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Demographic change and innovation: The ongoing challenge from the diversity of the labor force**

The demographic change influences the composition of the labor force in terms of a decreasing number of the workforce, its age structure, the quantitative relationship between men and women such as the proportion between people with migration background and native citizens. The new diversity of the workforce has consequences for the innovativeness of social groups, organization and regions. This literature review shows the state of research on the impact of diversity caused by the demographic change on innovation, captured on corporate and regional level, this means the relationship between diversity and innovation variables is examined in a micro-economic and a macro-economic approach. The aim is to summarize and to highlight utilizable insights as well as to identify research gaps. The results indicate the need to link the theoretical approaches, methods and results from the discussed research fields better and to develop new concepts build on this.

Key words: **demographic change, organizational demography, group research, diversity, labor diversity, innovation, corporate innovativeness, regional innovativeness**
(JEL: J11, J21, O31, R11, R12, R15)

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1. Demographic change: A cause for increasing organizational diversity and a challenge for regional innovation capacity

The demographic change is altering the composition of Germany's population which affects many social, political and economic systems. The demographic transition and the following demographic change are discussed in science since the 1940s. The public and the research interest in demographic issues have grown steadily and the science in 2013 was characterized by research on the topic of demographic change as clearly as never. The Year of Science of the German Ministry of Education and Research (BMBF) run under the motto "The demographic opportunity". In this sense the funding of research and development (R&D) within the program "Working – Learning – Developing Competencies. Innovation in a Modern Working Environment" is conceived to discover knowledge about the risks and potentials of demographic changes for the German economy. On May the 16th and 17th in 2013 the conference on "Innovativeness during Demographic Change" of the BMBF took place in Berlin. In this context, two things have been emphasized again: first, that because of its extensive effects the research on the consequences of demographic change have to have a high priority. Secondly, that specifically the impact of the demographic change on the innovativeness of German organizations has to be a major focus to keep a competitive position in Europe and in the world economy.

The demographic change is the fifth stage of a demographic transition, which is caused by industrialization processes and the emergence of post-industrial society (Friedrich & Schlömer, 2013). It is characterized by a negative population balance given a parallel increase of life expectancy (Tivig & Kühntopf, 2009; Friedrich & Schlömer, 2013) and is composed of a plurality of sub-dynamics that proceed at different speeds and with different socio-economic impacts. In general, the multiple consequences are summarized as population aging, population decline and an increasing population diversity (Friedrich & Schlömer, 2013). Those consequences are influenced by moderating variables such as the current age structure, the amount of inward and outward migration (Tivig & Kühntopf, 2009) and far-reaching social developments (Friedrich & Schlömer, 2013). The demographic impact of the political division and reunification of Germany, for example, still superimposes today's natural population movements[1] (Friedrich & Schlömer, 2013).

The aging is evident in shifts in the age structure of the population. 2060 one in three people will be older than 65, and every seventh person will be 80 years or older. This is a consequence of the baby-boom generation which is followed by a transition to low birth rates (Statistisches Bundesamt, 2009). Referring to the population decline there is – despite the registration of population growth in some German regions, due to positive natural population movements and/or migration gains – a significant de-

[1] As natural population movement it is referred to as the change in population size and composition because of births and deaths. The difference between live births and deaths of one year in the balance leads either to an excess of live births or deaths, which is also known as a natural balance and is included as balance of live births and deaths in the population balance. For more information see also: http://www.bib-demografie.de.

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crease in population assumed for the entire population in the long term. The Federal Statistical Office calculates in advance a population between 65 and 70 million in 2060 (Statistisches Bundesamt, 2009). Most affected are the New Federal States whose population development is negative since 1989 (Statistisches Bundesamt (Destatis), 2013). This means that German companies have to deal with the requirements of older workforces and an increasing competition for the declining number of available professionals. In case of the increasing heterogeneity of the population the diversity of cultural backgrounds is going to rise in two ways. On the one hand, the share of immigrants and their descendants of the total population is rising[2]. On the other hand, the range of countries of origin of the immigrants is growing compared to the 1960s and 1970s, in which most immigrants came as guest workers from southern Europe and Turkey. Since the 1980s, an increasing number of migrants from third countries of the European Union has been reported and the emigrants from Poland, Romania and the former Soviet Union contribute to the increasing diversity of countries of origin (Friedrich & Schlömer, 2013, p. 53).

As a result of these developments the structure of the workforce is changing significantly. Opportunities to mitigate the looming shortage of skilled workers are provided by different social, political and economic measures. For example, to be mentioned here are the activation of previously unused reserves of the workforce such as unemployed, underemployed in part-time, underemployed in full-time as well as the hidden reserves of persons outside the labor force[3]; the integration of the approach of lifelong learning into everyday work to keep especially older workers in profession or to reduce the potential for conflicts in age divers work teams; and the increasing opening of the labor markets in the context of the European integration (Tivig & Kühntopf, 2009). Ramifications are, among other things, that the age structure, the quantitative relationship between men and women and the share of people with migration background in the working population are subjected to the variances of the population development and are an expression of the simultaneously increasing diversity of the labor force.

Organizations depend on different critical resources such as the availability of a qualified labor force. This dependence may lead to the need that organizations have to adapt their strategic behavior to the availability of these resources. As just discussed the potential labor force is subject to regional demographic changes and so organizations also need to adjust their human resource management to the changing conditions to reduce the associated uncertainty (Pfeffer & Salancik, 2003). This means that they include the availability of a skilled labor pool in their location decisions (Tivig & Kühntopf, 2009). Based on the explanations above a progressing regional diversity of

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2 Immigrants and people with immigrant background refer to all immigrants who immigrated after 1949 in the present territory of the Federal Republic of Germany, as well as all foreigners born in Germany and all German-born in Germany with at least one parent who is an immigrant or born as a foreigner in Germany (Statistisches Bundesamt, 2013).

3 The labor supply (potential labor force) consists of the employed, the unemployed and the so-called hidden reserve. For more information about each group see also: https://statistik.arbeitsagentur.de.

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the available human capital in terms of social aspects as diverse educational background, professional experience and work culture is expected. Following Wydra (2009) it is to assume that this affects the ability of companies to innovate and to implement innovations. Moreover, the number of innovation-based start-ups may be subject to demographic influences (Wydra, 2009).

Therefor the global pressure on companies to remain competitive through constant innovative behavior (Dreu et al., 2006) is transferred on the regional level. Regions represent the spatial units which – in addition to providing an attractive labor pool- create the legal, political and economic conditions as well as the network of regional actors such as universities, agencies for economic development and local companies, which turn a region into a successful Regional Innovation System (RIS) and thus make it an attractive location competing for innovative companies (Cooke, 2001). Due to aging and migration an imbalance between regions arises, which is characterized by regions in which the working population is numerically increasing and is younger on average and regions where the aging of the population is increasing rapidly and which have to mourn the loss of young workers and simultaneously the rise of the number of people, which are no longer active in the labor market. This connection is supported by Poot (2008), who argues that the effect of migration and aging on the regional competitiveness is rising as the observed spatial scale becomes smaller. The explanation for this phenomenon is that structural changes of the population (size, density, growth and composition) which unfold only long-term effects on the national level, run much faster in smaller spatial units and thus have much greater impacts on regional economy (Poot, 2008). Germany's international competitiveness is intensely dependent on the innovative capabilities of these, so the study of the interrelationships between demographic changes and the regional innovation capacity is highly relevant. However, it should be mentioned that the insight of the importance of this topic has not yet found its way in a large part of the German companies or that dealing with the increasing diversity is deliberately excluded (Ortlieb & Sieben, 2013, 2014).

In this setting the joint research project Innografie[4] aims to examine the influence of demographic changes on the innovation capacity on the three different levels of workforce, organization and region. In addition the particular results are integrated in an analytical tool for the measurement of innovation potentials of organizations with special attention to demographic changes. It is publicly funded by the BMBF and the European Social Fund of the European Union (ESF) between 2012 and 2015.

Based on the objective of the collaborative project described above, this literature review has the function to show the state of research on the impact of diversity caused by the demographic change on innovation, captured on corporate and regional level, to summarize and to highlight utilizable insights as well as to formulate open research questions. The relationship between diversity and innovation variables can be examined in relation to various dimensions. One way to categorize the research on this issue provides the distinction between a micro-economic and a macro-economic ap-

4 It is a collaborative project of the University of Hamburg, the Helmut Schmidt University/University of the Federal Armed Forces Hamburg and the University of Flensburg. For further information see: www.innografie.de.

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proach. Here both perspectives will be outlined and its main results are shown. The choice of this method is based on the fact that both perspectives are of relevance for the different levels of investigations considered within the research project. In this context, it is of particular interest to elaborate how much the two mentioned investigation levels are intertwined and an exchange of research results takes place, which generates new impulses by the terms of various perspectives. It is assumed that currently an insufficient exchange and networking between the research paths will be revealed.

Diversity and innovation became very popular buzzwords in science and politics in recent years, which is why they have often become blurred and inflationary in their use. Both terms are very complex phenomena. This literature review is not intended to its comprehensive theoretical and conceptual disambiguation. However, it should be briefly outlined that the microeconomic perspective, on which the first major section is based on, is supposed to shed a light on the analysis of the relationship between the composition and the innovation ability of social groups. These may be individual teams, but also the entire workforce of an organization.

This research area is addressed by group researchers (Pelled et al., 1999; Bowers et al., 2000; Stewart & Johnson, 2009; Bell et al., 2011; Wegge et al., 2012), but is also applied in research on organizational demography (Pfeffer, 1985; Nienhüser, 1991; Jans, 2003; Gebert, 2004; Rastetter, 2006). The conceptualization of diversity which is used in the present context is typically referring to a distinction between individuals in a social group with respect to any attribute, which means that another person is perceived as different from the self (van Knippenberg & Schippers, 2007). This perception triggers a series of psychological processes that influence the innovation ability of the considered social unit. "Organizational demography is based on the data gathered on individuals, but is, in fact, a collective or unit-level property." (Pfeffer, 1985, p. 68). This means, that it is not only the property itself to predict the effects of group diversity. The distribution of the characteristics and the feature combination taking several context factors into account is crucial to examine (Ancona & Caldwell, 1992). It is not specified what personal characteristics of employees are used and defined as an explanatory variable to describe the heterogeneous or homogeneous distribution in a group. What diversity dimensions were used and to what results they led is going to be shown in the course of the research paper.

As already mentioned above, there are various definitions for the term "innovativeness". Innovation processes are complex and differ from others according to the considered level of analysis (Grupp, 1997; Hausschildt & Salomo, 2011). In the context of the micro level analysis only the outputs of innovation processes named as innovation capability of teams or working groups are of interest. This includes – referring to Gebert (2004), who examined the conditions under which teamwork leads to innovations, the idea generation and the implementation of ideas into a manageable result. It is the idea generation and development of innovative product parts, products, procedures and business processes, which are released at the level of each team. It is not about implementation, marketing or diffusion concerns of complex innovations, which have been produced by the organization as a whole (Gebert, 2004). Common proxies to measure the group outputs are patent applications, citation statis-

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tics, turnover rates and communication frequencies. Patent applications provide the clearest indicator of successful, innovative group work in this context, because a successful patent application reflects the commercialization potential of an innovation. The reason is, that a patent application is only successful if a potential commercial benefit can be demonstrated (Jaffe et al., 1992, p. 5). Thus, by patents not only the invention is measured, but in parts it may also the economic value of an innovation be estimated in the case of its marketing and so by this means following Acs et al. (2002) the output of innovation processes is defined. The number of published publications by research groups and their citation statistics "document the ultimate end of every innovation process: the commercialization of technical ideas" (Acs et al., 2002, p. 2) and make it possible to understand to what extent the new findings and developments are taken up and are re-used (Acs et al., 2002). Turnover rates on the other hand provide a negative indicator, of which it is assumed that it is the higher, the worse the working environment in heterogeneous groups fails because of greater potential for conflict. The communication rates as a proxy is based on a similar argument structure to reason: It is assumed that a harmonious working environment and an increased frequency of communication go hand in hand and carry the increase in team output (Bowers et al., 2000).

Based on the approach of the Regional Innovation System (RIS) established since the 1990s the innovative capacity of regions is understood as the sum of all innovation-related activities (Cooke, 2001), which are expressed in terms of output indicators such as citations, patents, start-ups, R&D expenditure, R&D personnel as well as economic growth (Wydra, 2009). The five references mentioned first are established indicators to measure innovation activity (Tanaka et al., 2005). Economic growth is taken as an indicator in this case, since innovations are defined as a prerequisite for economic growth in the current economic discourses (Romer, 1990; Stern et al., 2000) and economic growth thus can be considered as the result of successful innovation and start-up activities (Wydra, 2009). In this approach, innovation processes are considered as the result of a collective innovation performance, which arise due to the interaction of a variety of regional actors that are organized into subsystems and subject institutions, structures and routines. This means that an innovation is not seen as an isolated product of a company's performance, but that regionally based universities, research institutions, Chambers of Industry and Commerce and political instances make a contribution by creating an appropriate environment for the creation of innovation (Cooke, 2001).

The paper is organized as follows: The main part of this work is an introduction to the two previously mentioned research perspectives. In that section the starting point of the scientific debate, the considered aspects of diversity and the current state of research are summarized. In the following chapter the embedding of the findings in the research framework of Innografie is conducted. The paper concludes with the identification of research gaps.

The literature sources used for this review were selected using a systematic research. For this purpose database queries have been performed for the micro- as well as the macro-level to search for existing literature reviews, meta-analyzes and recent studies in the digital libraries JStor, Social Science Research Network (SSRN) as well

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as in the digital libraries of the German Central Library of Economics – Leibniz Information Centre for Economics (ZBW): EconStor – free publication of scientific literature in economics and EconBiz, the virtual library for economics. In addition, publication series of relevant research institutes such as the Fraunhofer Institute for System and Innovation Research (ISI papers related to issues of demographic change and innovation); the Ifo Institute – Leibniz Institute for Economic Research at the University of Munich (CESifo working paper); and the Institute for the Study of Labor (IZA) / Institute for the Study of Labor (Discussion Paper Series) have been included. The first query was a full-text search for the key words innovation and diversity. For choosing publications in a pre-selection the title and abstract of a publication have been examined. It was checked whether the capacity for innovation at the organizational or regional level, the diversity of the workforce and the regional population, and their ability to influence innovativeness is object of study of the respective work. Finally there was a fine selection based on the empirical analyses and the indicators for diversity and innovativeness which have been used.

The number of papers which were available is documented in the table below:

Database	First Inquiry: Full Text Innovation/Diversity	Pre-selection Title, Abstract	Final selection Studys Empirical Analysis
JSTOR	110	5	2
SSRN	365	29	12
EconStor	1147	37	15
ISI Publica	8	-	-
Ifo Institute	880	1	-
IZA	368	3	3
EconBiz	220	15	13

There is no claim to completeness in the used literature, the focus was directed on the integration of work that seemed to clarify the research question the best.

2. One research question – two perspectives

2.1 Organizational diversity

Starting point of the debate and theoretical embedding

An interest in the demographic composition of companies and their impact on business performance has been developed since the 1950s motivated by the endeavor of U.S. companies to profitably integrate the increasing number of women and people with immigrant backgrounds in their workforces as well as by the need for modern management strategies that focus on interactive collaboration (Pelled et al., 1999). The aim of the studies is to analyze the influence of the heterogeneity of the corporate workforce on the results of working groups and on the entire organization output. This question is explored with a growing popularity in the relevant scientific disciplines of psychology, business studies and economics, sociology, anthropology as well

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as of communication and education researchers (Nienhüser, 1991; Williams & O'Reilly, 1998; Rastetter, 2006). In more than 60 years, not only a wide range of studies has been written – google scholar shows 2,790,000 hits for the search of „Diversity and Organizations" after 0.08 seconds (04.09.2013) – also literature reviews (i.a. Williams & O'Reilly, 1998; Jans, 2003; van Knippenberg & Schippers, 2007; Shore et al., 2009; Shore et al., 2011) and meta-analyzes (i.a. Joshi & Roh, 2009; Bell et al., 2011) have been published at regular intervals. Different theoretical and paradigmatic approaches have been established to explain the mechanisms of action, this includes critical one too. Most commonly, the instrumentalist/functionalist research on diversity: the similarity / attraction paradigm, the theory of self-categorization and the cognitive information processing approach were cited (van Knippenberg & Schippers, 2007; Gläsener, 2011). As there is much more to report than the socio-psychological paradigms, which are shortly presented here, see the articles of Krell and Sieben (2007, 2011). For a specific consideration of critical approaches see e.g. Zanoni, Janssens, Benschop, & Nkomo (2010).

The similarity / attraction theory of diversity research goes back to the attraction paradigm of Berscheid and Walster (1969) and Byrne (1971). This is based on the assumption that the perceived similarity of two individuals for one or more features leads to an increased interaction between these, since humans subconsciously seek for a positive reinforcement of their own personality and self-esteem. In groups, regarding to the attraction paradigm, a high degree of homogeneity leads to an improved communication and to a strengthen sense of belonging (Berscheid & Walster, 1969; Byrne, 1971). Accordingly, heterogeneity can result in higher process costs caused by conflict, communication barriers and a higher turnover tendency (Jans, 2003). In 1986 Rosenbaum developed a counter-hypothesis, in which it was assumed that it is not the similarities that result in attraction and lead to the exclusion of the dissimilar, but that inequalities between individuals are the real reason for the avoidance of interactions that entail an increase of communication frequencies with people, which must therefore be similar to the self (Rosenbaum, 1986).

Unlike the similarity / attraction theory, which assumes a comparison of perceived personal self with other persons, in the theory of self-categorization the self is constructed by the membership to a social group (van Knippenberg & Schippers, 2007). The theory of self-categorization is an extension of social identity theory of Tajfel and Turner (1986) and by Turner et al. (1989). This is important insofar that Turner et al. presuppose that in the context of interpersonal interactions each man carries out a social self-categorization to subsequently derive the own social identity with the help of the categorization into a group (in-group). They assume that people define their self-esteem and their social affiliation through these membership in groups. The result is that usually the in-group is judged more positive, than the grouping which is perceived as unequal (out-group) (Turner et al., 1989). In diverse work groups, this behavior can lead to the emergence of sub-groups within the team, which are characterized by a greater confidence and an increased willingness to cooperate (Tajfel & Turner, 1986; Dreu et al., 2006). This supports the conclusion that cooperation in homogeneous groups increases the group cohesion, reduces the employee's

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tendency of fluctuation and that a higher performance is achieved than in heterogeneous groups (van Knippenberg & Schippers, 2007; Gläsener, 2011).

Authors who follow the cognitive processing approach assume that group diversity is always accompanied by cognitive diversity. This means that the organization or the group is able to have recourse to divergent features in terms of educational background, experience, function, and so a much greater range of knowledge, experience and skills is reachable as in a homogeneous group. Based on these resources an enlarged problem solving competency itself, as well as the ability to find more creative and more innovative approaches is attributed to varied composite groups (van Knippenberg & Schippers, 2007; Bell et al., 2011).

In summary it can be stated that similar arguments were formulated for and against diversity in the most research work. On the one hand it is argued for the positive effects of diversity using the resource hypothesis. From the workforce or workgroup diversity a greater availability of cognitive resources is derived. In this context, the chain of arguments most commonly used can be grouped as creativity, problem-solving and flexibility argument. These affirm that a greater diversity engenders a greater adaptability, communication and network activity as well as flexibility in new competition and problem situations, because the organization has access to a wider range of abilities, skills and knowledge (Jans, 2003; Dreu et al., 2006). It is opposed by a position which emphasizes the negative effects of diversity. Also referred to as process hypothesis, it purports that employees who have the free choice, frequently communicate and interact with colleagues, which have similar characteristics in subjective and objective categories. Thus, in homogeneous groups, more intensive interaction takes place and hence cooperation along with cohesion is promoted. Interaction and cohesion in turn reduce the tendency of employees to turnover, but can on the other hand; by reducing the angles of view also have a negative impact on innovativeness (Jans, 2003). Of the here outlined, theoretical assumptions can be derived hypothetically that an increase in innovation on the basis of increasing the diversity must be bought at the expense of other organizational key figures and ultimately in the development of human resource strategies (HRS), the overall balance of costs and benefits of diversity is to be calculated for each organization individually. But it is not possible to make any reliable statements on the actual ratio of costs and benefits so far (Jans, 2006). Yet scholars consent in that managing diversity by an efficient diversity programme with an explicit diversity philosophy and related instruments helps to create the expected benefits (Shore et al., 2009).

Considered aspects of diversity

Pfeffer (1985) emphasizes that organizations are relational entities that are constructed from people that make contact with each other through formal and informal structures and who work together. It is appropriate to add, that any cooperation in such structures is a social act, which is marked by the fact that an individual's way of thinking and way of operating, is due to countless features, characteristics and beliefs of each individual. The sum of these properties has an impact on relations with other people and the way people act together in groups.

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Although the possible dimensions of diversity in this regard appear to be limitless, they generally follow the perspective of the relevant scientific discipline and tradition from which an investigation is conducted (Rastetter, 2006; Vedder, 2006). This also means that especially between the researches within the individual disciplines, there has been only a small comparability and the corresponding results are rarely mutually integrated into the reflection of the state of research (Rastetter, 2006). Nevertheless, there are a lot of overlaps between the demographic research of management and organization researchers, which focuses on company workforces as well as workgroups and the empirical group research in psychology and sociology.

Above all, age, gender, race (primarily in U.S. American publications), ethnicity, job tenure and functional diversity gained acceptance as indicators of diversity (Ancona & Caldwell, 1992; Harrison, Price, & Bell, 1998; Krell & Sieben, 2007). Usually, the demographic diversity characteristics are classified as easy observable, not task-oriented and relationship-oriented or are described alternatively as surface-level diversity. Compared to that educational background, function, position and job tenure are considered as task-oriented, job- and subject-related or are referred to as deep-level diversity (Dreu et al., 2006; Jans, 2006; Rastetter, 2006; van Knippenberg & Schippers, 2007). On the one hand the relatively easy measurability and accessibility for scientists is named as the reason for the preferred recourse to these variables (Rastetter, 2006). On the other hand, the operationalization of psychological characteristics with those variables is generally accepted as sufficiently (Harrison et al., 1998). Based on the assumptions of the resource hypothesis and referring to the categorizations used for the diversity dimensions it can be assumed, that primarily the job-or task-related features have an impact on the innovation capacity of social groupings (Dreu et al., 2006; Bell et al., 2011). This does not mean that the demographic variables theoretically have no effects. Following self-categorization theory similarities are fostering the interaction frequency and therefore the team performance (Bell et al., 2011). Easily observable human characteristics, such as age, gender and ethnicity therefore play a greater role, particularly in the early stages of cooperation as deeper, not immediately observable characteristics, which gain in importance over the cooperation, as the group members get to know each other better and better (Dreu et al., 2006; Rastetter, 2006). This allows the conclusion to a sequence of significance, which is based on the duration of the collaboration of groups. That means that a high demographic diversity makes it difficult to enter into the joint work (attraction paradigm), but on the other hand a high degree of diversity pays through diverse cognitive resources (resource theory) when the team members know each other better. Katz (1982) documented in his work on the influence of the term of groups on group performance that people go through certain phases of cooperation, in which stimulating intervention measures can be taken by the human resource management (HRM) and thereby the innovation performance can be increased (Katz, 1982).

Current state of research

There is agreement in all the works considered above, that there is no consensus in regard to the impact of diversity on the performance of teams (Joshi & Roh, 2009; Bell et al., 2011). The disagreement relates to the actual presence of effects, the effec-

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tive direction, and also the strength of the relationships (Bell et al., 2011). The lack of comparability of the individual works is criticized in this context, for the reason that the variety of verifiable dependencies and interactions between investigative, context and output variables is unlimited (Rastetter, 2006) and the study design and subject matter are rarely uniform. Moreover, the pragmatic motivated and simplified application of theoretical concepts is faulted. It does not provide a comprehensive theory building for research on diversity (Harrison & Klein, 2007; van Knippenberg & Schippers, 2007; Bell et al., 2011).

Building on this, complex models have been calculated in recent works, which check the influence of demographic variables on group performance moderated by the present form of diversity, the required type of performance and the study setting (Bell et al., 2011). The introduction of contextual variables, such as management style and nature of the task, is perceived as helpful to explore the modes of action too (Joshi & Roh, 2009). Bell et al. (2011) found out that the binding of several demographic variables into categories and indexes promises no gain in knowledge, but rather that the relationship between each demographic dimension of diversity and the performance of groups diverged. In addition, it has to be refrained from applying demographic variables such as nationality on behalf of psychological characteristics in empirical models, as the influence of these surface variables is due to the triggering of psychological processes which lead to self-categorization or on which the attraction paradigm is based.

2.2 Regional innovation

Starting point of the debate and theoretical embedding

In contrast to the long tradition of economic research to measure the impact of diversity on productivity, efficiency and innovation ability of groups and corporate workforces, the number of studies that analyze the impact of different dimensions of diversity on regional aggregated innovation indicators is more manageable (Grözinger, 2012; Bosetti, Cattaneo, & Verdolini, 2012a). This is compared to the empirical group research (or organizational demography) a rather young field of investigation, that, with the exception of a very few elaborations (i.a. Poot & Siegers, 1992; Brandner & Dowrick, 1994; Malmberg, 1994), has greatly developed only since the last millennium. The origins of the research field can be found in the U.S., which seems to be the reason why most of the work done so far has largely focused on the North American states (i.a. Chellaraj, Maskus, & Mattoo, 2004; Kerr & Lincoln, 2008; Hunt & Gauthier-Loiselle, 2009) and only a few studies take Europe (i.a. Ozgen et al., 2011; Bosetti et al., 2012a) or Germany in particular (i.a. Niebuhr, 2006; Bönte, Falck, & Heblich, 2007; Grözinger, 2012) into account.

There are different arguments for the necessity of research in this field. Among others, the changing age structure (Lindh & Malmberg, 1999), the growing demand for skilled workers from abroad as a result of demographic changes (Niebuhr, 2006) a new political focus on creativity and innovation (Grözinger, 2012), the increasing internal integration of the European economy (Bellini et al., 2009), and the rising importance of Europe as a destination of migration (Ozgen et al., 2011; Bosetti et al., 2012a) are cited. Stern et al. (2000) demonstrate the desideratum with the question: "if

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inventors can draw on technological and scientific insights from throughout the world, why does R&D productivity depend on location?“ (Stern et al., 2000, p. 1). Behind this demand, according to the authors, lies the agreement on the role of innovation for the long-term economic growth, but the disagreement about the drivers of innovation processes as well as the need of improved knowledge for science, economics and international policy to understand the different performance characteristics. Within this perspective, the varying degree of international innovation performance even is a new possibility for scientific investigations (Stern et al., 2000).

Among the first influential parameters of innovation, the influence of ethnic or cultural diversity is analyzed in most of the present studies. This may i.a. be due to the fact, that research on the impact of immigration on the economies of the host countries, in particular on their labor markets, welfare systems, wage and education levels, already offers a large pool of diverse studies, whose essential theoretical preparatory work provides good transferability. Among others, Prskawetz, Fent, and Barthel (2006), Niebuhr (2006), Bellini et al. (2009), Ozgen et al. (2011), Bosetti et al. (2012a) as well as Bosetti et al. (2012b) are available for the investigation of the correlation between cultural diversity and innovation capacity with a European perspective.

The endogenous growth theory, originally introduced by Romer (1990), is the most commonly used theoretical basis, in which technological progress is viewed as an inherent part of an economic growth model and new technologies (technological progress) and human capital play a crucial role in explaining economic growth (Romer, 1990). Research works which are building on this theoretical model frequently start from a R&D-based endogenous growth, which can be expressed mathematically by an endogenous knowledge production function. With whose help the level of knowledge is recorded, on which scientists can draw on in progressing research. The knowledge production function is modified in line with the applied theoretical approach in the consulted studies and it is referred to also as an innovation production function (Bosetti et al., 2012a) or idea production function (Stern et al., 2000).

Considered aspects of diversity

Mostly depending on the data availability nation-states and regional entities are taken as spatial levels of analysis, which correspond in Germany with the federal states (NUTS-1), the planning regions (NUTS-3) or districts and cities (NUTS-2). In the included studies the focal point on migration, i.e. the ethnic and cultural diversity, clearly dominates. The impact of different age distributions and demographic change play a minor role so far.

As a proxy for ethnic diversity in most cases the nationality, i.e. the proportion of foreigners in the total population is deployed. There are also methodological approaches, which only include the share of high-skilled foreign population or use the distribution of nationalities for the calculation of diversity indices. The Herfindahl-Index is a commonly used measure of concentration for this methodology.

The dimension of age is depicted by the strength of allocation of certain age groups within the population or by calculating variances of age. Meanwhile these are offered for larger spatial units by public data providers such as EUROSTAT. An important aspect to consider when comparing the different findings is whether the size

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of the age cohort refers to the population in total or specifically to the labor force. Since the labor force only relates to the group of 15-64 year olds and this group in particular will be more affected by demographic change than the general population (Tivig & Kühntopf, 2009), the use of statistics referring the total population can lead to the distortion of the results and to the complication of the interpretation of the actual interactions. While Lindh and Malmberg (1999) used the entire number of population as a reference, Feyrer (2007) used both approaches and Werding (2008) focusses on the labor force.

With the use of social milieus as diversity factor Grözinger (2012) introduced a variable, which has not been applied in this context to date, to explain regional innovativeness. Cultural diversity is not understood as ethnic diversity here, but as based on the culture of different social groups of an individual state. In general social milieus are considered as social groups whose members have a close proximity in terms of their values, everyday aesthetic, behavioral routines, residence, leisure and consumer preferences, but also relative to their education, occupation and social status. Social milieu models are primarily used in research for social structure analysis and for the explanation of social inequality as well as instrument for the target group analysis in marketing in business practice. The origin of socio-scientific concepts of social milieus can be found in the theoretical considerations of Taine (Hradil, 2006), Durkheim and Bourdieu (Vester, 2006), but as a novelty of market and social research Ueltzhöffer and Flaig developed an approach of social milieus in the second half of the 1970s and devised on this basis the so-called SINUS Model (Ueltzhöffer & Flaig, 1980). As the only licensed adaptation of the Sinus Milieus ® the Micromarketing-Systeme und Consult GmbH works with microm Geo Milieus®. Theoretical background is a micro-geographical marketing approach: people, who live in close proximity to each other, are similar in their social status, their lifestyle and their consumer behavior. This may involve neighborhoods, road sections or even individual residential buildings. In practice, settlement areas are parceled into units corresponding to the requirements of data protection and connected to socio-demographic, psychographic and behavioral-oriented data (microm costumer marketing, SINUS Markt- und Sozialforschung GmbH, 2011; SINUS Markt- und Sozialforschung GmbH, 2011).

Current state of research

There is the impression that the investigation of the impact of demographic changes on the innovative capacity of regions has caused only little research interests so far (Bönte et al., 2007; Werding, 2008; Poot, 2008; Wydra, 2009). In 2011 Ozgen et al. still reported that there are only ten studies that examine the relationship between immigration and innovation up to then (Ozgen et al., 2011). Of course, immigration is not the same as demographic change, but yet the increasing importance of immigration for the host societies is an integral part of demographic change and the internationalization of the population is a consequence, which is inherent to both phenomena. According to this, two interesting aspects caught the eye in the review of the existing literature. On the one hand, there are numerous studies on demographic change, which make its impact on wages, welfare systems, labor market and economic growth a subject of discussion. Publications, which test for innovation as dependent indicator, are

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few in number, even if the interest has grown over the past decade. On the other hand, in almost all studies, which examine the determinants of innovation, problem aspects of demographic change are applied. But they are only a few, which explicitly attributed them to demographic changes, e.g. Niebuhr (2006), Prskawetz et al. (2006), Bönte (2007) und Wydra (2009). This means, that there is already a wide range of scientific publications, on which preliminary works and results can be fallen back on in future research approaches, even if they do not correspond exactly to the problem definition, which was formulated within the context of the literature review.

As a starting point for further investigations it can be stated, that, for the relationship between internationalization and innovation in Germany and Europe a positive correlation between the proportion of migrants with a high level of education and the innovation capacity of the host country can be demonstrated, and it is assumed, that skilled workers from abroad, and with them a greater diversity of the workforce in R&D bring an increased level of innovation activity and patent performance with them (Niebuhr, 2006; Grözinger, 2012; Bosetti et al., 2012a). This relationship is explained by the resource hypothesis or via the problem-solving-argument, that is to say, via the positive effects of different points of view in processing innovation projects (for more information see also Ortlieb & Sieben, 2013) .

In terms of age diversity, to the current state of knowledge, in particular a high number of people in the age group 50-64 years is estimated to have a positive effect on the regional innovation capability. For younger and older age cohorts are either contradictory or even negative interactions turned out (Lindh & Malmberg, 1999). Other studies look at the relationship between age and productivity / technological progress in the form of an inverted U-curve (i.a. Feyrer, 2007; Werding, 2008; Backes-Gellner et al., 2011; Bal et al., 2011). One interpretation of these results suggests that the shift of the ages is profitable up to a certain point, even has an ideal point, but then the returns begin to sink. The divergent findings may be attributed to the use of either the total population or the labor force as a reference.

Wydra presented in 2009 the first research paper on the impact of demographic change on the performance of an entire innovation system and draws the conclusion, that due to the complexity and multiplicity of innovation systems no clear direction of effects can be determined. Wydra interprets his results in a way that the innovation ability and thus the position in the economic competition depend on the adaptability of the system (integration of older into innovation processes) to the conditions changed by demographic change (Wydra, 2009).

3. Conclusion and outlook

In this literature review, the current state of research on the question of innovation capacity of social groups, organizations and regions in demographic change was reflected in terms of the increasing diversity of the workforce. For future research it must be noted that the number of research papers, which cite the demographic change as a cause for the observed change in the composition of the workforce, represents only a small proportion of the sum of the scientific work on innovativeness. Nevertheless characteristics of age, gender and migration background are among the established units of investigation in most research contexts focussing that issue.

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At the level of social groups, it is mainly basic human psychological processes that play a role and which determine group collaboration. It is difficult to detect and to interpret these processes, because they are subject to various contextual conditions (e.g. task of the group, style of leadership / management, organizational culture). Because of the innumerable variety of verifiable predictor variables and the uncontrollability of their embedding little agreement with regard to the actual effect relationships has hitherto become evident and no reliable management or control methods can be deducted on this basis respectively. Though according to new findings one can assume, that the formation of variable categories and the computation of demographic indexes are less promising, but the identification of the impact of each factor is appropriate (Bell et al., 2011).

On the organizational level, the structure of the entire workforce is taken into view. This can be done in general or broken down by organizational units / teams, whereby large amounts of overlap with the group research occur. With regard to the moderating variables and contextual factors that help to come closer to the real interdependencies, in the case of the present research question it would be of relevance to consider inter alia the impact of HRM strategies of organizations. As this is the basic management tool of organizations, to remain competitive under the conditions of demographic change.

At the regional level, the whole interrelating system is composed of all organizations (consisting of social groups / units) in the interplay with all other regional actors in the context of regional cultural, economic, and political settings in the form of an interaction between different subsystems. The functioning of a RIS, regardless of demographic change, is yet been recorded only within the limits of spotlight-like approaches of explanation and can hardly be displayed in their entirety due to the high complexity and multifacetedness. There are indeed a number of publications, which demonstrate statistically a positive relationship between ethnic / cultural diversity and the large population of the age group of 50-64 year old to the regional innovation capability, but the causality explanations cannot provide an adequate explanation of the actual interactions yet. Based on the stated results, several issues for regional research approaches remain to clarify. Firstly, the influence of the size of the shifting proportions of men and women was not reflected in the various labor market sectors (especially in R&D) as well as on the different levels of management. In all studies that rely on demographic change as consequences either ethnic or cultural diversity or the problem of the alteration of the population of the age cohorts are addressed. Secondly, the focus on contextual factors, such as labor market policy (legal framework, regulations, opening of the labor market migrants), research and start-up funding, as well as the cultural setting should be strengthened and inserted into future testable hypothesis. In this context, the approach of the social milieu is a promising integrative approach, to reach a better understanding of the impact of organizational (workforce) and regional culture (labor force potential) on the innovative ability. After all, at the regional level it is also about revealing possibilities for setting the direction. These would have to be checked afterwards in interregional and international comparisons, to evaluate the success of different measures of adjustment.

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Thus, on all three levels of research attention with respect to the demographic change should be raised. Assessing the resulting overall picture, in which the question of the influence of diversity variables on the ability to generate innovations is examined at the three levels of groups, organizational demography and regions, the need arises to link the theoretical approaches, methods and results from the discussed research fields better and to develop new concepts build on this. The integration of the three levels of research through interfaces between the group and the organizational research and between the organizations and their regional embeddedness offers an opportunity, to advance the knowledge of the organization-inherent and of the organization-surrounding factors of demographic change, in which the key for maintaining and increasing the capacity for innovation and thus competitiveness of German companies lies.

In addition, another demand can be formulated, which can't be satisfied by science on its own. This refers to the provision of data sets for meaningful and reliable analyzes. The deficiencies in the availability delimit the scientific possibilities and lead to more imprecise, biased or distorted results, which are difficult to interpret, because of the evasion on less pertinent figures.

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