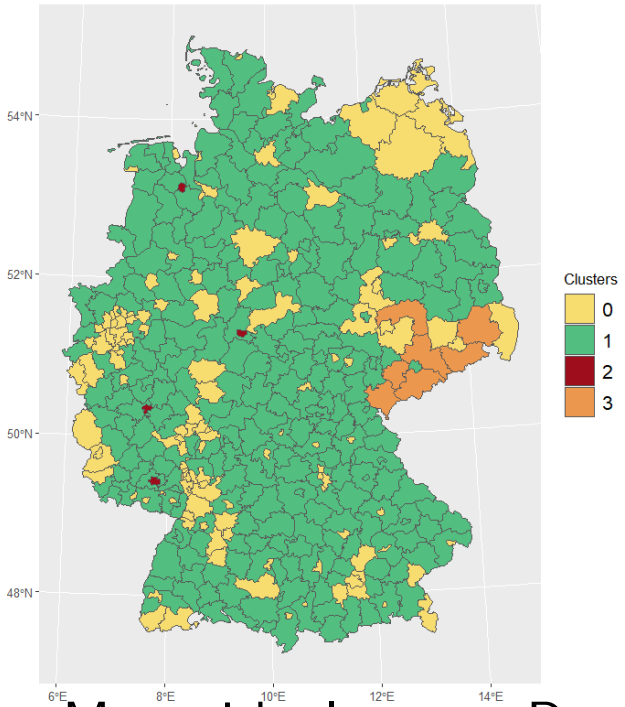

Figure: Map with clusters - Data 2020

Results DBSCAN- Clustering Analysis

clusterResult	$cluster_0$	$cluster_1$	$cluster_2$	$cluster_3$
Members	121	269	4	7
Rate of IT employees	4.30	2.21	4.70	1.73
log of GDP	8.94	8.45	9.00	8.99
ln of Physical investment	5.72	6.04	5.51	4.21
Employment rate	59.97	64.09	55.84	68.87
% of residents from 18 to 50 years	39.63	36.21	43.60	31.17
Settlement density by km2 (1k)	2.91	1.19	2.86	1.37

Table: Median estimate for each feature

Conclusions

- In the SDM, a positive spatial spillover effects between Rate of IT employees with ln of GDP.
- There was a small negative influence of ln of Physical investment with ln of GDP (-0.001).
- A positive direct of Rate of IT employees within the same area (1%), but a very small positive indirect effect outside the area (0.3%)

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