The Impact of Aging and Age Diversity on Company Performance

Prof. Dr. Uschi Backes-Gellner and Stephan Veen[1]
Institute for Strategy and Business Economics, University of Zurich, Plattenstrasse 14, CH-8032 Zurich, Switzerland

1. INTRODUCTION

In view of the foreseeable demographic changes and the resulting changes in the age structure of the working population, the question arises as to what effects an aging working population will have on the productivity of firms. Companies will be confronted with an aging workforce, on the one hand, and with changes in age composition, on the other hand. Thus, they will have to make greater use of the skills of an increasing number of increasingly older employees who, in turn, will have to be productively employed amidst a decreasing number of young, and in some instances very young, employees. Today, in contrast, many companies have no, or very few, older workers on their payrolls. This means that the average age of employed workers will increase in the foreseeable future, as will the variance in workers age, or age diversity. This paper addresses both the productivity effects of changes in average age as well as in age diversity, however, our primary focus is on the effect of age diversity on firm performance.

Although there is a rather large number of studies on age-related productivity changes with regard to *individual* productivity, the question of how aging and age diversity in an *organization* affects *organizational* productivity has largely been overlooked and few theoretical frameworks have been provided to deal with the structure of this problem. Studies on age heterogeneity at top management levels (Charness, Villeval 2007; Hamilton, Nickerson, Owan 2004; Jehn, Bezrukova 2004; Pitcher, Smith 2001) represent the main exceptions here, but the applicability of these findings to the rest of the workforce is limited. Therefore, we propose a new type of theoretical analysis that borrows from economic theory to study the structural effects of workforce heterogeneity on company performance on the one hand side, and from a very diverse literature on aging and diversity to bring life to the structure and derive empirically testable hypotheses on the other hand side. We argue that changes in age diversity exert a systematic effect on firm performance and that the nature of this relationship depends on the nature of the tasks involved and on the business area in which an organization is active. Our hypotheses are empirically tested with the aid of the so-called LIAB, which is a representative linked employer-employee data set for Germany based on more than 18,000 companies and more than 2 million employees over a ten year period.

2. BACKGROUND

Workforce composition and firm performance: theoretical framework and empirical implications

The starting point of our theoretical framework is the assumption, widely supported by medical, psychological and economic research, that old and young employees possess different skills and abilities (Johnson 2005; Skirbekk 2005; Staudinger 2006). The competencies and capabilities of old and young employees vary depending on their occupational field and activity. It generally can be assumed that individual productivity declines with age, and that depending on the type of task, this process starts sooner or later and progresses more or less quickly. However, this age-related change in the individual

[1] The authors are part of a joint project of the German Academy of Sciences Leopoldina and the German Academy of Sciences and Engineering acatech. The project is funded by the Jacobs Foundation Zurich. We thank the Jacobs Foundation for funding and all members of the project for important insights and fruitful discussions. All remaining errors are ours.

productivity of each and every individual is only one aspect of productivity-relevant effects of aging, since in organizations individuals work alongside other individuals. Thus, the resulting organizational productivity is typically more than the sum of individual outputs (Williamson, 1975). So far, organizational studies on the effects of age heterogeneity of a workforce produced unequivocal evidence on how the joint interaction of workers within an organization may influence performance outcomes. There are studies which find positive effects, for example, when employees are involved in the transfer of knowledge and experience. But there are also studies which find negative effects for example when employees are hindered in their duties when working together (for an overview cf. Cleveland, Lim 2007). In our study, we aim at identifying the circumstances under which the positive or the negative effects may dominate. To do so we introduce a theoretical framework which we derive from Lazear (1999), whose theoretical model makes a simplifying distinction between costs and benefits of cultural diversity. We apply this model to age diversity in organizations and argue that there are *organizational costs* of age diversity, on the one hand, and *organizational benefits* of age diversity, on the other.

In the model, an increasing and ever steeper costs curve reflects the standard economic assumption of increasing marginal costs, meaning that heterogeneity problems increase faster with increasing heterogeneity. The shape of the benefit curve likewise reflects the standard economic assumption of decreasing marginal returns, i.e. it increases but levels off as heterogeneity keeps increasing meaning that increasing heterogeneity may be associated with additional benefits, bit these additional benefits decrease in size the more heterogeneous an organization becomes. To give an example on what increasing marginal costs or decreasing marginal returns with increasing heterogeneity mean, one could think of increasing diversity in a workforce's languages and its effect on performance. 'Increasing marginal *costs'* of language heterogeneity implies that while it may be fairly easy to cope with one or two additional languages in a given workforce, any further increases in the number of languages spoken in an organization however will make it increasingly difficult to communicate, and the costs of translating into all languages and/or the costs of communication errors will rise disproportionately. 'Decreasing marginal *returns*' means that, although it may be a large benefit to have one or two additional languages represented in a workforce (for example, because it enables a team to communicate directly with its most important groups of foreign customers or vendors in an international business environment), such benefits will decline with increasing language heterogeneity until a point is reached at which any benefit is minimal or absent.
To find the point where the *overall* effect of age heterogeneity on productivity is largest one has to look at the combined effect of the benefits and costs curves which follows an inversely u-shaped curve with increasing heterogeneity. This implies that overall productivity is very low if an organization has no diversity at all, but it is also very low if an organization is overwhelmingly diverse, and it peaks at a middle level of heterogeneity (a similar argument is made by Page 2007 and Richard and Shelor 2002 for diversity in teams).

Based on this simple model we then argue, that the exact shape of the costs and benefits curves depends on what type of skills and on what type of production process or business task an organization is characterized by. Hence, the cost and benefit curves and naturally also the overall productivity effect as well as the optimal heterogeneity level can be expected to vary depending on these characteristics. For example, in a context such as a standard assembly line, where increasing heterogeneity has few benefits, the benefit curve may be very flat, meaning that the overall productivity effect may even become negative with increasing heterogeneity. On the other hand, in an area where creative problem-solving is important and increasing heterogeneity brings major benefits because it, for example, significantly enhances the spectrum of proposed solutions, the benefit curve may be very steep. In this case, the overall productivity effect may also be quite large and peak at a higher level of heterogeneity. Accordingly, we hypothesize that the net productivity effect of increased age heterogeneity crucially depends on whether in a particular work setting the expected benefits of heterogeneity can be assumed to be large or small.

To identify these costs and benefits of heterogeneity more precisely, we use the multi-disciplinary body of research on aging, which provides valuable insights on aging effects in different environments and different tasks. We draw from this large variety of disciplinary results to assemble the effects of age heterogeneity in various business contexts and gain conclusions on the expected costs and benefits of heterogeneity given different types of production processes.

Costs of increasing (age) heterogeneity

Communication costs and interaction problems

Social psychological research shows that communication and the formation of social relationships between highly dissimilar individuals generally entail higher costs than that within homogenous groups of individuals (Harrison, Price, Gavin, Florey 2002; Horwitz, Horwitz 2007; Lazear 1999; Page 2007; Prat 2002; Richard, Shelor 2002). Employees communicate better with people who are similar to themselves, because they share similar lifetime experiences, a common language and a common set of symbols. Therefore communication costs tend to be higher with a more age-heterogeneous workforce than with an age-homogenous workforce and the cost curve increases with heterogeneity (Milliken, Martins 1996: 408). Resulting *less* frequent communication is particularly performance-inhibiting when information flow is important, namely, in a business context where employees must work in concert to solve creative tasks (Zenger, Lawrence 1989). Accordingly the optimal degree of age heterogeneity depends on how creative the problem-solving tasks are.

Identification, integration, dissatisfaction and turnover

Besides the immediate costs caused by communication difficulties, heterogeneity can also have an indirect productivity-inhibiting effect by increasing the rate of turnover. There is strong empirical evidence that age heterogeneity increases the turnover rate, as shown by Richard and Shelor (2002), Milliken and Martins (1996: 408) and O'Reilly, Caldwell and Barnett (1989). In a business context, absenteeism and turnover cause disproportionately high productivity losses, particularly when team efforts are required and interactive tasks must be performed (Nicholson et al. 2004; Pitcher, Smith 2001). Therefore, it can generally be assumed that the above-mentioned negative productivity effects of age heterogeneity are magnified through an increase in absenteeism and turnover rates causing an increasing cost curve with heterogeneity.

Conflicts and turnover

Another indirect mechanism by which age heterogeneity can negatively affect productivity concerns differences in the values and preferences of distinct age groups. Different age cohorts, each with varying socialization processes behind them, regard their environment against the backdrop of very different cultural and normative attitudes, which heightens the likelihood of value conflicts. This, in turn, lessens the degree of social integration and ultimately diminishes productivity (Jackson, Joshi 2004: 681). It has been shown that productivity-diminishing conflicts are particularly frequent in the presence of "generation gaps" and demographic faultlines (Lau, Murnighan 2005: 645; Pitcher, Smith 2001).

In summary, based on previous empirical findings we also come to the conclusion that the productivity-diminishing effects of age diversity increase with increasing age heterogeneity. Whether these costs are outweighed by respective benefits depends according to our model on how routine the tasks are that have to be performed.

Benefits of increasing (age) heterogeneity

The costs of age heterogeneity may be juxtaposed with its potential benefits. The general drivers of these benefits are positive complementarities and composition effects. Complementarity effects emerge when collaboration in a group enables individuals to be

more productive than when working on their own. As a result, the overall output of the group surpasses the sum of the individual outputs. Composition benefits emerge when different organizational activities can be better performed by staff with differing skills. Having employees of different ages, for example, can help a firm maintain better relationships with customers from different age groups. A group of employees consisting of different age groups would therefore be more productive than a group with employees belonging all to the same age group (Zenger, Lawrence 1989: 372). Hence, the benefits of age heterogeneity are based on additional productivity effects that arise due to the interaction among individuals of different ages with differing skill profiles, differing perspectives and perhaps also different personality traits. In the following, we summarize empirical resultsthat discuss the possible origins of the added value of age-specific differences that can make collaboration among age-heterogeneous staff enhance productivity.

Diversity, problem-solving approaches and creativity

An age-diverse workforce will display a host of different values, preferences and experiences, which makes it very likely that employees will also express differing opinions and approach problems in different ways. In comparison, within a homogeneous workforce, there is the risk that only highly similar ways of looking at and approaching problems will emerge, which tends to engender more of an innovation-inhibiting culture (Mas, Moretti 2006; Wiersema, Bird 1993: 1015-1019). Age homogeneity tends to lead to "groupthink", which refers to a rigid, static style of decision-making that is conducive to within-group cliquish views and circles (Janis 1982). Page (2007) argues that the different perspectives, interpretations, heuristics and mental models within a relatively heterogeneous group represent a collection of cognitive tools that is enhanced by group diversity. Thisenlarged "tool box", in turn, enhances the group's flexibility and creativity, which ultimately leads to more creative, faster and flexible problem-solving processes with better outcomes (Page 2007: 293-294; Canella, Park, Lin 2008; Hamilton et al. 2004; Kilduff, Angelmar, Mehra 2000: 32; Richard, Shelor 2002: 961). However, it also has been shown that the company-specific context played a critical role with respect to productivity effects, because the relevance of the enhanced problem-solving competencies was basically dependent on the type of task at hand. For example, it has been shown that social heterogeneity has clearly positive effects, particularly when the work to be done required a high degree of creativity and decision-making skills or when dealing with strategic and complex decision-making and vaguely-defined problems in a dynamic setting (Jackson 1992; Jackson, Joshi 2004; Page 2007: 314-328; Richard Shelor 2002). We therefore postulate that in dynamic work environments, increased age diversity exerts a more positive effect on firm productivity than in relatively routine work settings.

Dominance of an age group, organizational problems and the transfer of experience and knowledge

Another benefit of greater age diversity is that it tends to counteract the dominance of one particular age group and the ensuing organizational problems. A homogeneous and dominant age group might reduce career options for the up-and-coming age group, because they clog the corporate career ladder. Within a homogeneous age group, increased conflicts over scarce job vacancies can be expected, which diminishesthe effectiveness of promotion-based incentives as a result. Such reduced performance incentives, in turn, negatively affect the productivity of firms with age-homogeneous workforces. Conversely, the productivity of more age-heterogeneous workforces should be higher due to more effective promotion incentives (Pelled, Eisenhardt, Xin 1999).

In addition to such incentive problems, promotion backlogs in age-homogeneous workforces may also cause coordination problems, because they impede the transfer of knowledge from one working generation to the next. If, for example, due to a lack of promotion options, a firm is unable to promote workers with important knowledge into higher ranking positions, workers may leave and take their knowledge with them. In this respect, heterogeneity is also necessary for an efficient in-house distribution of knowledge, which is especially important in settings with a preponderance of implicit knowledge. Only if the workforce is sufficiently age-

heterogeneous will an internal labor market be able to optimally perform its assigned function (for a theoretical model, cf. Gibbons, Waldman 2006).

Implicit knowledge benefits and incentive problems mostly arise in occupational fields where production is knowledge-intensive, highly innovative with little standardization, and in which information and knowledge transfer plays a critical role. In other words, we expect the positive productivity effects of age diversity to be greater in knowledge-intensive and highly innovative work settings.

Summary of hypotheses

The findings presented thus far consistently suggest that the type of task performed and the production process itself greatly mediate the relationship between age heterogeneity and firm productivity. According to the literature, we suggest a distinction between two fundamentally different types of work settings: work settings with mostly routine tasks, on the one hand, and with creative problem-solving tasks, on the other.

Routine tasks in a stable environment with standard processes are generally characterized by modest problem-solving demands and coordination needs as well as by a low degree of innovation. Rationalized work processes necessitate rapid, efficient and standardized communication processes, where little is gained from diversity-related competencies but much may be lost in the event of communication problems attributable to age heterogeneity. Therefore, under these circumstances, the possible benefits of age heterogeneity might not be sufficient to offset the increasing costs of age heterogeneity. So for routine work tasks, we expect that any reduction in age heterogeneity will have a favorable effect on productivity, while every increase in age heterogeneity will reduce productivity. Empirically, this should produce a significantly negative statistical coefficient between age heterogeneity and firm productivity.

In contrast, *innovative and creative tasks* are associated with more complex problem-solving requirements and low levels of standardization. The dynamic work environment associated with these problem-solving tasks engenders ill-defined and novel problems and necessitates flexible responses as well as a constant ability to adjust. Though communication may also be important in these areas, it is important not so much for coordination purposes but for group discussion and solution-finding efforts. This is where the benefits of heterogeneous competencies come into play, and thus these benefits may outweigh the losses due to standard communication problems leading to a positive effect of age heterogeneity on firm productivity.

In summary, we are able to derive two empirically-testable hypotheses.

Hypothesis 1: In companies with mainly routine tasks, increasing age heterogeneity has a negative effect on firm productivity.

Hypothesis 2: In companies with mainly creative problem-solving tasks, increasing age heterogeneity has a positive effect on firm productivity.

3. DATA AND RESULTS

Data, operationalization and descriptive findings

To evaluate our hypotheses we need a comprehensive set of information about the types of tasks performed at company level as well as about individual employees and their age. Therefore we use LIAB, a linked employer-employee panel data set, collected in Germany by the Institute for Federal Employment Research (IAB) at Nuremberg. LIAB matches a large company data set with an employee data set from public employment statistics of the German Federal Employment Agency (Alda, Bender, Gartner 2005; Bellmann, Bender, Kölling 2002). The company data stem from a representative annual panel survey with about 18,000 companies. It includes an extensive set of company-related information. Added to this company data set is information from social security records about all workers employed in these firms, resulting in about 2 million employees. The final data set encompass detailed information regarding level of education, occupational status, tenure, age and income (Alda

et al. 2005: 8-10; Bellmann et al. 2002: 23-24). We use the years 1993 to 2003, which means that we have a panel data set with a total of 10 panel years.

Summary of empirical findings

We apply fixed effect estimation and several specifications as robustness checks. We use 'standard deviation of age' and 'coefficient of variation of age' as measures for age heterogeneity and three different measures for the dominant nature of tasks performed in a company. We respect to average age of a workforce we firstly find that *organizational* productivity doesnot necessarily decline with increasing average age, particularly if changes in age heterogeneity and type of tasks are controlled for. Instead, our results show that increasing average age consistently shows a positive effect on company performance, which is a strong indication of a positive selection of those who stay in the workforce.

Controlling for tenure and tenure diversity we secondly find that age heterogeneity on its own has a negative effect on firm productivity, but that thisnegative heterogeneity effect is offset by strong heterogeneity benefits in companiesthat are engaged in innovative/creative tasks. According to our theoretical explanation, this is due to higher benefits of increasing age heterogeneity that emerge in creative activities where these benefits clearly offset the general costs of additional age diversity. In the case of routine tasks, however, there are no substantial gainsfrom age heterogeneity that could offset the increasing costs resulting from greater age heterogeneity. Thus, in companies with routine types of work, increasing age heterogeneity overall leads to a decline in productivity. Accordingly, both Hypotheses 1 and 2 were confirmed by the empirical tests.

To get a feeling for the magnitude of the positive heterogeneity effect in innovative companies we calculate how much productivity would increase with a 10% increase in age heterogeneity (which is equal to the maximum range of age heterogeneity within the observation period). We find that it increases annual productivity by approximately 3.5%. In comparison to average GDP growth rates in the respective time period, which were around 1%, this is a very large and economically important effect. Thus we can conclude, that the age composition of a workforce and organizational demography in general are a very important source of productivity growth particularly for innovative and creative companies.

Concluding remarks

The aim of this paper was to examine how the age structure of a company's workforce affects a company's productivity. In doing so, we not only look at *individual* productivity effects but also on *organizational* productivity effects, which we assume are more than the sum of the individual effects. Furthermore, we do not only address the effect of changes in *average* age but also of changes in *age diversity* on organizational performance. To investigate these problems we make a theoretical contribution by introducing a simple economic model to study the effects of differing workplace characteristics on the relationship between age heterogeneity of a workforce and company performance. The model basically compares costs and benefits of increasing heterogeneity and demonstrates how changes in age diversity may affect organizational performance depending on the type of task performed. We fill this framework by combining it with theoretical insights and empirical results from very diverse disciplines such as psychology, management, medicine and gerontology. We test our hypotheses with a linked employer employee dataset with approx. 18'000 companies and 2 million employees.

Our results show that *organizational* productivity does not necessarily decline with average workforce age. More importantly however, we also show that *company* productivity ismore than the sum of *individual* productivities. We argue that increasing age heterogeneity in general can cause either an increase or a decrease in company productivity. The effect depends on the kind of tasks a company's workforce is confronted with because the tasks determine whether costs orbenefits of increased heterogeneity are larger. The benefits of increased heterogeneity are more pronounced in companies with innovative/creative tasks and less pronounced in companies with routine tasks, because the latter require only a low degree of diversity or creativity. Thus, in firms with *routine tasks*, the benefits do not outweigh

additional cost. In firms with *creative problem-solving tasks*, however, the benefits of heterogeneity are much larger and do outweigh additional costs. The effect we find is not only statistically significant but also economically important.

Thus, to conclude, we argue that the foreseeable demographic changes should not only be seen as a threat to companies but should be considered as a valuable resource that may particularly support productivity growth in innovative firms if utilized in an effective manner. Accordingly, firms are well advised to adapt their personnel policy and their production and outsourcing strategies to match these future challenges.

References

Alda, H., S. Bender, H. Gartner. 2005. The linked employer-employee dataset of the IAB (LIAB). *IAB Discussion Paper* **6**.

Bellmann, L., S. Bender, A. Kölling. 2002. Der Linked Employer-Employee-Datensatz aus IAB-Betriebspanel und Beschäftigtenstatistik der Bundesanstalt für Arbeit (LIAB). *Beiträge zur Arbeitsmarkt- und Berufsforschung*, BeitrAB **250** 21-30.

Canella, Albert A. Jr., J. Park, H. Lin. 2008. Top Management Team Functional Background Diversity and Firm Performance: Examining the Roles of Team Member Colocation and Environmental Uncertainty. *Academy of Management Journal* **54**(4) 768-784.

Cleveland, Jeanette N., A. S. Lim. 2007. Employee Age and Performance in Organizations. K. S. Shultz, G. A. Adams, eds. *Aging and Work in the 21st Century*. Lawrence Erlbaum Assoc Inc., Mahwah, 32-90.

Gibbons, R., M. Waldman. 2006. Enriching a Theory of Wage and Promotion Dynamics inside Firms. *Journal of Labor Economics* **24**(1) 59-107.

Hamilton, Barton H., J. A. Nickerson, H. Owan. 2004. Diversity and productivity in production teams. Working Paper, Washington University, St. Louis.

Harrison, D. A., K. H. Price, J. H. Gavin, A. T. Florey. 2002. Time, Teams, and Task Performance: Changing Effects of Surface- and Deep-Level Diversity on Group Functioning. *Academy of Management Journal* **45**(5) 1029-1045.

Horwitz, Sujin K., I. B. Horwitz. 2007. The Effects of Team Diversity on Team Outcomes: A Meta-Analytic Review of Team Demography. *Journal of Management* **33**(6) 987-1015.

Jackson, Susan E. 1992. Team Composition in Organizational Settings: Issues in Managing an Increasingly Diverse Work Force. S. Worchel, W. Wood, J. A. Simpson, eds. *Group Process and Productivity*. Sage Publications, London and New-Delhi.

Jackson, Susan E.; A. Joshi 2004. Diversity in social context: a multi-attribute, multilevel analysis of team diversity and sales performance. *Journal of Organizational Behavior* **25**(6) 675-702.

Janis, Irving L. 1982. *Groupthink*. Houghton Mifflin Company, Boston.

Johnson, Malcom L. 2005. *Age and Ageing*. Cambridge University Press, Cambridge.

Kilduff, M., R. Angelmar, A. Mehra. 2000. Top management-team diversity and firm performance: Examining the role of cognitions. *Organization Science* **11**(1) 21-34.

Lau, Dora C., J. K. Murnighan. 2005. Interactions within Groups and Subgroups: The Effects of Demographic Faultlines. *Academy of Management Journal* **48**(4) 645-659.

Lazear, Edward P. 1999. Globalisation and the market for team-mates. *The Economic Journal* **109**(454) C15-C40.

Mas, A., E. Moretti. 2006. Peers at Work. *NBER Working Paper Series* (**12508**).

Milliken, Frances J., L. L. Martin. 1996. Searching for Common Threads: Understanding the Multiple Effects of Diversity in Organizational Groups. *The Academy of Management Review* **21**(2) 402-433.

Nicholson, S., M. V. Pauly, D. Polsky, C. Sharda, H. Szrek, M. L. Berger. 2004. Measuring the Effects of Workless on Productivity with Team Production. *NBER Working Paper Series* (**10632**).

O'Reilly, Charles A., D. F. Caldwell, W. P. Barnett. 1989. Work group demography, social integration, and turnover. *Administrative Science Quarterly* **34**(1) 21-37.

Page, Scott E. 2007. *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton University Press, Princeton.

Pelled, Lisa H., K. M. Eisenhardt, K. R. Xin. 1999. Exploring the black box: An analysis of work group diversity, conflict, and performance. *Administrative Science Quarterly* **44**(1) 1-28.

Pitcher, P., A. D. Smith. 2001. Top Management Team Heterogeneity: Personality, Power, and Proxies. *Organization Science* **12**(1) 1-18.

Prat, A. 2002. Should a team be homogeneous? *European Economic Review* **46**(7) 1187-1207.

Richard, Orlando C., R. M. Shelor. 2002. Linking top management team age heterogeneity to firm performance: Juxtaposing two mid-range theories. *International Journal of Human Resource Management* **13**(6) 958-974.

Skirbekk, V. 2005. *Why not start younger? Implications of the timing and duration of schooling for fertility, human capital, productivity, and public pensions*. International Institute for Applied Systems Analysis, Laxenburg, Austria:

Staudinger, U. 2006. Konsequenzen des demographischen Wandels für betriebliche Handlungsfelder: Eine interdisziplinäre Perspektive. *ZFBF Schmalenbachs Business Review* **58**(5) 690-698.

Wiersema, Margarethe F., A. Bird. 1993. Organizational demography in japanese firms: Group heterogeneity, individual dissimilarity, and top management team turnover. *Academy of Management Journal* **36**(5) 996-1025.

Williamson, O. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications.* Free Press, New York

Zenger, Todd R., B. S. Lawrence. 1989. Organizational demography: The differential effects of age and tenure distributions on technical communication. *Academy of Management Journal* **32**(2) 353-376.