THE RELATION BETWEEN INDUSTRIAL AND SOCIO-ECONOMIC FUNDAMETALS IN GERMAN DISTRICTS

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Abstract
For the impartial observer of German regions, differences in regional industry structures and prosperity are quite obvious. On the one side, there are regions characterised by different industries, firm structures and labour qualification profiles. On the other side, some of these regions are prosperous, dynamic and growing in terms of inhabitants, labor force and income while others obviously suffer from high unemployment, low tax base and an unsatisfactory income situation. The analysis presented in this paper relates the regional industry structure to the socio-economic fundamentals that describe the regions' productivity, its income distribution and its population dynamics. The statistical model is based on the approach of moderated mediation. It is thereby able to show that the estimated relations are conditional on the degree of regions' centrality respectively remoteness. Moreover, the analysis distinguishes direct and indirect relations and therefore allows for an identification of the multiple dimensions of the potential effects of local industry structures in cultural, productivity and distributive terms.

Keywords
Rural development, socio-economic development, agglomeration, localisation, industry structure, labour qualification, moderated mediation

JEL Classification: R11, R12, O18, P25

1 Introduction

For the impartial observer of German regions differences in regional industry structures and prosperity are quite obvious. On the one side, there are regions characterised by heavy industries, or by primary production based on agriculture, fishery and/or forestry, or by a multitude of firms from manufacturing, or by hospitality industry, or by services in the finance and insurance industry, or by knowledge intensive production and services or by big industry. On the other side, some of these regions are prosperous, dynamic and growing in terms of inhabitants, labor force and income while others obviously suffer from high unemployment, low tax base and an unsatisfactory income situation. The analysis presented in this paper relates the regional industry structure to the socio-economic fundamentals that describe the regions' productivity, its income distribution and its population dynamics. The analysis differentiates between direct and indirect relationships between industry-structure and the socio-economic situation. In the estimation model, relations are conditional on districts' centrality, respectively remoteness.

Such an analysis might be judged as naive and simplistic for two reasons. From a methodological perspective, one cannot expect to identify causal effects of industry structures upon the economic development in such a cross-sectional analysis. The identification of these causal effects is not the purpose of the present analysis. It is content with a description of the observed relation between a multitude of different indicators that picture the local industry on one side and the socio-economic situation on the other. From a theoretical perspective, many might expect more subtle relations between local production and the socio-economic situation. According to standard economic theory, productivity differences should not be explained in terms of industry characteristics but rather in terms of firm- and region specific characteristics. At the same time, productivity differences should be the main reason for other differences in socio-economic aspects.

According to standard economic theories, there should be no difference in the income generating capability of different industries. According to respective models, the economy is in equilibrium as long as no exogenous disturbances occur. In this equilibrium, the marginal productivity of all factors of all activities are identical (Paci and Pigliaru, 1997). Accordingly, differences in income and income distribution should not depend on industry characteristics but rather on exogenous, fundamental site related factors. The evolutionary paradigm, in contrast, takes into account the possibility of endogenous dynamics. The course and the direction of endogenous dynamics depend upon decisions of economic actors themselves. In alternative economic models, the assumption of endogenous differences often relies on the argument of positive external effects of production. These general, not industry specific effects are usually referred to as urbanization effects. They are most famously introduced by Marshall (1890) and have been formalised based on specific assumptions and monopolistic competition by Krugman (1998). Thereby he founded the "New Economic Geography". In recent decades, most famously represented by Porter (1998), industry specific external effects of production, the localisation effects, have also been taken into account, in order to explain an uneven distribution of industries in space. Nevertheless, in these cases, differences in regional productivity have usually not been attributed to the prevalence of specific industries but rather to the clustering of these industries in space.

Industries' potential differences in economic productivity are mainly acknowledged by theories of a Schumpeterian origin. In respective models, profits and thereby growth are determined by innovative activities. Due to pioneering rents the most innovative firms and industries show the highest economic productivity and create the highest income. While these rents are of a temporary character principally due to the adoption of innovations by followers and their replacement in the course of creative destruction, it has frequently been observed that different industries differ in their propensity for innovation. Accordingly, "countries specialised in technological areas with opportunities for higher rates of productivity growth might be in a better position to achieve fast overall growth" (Jungmittag, 2004:248). Jungmittag (2007) analyses the relation between total productivity growth and employment shares in different sectors which are divided according to their knowledge intensity. He finds a significant correlation between shares in high- and medium technology production and knowledge intensive services on the one side and productivity growth on the other side. Pavitt (1984) provides a taxonomy of patterns of innovation which is based on industry-specific characteristics (Castellacci, 2006). He differentiates manufacturing industries into science based, scale intensive and supplier dominated sectors and specialised suppliers.

In the innovation based "evolutionary view, the impact of innovation on the international competitiveness of industries must therefore be analysed within a complex framework comprising both, the broader systemic context shaping innovative activities, and the sectoral specificities that characterize the creation and diffusion of knowledge" (Castellacci, 2008). Due to long-term endogenous differences between regions and given exogenous differences in site-specific factors, absolute convergence will not be reached with industry specific differences in productivity if different industries have different requirements with respect to their location. Especially, different industries might take differing advantages of urbanisation and localisation effects. Specifically, evidence and theory imply that it is mainly knowledge intensive industries with high propensity for innovation that profit from agglomeration effects. Therefore, peripheral regions might be disadvantaged because their industry mix is less knowledge based and those firms in peripheral regions that belong to knowledge based industries might be less productive due to the lack of positive external effects of production. Nevertheless, these negative effects might differ across industries. Accordingly, preferable industry compositions might differ for agglomerated and for peripheral regions.

Once the rigid assumptions of standard economic theory is dropped, it becomes evident that not only total productivity and prosperity of regions might be linked to the local industry mix but income distribution as well. As Sener (2001:121) writes, standard models ignore "dynamic linkages between trade, technological change, and labor markets". Nevertheless, alternative Schumpeterian models of economic growth have been developed (Dinopoulos and Segerstrom, 1999; Sener, 2001), which show that if higher degree of innovative activity causes a higher relative demand for skilled labour it may go along with a rise in the relative wage of skilled workers and a rise in the unemployment rate of less-skilled workers. The regional industry mix might therefore have significant implications for the local income distribution. Depending on the mobility of different kinds of labour it will thereby also affect regional development in terms of population dynamics.

Important political consequences result. Under the standard economic assumptions there is no necessity to support a change in industry structure in order to support regional convergence. Instead, efficiency and the amelioration of productivity would have to be supported irrespective of regional industry mix. If the relation between industry mix and productivity that is implied by innovation based approaches would be confirmed, in contrast, addressing the productivity of existing industries might not suffice in order to support regional convergence. Instead, the local reallocation of resources between industries would have to be supported (Fagerberg, 2000).

Based on these insights we postulate that a region's wealth and income distribution should at least partly be explained by its industry structure, i.e. by its industry composition, the size of its firms and the qualification of its labour. This analysis is a modest first attempt to get an idea of the observable relation between local industry structures in agglomerated and peripheral regions on the one side and regional wealth and income distribution on the other.

2 Indicators and measurement issues

In this study, economic fundamentals of districts are related statistically to the local industry structure and the districts' remoteness. The economic fundamentals to be explained are the district's GDP per inhabitant, its unemployment rate, mean wages paid in the district, mean household income, the district's tax receipts and its population development (Table 1). Industry structure is defined by the qualification of the work force, the size distribution of firms (Table 1) and by the industry mix. The local industry structure is characterised by the firm size distribution and the qualification of employees (Table 1) and by the share of employees in different industry on the two-digit level of the NACE classification.[1] Some industries were omitted from the analysis due to problems with missing values due to disclosure rules.[2] Remoteness is measured with three indicators, the distance to the next regional metropolis, the distance to the next highway and the district's population potential (Table 1).

[1] Due to space restrictions, statistics on the 63 variables from manufacturing and non-manufacturing industries are not presented here. The complete presentation of data, methodology and results can be found in a technical report (Margarian, 2013).

[2] There were too many missing values in all activities related to mining (NACE section B, two-digit classification industries 5 to 9). The same applies to manufacturing of tobacco products (12), manufacture of coke and refined petroleum products (19), water transport (50), air transport (51), programming and broadcasting activities (60) and creative, arts and entertainment activities (90).

We deliberately did not take into account those "industries" that represent ubiquitous public services and therefore have little potential for industry differentiation, specifically water collection, treatment and supply (36), sewerage (37), remediation activities and other waste management services (39), public administration and defense, compulsory social security (84), Education (85), residential care activities (87), social work activities without accommodation (88) and libraries, archives, museums and other cultural activities (91). Also not included were all industries starting from section S or industry 94 upward.

Table 1: Size of firms, qualification of labour and socio-economic fundamentals in the districts

Variable	Label	N	Mean	Std Dev	Min	Max
Share of employees 2007: (data from Federal Labour Office)						
ShareLargeFirms	Share of firms with 250 and more employees	372	0.42	0.17	0.00	0.96
ShareSmallFirms	Share of firms with one to nine employees	372	0.08	0.04	0.00	0.31
ShareMedFirms	Share of firms with 100 to 249 employees	372	0.19	0.07	0.00	0.46
ShareHighqual	Share of employees with university degree	372	0.04	0.03	0.01	0.26
ShareAddqual	Share of employees with university entrance and occupational qualification or with polytechnic degree	372	0.08	0.03	0.02	0.23
ShareNoqual	Share of employees without occupational or university entrance qualification	372	0.18	0.06	0.05	0.37
DominantFirm	Share of "lost" employees due to disclosure rules as indicator for the dominance of one to three large firms within specific industries	371	0.07	0.08	0.00	0.60
Other indicators for socio-economic situation: (Data from INKAR)						
PopPotential	Weighted population within a radius of 100 km (in 1000), 2008	371	432.88	392.33	50.60	2,308.60
DistCity	Journey time to the next regional metropolis (minutes), 2010	371	28.77	18.11	0.00	79.60
DistHighway	Journey time to the next highway (minutes), 2010	371	14.49	9.60	0.40	63.30
Income	Household income, 2007 (Euro/inhabitant)	371	1,506.53	196.96	1,117.10	2,397.00
Unempl	Unemployment, 2008 (in percent)	371	8.31	4.25	1.90	21.50
Wages	Wages, 2007 (Euro/employee/month)	371	2,648.42	355.04	1,880.50	4,124.30
GDP	Gross domestic product (GDP), 2007 (1000 Euro/inhabitant)	371	27.40	10.02	15.10	83.50
Tax	Tax receipts, 2008 (Euro/inhabitant)	369	644.35	215.11	238.90	1,912.20
PopDev	Population development, 2003-2008 (in percent)	371	-1.27	2.83	-9.00	6.50

Source: Own calculation based on data from sources named in the Table

2.1 Factor analysis

In order to handle the large number of indicators that characterise industry structure and remoteness on the right hand side of the regression equation, two separate factor analyses were conducted for the measurement of remoteness and industry structure. Factor analyses allow to capture the larger part of the information contained in a number of indicators within a smaller number of artificially constructed indicators, the factors. Therein, the covariance between factors is minimised and the common variance of indicators within factors is maximised. Depending on the common variance of the indicators, their contribution to each factor is weighted by the so called factor loading. A high factor loading shows that an indicator contributes a high share to the common variance of all indicators combined within a factor.

In the present analysis we rely on principal component analysis, a specific type of factor analysis that aims at the reproduction of the structure of data by a minimised number of factors (Backhaus et al., 2003). Each factor, or principal component, explains a specific share of the variance of all indicators, which is expressed by the factor's eigenvalue. Technically spoken, the principal component analysis aims at a reproduction of the correlation matrix that forms the starting point of the factor analysis. The communality, i.e., the share of the variance to be reproduced, is always assumed to be one in the principal component analysis as in contrast to the explanatory factor analysis. The variance of all indicators is distributed such that the variance of all indicators can be captured by a minimised number of factors. Finally, those coefficients, or factor loadings are calculated, which describe the quantitative relation of the single indicators to the common factors. The squared factor loading equals the share of the variance of an indicator that is explained by the factor. All squared factor loadings of a variable sum up to its communality, i.e., to the share of the indicator's variance that is captured by the factors. The eigenvalue of a factor, on the contrary, describes the share of the variance of all indicators that is ascribed to the factor. Usually, only those factors with a relatively high share in the reproduction of the variance of all indicators are extracted. Geometrically, these factors can be seen as axes of a coordinate system. A rotation of theses axes often enables a more unambiguous attribution of indicators to specific factors and therefore facilitates interpretation without damaging the analysis' validity (Backhaus et al., 2003).

With respect to the measurement of remoteness, one single factor was created in a principal component analysis based on the three indicators (see Table 1). With a scree-test we test the adequateness of the selection of a single factor. The scree-test is based on a graphic representation of the share of total variance that can be explained by each additional factor. If the resulting curve kinks downward at one place, the optimal number of factors is determined by the last factor previous to the kink. With respect to remoteness, the scree-test clearly confirms the selection of one single factor. Moreover, only the first factor has a eigenvalue larger one. With a eigenvalue of 1.44 it explains significantly more from the overall variance than its own variance and therefore complies to the Kaiser-criterion for the determination of the number of factors. The Kaiser-Meyer-Olkin criterium tests for undesired endogenity of indicators. Its value of 0.67 is sufficiently high in order to justify the factor analysis with our three indicators. The unexplained variance aside the main diagonal is 0.057 in the mean, which indicates that the deviation of the reproduced matrix from the original matrix is sufficiently low. Factor loadings of the factor that describes remoteness are presented in Table 2.

Table 2: Loadings of variables on the remoteness factor

	Loadings factor "remoteness"
PopPotential	-0.60
DistCity	0.75
DistHighway	0.71

Source: Own calculation based on data from Table 1

2.2 Measurement of industry mix

Obviously, the number of variables would get far too large for an estimation if all industry shares were included separately. Therefore, as in the case of the measurement of remoteness, factors were created in order to capture the relevance of groups of industries that are commonly located close to each other in the different districts. As in the measurement of remoteness we rely on principal component analysis (see above). Eight factors were selected (Table 3).

Table 3: Industry factors and loadings of 0.2 and higher of the underlying variables

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
Ind69	Legal and accounting activities	0.76	.	.	.	.	.	.	0.25
Ind66	Activities auxiliary to financial services and insuranc	0.73	.	.	.	.	.	.	.
Ind64	Financial service activities, except insurance and pen	0.73	.	.	.	.	.	.	.
Ind73	Advertising and market research	0.68	.	.	.	.	.	.	.
Ind65	Insurance, reinsurance and pension funding, except c	0.58	.	.	.	.	.	.	.
Ind70	Activities of head offices; management consultancy a	0.58	.	.	.	.	.	.	.
Ind79	Travel agency, tour operator reservation service and	0.51	.	.	.	.	.	.	.
Ind58	Publishing activities	0.46	.	.	.	.	.	0.23	.
Ind63	Information service activities	0.38	0.21	.	.	.	.	.	.
Ind74	Other professional, scientific and technical activities	0.38	.	.	0.20	.	.	.	.
Ind61	Telecommunications	0.34	.	.	.	.	.	.	.
Ind92	Gambling and betting activities	0.27	.	.	.	.	.	-0.20	.
Ind59	Motion picture, video, and television programme pro	0.26	.	.	.	.	.	0.21	.
Ind71	Architectural and engineering activities; technical tes	.	.	.	.	.	.	.	.
Ind68	Real estate activities	0.29	0.60	.	.	-0.24	.	.	.
Ind49	Land transport and transport via pipelines	.	0.57	.	-0.22	.	.	.	.
Ind38	Waste collection, treatment and disposal activities; m	-0.25	0.56	.	.	.	.	.	.
Ind81	Services to buildings and landscape activities	.	0.54	.	.	.	.	.	.
Ind80	Security and investigation activities	0.25	0.47	.	.	.	.	.	.
Ind82	Office administrative, office support and other busin	.	0.43	.	.	-0.25	.	.	.
Ind78	Employment activities	.	0.38	.	.	.	-0.26	.	.
Ind53	Postal and courier activities	.	0.31	.	.	.	.	.	.
Ind35	Electricity, gas, steam and air conditioning supply	.	0.30	.	0.24	.	.	.	.
Ind33	Repair and installation of machinery and equipment	.	0.20	.	.	.	.	.	.
Ind15	Leather and related products	.	.	.	.	.	.	.	.
Ind18	Printing and reproduction of recorded media	.	-0.26	.	.	.	.	.	.
Ind14	Wearing apparel	.	-0.26	.	.	.	.	.	.
Ind31	Furniture	.	-0.29	0.28	.	.	.	.	.
Ind32	Other manufacturing	.	-0.31	.	.	.	.	.	.
Ind22	Rubber and plastic products	.	-0.33	0.26	.	.	.	.	.
Ind27	Electrical equipment	.	-0.43	.	.	-0.31	.	.	.
Ind25	Fabricated metal products except machinery and equ	-0.22	-0.46	.	-0.32	-0.37	.	-0.29	.
Ind28	Machinery and equipment	.	-0.54	.	.	.	.	.	.
	ShareNoqual	.	-0.66	.	.	.	.	-0.30	.
Ind16	Wood and products of wood and cork except furnitu	.	-0.32	0.63	.	.	.	.	.
	Share of workforce in Agriculture	.	.	0.62	.	0.39	.	.	.
Ind41	Construction of buildings	.	.	0.59	.	.	.	.	.
Ind02	Forestry and logging	.	.	0.56	.	.	.	.	.
Ind43	Specialised construction activities	-0.26	.	0.44	.	0.31	.	.	.
Ind23	Other non-metallic mineral products	.	.	0.39	.	.	.	.	.
Ind42	Civil engineering	.	0.26	0.31	.	.	.	.	.
	DominantFirm	.	.	.	0.83	.	.	.	.
Ind29	Motor vehicles, trailers and semi-trailers	.	.	.	0.69	.	.	.	.
	ShareLargeFirms	.	.	-0.31	0.66	.	.	.	.
Ind30	Other transport equipment	.	.	.	0.42	.	.	.	.
Ind11	Beverages	.	.	0.20	0.30	.	.	.	.
Ind21	Basic pharmaceutical products and pharmaceutical p	.	.	-0.24	0.24	.	.	0.24	.
Ind17	Paper and paper products	.	.	.	0.21	.	.	.	.
Ind20	Chemicals and chemical products	.	.	.	.	.	.	.	.
	ShareMedFirms	.	.	0.25	-0.51	.	-0.20	.	0.22
Ind75	Veterinary activities	.	.	.	.	0.58	.	.	.
Ind47	Retail trade except of motor vehicles and motorcycle	.	.	-0.27	.	0.58	.	.	.
Ind45	Wholesale and retail trade and repair of motor vehicl	.	.	.	.	0.47	.	.	.
Ind10	Food products	.	.	0.24	.	0.45	.	.	.
Ind46	Wholesale trade except of motor vehicles and motor	.	-0.28	-0.27	-0.27	0.36	.	.	-0.34
Ind55	Accomodation	.	.	.	.	.	0.88	.	.
Ind03	Fishing and aquaculture	.	.	.	.	.	0.72	.	.
Ind56	Food and beverage service activities	.	.	.	.	.	0.71	.	.
	ShareSmallFirms	.	.	.	-0.37	.	0.48	.	.
Ind93	Sports activities and amusement and recreation activi	.	0.21	.	.	.	0.25	.	.
Ind13	Textiles	.	.	.	.	.	.	.	.
	ShareHighqual	.	.	-0.22	.	.	.	0.61	.
	ShareAddqual	.	.	-0.41	.	.	.	0.54	.
Ind72	Scientific research and development	.	.	.	.	.	.	0.47	.
Ind26	Computer, electronic and optical products	.	-0.41	.	.	-0.24	.	0.45	.
Ind62	Computer programming, consultancy and related acti	0.30	.	-0.21	.	.	.	0.41	.
Ind24	Basic metals	.	.	-0.33	.	-0.24	.	-0.41	.
Ind86	Human health activities	.	.	.	.	.	.	.	0.72
Ind77	Renting and leasing activities	0.24	.	.	.	.	.	.	-0.39
Ind52	Warehousing and support activities for transportatio	.	0.24	.	.	0.21	.	.	-0.43

Note: Values < 0.2 not printed

Source: Own calculation based on data on employment shares calculated from data from Federal Labour Office

The scree-test in this case did not provide unambiguous guidance. The eighth factor is the last factor to have an eigenvalue larger one. The selection of eight factors therefore complies to the Kaiser-criterion. The Kaiser-Meyer-Olkin criterium shows a value of 0.78 and therefore confirms the adequateness of a factor analysis based on our indicators for local industry structure. The unexplained variance aside the main diagonal is 0.037 in the mean, which indicates that the deviation of the reproduced matrix from the original matrix is sufficiently low. The rotated factors are well interpretable. Factor 1 is mainly constructed by services related to financial, legal and market services. They might be summarised as business or professional services (Table 4).

Table 4: Characterisation of factors by industry and innovation type

Factors		Production		Service
	Type	Type	Innovation type	Type
Factor1	Service			Professional
Factor2	Production	Simple	Specialized supplier	
Factor3	Production	Primary and related	Supplier-dominated	
Factor4	Production	Large scale/motor vehicles	Scale intensive	
Factor5	Service	Food related		Trade
Factor6	Service			Recreation
Factor7	Production	Knowledge intensive	Science-based	
Factor8	Service			Health

Source: Own figure

Factor 2 shows that there is a polarisation between regions that are characterised by low level professional services and regions that are characterised by production activities and a high share of unqualified labour. We decided to define the factor via the latter pole. Therefore, the signs of the factor's loadings are reversed, and a high value of factor 2 accordingly implies the prevalence of a high share of simple production activities (Table 4), specifically of metal production including machinery and equipment. Respective firms are often organised as "specialised suppliers". Therefore this factor corresponds to the respective innovation pattern in Pavitt's (1984) classification (Table 4; see chapter 1). Factor 3 has high loadings on activities related to construction or primary production. Especially primary production is characterised by rapid technical progress, but this technical progress is imported from upstream sectors. The factor therefore is related to the supplier-dominated innovation pattern as it is described in Pavitt's taxonomy. Factor 4 has high loadings on the indicator for dominant firms and on the share of large firms as well as on the production of motor vehicles and other transport equipment. The factor therefore reflects industries that belong to the scale intensive innovation pattern in Pavitt's taxonomy. Factors 5 and 6 are created based on services related to trade and recreation respectively. Factor 7 has high loadings on activities related to research and development and on highly qualified employees, which support knowledge intensive types of production. It therefore relates to the science-based innovation pattern in Pavitt's taxonomy. Factor 8 is defined by its high loading on health related services.

3 Estimation

The economic fundamentals described in the last chapter are not independent from each other. Accordingly, if one wishes to comprehensively address the relation between industry structure and the local socio-economic situation as it is depicted by the six indicators, a simultaneous estimation approach needs to be applied that accounts for the indicators' partial endogeneity. Here, the model is formulated in a mediation approach, which allows testing direct impacts of variables upon each other as well as indirect effects, i.e., effects that are mediated by another additional variable. The construction of the model to be estimated is guided by a simple logic of causation: It is assumed that the local economic productivity (GDP) is the most fundamental indicator that is determined by industry structure. GDP per inhabitant in turn partly determines unemployment, both are influential upon wages. BIP, unemployment and wages partly determine household income, all of them influence local tax revenues, and finally, regional demographic development depends upon all the other variables. Additionally, each one of the socio-economic indicators is assumed to be directly affected by industry structure. Accordingly, each of the indicators besides GDP is additionally indirectly influenced by industry structure via their dependence on the other variables in the chain. Finally, each of these effects is allowed to differ between agglomerated and peripheral regions (remoteness). In all regressions a west-east dummy is included in order to control for the historically caused fundamental differences in industry, employment and demographic structures between regions in the former West and East Germanys.

The mediation approach allows testing direct impacts of variables upon each other as well as indirect effects, i.e., effects that are mediated by another additional variable. The idea of mediation is conceptually a challenge while it is rather easy to implement technically. Mediation models simply consist of a series of regressions with a subsequent inclusion of mediation variables (Hayes, 2012). In the following explanation, we relinquish from the inclusion of the interaction terms and thereby simplify our moderated mediation approach to a simple mediation approach in order to facilitate understanding. Remoteness is therefore treated as if it were an exogenous control variable in the principal explanation. In order to identify the indirect effects of the exogenous variable on the endogenous variable via the *m* mediators, *m+1* models are estimated in an overarching logical model with a hierarchical causal structure. The first model explains the first mediator (*GDP*) in terms of the exogenous variables (*West* and *Remote*) and the *n* covariates (the industry factors, $Industry_i$):

$$GDP = \beta_{10} + \beta_{11} West + \beta_{12} \mathrm{Re}\, mote + \sum_{1}^{i} \left[\beta_{1;i+2} Industry_i \right] + e_1 \quad (5)$$

The second model explains the second mediator (*Jobless*) in terms of the exogenous variables, the covariates and the first mediator:

$$Jobless = \beta_{20} + \beta_{21} West + \beta_{22} \mathrm{Re}\, mote + \beta_{23} GDP + \sum_{1}^{i} \left[\beta_{2;i+3} Industry_i \right] + e_2 \quad (6)$$

The third (*m*th) model explains the third mediator ($Mediator_m$) in terms of the exogenous variable and the first and second (*n*th) mediator ($Mediator_n$) and so on:

$$Mediator_m = \beta_{m0} + \beta_{m1} West + \beta_{m2} \mathrm{Re}\, mote + \sum_{1}^{m-1} \beta_{m;n+2} Mediator_n + \sum_{1}^{i} \left[\beta_{m;i+m+2} Industry_i \right] + e_m \quad (7)$$

$\beta_{m;n+2}$ determines the direct effects of the mediators and $\beta_{m;i+m+2}$ determines the direct effects of the covariates upon the mediator on the left hand side of equation (7). The indirect effects of the covariates upon the different endogenous variables via selected mediators is calculated by the multiplication

- of the estimated effect of the covariate under interest upon the first mediator upon interest
- with the estimated effect of this first mediator upon the following mediators under interest in the causal chain
- with the estimated effect of the last mediator under interest in the causal chain upon the endogenous variable under interest.

A summation of all direct and indirect effects gives the total effect of a covariate upon any of the endogenous variables ($SocioEconomic_n$). The total effect could also be estimated as

$$SocioEconomic_n = \beta_{n0} + \beta_{n1} West + \beta_{n2} \mathrm{Re}\, mote + \sum_{1}^{i} \left[\beta_{n;i+3} Industry_i \right] + e_n \quad . \quad (8)$$

The total effect may be insignificant despite significant direct and indirect effects if the signs of single effects are oppositional. The assessment of the significance of indirect effects necessitates some further calculations. As we not only deal with mediation but simultaneously introduce moderator variables, i.e. multiplicative interactions among explanatory variables, matters get further complicated (see Margarian, 2013, Figure 1). The different regressions to be estimated in this case have the following structure with interaction effects:

$$Mediator_m = \beta_{m0} + \beta_{m1} West + \beta_{m2} \text{Re}\,mote$$
$$+ \sum_1^{m-1} \beta_{m;n+2} Mediator_n + \sum_1^{i} \left[\beta_{m;i+m+2} Industry_i\right] + \sum_1^{i}\sum_1^{j} \left[\beta_{m;2(i+m)+2} Industry_i Industry_j\right]$$
$$+ \sum_1^{m-1} \beta_{m;3(i+m)+2} Mediator_n \,\text{Re}\,mote + \sum_1^{i} \left[\beta_{m;4(i+m)+2} Industry_i \,\text{Re}\,mote\right]$$
$$+ \sum_1^{i}\sum_1^{j} \left[\beta_{m;5(i+m)+2} Industry_i Industry_j \,\text{Re}\,mote\right] + e_m \quad (9)$$

This implies that we expect to find a relation between the prevalence of specific industries and different indicators of a district's socio-economic situation. This relation is assumed to be conditional upon, or moderated by, the prevalence of a second important industry as indicated by the interaction between industry factor *i* and industry factor *j*. This moderated effect is assumed to be partially mediated by the relation between industry structure and other socio-economic indicators. This mediation is accounted for by the sequential regression of hierarchically models that build upon each other by the sequential introduction of mediating variables. The mediated effect is calculated by the subsequent multiplication of coefficients as explained above. Nevertheless, in order to complicate matters further, equation (9) shows that the direct industry effect as well as the mediated industry effect are assumed to be conditional upon, or moderated by, the remoteness factor. This is indicated again by the three last interaction terms in equation (9). Thereby the direct relation of the prevalence of a specific industry type as well as its indirect relation to one of the socio-economic dimensions via other socio-economic dimensions are allowed to differ, depending on districts' remoteness.

Even in this case, the calculation of conditional indirect effects via the product of coefficients method (Preacher et al., 2007) as described above is rather unproblematic. Nevertheless, working with interaction effects introduces some specific difficulties in the interpretation of coefficients as the different coefficients need to be combined, and the effect often depends on the level of the intervening variable itself. Standard errors, too, need to be corrected taking into account the correlation of variables with the interacted terms. In the calculation of the significance of estimated overall effects the covariance between distinct estimators needs to be taken into account (Aiken and West, 1991).[3] We present marginal overall-effects whose combined significance is evaluated separately for each observation in the final model to be presented below. Preacher et al. propose a bootstrapping approach to the calculation of standard errors and confidence intervals. This is the preferred method as the alternative normal theory based approach's assumptions concerning the normal distribution of effects does often not apply for conditional indirect effects, i.e., for moderated mediated effects.[4] Despite this problem, the analysis in this paper relies on the normal theory based approach, which has also been described by Preacher et al. (2007). The reason for this choice is simple: Due to the various mediators, moderators and the large number of relevant covariates the bootstrapping approach is too computational intensive to be practicable for us. We implement the normal theory based approach as it is described by Preacher et al. (2007) in STATA.[5] The

[3] For a more detailed treatment see the technical report (Margarian, 2013). See also Aiken and West (1991) and https://files.nyu.edu/mrg217/public/interaction.html#code

[4] For an assessment of different test of the significance of mediated effects refer also to MacKinnon et al. (2002).

[5] There is a very good description of the possibility to implement moderated mediation in STATA on http://www.ats.ucla.edu/stat/stata/faq/modmed.htm. The most flexible and easily accessible approach in

"nlcom" (non-linear combination) command we use in STATA in order to calculate mediated effects and their standard errors from the original separate regressions computes the standard errors using the delta method which assumes that the estimates of the indirect effect are normally distributed (UCLA, 2013).

The results show the kind of relation between industries and socio-economic fundamentals, they help to distinguish between direct and indirect (mediated) effects and they allow assessing, whether relations are significant in central, medium and remote locations. The resulting moderated and mediated effects for different combinations in the levels of the mediating and moderating variables with their point-specific significances are discussed in the following chapter.

4 Selected results

The results of the initial seemingly unrelated regression (SUR) on which the calculation of marginal effects is based (Table 5) give a first impression of the relations between endogenous and exogenous variables and the industry covariates (f1 to f8) and their interactions (fxfv). The Table has been abbreviated in that not all interaction coefficients are presented. With concern to them, only the marginal effects and their significance is informative. The Table gives a condensed overview that allows for an intuitive understanding of the estimation: In the first two columns only the covariates explain the first mediator variable (*GDP*). The first column shows the estimated effects for central regions, the second column shows the change in respective coefficients for remote regions. Professional services (f1) for example, relate accordingly to the initial SUR, positively to GDP in central regions (coefficient 1.72) and only slightly less positively (-0.20, insignificant difference) in remote regions. The R-squares reported in Table 5 show the relatively high explanatory power of the models as they reach values around 0.9.

Table 5: Estimation results from the seemingly unrelated regressions

	GDP	Remote	Jobless	Remote	Wage	Remote	Income	Remote	Tax	Remote	Population	Remote
Inter-	20.87 ***	0.95	11.29 ***	0.33	2410.0 ***	5.6	1464.2 ***	-34.2 *	623.9 ***	-6.7	-1.377 *	0.094
cept	(1.44)	(0.71)	(0.63)	(0.31)	(35.5)	(17.0)	(35.6)	(15.8)	(26.9)	(11.6)	(0.609)	(0.261)
tax											0.000	0.005 *
											(0.001)	(0.002)
income									0.1 **	0.0	-0.001	0.000
									(0.0)	(0.1)	(0.001)	(0.001)
wage							0.0	0.1	0.2 ***	0.0	0.001	0.001
							(0.1)	(0.1)	(0.0)	(0.0)	(0.001)	(0.001)
jobless					-4.5	0.3	-12.8 ***	4.8	-10.8 ***	-2.1	-0.449 ***	0.008
					(3.2)	(3.2)	(2.9)	(3.0)	(2.2)	(2.3)	(0.052)	(0.059)
GDP			-0.13 ***	-0.01	13.8 ***	6.4 ***	3.9 *	-1.1	8.4 ***	0.3	0.016	-0.081 *
			(0.03)	(0.03)	(1.6)	(1.9)	(1.7)	(2.0)	(1.2)	(1.5)	(0.031)	(0.037)
f1	1.72 *	-0.20	0.38	0.22	33.6 *	-73.3 **	45.0 **	14.1	30.2 *	-33.0 °	0.668 *	0.102
	(0.73)	(0.99)	(0.31)	(0.42)	(17.1)	(23.0)	(15.9)	(23.1)	(11.9)	(17.5)	(0.273)	(0.398)
f2	0.78	-0.48	-2.15 ***	0.22	37.9 *	24.1	51.3 ***	16.3	0.4	3.8	-0.689 **	-0.537 °
	(0.58)	(0.65)	(0.25)	(0.28)	(15.1)	(19.6)	(14.1)	(18.3)	(10.7)	(13.7)	(0.241)	(0.312)
f3	-1.50 *	0.55	-0.53 *	1.29 ***	-41.2 **	-34.9 *	-14.2	36.8 *	3.3	-17.3	-0.823 ***	0.277
	(0.63)	(0.66)	(0.27)	(0.28)	(14.6)	(15.9)	(13.8)	(15.6)	(10.5)	(11.6)	(0.239)	(0.262)
f4	0.28	0.46	0.41 *	0.60 *	44.3 ***	34.2 *	-26.2 *	6.5	-21.8 **	-4.7	-0.307 °	0.077
	(0.49)	(0.68)	(0.21)	(0.29)	(11.2)	(15.7)	(10.6)	(15.3)	(7.9)	(11.3)	(0.183)	(0.257)
f5	-3.01 ***	1.38 °	-0.76 ***	-0.37	-79.1 ***	5.4	5.1	-13.4	11.2	-5.6	0.705 ***	0.000
	(0.52)	(0.77)	(0.23)	(0.33)	(12.7)	(18.6)	(12.6)	(17.3)	(9.4)	(12.6)	(0.212)	(0.286)
f6	-1.62 *	2.01 *	-0.97 **	0.88 *	-57.9 ***	79.6 ***	23.0	-11.3	-11.0	14.9	0.470 °	0.741 *
	(0.72)	(0.94)	(0.31)	(0.40)	(17.0)	(22.2)	(16.0)	(21.2)	(11.8)	(15.6)	(0.266)	(0.352)
f7	1.55 **	2.18 *	-0.51 *	0.13	64.6 ***	21.9	25.0 *	10.1	28.0 **	21.3	0.334	-0.220
	(0.55)	(1.08)	(0.23)	(0.46)	(12.8)	(24.9)	(12.4)	(23.1)	(9.3)	(16.8)	(0.213)	(0.382)
f8	0.45	-1.07	0.79 ***	0.14	-19.8 °	27.0	-25.8 *	5.7	-14.3 °	12.8	-0.444 *	-0.413
	(0.50)	(0.75)	(0.21)	(0.32)	(11.9)	(17.4)	(11.0)	(16.0)	(8.1)	(11.7)	(0.183)	(0.267)
f2f1	-0.63	1.30	0.14	0.20	60.1 ***	44.4 *	29.6 °	23.2	29.0 *	29.5 *	-0.314	0.170
	(0.74)	(0.81)	(0.31)	(0.34)	(17.0)	(18.7)	(16.0)	(17.3)	(11.7)	(12.8)	(0.270)	(0.293)
fxf1	…	…	…	…	…	…	…	…	…	…	…	…
fxfy	…	…	…	…	…	…	…	…	…	…	…	…
West	4.63 **		-4.63 ***		298.2 ***		69.7 °		11.9		0.062	
	1.61		0.69		40.2		41.1		31.4		0.710	
r2	0.86		0.86		0.94		0.84		0.93		0.79	
p	0.000		0.000		0.000		0.000		0.000		0.000	

Source: Own calculation; interactions among industry factors (fxfy) are left out due to space limitations

While the initial estimates give a comprehensive impression of the relationships, only marginal effects and their significances show the kind of relation between industries and socio-economic fundamentals, help to distinguish between direct and indirect (mediated)

technical terms is via a combination of the sureg command and the nlcom command in STATA.

effects and allow assessing, whether relations are significant in central, medium and remote locations. The estimation of the moderated mediation model produces a large number of different marginal effects and a highly differentiated pattern of coefficients. All systematically calculated marginal effects for all combinations of industries and degrees of remoteness are presented in the technical report (Margarian, 2013). This section provides selected results from the large number of resulting moderated and mediated marginal effects for different combinations in the levels of the mediating and moderating variables with their point-specific significances. Specifically, the presentation concentrates on the estimated relations between the professional service industry factor respectively the recreation service factor and the districts' socio-economic conditions.

4.1 Relation between professional services and socio-economic fundamentals

Professional services is the first factor and accounts for the highest share in the variance in the variables related to industry structure. Professional services are generally believed to be of fundamental importance for economic development in the knowledge society but little is known about their relevance in remote regions. It has highly significant marginal relations to the economic fundamentals that are shown to depend on remoteness and on other accompanying industries (Table 6).

Table 6: Selected marginal relations between factor "Professional services" and economic fundamentals with point specific significances conditional on other industry factors in central and remote locations

		GDP		Wage		Tax	Population
Interaction	Level	direct		direct		direct	via taxes
with		Central	Remote	Central	Remote	Remote	Remote
None		2.356	1.337	174.993 ***	-99.887 **	-25.227	-0.220
		(1.688)	(1.597)	(38.871)	(37.075)	(27.059)	(0.250)
Simple production	low	4.948 ***	0.094	180.999 ***	-218.496 ***	-100.294 **	-0.874 *
		(1.428)	(1.997)	(34.512)	(46.109)	(32.713)	(0.437)
	high	-0.236	2.579	168.986 **	18.723	49.840	0.434
		(2.444)	(2.406)	(55.569)	(55.337)	(39.092)	(0.378)
Primary and related production	low	5.628 ***	0.181	120.755 ***	-79.516	-21.656	-0.189
		(1.260)	(2.080)	(31.606)	(48.949)	(33.734)	(0.303)
	high	-0.916	2.493	229.230 ***	-120.257 **	-28.799	-0.251
		(2.319)	(2.037)	(52.815)	(46.538)	(33.870)	(0.310)
Large scale production	low	0.296	3.945 °	172.100 ***	-76.776	29.454	0.257
		(1.736)	(2.285)	(39.918)	(54.174)	(38.801)	(0.352)
	high	4.416 *	-1.272	177.885 ***	-122.997 *	-79.908 *	-0.696 °
		(1.979)	(2.260)	(45.765)	(51.851)	(35.408)	(0.406)
Trade services	low	1.404	3.347 °	162.039 ***	-71.605	-31.841	-0.277
		(1.863)	(2.000)	(42.780)	(46.221)	(32.447)	(0.302)
	high	3.307	-0.673	187.946 ***	-128.169 **	-18.614	-0.162
		(2.040)	(2.143)	(46.957)	(49.419)	(35.097)	(0.312)
Recreation service	low	2.684	2.306	148.908 ***	-109.646 °	-26.100	-0.227
		(1.799)	(2.517)	(41.077)	(57.382)	(41.067)	(0.368)
	high	2.028	0.367	201.077 **	-90.128	-24.354	-0.212
		(2.894)	(2.496)	(66.511)	(57.940)	(39.222)	(0.351)
Knowledge intensive production	low	4.536 *	-4.826 *	131.770 **	-68.814	-63.513 °	-0.553
		(1.891)	(2.283)	(43.983)	(53.312)	(36.112)	(0.378)
	high	0.176	7.499 **	218.215 ***	-130.960 *	13.059	0.114
		(1.739)	(2.366)	(39.767)	(54.749)	(39.695)	(0.349)
Health service	low	1.319	-2.490	132.267 **	-71.980	-59.605 °	-0.519
		(1.811)	(2.028)	(41.804)	(47.100)	(32.668)	(0.346)
	high	3.393 °	5.163 *	217.718 ***	-127.793 *	9.150	0.080
		(1.881)	(2.241)	(43.258)	(51.693)	(36.720)	(0.321)

Note: Standard errors in parentheses below coefficients. Significance levels in percent: °<10; *<5; **<1; ***<0.1.

Source: Own calculation

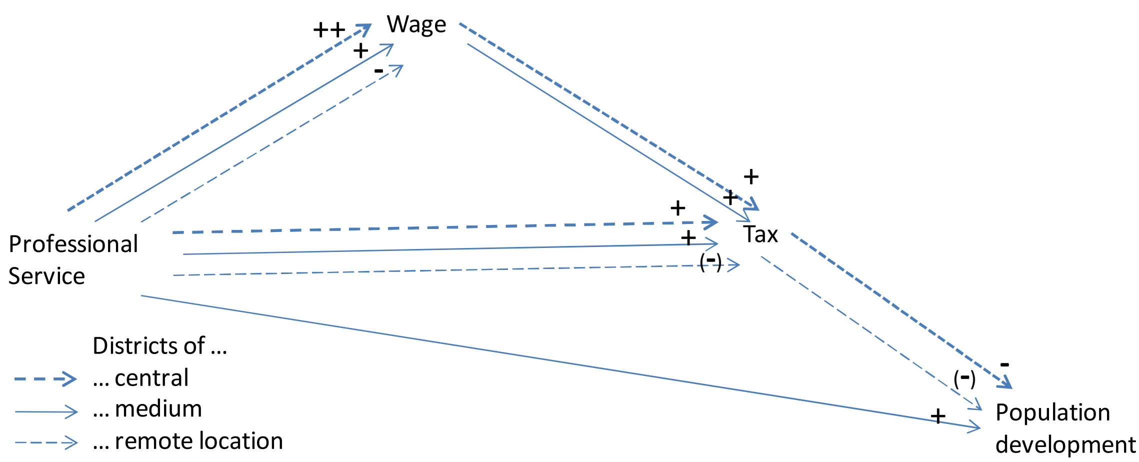
The selected marginal effects with their point specific significances presented in Table 6 show that a high share of employees in professional services go along with a relatively high regional productivity in terms of GDP per inhabitant in central districts if there is a low share of simple, primary and related and knowledge intensive production activity in the same district. Accordingly, in central regions with a high density of economic activity, a relative specialisation in services, specifically in professional services, seems to produce positive localisation effects that are favourable for central regions' productivity. In remote districts with sparse economic activity, on the other side, professional services' complementarity to specific other activities, rather than regional specialisation, seems to support the industry's productivity. According to the second column in Table 6, professional services contribute to regional productivity if they complement knowledge intensive production or health service.

Wages are positively related to a high prevalence of professional service activities in central regions and negatively in remote regions. The observation that there is no positive relation between wages and professional service activities in remote districts independent of the accompanying industries supports the notion of a lack of specialisation in the most profitable activities due to missing urbanisation effects. In conclusion, there seems to be a fundamental heterogeneity in professional service character between central and peripheral regions.

Figure 1 is an alternative representation of selected estimated direct and indirect relations. It shows that professional services' positive relation to wages in central and medium districts translates into an indirect positive relation to local tax revenues as well. This indirect effect is paralleled by a direct effect. The direct tax effect is positive for central and medium districts but it is negative for remote districts under specific conditions. These conditions are identified in Table 6. According to the fifth column professional services relate directly negative to tax revenues in remote districts if they are accompanied by a low share of simple production or a high share of large scale production. Specifically the dependence on simple production underlines the complementarity between the two types of activity.

Figure 1 also illustrates the opposed direct and indirect relation between professional services and population development. The differentiated relations highlight the complex conditional effects that can be revealed by the moderated mediation model. On the one side, the positive relation between professional services and taxes in central districts translates into an indirect negative relation to population development due to a negative relation between tax revenues and population development in central districts (see last column in Table 5)[6]. This negative effect of taxes is explainable if one interprets tax revenues as an indicator of the general income level and the related cost of living.

Figure 1: Relation between professional services, wage level, tax revenues and population development in different types of regions



Source: Own calculation

Nevertheless, in remote districts there is a positive relation between tax revenues and population development. Apparently in remote districts, not the cost of living aspect but

[6] Recall that the marginal effect with *Remote = -1* for central regions and the coefficients from Table 5 is $\delta Population / \delta Tax = 0.000 + 0.005*(-1) = -0.005$

rather the district's relative (public) prosperity is relevant for population dynamics. Due to this reversed relation between tax and population development, the likewise negative relation between professional services and taxes in remote districts translates into an indirect negative effect on population development as in central regions. The important insight is that the observed seemingly consistent estimated gross relations are due to opposed underlying relations. The indirect negative relation between professional services and population development is conditional upon the accompanying industries, just like the direct negative relation to tax revenues that mediated the effect (Table 6).

Figure 1 finally shows that there also exists a direct positive relation between professional services and population development in districts of medium location. This direct effect is not mediated via regional productivity, joblessness, wages, household income or tax revenues. It therefore hints at the relevance of unmeasured social or cultural traits that are related to the industry and to positive population developments. One possible explanation in the case of professional service abundance in medium districts is that these services might go along with alternative income sources and occupational alternatives that attract new citizens or allows old citizens to create their own work place and stay.

4.2 Relation between recreation services and socio-economic fundamentals

Recreation services indicate a strong tourism industry. Tourism is often propagated as a way for remote regions to make the most economically out of their specific advantages especially concerning natural amenities. Recreation services are labour intensive and provide income opportunities for unqualified labour as well as for small and micro-enterprises. Nevertheless, tourism does not support innovative activity and represents a sector under high competitive pressure. Accordingly, there is little established knowledge concerning the actual relevance of tourism and recreation for remote regions.

In central regions, a high relevance of recreation services is negatively related to regional productivity in terms of GDP per inhabitant (not shown) and to wages (Table 7). The lower wages in central regions with a relatively high share of recreation services translate into lower taxes in central regions (column 7 in Table 7). Nevertheless, recreation services are positively related to wages in remote regions, specifically if accompanied by a relatively high share in simple or large scale production, respectively by a relatively low share of primary production and related activities. This can be interpreted as positive synergies between production activities and recreation services which contribute to a higher marginal productivity of labour in recreation services than in regions without strong production activities.

While wages relate negatively to tourism and recreation activities in central regions, joblessness relates negatively to recreation services in central regions as well, indicating a positive socio-economic impact of this sector. It is important to note that this is a direct employment effect that is not mediated by the lower wage level. Accordingly, tourism probably offers low-wage jobs to employees with low qualification which remain unemployed in the knowledge-centered economy of central regions without activities in recreation services. This lower unemployment translates into relatively higher household incomes (column 5 in Table 7) and into more positive population developments (column 11 in Table 7). These employment-related positive socio-economic effects cannot be observed in remote regions. There, other than in central regions, a strong focus in recreation services often implies a lack of occupational alternatives. In many cases, there are low-wage jobs in remote regions, while opportunities for better qualified employees are missing.

Nevertheless, there is a positive direct relation between tourism and recreation services and population development in regions of remote location (column 10 in Table 7). This positive direct relation may be interpreted as a hint on the relevance of natural amenities and other factors positively related to quality of life as well as to tourism for population development specifically in peripheral regions. These “soft factors” attract people especially to regions that offer also qualified and potentially well-paid jobs in large scale and knowledge intensive production (column 10 in Table 7). Accordingly, we observe a positive relation between recreation services and population development in central and remote regions but the underlying causes for this observation are quite different. All in all, tourism and its promoting factors contribute to remote regions' positive socio-economic development, specifically to higher wages and more positive population development, if alternative economic activities, specifically in manufacturing industries are in place. On its own, tourism is not a panacea against remote regions' structural decline.

Table 7: Marginal relations between factor "Recreation services" and selected fundamentals conditional on remoteness and other industry factors with point specific significances

		Wage		Joblessness		Household income		Tax		Population development		Population development	
Interaction	Level	direct		direct		via joblessness		via wages		direct		via joblessness	
with		Central	Remote	Central	Remote	Central	Remote	Central	Remote	Central	Remote	Central	Remote
None		-190.768 ***	78.579 *	-2.468 ***	0.523	53.783 **	-1.776	-40.073 **	10.567	-0.776	1.715 ***	1.140 **	-0.228
		(40.028)	(32.723)	(0.726)	(0.605)	(20.606)	(3.336)	(15.334)	(8.240)	(0.624)	(0.508)	(0.414)	(0.269)
Professional service	low	-217.042 ***	68.750	-2.309 *	0.750	50.314 *	-2.550	-45.593 *	9.245	-0.661	2.483 ***	1.067 *	-0.327
		(55.375)	(46.607)	(1.011)	(0.856)	(25.261)	(4.764)	(18.659)	(8.743)	(0.868)	(0.714)	(0.519)	(0.381)
	high	-164.494 **	88.409	-2.627 *	0.295	57.253 *	-1.003	-34.554 *	11.888	-0.891	0.948	1.214 *	-0.129
		(57.204)	(62.665)	(1.052)	(1.163)	(26.898)	(4.223)	(16.330)	(11.509)	(0.878)	(0.978)	(0.550)	(0.508)
Simple production	low	-132.862 ***	33.604	-1.951 **	0.648	42.509 *	-2.204	-27.909 *	4.519	0.136	1.426 **	0.901 *	-0.283
		(38.571)	(30.798)	(0.701)	(0.568)	(18.495)	(3.789)	(12.059)	(5.102)	(0.592)	(0.490)	(0.376)	(0.256)
	high	-248.674 ***	123.555 **	-2.985 **	0.397	65.058 *	-1.348	-52.238 *	16.614	-1.688 °	2.005 **	1.379 *	-0.173
		(61.636)	(47.162)	(1.131)	(0.874)	(29.370)	(3.578)	(21.144)	(12.658)	(0.949)	(0.717)	(0.599)	(0.383)
Primary and related production	low	-249.764 ***	117.303 *	-2.815 **	1.082	61.353 *	-3.676	-52.466 **	15.774	-0.797	2.360 **	1.301 **	-0.471
		(51.141)	(47.496)	(0.896)	(0.871)	(24.671)	(6.193)	(19.932)	(12.205)	(0.815)	(0.739)	(0.498)	(0.395)
	high	-131.772 *	39.856	-2.121 °	-0.037	46.214 °	0.124	-27.681 °	5.359	-0.754	1.070 *	0.980 °	0.016
		(61.139)	(31.821)	(1.127)	(0.591)	(27.047)	(2.016)	(15.601)	(5.549)	(0.925)	(0.486)	(0.561)	(0.257)
Large scale production	low	-33.491	43.694	-2.036 *	-0.352	44.363 *	1.197	-7.035	5.876	0.259	0.534	0.941 *	0.153
		(47.648)	(44.627)	(0.877)	(0.825)	(22.001)	(3.317)	(10.259)	(7.143)	(0.726)	(0.686)	(0.452)	(0.361)
	high	-348.045 ***	113.464 *	-2.900 **	1.397 °	63.204 *	-4.749	-73.112 **	15.257	-1.811 °	2.896 ***	1.340 *	-0.609
		(58.860)	(46.447)	(1.056)	(0.840)	(27.757)	(7.584)	(26.462)	(11.841)	(0.937)	(0.722)	(0.565)	(0.392)
Trade services and food	low	-158.590 **	65.968	-2.894 **	0.815	63.064 *	-2.769	-33.314 *	8.871	-0.579	1.796 *	1.337 *	-0.355
		(51.225)	(45.452)	(0.939)	(0.843)	(25.663)	(4.999)	(15.147)	(8.460)	(0.783)	(0.700)	(0.519)	(0.376)
	high	-222.946 ***	91.191 *	-2.042 *	0.231	44.503 °	-0.784	-46.833 *	12.262	-0.973	1.634 *	0.944 °	-0.100
		(52.479)	(42.692)	(0.953)	(0.785)	(23.461)	(2.909)	(18.604)	(9.916)	(0.809)	(0.650)	(0.484)	(0.343)
Knowledge intensive production	low	-166.911 ***	83.764 *	-2.138 *	0.347	46.585 *	-1.180	-35.062 *	11.264	0.121	0.874	0.988 *	-0.151
		(48.647)	(41.879)	(0.887)	(0.774)	(22.465)	(3.159)	(15.176)	(9.320)	(0.752)	(0.643)	(0.461)	(0.339)
	high	-214.625 ***	73.395	-2.798 *	0.698	60.982 *	-2.372	-45.085 *	9.869	-1.673 °	2.556 **	1.293 *	-0.304
		(59.961)	(54.866)	(1.102)	(1.017)	(28.302)	(4.927)	(19.152)	(9.838)	(0.931)	(0.836)	(0.579)	(0.449)
Health service	low	-175.737 ***	81.908 *	-1.933 *	0.291	42.130 °	-0.990	-36.916 *	11.014	-0.705	1.594 **	0.893 °	-0.127
		(52.339)	(40.024)	(0.963)	(0.742)	(23.403)	(2.918)	(16.138)	(9.039)	(0.800)	(0.614)	(0.484)	(0.325)
	high	-205.799 ***	75.251 *	-3.003 ***	0.754	65.436 **	-2.562	-43.231 **	10.119	-0.846	1.837 ***	1.387 **	-0.329
		(44.472)	(31.559)	(0.803)	(0.579)	(23.762)	(4.271)	(16.692)	(7.907)	(0.702)	(0.495)	(0.474)	(0.263)

Note: Standard errors in parentheses below coefficients. Significance levels in percent: °<10; *<5; **<1; ***<0.1.

Source: Own calculation

5 Conclusion

The analysis generates conceptual / methodological and factual insights. On the factual level it becomes apparent that the relation between local industry-types and socio-economic fundamentals is conditional on regions' remoteness, respectively centrality, and on the specification of accompanying industries. Accordingly, the type of activities or the productivity of activities within specific industry factors differs depending on the density and diversity of local economic activity. Specifically, the complementarity between different industrial activities and thereby the local industry composition seem to gain importance in remote districts' sparse markets. In agglomerated districts, on the contrary, specialisation in professional services contributes to regional productivity due to positive localisation effects.

Not only are the relations conditional on (respectively moderated by) remoteness and industry composition, the results also show the differentiated direct and indirect (respectively mediated) relations to different socio-economic indicators. The importance of distributional effects is underlined by professional services' relation to wages in remote districts. While professional services here relate positively to GDP per inhabitant if accompanied by knowledge intensive production, they relate negatively to wages under the same conditions. Apparently, under these conditions the majority of jobs is positioned in the low wage segment. Accordingly, while professional services are rather positive for regional productivity in terms of GDP per inhabitant specifically in central regions, they might be judged negatively in terms of income distribution and further socio-economic consequences on tax revenues and population development in remote areas. Quite the contrary holds true for the effect of recreation services in central regions. While recreation services relate negatively to economic fundamentals like GDP and wages in central regions, they relate positively to distributional and social indicators like employment and population development.

On the conceptual level, the results provide different insights as well. Firstly, the different direct relations between tax revenues and population development show that the same variable indicates different phenomena under different conditions. In this case, high tax revenues indicate high public wealth in remote districts and high costs of living in central regions. Secondly, the relation between professional services and population development in remote and central districts show that seemingly consistent gross relations may be caused by fundamentally different underlying mechanisms and relations: The negative gross relation in central districts is due to a positive tax effect of professional services and a negative population development effect of tax revenues, while the negative gross relation in remote areas is due to a (conditional) negative tax effect of professional services and a positive population development effect of tax revenues. Similarly with recreation services: They show a positive relation to population development in central regions due to (mediated by) their positive employment effect; in remote regions, recreation services relate directly to more positive population developments, indicating that the cause is in some common underlying factors like favourable natural amenities. Thirdly, direct and indirect effects are sometimes opposite in direction as for example in the case of the direct and the indirect relation via joblessness between population development and recreation services in central regions. In this case, they would cancel out if only the gross effect was estimated, resulting in insignificant estimators. Nevertheless, the existence of two significant net effects is obviously an important information for example for the design of rational policies.

The important insight that should be gained for future inquiry is that industry structure matters, that it matters in multiple dimensions and that the effects are conditional upon location and multiple dimensions of industry structure. This implies that not only the strategies of empirical inquiry will need to be reconsidered but the theoretical foundation of these inquiries as well. Specifically, the acknowledgement of the different social, economic and cultural dimensions of industry structure and the relevance of distributional effects require careful further developments of theories within the evolutionary economic paradigm.

References

Aiken L. and S. West (1991): Multiple Regression: Testing and Interpreting Interactions. Sage Publications, London.

Backhaus, K., B. Erichson, W. Plinke and R. Weiber (2003): Multivariate Analysemethoden. Eine anwendungsorientierte Einführung. Springer-Verlag, Berlin.

Castellacci, F. (2006): The interactions between national systems and sectoral patterns of innovation. A cross-country analysis of Pavitt's taxonomy. DIME Working Paper 2006.01, Oslo.

Castellacci, F. (2008): Innovation and the Competitiveness of Industries: Comparing the Mainstream and the Evolutionary Approaches. In: Technological Forecasting & Social Change 75: 984-1006.

Dinopoulos, E. and P. Segerstrom (1999): A Schumpeterian model of protection and real wages. In: American Economic Review 89 (3), 450–472.

Dinopoulos, E. (2009): Growth in Open Economies, Schumpeterian Models. In: Reinert K. and R. Rajan (eds): Princeton Encyclopedia of the World Economy, Princeton University Press.

Fagerberg, J. (2000): Technological progress, structural change and productivity growth: a comparative study. In: Structural Change and Economic Dynamics 11: 393 – 411.

Hayes, A.F. (2012): An Analytical Primer and Computational Tool for Observed Variable Moderation, Mediation, and Condition Process Modeling. Working paper, School of Communication, Ohio State University.

Jungmittag, A. (2004): Innovations, technological specialisation and economic growth in the EU. In: International Economics and Economic Policy 1: 247-273.

Jungmittag, A. (2007): Innovationen, Beschäftigungsstruktur und Wachstum der totalen Faktorproduktivität. Eine Data Envelopment und Korrelationsanalyse für die deutschen Bundesländer. In: Jahrbuch für Regionalwissenschaft 27: 143-170.

Krugman, P. (1991): Increasing Returns and Economic Geography. In: The Journal of Political Economy 99 (3): 483-499.

MacKinnon, D.P., C.M. Lockwood, J.M. Hoffman, S.G. West and V. Sheets (2002): A comparison of methods to test mediation and other intervening variable effects. In: Psychological Methods 7 (1): 83-104.

Margarian, A. (2013): Regional industrial structure, productivity, wealth and income distribution in German regions. Thünen Working Paper 1, Thünen-Institute of Rural Studies, Braunschweig.

Marshall, A. (1890): Principles of Economics. Vol. I. London: Macmillan and Co.

Paci, R. and F. Pigliaru (1997): European Regional Growth: Do Sectors Matter? CRENoS Working Paper 199703, Centre for North South Economic Research, University of Cagliari and Sassari, Sardinia.

Pavitt, K. (1984): Sectoral patterns of technical change: towards a taxonomy and a theory. In: Research Policy 13: 343-373.

Porter, M.E. (1998): Clusters and the New Economics of Competition. In: Harvard Business Review 76 (6): 77-90.

Preacher, K.J., D.D. Rucker and A.F. Hayes (2007): Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. In: Multivariate Behavioral Research 42(1): 185-227.

Şener, F. (2001): Schumpeterian unemployment, trade and wages. In: Journal of International Economics 54(1): 119–148.

UCLA: Statistical Consulting Group (2013): How can I analyze multiple mediators in Stata? HTML: http://www.ats.ucla.edu/stat/stata/faq/mulmediation.htm. Last access: 02/20/2013