The impact of creativity on growth in German regions

Wedemeier, Jan

Hamburg Institute of International Economics (HWWI)

2010

The Impact of Creativity on Growth in German Regions

Jan Wedemeier
SUSDIV PAPER 14.2010

APRILE 2010

GLOBAL CHALLENGES Series

Jan Wedemeier, *HWWI*

The Impact of Creativity on Growth in German Regions

Summary

The objective of this paper is to analyze the impact of the creative professions – technological employees and bohemians - on economic growth in Germany's planning regions. It is concluded that technological employees and bohemians foster economic growth. We find that growth is particularly dynamic in agglomerated and urbanized regions. Among regional factors relevant to the location decisions of creative professionals, diversity is analyzed in particular, as it might stimulate growth because of its potential to increase the rate of interchange of different ideas and knowledge. Diversity is therefore a "knowledge production factor". The analysis of both – creative professions and diversity - is related to two current topics in regional economics, namely the knowledge based economy and its effects on city development, and the topic of creative cities.

Keywords: Regional Economic Growth, Creativity, Diversity

JEL Classification: O3, O4, R1, R2

I would like to thank participants of the 7th EURS Conference - especially Peter Nijkamp (VU University Amsterdam, The Netherlands) and Tüzin Baycan Levent (Istanbul Technical University, Turkey) - Katja Wolf (IAB Institute for Employment, Germany) and Wolfram Elsner (University of Bremen, Germany) for helpful comments and support.

Address for correspondence:

Jan Wedemeier
Hamburg Institute of International Economics (HWWI)
Heimhuder Strasse 71
20148 Hamburg
Germany
Phone: +49 0 40 34 05 76 663
Fax: +49 0 40 34 05 76 776
E-mail: wedemeier@hwwi.org

The Impact of Creativity on Growth in German Regions

Jan Wedemeier, HWWI[1]

September 23, 2009

Abstract

The objective of this paper is to analyze the impact of the creative professions - technological employees and bohemians - on economic growth in Germany's planning regions. It is concluded that technological employees and bohemians foster economic growth. We find that growth is particularly dynamic in agglomerated and urbanized regions. Among regional factors relevant to the location decisions of creative professionals, diversity is analyzed in particular, as it might stimulate growth because of its potential to increase the rate of interchange of different ideas and knowledge. Diversity is therefore a "knowledge production factor". The analysis of both - creative professions and diversity - is related to two current topics in regional economics, namely the knowledge based economy and its effects on city development, and the topic of creative cities.

Keywords: regional economic growth, creativity, diversity
JEL-codes: O3, O4, R1, R2

1 Introduction

Empirical analyses have provided significant evidence that especially cities are very successful in developing new ideas, inventions and innovations. Explanations of the technological capability of cities are manifold. Already Glaeser et al. (1992) have discussed how the interaction between economic agents in close proximity helps to stimulate the flow of ideas and knowledge between economic agents. In addition to regional conditions affecting the location decisions of agents, as in the case of regional capital endowments, the presence of cultural industries and the availability of housing, it is argued in the literature that the specialization of firms, or in the opposite the so-called industrial diversity, raises the rate of technological progress through spillovers (Jacobs 1969; Glaeser et al. 1992; Quigley 1998; Duranton and Puga 1999; Audretsch et al. 2008). Also the diverse composition of the labor force is regarded as a factor in the economic growth of cities (Jacobs 1969; Florida 2002). Both Jacobs (1969) and Florida (2002) conclude that cities bring together diverse economic agents, thereby fostering the combination and transmission of ideas as well as the acceleration of growth.

A prerequisite for the generation of innovation and of economic growth is, however, the knowledge endowment of economic agents, i.e. human capital. Lucas (1988) argues that human capital is of crucial importance for economic development, especially of economic agents as

[1] Hamburg Institute of International Economics (HWWI). I would like to thank participants of the 7th EURS Conference - especially Peter Nijkamp (VU University Amsterdam, The Netherlands) and Tüzin Baycan Levent (Istanbul Technical University, Turkey) - Katja Wolf (IAB Institute for Employment, Germany) and Wolfram Elsner (University of Bremen, Germany) for helpful comments and support.

"arts and sciences - the creative professions" (Lucas1988: 38). This argument prominently supports Florida's (2002) assumption about the importance of creative professionals, who are defined as an emerging group of economic agents working in the fields of education, engineering, science and the arts. Florida (2002) argues that the economic success and competitive advantages of both cities and regions is based on these creative professions. They can foster creative processes, ending in innovation.

The motivation of this paper is derived from these assumptions. The applied cross-section model presented in this work provides evidence that the effect of creative professions - measured as the share of engineers, technicians, scientists, computer associated professionals or bohemians in the regional workforce - can explain growth in Germany's planning regions. Using the IAB-Regionalfile data (IABS), it is concluded that the creative professions foster growth. Furthermore, this paper contributes to the debate whether diversity, here measured as the diverse composition of the technological employees and as the diversity of people (cultural-ethnic), has an impact on economic development.

The remaining sections of this paper are organized as follows. In the following section, the theoretical framework of the analysis is outlined. The data is described in the third section, and in the subsequent section presents evidence of growth across Germany's planning regions. In order to accomplish this, a cross sectional model based on data from 1995 and 2004 for all 97 planning regions is applied. Finally, the last section presents the conclusions that can be drawn from this study.

2 Growth and Creativity: Some Stylized Facts

Economic growth depends among other things on the knowledge endowment of economic agents, i.e. human capital. Already Lucas (1988) states that professions such as "arts and sciences - the creative professions." are of extraordinary importance for growth (Lucas 1988: 38).

This supports Florida's (2002) assumption about the importance of creative professionals. However, Florida's (2002) argument regarding the creative professions presents a "new" model of human capital. He measures human capital not only by the educational attainment of economic agents (for example, the share of a population with university degrees).[2] He argues instead that in a broader sense human capital refers to the accumulation of productive capabilities, skills, experiences and knowledge, as embodied in agents. The creative professions are defined as an emerging group of people working in the fields of education, engineering and the arts. Creative professionals are therefore not necessarily a highly educated group of agents per se (Marlet and van Woerkens 2004). However, a fundamental characteristic of the creative professions is that they are marked by capabilities, skills and quality characteristics which foster the structural transformation towards a knowledge-based economy. Although the creative professions concept has only a fuzzy theoretical model (Glaeser 2005; Peck 2005), numerous authors have adopted the concept of creative professions - such as Fritsch and Stützer (2006) in the case of Germany and Hansen (2007) for Sweden - to explain economic growth empirically. These authors consider bohemians, defined as people working in the arts, from audio engineering to design, to writers and visual artists of all kinds, as a central determinant for the attraction of economic agents. Bohemians are also simultaneously an economic factor. Theoretical explanations and empirical evidence on the role of bohemians and their impact on the attraction of economic agents, especially in the creative professions, is also provided by Wojan et al. (2007) for the United States.

[2] For further constructive analysis on Florida's The Rise of the Creative Class see Glaeser (2005).

Jacobs (1969) suggests that professional diversity enhances innovation and growth. This she bases upon the fact that different economic agents provide connections to different knowledge bases. The recombination of existing knowledge is crucial in the generation of new knowledge, and essential in giving impulse to new innovation. Therefore, creativity is embedded in the context of innovation (processes). Location theory also suggests that industrial variety is essential to economic growth, because of the high potential for exchanging ideas and knowledge, and because of the random collisions of economic agents (Jacobs 1969; Quigley 1998; Duranton and Puga 1999; Audretsch et al. 2008). Evidence presented by Glaeser et al. (1992) and Audretsch et al. (2008) supports the argument that industrial diversity, and not the regional clustering of firms of a certain branch alone, contributes to economic development. At the same time, the (Marshallian) argument that the proximity of firms increases innovation is still prominent. The pooling of economic agents in clusters diminishes search and transaction costs. Clusters establish more stable interactions between economic agents and therefore lead to more stable expectations, i.e. they contribute familiarity and thus trust (Elsner 2004). More recent empirical work in economics provides evidence that cultural-ethnic diversity (the diversity of people) has an impact on economic development (Florida 2002; Niehbuhr 2006; Damelang et al. 2007; Bellini et al. 2008; Audretsch et al. 2008).

All these authors conclude that especially cities bring together diverse economic agents, which raises the possibility of creating new knowledge, inventions and innovations. At the same time, diversity has the possible benefit of increasing the variety of goods and services, as well as raising the level of production and consumption (Berliant and Fujita 2007; Bellini et al. 2008). In general, it is further assumed that diversity helps innovation processes by helping them to avoid regional (or cluster) lock-ins, i.e. innovation failure, as diversity provides links to outside economies and other clusters. The topic of diversity is further related to creativity, since diversity provides an open atmosphere, which encourages creativity. It signals "low entry barriers for people [...]" (Florida 2002: 250). Thereby, economic agents can integrate themselves more quickly into markets and society, as institutional crusted structures are permeable. This might be especially relevant in creative and artistic milieus. Finally, in the case of economic crises, it contributes to the reorganization of markets.

Our empirical work seeks to shed light on the topic of creative professions and diversity, both of which are meant to capture the "creative capacity" of regions. The results contribute by partially explaining the impact of creativity on growth in Germany's planning regions, between the years 1995 and 2004.

3 Data and a Descriptive Overview

The economic literature discusses different ways to measure economic development, i.e. growth. We use two measures of economic growth: a first *dependent variable* is the labor force growth from 1995 to 2004; a second *dependent variable* is the gross domestic product (GDP) per labor force growth, from 1995 to 2004. Growth in employment is hypothesized to capture changes in regions' competitive capacity and technology (Glaeser et al. 1992). Meanwhile, growth in the GDP per labor force is assumed to capture changes in regions productivity. Productivity is furthermore a determinant of the regional technological capacity, which is also dependent on the regional stock of knowledge.

In order to measure the number of creative professionals, the "IAB Regionalfile 1975-2004" data is used. It is a representative sample of 2% of all German employees (persons subject to compulsory insurance deductions) and includes 1.3 million employment career histories. It is possible to identify 132 professional groups (by means of a three-digit code). Civil servants, freelancers and the self-employed are not recorded in this employment sample; however, in the year 2000 the sample accounted for approximately 70% of the total labor force in Germany (Bundesagentur für Arbeit 2007). An advantage of this sample is the inclusion of the regional professional composition of the employed persons. Further advantages are the high validity and the up to date nature of the data (Hamann et al. 2004; Drews 2008).

For the purposes of measurement, creative professionals, engineering, technical, scientific and IT professionals have been aggregated into a group of technological employees. Whereas the group of technological employees is characterized as improving "technology in the line of business they pursue, and as a result, productivity and growth" (Murphy et al. 1991). This group is highly creative and innovative. We consider technological employees as a group with knowledge intensive input and output. For our regression analysis, we calculated the growth among technological employees from 1995 to 2004, and also took into account the initial size of technological employees in year 1995, as further *independent variables*.

Furthermore, the second agent group of creative professionals, the bohemians, are integrated in the analysis as an *independent variable.* It is assumed that bohemians are a location factor that increases economic dynamism and the local atmosphere. Bohemians have a signal role "in identifying creative milieus" (Wojan et al. 2007). Bohemians themselves are also, according to the hypothesis, an economic factor. Both growth and the initial amount of bohemians are calculated. For this reason, the "IABS Regionalfile 1975-2004" data sample is used. The IAB-Regionalfile also includes data from social insurance provision for artists and publicists, the so called "Künstlersozialkasse" (Social Welfare Fund for Artists). Therefore, bohemian freelancers are included in the data set.

The IAB employee's data is statistically collected by workplace, and both full-time and part-time employees are included in the data set. Table A.1 in the annex gives a detailed overview of both groups.

Jacobs (1969) suggests that professional diversity might contribute to the overall development of economies. Her argument is that diverse professions bring in diverse knowledge backgrounds into the production process. We will measure the diversity of creative professionals among technological employees by using a Herfindahl-Hirschman-Index: $DIV_{i,t} = 1 - \sum_{k=1}^{K} s_{i,k,t}^2$, where $s_{i,k,t}$ is the share of technological employees with profession *k* in region *i* in year *t*. This index thus takes into account only the diversity among technological employees. As an additional measure of diversity we apply the composition of employees by nationality. Both diversity measures have been captured by the "IABS Regionalfile 1975-2004" data sample. Cultural-ethnic diversity is assumed to be important in the knowledge creation process, since more differentiated knowledge increases the possible combination of knowledge and knowledge networks (Florida 2002).

Besides the creative professionals and the diversity measures as *independent variables*, we consider *independent variables* usually applied in growth regressions, which include the growth of the population from 1995 to 2004. Additionally, the relative size of the total labor force in the service sector in the year 1995 is taken into consideration. It is assumed that the service sector contributes to regional growth, since service businesses tend to bring about more employment than industrial production. The initial gross domestic product (GDP) per labor force in 1995 is further included as a variable for measuring possible productivity catch up effects. GDP, population, labor force and the service sector's labor force data are available through Arbeitskreis

“Volkswirtschaftliche Gesamtrechnung der Länder” (2007). We use patent data for measuring regions’ innovativeness, i.e. as a mechanism for productivity growth (Florida 2002). The patent data are provided by Schmiedl and Niedermeyer (2006) for the time period from 1995 to 2004, and calculated as growth. In general, growth is calculated by: $growth = \log(\frac{A\ in\ 2004}{A\ in\ 1995})$, where A refers to the relevant variables.

The regional level for the empirical analysis are Germany’s 97 planning regions (“Raumordnungsregionen”). These functional regions are defined according to commuter flows. Due to the fact that regions have to be seen complementarily with their surroundings, it is an advantage to take functional planning regions into consideration since regions are not isolated, but are “part of a spatial economic network [...]”(Nijkamp1993: 1) and of their regional surroundings. The applied model takes three different region types into consideration. Hence, we employ dummy variables to control the regional effects on agglomerated, urbanized and rural regions.[3] In the regression analysis, the dummy variable for the rural regions is used as the reference category.

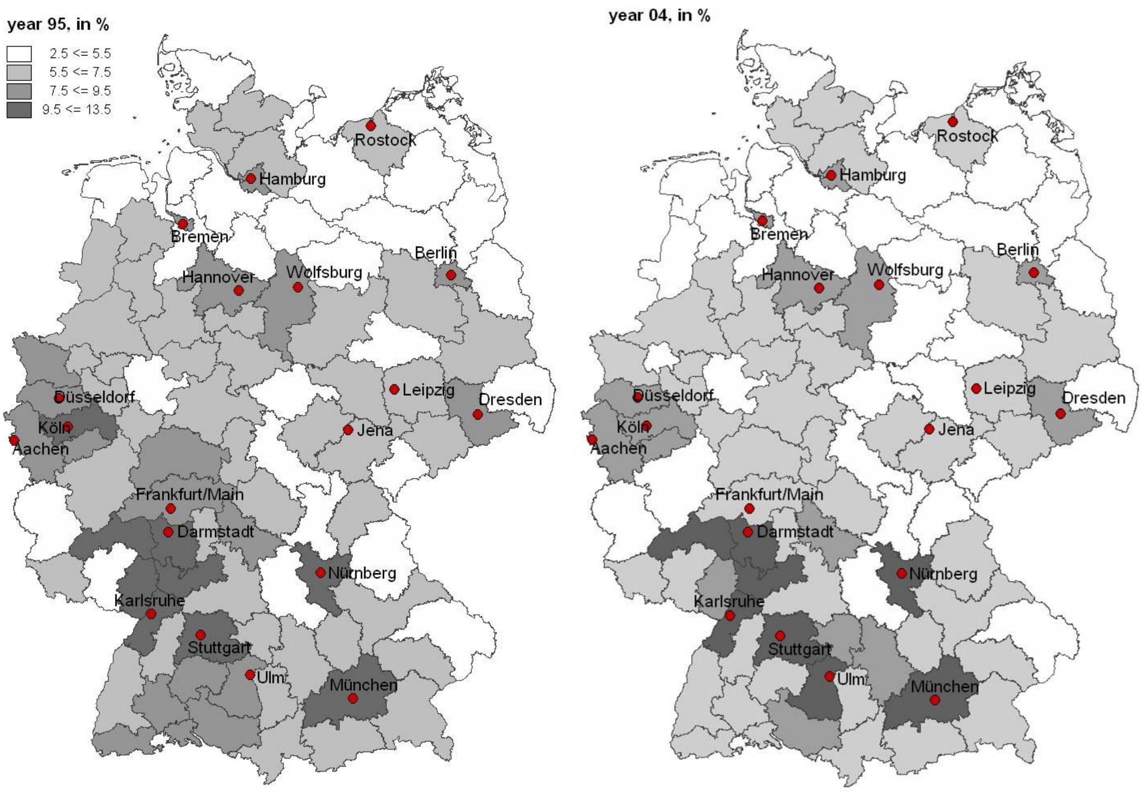
Table A.2 in the appendix presents the summary statistics for the creative professions by region types from year 1995 and 2004. Both in year 1995 and 2004, table A.2 indicates that the highest relative concentrations of technological employees can be found within the agglomerated regions (63.1% in year 1995, and 63.3% in 2004). This is also the case for bohemians. The next maps show the regional distribution of creative professionals.

Figure 1 maps the distribution of the share of technological employees by Germany’s planning regions in 1995 and 2004. According to the results for 1995, the Bavarian planning region for Munich had the highest concentration (12.9%) and the East German rural planning region of Altmark the lowest (3.7%). In 2004, the planning region Munich led with a share of 13.5%, whereas the planning region Altmark in northern Saxony-Anhalt retained the lowest concentration of technological employees (3.0%) of all 95 planning regions.

Both in 1995 and 2004 the surroundings of the agglomerated planning regions of Stuttgart (11.6% and 12.3%), Karlsruhe (10.2% and 10.2%) and Nuremberg (11.0% and 10.9%) exhibited high shares of technological employees, that can be explained through the regional concentration of automotive and other industries around Stuttgart and Nuremberg. But also other agglomerated areas like Frankfurt on the Main (10.7% and 9.8%), the city of Hamburg (9.1% and 9.2%) and the north-western city of Bremen (9.1% and 8.7%) had high employment rates of technological employees in 1995 and 2004. In general, we can see a tendency of technological employee concentration in the south of Germany and a slightly decreasing share of technological employees in the north-east and north-west of Germany.

[3] For further details see also Federal Office for Building and Regional Planning, http://www.bbr.bund.de.

Figure 1: Shares of technological employees in German regions

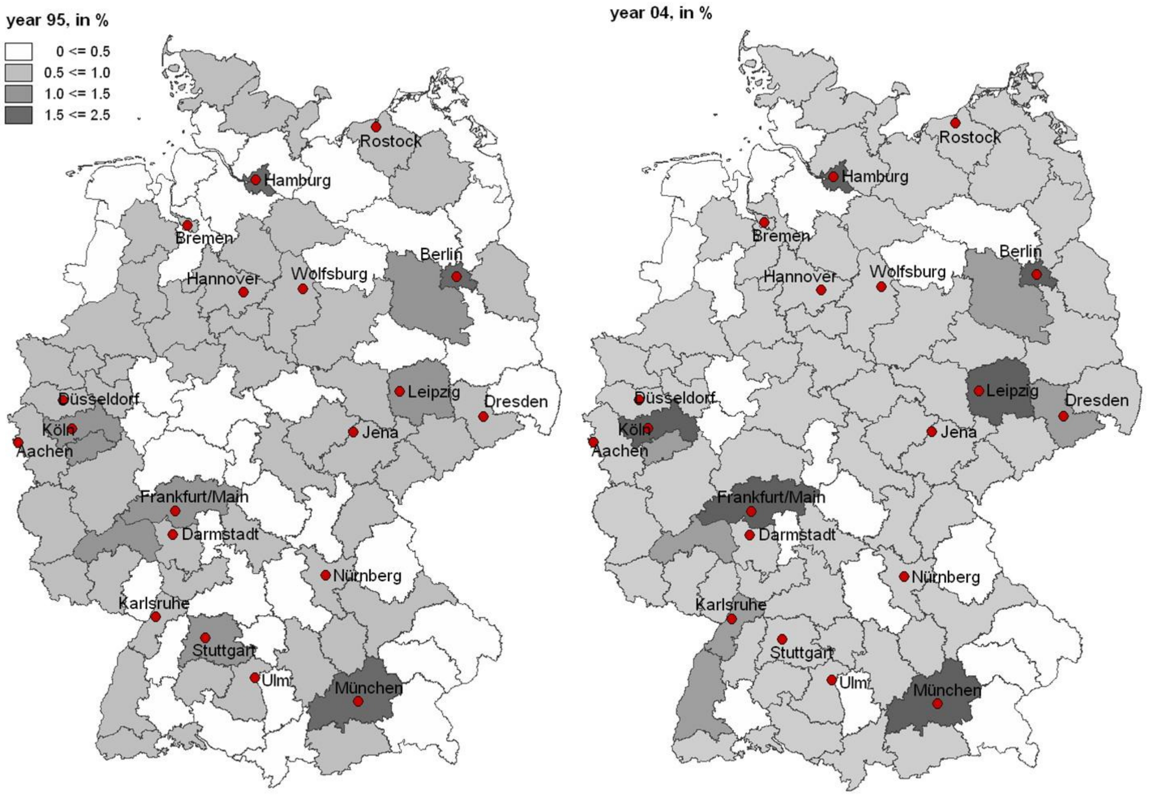


Source: IABS Regionalfile 1975-2004, own calculations.

Figure 2 shows the spatial distribution of bohemians in Germany. The three biggest German cities of Hamburg (2.1%), Munich (2.0%) and Berlin (1.7%), had the highest shares of bohemians in 1995, but by 2004 Hamburg (2.1%) had lost its relatively dominant position, as the share of bohemians had grown in Munich (2.1%) and Berlin (2.0%). In 2004, the Saxon city of Leipzig had the fourth highest share of bohemians (1.7%), followed by Frankfurt (1.6%). In 1995, seven regions had between 1% and 1.5% shares of bohemians. Three regions had more than 1.5%. In year 2004, six regions had between a 1% and 1.5% share of bohemians, whereas six regions had above a 1.5% share of bohemians. In general, between year 1995 and 2004 the shares of bohemians have increased, especially within the biggest agglomerations.

To sum up, the highest concentration of creative professionals can be found in the south of Germany. The next step is to investigate the interaction between growth and the share of technological employees, bohemians and diversity. These explaining factors are meant to capture the "creative capacity" of a region.

Figure 2: Shares of bohemians in German regions



Source: IABS Regionalfile 1975-2004, own calculations.

4 Some Empirical Evidence

This section of the paper presents the regression results, which illustrate whether technological employees and bohemians are contributing to growth in German planning regions. Table 1 shows the statistical summary, including means and standard deviations of the variables.

The cross-section analysis investigates whether these factors have any positive growth effect on the labor force and the GDP per labor force, for the subject time period. According to that, the basic model for the growth of labor force is:

$$\Delta N_i = \beta_0 + \beta_1 BOH_i + \beta_2 \Delta BOH_i + \beta_3 TE_i + \beta_4 \Delta TE_i + \beta_5 DIVTE_i + \beta_6 DIV_i + \beta_7 SERV_i + \beta_8 \Delta POP_i + \beta_9 AGGL_i + \beta_{10} URBAN_i + \varepsilon_i \quad (1)$$

where ΔN_i is the logarithmic growth of the labor force from 1995 to 2004 in region *i*. BOH_i is the share of bohemians in 1995, and ΔBOH_i is the logarithmic growth of bohemians from 1995 to 2004. TE_i is the share of technological employees in region *i* in 1995. ΔTE_i is the growth of technological employees from 1995 to 2004, while $DIVTE_i$ is the diversity measure for technological employees in region *i* in year 1995, and DIV_i is the diversity of employees by nationality in 1995. We control for the share of the service sector in 1995 with the variable $SERV_i$. ΔPOP_i is the logarithmic growth of population in region *i* from 1995 to 2004. Dummies for agglomerated and urbanized planning regions are integrated as $AGGL_i$ and $URBAN_i$. The error term is ε_i. The second basic regression model is:

$$\Delta GDPN_i = \beta_0 + \beta_1 BOH_i + \beta_2 \Delta BOH_i + \beta_3 TE_i + \beta_4 \Delta TE_i + \beta_5 DIVTE_i + \beta_6 DIV_i + \beta_7 SERV_i + \beta_8 \Delta N_i + \beta_9 \Delta PAT_i + \beta_{10} GDPN_i + \beta_{11} AGGL_i + \beta_{12} URBAN + \varepsilon_i \quad (2)$$

where $\Delta GDPN_i$ is the growth in the GDP per labor force (in 1,000 Euro, at current prices) between 1995 and 2004. ΔPAT_i is the logarithmic growth of patents in region *i*. $GDPN_i$ is the initial log GDP per labor force in 1995. The other variables are given by equation (1). The estimation of the coefficients in the model was completed using the method of ordinary least squares (OLS), checked for specification, multicollinearity, distribution of residuals, variance (i.e. homoscedastic) and outliers.[4] Table 2 reports the results for the two basic models, and further results for two derived models (3, 4).

Table 1: Variable means and standard deviations

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
Log(labor force in 2004/labor force in 1995)	0.021	0.069	-0.179	0.143	97
Log(GDP per labor force in 2004/GDP per labor force in 1995)	0.162	0.086	-0.006	0.365	97
Share of bohemians in 1995	0.007	0.003	0.001	0.021	97
Log(bohemians in 2004/bohemians in 1995)	0.253	0.295	-0.375	1.446	97
Share of technological empl. in 1995	0.067	0.019	0.037	0.129	97
Log(technological employees in 2004/technological. employees in 1995)	0.077	0.17	-0.424	0.425	97
Diversity of techn. empl. in 1995	0.102	0.013	0.084	0.141	97
Diversity of people in 1995	0.122	0.082	0.005	0.32	97
Share of service sector in 1995	0.631	0.083	0.485	1.146	97
Log(population in 2004/population in 1995)	0.01	0.048	-0.114	0.091	97
Log(patents in 2004/patents in 1995)	0.398	0.291	-0.234	1.361	97
Log(GDP per labor force in 1995)	3.822	0.182	3.471	4.458	97
Dummy Agglomerated	0.309	0.465	0	1	97
Dummy Urbanized	0.433	0.498	0	1	97

Source: IABS Regionalfile 1975-2004, own calculations.

First of all, as reflected in the adjusted R-squared (R^2), the overall fit of the estimations are quite good for the two basic models and the derived models (82.3%, 76.1%, 65.6% and 63.5%). The estimated results indicate that the amount of technological employees and bohemians do matter for growth, especially in correlation with the *dependent variable* labor force growth (ΔN_i). With the exception of the initial share of bohemians, the coefficients tend to have the ex-

[4] We use Intercooled STATA 9.2 to produce the regression results.

pected signs. In equation (1), the coefficients of ΔBOH_i and ΔTE_i are significant, while in the regression with the dependent variable GDP per labor force ($\Delta GDPN_i$) the initial share of technological employees is highly significant.

Table 2: Estimation results

	ΔN (1)	ΔN (3)	$\Delta GDPN$ (2)	$\Delta GDPN$ (4)
BOH	-1.127 (1.372)	...	-1.209 (2.411)	...
ΔBOH	0.026** (0.012)	...	0.019 (0.023)	...
TE	0.305 (0.301)	...	1.524*** (0.540)	...
ΔTE	0.156*** (0.026)	...	0.052 (0.058)	...
DIVTE	-0.482 (0.295)	-0.225504	1.157** (0.528)	1.093** (0.539)
DIV	0.006 (0.064)	0.143** (0.059)	0.132 (0.134)	0.294** (0.123)
SERV	0.082* (0.045)	0.045 (0.049)	0.032 (0.102)	-0.041 (0.089)
ΔPOP	0.597*** (0.095)	0.920*** (0.093)	...	...
ΔN	...	...	-0.363** (0.158)	-0.324** (0.126)
ΔPAT	...	...	0.072*** (0.020)	0.083*** (0.020)
GDPN	...	...	-0.304*** (0.076)	-0.253*** (0.071)
AGGL	0.029** (0.011)	0.025** (0.011)	-0.00066	-0.007 (0.017)
URBAN	0.019** (0.008)	0.022** (0.009)	-0.023 (0.014)	-0.011 (0.014)
Constant	-0.037 (0.051)	0.014 (0.056)	1.068*** (0.262)	0.987*** (0.256)
N	97	97	97	97
R^2	0.841	0.699	0.761	0.665
Adj. R^2	0.823	0.656	0.745	0.635
F-stat.	F(10, 86)=45.53	F(12, 84)=16.24	F(6, 90)=47.67	F(8, 88)=21.85

LEGEND: *** p<0.001; ** p<0.05; * p<0.010.

NOTE: Standard errors are in parentheses.

Source: IABS Regionalfile 1975-2004, own calculations.

In the derived model of equation (1), the coefficient of $DIVTE_i$ (the diversity among technological employees) is not significant. The hypothesis that the diversity of technological employees does matter for labor force growth cannot be confirmed. The findings suggest rather that a relative concentration of professions contributes to labor force growth. Conversely, $DIVTE_i$ is positively correlated with the GDP per labor force growth, in equation (2) and (4). That effect is statistically significant. This result suggests that the diversity of technological employees is linked to GDP per labor force growth, i.e. productivity. The variable DIV_i is positively correlated with growth. The effect is also statistically significant on a relatively high level in equations (3) and (4). These results confirm that the diversity of employees by nationality (DIV_i) is an economic factor.

The variable ΔPOP_i has in model (1) and in its derived model (3) an effect on the OLS model. The coefficients are significant and the hypothesized direction is, as expected, positive. The initial level of the service sector, variable $SERV_i$, is positive in model (1) and significant at the 10% level. The variable ΔPAT_i is positive as expected and highly significant. In equations

(2) and (4), the regression results for the variables ΔN_i and $GDPN_i$ are negative, as expected. Both are significant at the 1% level. We have used dummy variables for agglomerated and urbanized regions. As reference category we use the rural regions. In model (1) and (3) both agglomerated and urbanized dummies are significant, and the observable effect is positive as expected. Meanwhile in equations (2) and (4) the observable effect is negative, and in model (2) the dummy variable for agglomerated regions is significant at the 10% level.

The estimation results with standardized beta coefficients documented in table A.3 (see appendix) suggest that the effects coming from creative professionals is quite large. In equation (1), the standardized beta coefficients indicate that labor force growth is most highly correlated with the growth in the population (0.417), followed by the growth of technological employees (0.388). Also the effect coming from agglomerated regions is quite high (0.195). In equation (2), gross domestic product (GDP) per labor force growth is most highly correlated with the initial level in technological employees (0.340), which indicates that productivity growth depends highly on the creative professional group.

Based upon this analysis, we can conclude that labor force growth is highly correlated with creative professionals. Further, we have shown that GDP per labor force depends on the level of creative professionals, i.e. that of technological employees. If we estimate the equations (1) and (2) without including creative professionals, we get the expected correlation between the diversity of people and the two dependent variables. In theory, the estimates suggest that diversity among people contributes to economic development.

5 Conclusion

The overall results of this paper indicate that technological employees and bohemians contribute to growth. Insofar, our results confirm Florida's (2002) theory that a high level of bohemians and technological employees foster economic development: the economic success and competitive advantage of cities, and regions, relies on their creative capacity, since creativity is embedded in innovation processes. However, despite the fuzzy definition of creative professions, the group of technological professions and bohemians reflect the best possible effort to measure creativity in cities and regions. The concept of technological professions and bohemians used here fits into the theory that creative professions are an essential ingredient of economic growth.

The results presented also allow some tentative conclusions regarding professional diversity, i.e. the diversity of technological employees. Although the findings indicate that the diversity among technological employees does not contribute to labor force growth, it gives us weak evidence to conclude that a critical mass (pool) of labor is necessary for regions' and cities' development. But, since we measured the diversity of the group of technological professions, a broader definition might lead to other results. If the diversity of technological employees is an important factor for stimulating GDP per labor force growth, it can be clearly answered with yes. We have also shown that the diversity of people, i.e. cultural-ethnic diversity, is correlated with the logarithmic growth of labor force and GDP per labor force. For the two derived models (3) and (4), the results correspond to our assumption that diversity plays a crucial role in the (knowledge) production process.

We have also demonstrated that labor force growth occurs relatively more often in agglomerated and urban areas, than in rural regions. This corresponds to the fact that especially cities are vibrant economic places. If the dependent variable is GDP per labor force, the observable effect is negative. This result indicates a convergence process, although there is little evidence of such.

We can not within the framework of this paper empirically address the variables processes, the causality. However, the presented results do allow the conclusion that creativity has an impact on growth. Although there can be no a “one-size-fits-all-regions-approach” to increasing the number of creative professionals in an area, it is generally important for cities, and regions, to attract human capital, particularly if the presence of such professionals has been lacking.

References

Arbeitskreis "Volkswirtschaftliche Gesamtrechnungen der Länder" (2007). Bruttoinlandsprodukt, Bruttowertschöpfung in den kreisfreien Städten und Landkreisen Deutschlands 1992 und 1994 bis 2006, Reihe 2, Band 1, Frankfurt/Main.

Audretsch, D. B., Dohse, D. and Niebuhr, A. (2008). Cultural diversity and entrepreneurship: a regional analysis for Germany, *Centre for Economic Policy Research Discussion Paper 6945*.

Bellini, E., Ottaviano, G. I., Pinelli, D. and Prarolo, G. (2008). Cultural Diversity and Economic Performance: Evidence from European Regions, *HWWI Research Papers 3-14*.

Berliant, M. and Fujita, M. (2007). Knowledge creation as a square dance on the Hilbert cube, *MPRA Paper 2884*.

Bundesagentur für Arbeit (2007). Sozialversicherungspflichtige Beschäftigung und Erwerbstätigkeit: Entwicklung und Struktur 2000-2007, Nürnberg.

Damelang, A., Steinhardt, M. and Stiller, S. (2007). Europe's diverse labour force: The case of German cities, *EURODIV PAPER 49*.

Drews, N. (2008). Das Regional_le der IAB-Besch□aftigtenstichprobe 1975-2004: Handbuchversion 1.0.0, *FDZ Datenreport* **02**: 1-87.

Duranton, G. and Puga, D. (1999). Diversity and specialisation in cities: Why, where and when does it matter?, *Centre for Economic Policy Research Discussion Paper 2256*.

Elsner, W. (2004). The 'new' economy: complexity, coordination and a hybrid governance approach, *International Journal of Social Economics* **31**(11/12): 1029-1049.

Florida, R. (2002). *The rise of the creative class and how it's transforming work, leisure, community, and everyday life*, Basic Books, New York.

Fritsch, M. and Stützer, M. (2006). Die Geografie der kreativen Klasse in Deutschland, *Freiberger Arbeitspapiere 11*.

Glaeser, E. L. (2005). Review of Richard Florida's the rise of the creative class, *Regional Science and Urban Economics* **35**(5): 593-596.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A. and Shleifer, A. (1992). Growth in cities, *The Journal of Political Economy* **100**(6): 1126-1152.

Hamann, S., Krug, G., Köhler, M., Ludwig-Mayerhofer, W. and Hacket, A. (2004). *Die IAB-Regionalstichprobe 1975-2001: IABS-R01*, 55, Zentralarchiv für Empirische Sozialforschung Universität zu Köln, ZA-Information, Köln.

Hansen, H. K. (2007). Technology, Talent and Tolerance: The Geography of the Creative Class in Sweden, Department of Social and Economic Geography, Lund University, *Rapporter och Notitser 169*.

Jacobs, J. (1969). *The Economy of Cities*, 1 edn, Random House, New York.

Lucas, R. E. (1988). On the mechanics of economic development*, Journal of Monetary Economics* **22**: 3-42.

Marlet, G. and van Woerkens, C. (2004). Skills and Creativity in a Crosssection of Dutch Cities, *Discussion Paper Series Utrecht School of Economics and Tjalling C. Koopmans Research Institute 4-29*.

Murphy, K. M., Shleifer, A. and Vishny, R. W. (1991). The allocation of talent: Implications for growth, *Quarterly Journal of Economics* **106**: 503-530.

Niebuhr, A. (2006). Migration and innovation: Does cultural diversity matter for regional R&D activity?, *HWWI Research Paper 3-1*.

Nijkamp, P., van Oirschot, G. and Oosterman, A. (1993). Regional Development and Engineering Creativity: an International Comparision of Science Parks in a Knowledge Society, *Vrije Universiteit Amsterdam, Research Memorandum* **70**: 1-32.

Peck, J. (2005). Struggling with the creative class, *International Journal of Urban and Regional Research* **29**(4): 740-770.

Quigley, J. M. (1998). Urban diversity and economic growth, *Journal of Economic Perspectives* **12**(2): 127-138.

Schmiedl, D. and Niedermeyer, G. (2006). Regionaldaten der Erfinndungstätigkeit: Deutschland 2000- 2005, Deutsches Patent- und Markenamt, München.

Wojan, T. R., Lambert, D. M. and McGranahan, D. A. (2007). Emoting with their feet: Bohemian attraction to creative milieu*, Journal of Economic Geography* **7**: 711-736.

Appendix

Table A.1: Technological employees and bohemians

Technological employees	Label
Mechanical and vehicle engineers.	63
Electrical engineers.	64
Architects and construction engineers.	65
Surveyors, mining, metallurgists and related engineers.	66
Miscellaneous engineers.	67
Chemists, physicists, chemical/physical engineers, mathematicians, and civil engineering technicians.	68
Mechanical engineering technicians.	69
Electrical engineers technicians.	70
Surveyors, chemical, physical, mining, metallurgists, and miscellaneous engineering technicians.	71
Miscellaneous technicians.	72
Biological/mathematical/physical-technical assistant, chemical and related laboratory technician workers.	74
Draft persons.	75
Computer related professions.	99
Statisticians, humanists, natural scientists, and pastors.	120
Bohemians	
Journalists, publishers, librarians, archivists, museum specialists.	107
Musicians, performing artists, performers, graphic artists, designers, decorators, sign painters, stage, image and audio engineers, photographers, artists, and professional athletes.	108

Source: IABS Regionalfile 1975-2004.

Table A.2: Description of the data

Region Type	Others	Techn.*	Boh.**	Total***
	year 1995			
Agglomerated (n=30)	299,635	30,068	3,693	333,396
	89.87	9.02	1.11	100
	52.98	63.05	67.59	53.89
Urbanized. (n=42)	192,529	13,631	1,343	206,503
	92,75	6.6	0.65	100
	33.87	28.58	24.58	33.38
Rural (n=25)	74,349	3,989	428	78,766
	94.39	5.06	0.54	100
	13.15	8.36	7.83	12.73
Total (n=97)	570,977	47,688	5,464	618,665
	91.41	7.71	0.88	100
	100	100	100	100
	year 2004			
Agglomerated. (n=30)	339,324	33,310	4,523	318,824
	89.97	8.83	1.2	100
	53.32	63.28	66.89	54.2
Urbanized. (n=42)	217,197	15,080	1,728	234,005
	92.82	6.44	0.74	100
	34.13	28.65	25.55	33.63
Rural (n=25)	79,894	4,251	511	84,656
	94.37	5.02	0.6	100
	12.55	8.08	7.56	12.17
Total (n=97)	636,415	52,641	6,762	695,818
	91,46	7.57	0.97	100
	100	100	100	100
	Growth, 1995 to 2004****			
Agglomerated (n=30)	5.4	4.4	8.8	-1.9
Urbanized (n=42)	5.2	4.4	10.9	5.4
Rural (n=25)	3.1	2.8	7.7	3
Total (n=97)	4.7	4.3	9.3	5.1

Key
frequency
row percentage
col. percentage

*Technological employees. **Bohemians. *** Total numbers of professional groups.
***Growth is log(A in year 2004/A in year 1995).
Source: IABS Regionalfile 1975-2004, own calculations.

Table A.3: Estimation results, standardized coefficients (beta)

	ΔN	ΔN	$\Delta GDPN$	$\Delta GDPN$
	(1)	(3)	(2)	(4)
BOH	-0.057 (1.372)	...	-0.048 (2.411)	...
ΔBOH	0.110** (0.012)	...	0.066 (0.023)	...
TE	0.086 (0.301)	...	0.340*** (0.540)	...
ΔTE	0.388*** (0.026)	...	0.103 (0.058)	...
DIVTE	-0.094 (0.295)	-0.043848	0.179** (0.528)	0.169** (0.539)
DIV	0.008 (0.064)	0.172** (0.059)	0.126 (0.134)	0.280** (0.123)
SERV	0.099* (0.045)	0.055 (0.049)	0.031 (0.102)	-0.040 (0.089)
ΔPOP	0.417*** (0.095)	0.642*** (0.093)	...	...
ΔN	...	...	-0.289** (0.158)	-0.257** (0.126)
ΔPAT	...	...	0.242*** (0.020)	0.279*** (0.020)
GDPN	...	...	-0.644*** (0.076)	-0.534*** (0.071)
AGGL	0.195** (0.011)	0.171** (0.011)	-0.00358	-0.037 (0.017)
URBAN	0.141** (0.008)	0.161** (0.009)	-0.135 (0.014)	-0.065 (0.014)
Constant	...	...	...	...
N	97	97	97	97
R^2	0.841	0.699	0.761	0.665
Adj. R^2	0.823	0.656	0.745	0.635
F-stat.	F(10, 86)=45.53	F(12, 84)=16.24	F(6, 90)=47.67	F(8, 88)=21.85

LEGEND: *** p<0.001; ** p<0.05; * p<0.010.

NOTE: Standard errors are in parentheses.

Source: IABS Regionalfile 1975-2004, own calculations.