

## **The Role of Employees for Post-Entry Firm Growth**

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# The role of employees for post-entry firm growth<sup>1</sup>

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## Abstract

While the majority of existing studies on the determinants of post-entry firm growth focus on the role of the founders or on the impact of firm-specific characteristics like size, age or industry affiliation, a possible impact of the characteristics of a start-up's workforce on post-entry growth has been widely neglected in the literature so far. Based upon a comprehensive panel dataset of establishments in Germany, this paper contributes to fill this gap and examines the role of the initial employment structure with respect to qualification, age, gender and nationality for post-entry employment growth measured both in terms of employees and in terms of full-time equivalents. Moreover, it is analyzed whether the use of flexible work forms like regular part-time and / or marginal employment in the year of foundation affects post-entry growth. Our empirical results confirm that in particular the initial qualification structure of a start-up's employees matters for post-entry growth. Establishments using flexible work forms show higher post-entry growth with respect to total hours worked, but a significantly lower growth with respect to the number of employees.

**JEL Classification:** J24, L10, L25

**Keywords:** start-ups, post-entry performance, firm growth, job quality, flexibility, human capital

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# 1 Introduction: Motivation and Overview

Human capital is seen as one of the most decisive drivers of the post-entry growth of newly founded firms. As most new firms start small – at least when they are independent start-ups and not e.g. spin-offs or outsourced entities –, it is not surprising that much attention is directed towards the role of the human capital of the founders or the founding teams of these firms. Thus, as a matter of fact, their human and social capital – i.e. their qualifications, their experiences, their ideas and their networks – are believed to have the most relevant impact on the early performance of their firms (e.g., Bates 1990, Cooper et al. 1994, Colombo and Grilli 2005, Delmar and Shane 2006, Dahl and Reichstein 2007, Gottschalk and Niefert 2011).

Nevertheless, a significant share of new firms already start with some employees, and many start-ups surviving the first months employ their first personnel already in early stages.<sup>3</sup> Questions of the early growth of new firms have been discussed extensively (for overviews, see for example Audretsch and Mata 1995, Santarelli and Vivarelli 2007 or Stam et al. 2008) and a bunch of theoretical arguments for a possible impact of employee-level characteristics on the post-entry performance of firms exists. Moreover, several recent papers explicitly describe and analyze the characteristics of the workforces of young firms and compare them to those of established firms. For instance, Schnabel et al. (2011) find that an “individual’s employment stability was higher in incumbent than in newly founded firms while their risk of becoming unemployed was lower” (Schnabel et al. 2011, p. 85). In contrast, Böheim et al. (2009) find – on the basis of employer-employee data from Austrian workers and firms – that new jobs in new firms last considerably longer than new jobs in incumbent firms. In a previous paper on the basis of a similar dataset as in the present paper, Koch and Späth (2009) analyze differences in the quality of employment between new and incumbent firms. They find, inter alia, that new firms revert to more flexible forms of labor with e.g. higher shares of part-time workers and of marginal employment.

However, studies on the potential *effects* of the characteristics of the workforce on a firm’s performance are hardly directed towards start-ups. Whereas several contributions, particularly from the field of labor economics, address the effects of employees’ characteristics and the structure of the workforce, e.g. qualifications (see Rauch et al. 2005, Iranzo et al. 2008), age (e.g., Grund and Westergard-Nielsen 2008, Backes-Gellner and Veen 2009, Göbel and Zwick 2009, Lallemand and Rycx 2009), employee mobility (see Boschma et al. 2009), diversity (e.g., Ilmakunnas and Ilmakunnas 2010, Parotta et al. 2010) or forms of employment (see Montgomery 1988, Valverde et al. 2000, Lepak et al. 2003, Arvanitis 2005, Nelen et al. 2011) on firm performance<sup>4</sup> – mostly based on measures of productivity –, none of these explicitly addresses the role of start-ups in this context.

The basic assumption of the paper at hand is that not only the initial size of a firm’s workforce has an impact on its growth and survival (see Audretsch 1991, Wagner 1994, Persson 2004), but that also qualitative aspects of that workforce, i.e. the characteristics of employees as well as their modes of work, matter for its early development. The paper thus complements existing research on the post-entry growth of new firms by analyzing the role of the employees as a determinant of a start-up’s early performance.

Based on our belief that the influence of human capital on the development of a new firm is not restricted to its founders, but that also the characteristics of its individual employees as well as the structure and organizational characteristics of employment have an impact on a firm’s post-entry performance, it is the aim of this paper to empirically analyze how the initial employment structure in a new establishment affects its

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<sup>3</sup> Data from the German trade register (see Angele 2007) indicate that about 41 % of formally founded new establishments start with one or more employees. On the basis of data from representative surveys in Germany, Gude et al. (2010, p. 18) report values between 38.6 % and 45.6 % for the years 2006-2009.

<sup>4</sup> Many of these studies are based on the measurement of productivity and only few studies also measure the growth in terms of employment or turnovers. Exceptions in this sense are the contributions of Koch and Strotmann (2006) and Rauch et al. (2005).

future development: do companies starting with a highly qualified workforce grow faster than those employing mostly unqualified personnel? What are the impacts of the engagement of older or younger workers in the team on the development of the start-up? (How) do qualitative aspects of employment and specific compositions of the workforce influence the start-up's performance? Do young firms with a more flexible labor force run better than firms using more rigid or stable types of employment?

For our analysis, we have access to a comprehensive annual panel dataset of establishments in Germany for the period 1999 to 2006 containing not only information on the start-up year of each establishment, but also several variables on qualitative aspects of employment in these entities, e.g. qualifications, age structure, nationality and workload. Thereby, we are able to overcome some of the shortcomings of existing research and to complement available studies on the determinants of the post-entry performance of start-ups.

The remainder of the paper is structured as follows: section 2 gives an overview of previous studies and elaborates a conceptual background eluding the intersection between new firm growth and qualitative aspects of the early workforce. Section 3 introduces the data whereas section 4 outlines the empirical specifications and measurement issues. The empirical results and their discussion are subject of section 5. Section 6 concludes by summarizing the main results and by giving an outlook on potentials for further research.

## **2 Conceptual Background: Employment Quality as a Determinant of Start-up Performance**

As outlined above, the present contribution is based on our belief that the characteristics of the workforce of a newly founded firm matter for its post-entry growth. Two main channels of this impact will be addressed in the paper: (1) the characteristics of the employees themselves, e.g. qualifications, age or gender and (2) the modes of how the work of these employees is organized, particularly the degree of flexibility. In the following, a conceptual background will be developed by giving an overview of relevant previous studies. First, it will be argued why employment quality matters particularly in young firms, and, secondly, it will be outlined how, i.e. on which channels, it impacts.

### **2.1 Why employment quality matters**

In times of increasing internationalization and a continuous acceleration of technological change, factors like knowledge, innovation, connectivity and reactivity become more and more important for economies, regions and firms in order to maintain and strengthen their levels of competitiveness. Two main factors illustrating these trends are the increasing importance of both human capital and flexibility.

This growing role of human capital can be observed, for example, in considerably rising educational levels, in increasing R&D expenditures as well as in the constant and remarkable growth of labor productivity.<sup>5</sup> For firms, the availability of human capital is an important precondition to obtain information about markets and technologies, it is a pivotal element of their strategic development and, last but not least, it may serve as a signal to clients and competitors (Bosma et al. 2004, Gimmon and Levie 2010).<sup>6</sup>

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<sup>5</sup> The shares of people aged 25-64 with a tertiary-level education, for example, grew from slightly more than 21.2 % in 1999 to 26.8 % in 2006 in the average of most OECD countries; total R&D expenditures have been rising from 2.21 % of GDP in 2003 to 2.34 % in 2008 in the OECD; labor productivity grew by 1.5 % in the annual average between 2001 and 2010 ([www.oecd.org](http://www.oecd.org)).

<sup>6</sup> "[P]rospective stakeholders such as clients, subcontractors, and investors are likely to have imperfect information about the type of firms they consider dealing with. Therefore, these parties evaluate firms (and the prices involved in for instance buying their services) based on observable characteristics that they presume to be correlated with the unobserved type/quality of the firm and its founder" (Bosma et al. 2004, p. 229).

The increasing flexibility of work can be observed both on a quantitative level with e.g. growing shares of part-time work, marginal and short-term employment and on a qualitative level with higher degrees of self-dependence of employees or declining job security (for an overview, see Kalleberg 2009). Flexibility of the workforce of a firm can help the firm acting in volatile markets and reacting to technological trends and/or economic needs by, e.g. reallocating employees within the firm or between the firm and the market. Flexibility has various facets (see Valverde et al. 2000): numerical flexibility refers to changes in the quantity of the workforce, functional flexibility relates to the allocation of tasks to employees, and, last but not least, financial flexibility is characterized by wages and labor costs.

Human capital and flexibility are supposed to be particularly important for newly established firms.<sup>7</sup> Due to their often immature internal structures, due to lacks of reputation, imperfect channels of distribution, insufficient access to knowledge and networks – briefly: due to less developed resources (Penrose 1959, Garnsey 1998) – new firms are facing specific hazards and they need particular strategies to be capable of competing successfully with incumbents and to be able to grow: “Since it takes some years to develop specific knowledge, trust and appropriate routines, it follows that newly founded firms are less likely to be able to cope with environmental challenges than established organizations” (Baptista et al. 2007, p. 7).

These particular challenges of young firms have been described decades ago as the “liability of newness” (Stinchcombe 1965, Freeman et al. 1983). As most new firms start small, liabilities of newness frequently go hand in hand with “liabilities of smallness” meaning that many new firms fail to grow to the minimum efficient size in their respective industry necessary to be successful (e.g. Aldrich and Auster 1986, Strotmann 2007).

In the view of Cohen and Levinthal (1989, 1990) the combination of individual skills and prior knowledge of people constitutes their capacity to cope with external developments and progress, to absorb e.g. new technologies or new managerial techniques and to apply them to the context of their own firm – the absorptive capacity. Therefore, particularly in new firms, the skills, the experiences and the qualifications of the people working there constitute an important basis for the firm in order to cope with technological development and other external challenges.

For young firms, various strategies and factors may help to overcome these liabilities, most of them associated with human capital as a pivotal resource. In this context, most empirical studies describe and analyze how the human capital of founders (including founding teams) influences both the survival and the growth of new firms (see, for example, Bates 1990, Cooper et al. 1994) and only very few studies also account for a potential role of the characteristics of employees and the structure of the workforce in early stages of firms’ development (e.g. Boschma et al. 2009, Timmermans 2010, Ostergaard et al. 2011). However, precisely because of the newness and the smallness of young firms, the role and the influence of the early employees might be quite important, although probably of a different quality compared to that of the founders.

In the present paper, therefore, we follow a more general approach by primarily analyzing the role of the human capital embodied in the employees of the firms: “Employees are considered as the most important resource for SMEs. Knowledge of individuals plays a crucial role in building competitive advantage of a firm. Small firms are more likely to engage in innovation activities due to their constraints in available resources, and therefore high quality workforce and further human resource development within the organization is rather important for such firms” (Zhou and de Wit 2009, p. 10).

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<sup>7</sup> By “newly established firms” we refer to ordinary and independent start-ups throughout the present paper. I.e., firms evolving from processes of outsourcing, M&A or restructuring (e.g. spin-offs, dependent subsidiaries) are excluded due to the fact that these types of new organizations dispose of fundamentally different endowments with and access to external resources (see also Freeman et al. 1983).



When a new firm comes to the market, it has to cope with various environmental challenges. Those start-ups disposing of the most relevant resources and developing the best strategies will be most likely to survive and to grow in their early years. Thereby, some scholars (e.g. Cooper et al. 1994, Dahlqvist et al. 2000, Geroski et al. 2010) stress the important role of the conditions at the time of founding both of the environment and of the firm itself (size, strategic choice, human capital) for the probability of survival and growth. The initial choice of strategies is believed to be highly persistent over time. As strategies are strongly dependent on the decisions of the management of a new firm, the founder or the founding team are quite influential in this respect (theory of organizational imprinting, see Stinchcombe 1965, Heirman and Clarysse 2005).

“The effect of initial decisions may also persist because strategic decisions frequently involve the deployment of resources that cannot be later reallocated, that is, which are sunk. When investment costs are sunk, there may be little point in reversing a decision, as costs cannot be recovered” (Geroski et al. 2010, p. 12f). However, also the personnel of the early stages of a new firm is likely to have a long-ranging impact on the development of the firm as – particularly in small firms – the employees of a new firm supposedly have strong and intense linkages to their firm and thus also influence its performance. In the following paragraphs, it will be shown through which channels employment quality influences the post-entry growth of new firms. We will thereby focus on the roles of particular characteristics as well as of the structure of the workforce of the new firms.

## **2.2 How employment quality matters**

The workforce during the early stages of new firm’s development can be conceived as a strategic resource and we will analyze several aspects of its impact on the firm’s early growth. These aspects are classified into two main groups: first, factors related directly to the employees, i.e. their immanent characteristics like e.g. education, age, sex and nationality. Thereby, it will be shown that not only the quantity (or the shares) of these characteristics matter, but also their composition, i.e. diversity. The second group of factors concerns the organization of work inside the firm, i.e. the flexibility of the workforce.

### **Human Capital**

Human capital, mostly conceptualized as education, experiences and skills (e.g. Rauch et al. 2005) is known for being an important factor affecting productivity and growth both on the level of individuals, firms, and economies (cities, regions and nations). On the individual level, a plethora of empirical studies have shown how both general and specific human capital positively affect e.g. employee productivity, wages or careers (for overviews, see Mincer 1974, Card 1999, Tchernis 2010).

On the level of firms, a number of empirical studies analyze the effects of the human capital of workers on firm performance, i.e. productivity and growth (see, for example, Black and Lynch 1996, Rauch et al. 2005, Crook et al. 2011). With regard to young firms, the majority of these contributions is directed towards the human capital of the founders of start-ups (e.g. Bates 1990, Cooper et al. 1994, Bosma et al. 2004, Colombo and Grilli 2005, Dahl and Reichstein 2007). Many of these empirical studies agree in observing that the specific human resources of founders (e.g. industry experience or prior entrepreneurial ventures) are more important than the general human resources like years of schooling or overall work experience (e.g. Stam et al. 2008, Brixy and Hessels 2010, Gimmon and Levie 2010). Colombo and Grilli (2005), in a sample of more than 500 Italian new technology-based firms, show that especially education related to the new firm’s field of activity and work experience involving prior entrepreneurial ventures have positive impacts on the post-entry growth of the new firm, albeit the relations are not always clear-cut. On the basis of a dataset covering the entire Danish labor market, Dahl and Reichstein (2007) conclude that prior experience of founders “facilitates access to knowledge and routines, which ultimately will be of significant benefit” for the survival of the new organization (p. 507).

With regard to the effects of employees' human capital on the growth of new firms, the majority of existing empirical research is directed towards incumbent firms, although at least small and medium sized enterprises are not neglected. Lepak et al. (2003) show, for example, that knowledge-based forms of employment can generate resource flexibility and are thus beneficial for firm performance. By accumulating knowledge inside the firm – for example by hiring employees with high formal qualifications or specific skills adequate to the start-up's demand –, a strategy of innovation can be pursued and it also may help sticking to the forefront of technological and/or managerial development. Rauch et al. (2005), in a longitudinal study of 119 small scale businesses in Germany, find that "human resources development and utilization was most effective when the human capital of employees was high" (p. 681). With regard to firm survival, Geroski et al. (2010), in a study of nearly 120,000 Portuguese firms, find that firms with more human capital (measured as the share of employees with college degree) are less likely to exit the market within the first ten years.

Whereas for founders the majority of empirical studies are able to identify positive effects for *specific* human capital only and results for general human capital like education are mixed, particularly studies from the field of labor economics show that there may be effects from *general* human capital of the workforce on firms' performance. Due to the small size of young firms, the early labor force is a pivotal factor in a start-up's development, but specific competencies might not be as important as those of the founders or owner-managers. Therefore, general human capital of employees like, e.g. their education and general skills are assumed to have a positive impact on a new firm's early growth. The theoretical rationale is, inter alia, the conception of employees' education as a resource of the firm, allowing e.g. for gains in opportunity identification and absorptive capacity, particularly with regard to innovation and competitiveness. Qualification opens channels for the perception of opportunities; it is associated with technological and business competencies and is a signal to customers (Bosma et al. 2004).

However, formal qualifications and skills are not equally important for all firms and there might also be drawbacks. For example, employees with higher qualifications earn higher wages *ceteris paribus*, they have higher requirements to the workplace (which can often not be fulfilled in young firms) and they are more likely to change the employer as they dispose of more and better information channels. Therefore, it depends on the specific circumstances of the firm as well as on its abilities to attract and bind highly qualified personnel whether these people have a positive impact on the firms' performance.

### **Age of employees**

A second factor which might have an effect on a start-up's performance is the age of employees. Older and younger individuals do not only differ with regard to their past experiences (i.e. specific human capital), but also with regard to e.g. attitudes, capabilities and flexibility. Thus, older and younger employees might be relevant to the performance of young firms in different ways. Whereas younger people might be conducive to growth, as they might be more willingly to take risks, older workers might be more beneficial regarding survival as they could be more intent on the safety of their job.

Particularly in labor economics, several empirical studies have analyzed how the age of the workforce influences firm performance, albeit with mixed results. Göbel and Zwick (2009), for example, in an empirical study of 8,500 German establishments, find that the productivity of these establishments increases with the mean age of their employees until the age of 50 to 55 years and it decreases only slightly afterwards. In a similar vein, Bellmann et al. (2003) conclude in an examination of the IAB Establishment Panel, a yearly survey of employers in Germany, that older workers are considered at least as capable by human resources managers as the younger (average across all items). Grund and Westergaard-Nielsen (2008) find an inverted U-shaped relationship between employees' age (and age diversity) and firm performance.

Unfortunately, none of these studies considers new firms explicitly. With regard to young firms, the role of younger and older workers might have different key aspects as start-ups requirements and characteristics differ from those of incumbents. With regard to the young firms' greater risk and uncertainty, younger workers might be more conducive to bring such undertakings to a successful end. However, at the same time, precisely older workers might help overcoming periods of uncertainty and turn them into growth with their experience. From a theoretical viewpoint, obviously, it seems difficult to judge which characteristics are more conducive to a good performance of a new firm. This might strongly depend on other characteristics of the employees or of the firm itself or on the diversity of the workforce (see below).

## **Diversity**

Various empirical studies point to the fact that the internal structure and the diversity of the characteristics available in a (new) firm is a more important asset than the simple presence of one group of workers or another. A diversified structure of the workforce regarding, for example, age, qualifications or experiences can be beneficial to the success of a new firm in several ways (Johannisson 2000): With regard to the environment, it may raise its ability to react and to adapt to external shocks, as there are more capabilities to cope with different (unexpected) situations. There is some reason to believe that firms with more heterogeneous workforces outperform firms with more homogeneous employees, as diversity might provide access to a broader set of external resources (e.g. Brüderl et al. 1996, Colombo and Grilli 2005, Stam and Schutjens 2005). With regard to internal processes and performance, it may be beneficial with regard to a problem solving behavior and to processes of innovation, as diversified teams have a higher absorptive capacity and allow for more and new resource combinations which can yield firm growth themselves (Eisenhardt and Martin 2000).

For new ventures, diversity has been exclusively analyzed with regard to founding teams, where several studies show mainly positive, but also somewhat mixed effects (see Delmar and Shane 2006, for a critical overview). Stam and Schutjens (2005), for example, find in principle positive effects of team foundations on the growth of new ventures, but they also find a rather differentiated picture when looking closer – including a superior performance of solo start-ups after the first three years and team start-ups losing “their shine” after that period. Cantner et al. (2010), in a study of more than 330 new ventures in Germany, find that whereas the *knowledge scope* dimension of founding teams positively affects new venture performance, the dimension of *knowledge disparity* has negative effects. This is in principle in line with the more general observation that diversity needs coordination which could be difficult to provide beyond a certain point (see Tibben 2006, Ilmakunnas and Ilmakunnas 2010).

With respect to the role of the workforce's diversity on firm performance – where start-ups are widely disregarded –, the tenor of empirical studies is also positive, but also some drawbacks are outlined. Ilmakunnas and Ilmakunnas (2010), for example, find positive impacts of employee age diversity, but negative impacts of the diversity of qualifications on the productivity of firms. Parrotta et al. (2010), contrariwise, find evidence that educational and skill diversity enhance firm performance, but that diversity in terms of age and ethnicity brings mixed results. In their study based on a dataset comprising all Danish employees in the years 1980-2005, they interpret this finding by negative effects of communication and integration costs regarding the latter.

Studies focusing on the possible effects of the age structure of the workforce on firm productivity (for an overview, see Lallemand and Rycx 2009) also bring a series of mixed results: In a representative study based on German linked employer-employee data, Backes-Gellner and Veen (2009) analyze the role of the age and the age structure of the workforce for the productivity of firms. Whereas they have mixed results regarding the role of the average age of the workforce, they find that a diversified age structure has positive impacts, particularly in innovative and creative industries (i.e. where people collaborate in their everyday work). For a sample of all Danish firms with at least 20 employees, Grund and Westergaard-Nielsen (2008) show a differentiated picture regarding the effects of the age structure of the workforce on firm performance (value

added/employee): they find inverse U-shaped relationships between mean age and standard deviation of age with firm performance.

Last but not least, some studies also examine the role of diversity on innovation, which could be of particular interest to young firms. Ostergaard et al. (2011), for example, investigate the relation between employee diversity in different respects and innovation. They find, inter alia, positive effects of diversity in education and gender, whereas age diversity negatively affected the likelihood of introducing an innovation.

As already noted above, studies also point to a downturn of diversity: Tibben (2006), e.g., finds an inverse U-shaped relation between diversity and performance meaning that there is a turning point behind that an increase in diversity might be harmful to a firm. This finding corresponds with the assumption of Ilmakunnas and Ilmakunnas (2010, p. 3) that “even with positive diversity effects, there may also be additional communication costs, which lead to a trade-off between the benefits and costs.”

## **Flexibility**

As new companies are likely to be active in more volatile and/or innovative market segments and also face a higher exit risk due to the liability of newness, the structure of labor which is contracted in a new firm constitutes an important resource with regard to possible reactions to external changes. But also in a more general way new entities have to cope with several disadvantages in comparison to incumbents. One further strategy to cope with these challenges in early stages of the start-up’s development, which may not only increase the probability to survive but which may even enhance early growth, is the flexible allocation of the workforce (e.g. Nelen et al. 2011). Firms can achieve flexibility in a number of ways of which two main classes are of interest for the present contribution (see Valverde et al. 2000, Lepak et al. 2003):

**Numerical or coordination flexibility** is associated with the ability to adapt the number of employees or of the hours worked to changing external conditions, e.g. a quickly rising demand or a need to produce cheaper than before. This type of flexibility can be achieved, for example, by flexible work contracts, by part-time work, by reverting to temporary work or by contracting marginal employees (external vs internal employment modes).

**Functional or resource flexibility**, on the other hand, refers to the observation that it is sometimes necessary to have flexible employees in the sense that one can undertake the tasks of her colleague very flexibly – or, in the words of Lepak et al. (2003, p. 684), “flexibility in terms of the effective deployment of their internal workforce”. In this perspective, flexibility may be achieved by employing experienced or highly skilled (but not necessarily highly specialized) employees that can be deployed for very different tasks (Lepak et al. 2003, p. 684).

Many scholars stress the significance of the ability of firms to adapt to changing external conditions (Levinthal 1997, Geroski et al. 2010). In an empirical survey of 148 large U.S. firms, Lepak et al. (2003) examine the role of different modes of employment (knowledge-based, job-based, contract, and alliances) in firms on the performance of these firms. They find, inter alia, that a greater use of contract work enhances performance, but that, however, contract work and knowledge-based employment mutually exclude each other.

Nelen et al. (2011), in a study of Dutch pharmaceutical firms, find that “firms with a large share of part-time employees are more productive than firms with a low share of part-time employees” (p. 12) and they trace these differences back to allocation efficiencies. On the basis of survey data from 1,400 Swiss firms, Arvanitis (2005) finds a negative impact of numerical flexibility, though positive effects of functional flexibility on labor productivity. He also finds, however, that both numerical and functional flexibility positively affect innovation measures on the firm level.

However, there may also be a downside of flexibility, as it may cause discontinuity and instability in the firm's development and it faces a higher risk of exit due to internal problems – “flexibility comes with built-in costs and problems” which may undermine the potential benefits of flexibility for competitiveness and growth (Valverde et al. 2000, p. 653).

### 2.3 Further Factors

Additionally to education and age of employees, further factors immanently linked to the employees are supposed to have an impact on the post-entry growth of new firms. For example, gender of founders has been examined in various studies, albeit with mixed results. According to Gottschalk and Niefert (2011, p. 1), two main approaches can be summarized with regard to the observation that female-owned businesses are outperformed by male-owned businesses: “Liberal feminist theory suggests that women lack access to relevant resources like education and business experience or financial capital. Social feminist theory suggests that women have different attitudes and values and, consequently, adopt a different approach to business.”

There is a broad set of other factors influencing the development of start-ups. These are partially internal to the firm (e.g. characteristics of founders, business strategies, firm size) and partially external to the firm (e.g. market size, industry, region, business cycle). For overviews see Evans (1987), Geroski (1995), Brüderl et al. (1996), Garnsey (1998), Koch and Strotmann (2006), Shane (2006), Coad (2007). Although the present contribution focuses on the analysis of a possible impact of characteristics of the workforce on the post-entry growth of start-ups, we will therefore include several of these further variables like firm size and firm age into the estimations without discussing them here in detail.

## 3 Data and measurement issues

To analyze the impact of a newly founded establishment's employment structure on its post-entry growth in Germany this study uses the weakly anonymous Establishment History Panel (Years 1999 – 2006<sup>8</sup>, “Betriebs-Historik-Panel” – BHP). Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and remote data access. The BHP is composed of annual cross sectional datasets containing all establishments (local units) in Germany with at least one employee liable to social security (for details see e.g. Spengler 2008). BHP data are available since 1975 for West Germany and since 1991 for East Germany. The number of establishments amounts to approximately 2.7 million in 2006 with about 32 million employees. Since 1999, establishments with no employees liable to social security but with at least one marginal part-time employee are also included (see Koch and Späth 2009 for further information). As external researchers, we have access to a 50% random sample stratified by establishment size.

As the BHP is based on data generated on the basis of administrative processes (namely the compulsory employment notifications of employers), most of the information provided is very reliable and of high quality compared to data from establishment surveys. As the employers are obliged to provide the information, many typical problems of survey data as e.g. the refusal to give information or giving deliberately false information are of minor importance in the BHP (see also Spengler 2008, p. 503f.). Moreover, panel mortality is a less important problem compared to survey data.

As the following empirical analyses will focus on the post-entry performance of newly-founded establishments, some remarks with respect to the identification of entries have to be made. Following the proceeding of many

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<sup>8</sup> We use this reduced time period because of our interest in flexible work forms such as marginal employment, which are partially only included in the data since 1999 (see below).

empirical studies, an establishment is supposed to be an entry if it reports employment liable to social security in year  $t$ , but not in year  $t-1$ .<sup>9</sup>

However, it has to be noted that there may be other reasons than the foundation of a new entity for being newly included into the dataset: a temporary interruption of production, having temporarily no employees, a change of the ownership or of the legal status, the occasion of a merger of two existing companies or a partly inconsistent proceeding in different local employment agencies may also generate new establishment IDs (see Bender et al. 2000, Brixy and Fritsch 2002, Koch and Späth 2009, Spengler 2008).<sup>10</sup>

While a “true” identification of actual entries is impossible, some important corrections are made to reduce the ambiguity as far as possible. Following a suggestion by Brixy and Fritsch (2002), establishments that have temporarily disappeared from the data are counted as one and the same establishment if the gap is shorter than three years, whereas larger gaps are considered to be closures with subsequent re-founding.<sup>11</sup> Possible identification problems due to changes of ownership, the occasion of mergers or spin-offs are mitigated by excluding new establishments with a start-up size of 20 or more employees liable to social security from the analyses. Moreover, information on new establishments for the years without employees subject to social security but with marginal employees is discarded in order to guarantee a consistent definition of entries and exits throughout the whole sample period.

Another possible problem relates to the fact that the BHP data contain information on establishments (local units) and not on firms (legal units). Thus, it is probable that – despite the outlined corrections – not all new entities which we identify in the data are de facto independent, originary foundations – they may also be newly established dependent subsidiaries of established firms. However, as nearly 98% of all establishments in Germany are single-site companies (local and legal unit at the same time, see Koch and Krenz 2010) and as we exclude establishments with 20 or more employees in the start-up year, this problem is of minor relevance.

A further aspect that must be taken into account when analyzing entry and exit with the BHP is that the dataset only contains annual snapshot information for June 30<sup>th</sup>. On the one hand, this may lead to an underestimation of entries and exits, as units entering and exiting the market within one year are not covered. On the other hand, due to high seasonal employment in summer, the number of entries and exits may also be biased compared to other periods of the year.

## 4 Specification of the Model and Estimation

The aim of the following empirical analyses is to examine the impact of the initial employment structure on the post-entry growth of newly founded establishments in Germany. As there is a considerable structural break in

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<sup>9</sup> Exits are identified in an analogous manner: an establishment is considered to be a closure if it reports data in the year  $t-1$ , but not in the year  $t$ . Closures comprise both the cases of insolvency and of voluntary closure, as a distinction cannot be made.

<sup>10</sup> The IAB has recently released a new version of the Establishment History Panel where these shortcomings can – in part – be avoided. This study, however, uses an earlier version of this dataset where the identification of entries relies on a different method. See next paragraph.

<sup>11</sup> This implies that exits can be identified in our data until the year 2003. If an establishment still exists in 2004, but fails to appear in the data from 2005 onwards, we cannot observe whether it will re-appear in the data after the year 2006 (the end of our observation period) or whether it will not come back. In the former case, it would just be a temporarily disappeared establishment, whereas in the latter case it would have to be counted as an exit. The calculations in this paper use data for the years 2000-2006 (see below). Thus, even establishments potentially disappearing from the data only temporarily are counted as exits. Robustness checks showed, however, that the results nearly did not change at all.

the data in 1999 due to (1) the additional inclusion of marginal employment<sup>12</sup> and (2) because of a major change in the classification of industries, the following empirical analyses will be restricted to the period from 1999 to 2006.<sup>13</sup> Based upon the proceeding described in section 3, all establishments founded between July 1999 and June 2005 are used for the analysis of post-entry employment growth until June 2006. Following the usual proceeding in the empirical literature on firm growth, an establishment's annual employment growth is calculated as the difference of the natural logarithms of its employment in the years  $t$  and  $t - 1$ :

$$(1) \quad growth_{i,t} = \ln(E_{i,t}) - \ln(E_{i,t-1})$$

where  $E_{i,t}$  stands for the number of employees in establishment  $i$  at time  $t$ .

The vast majority of existing studies on post-entry performance of firms measures employment growth according to the upper definition. However, in times of rising or decreasing prevalence of part-time work, the growth of the number of employees may deviate significantly from the growth of total labor demand measured in hours worked. In order to gain additional insights in possible differences between employment growth measured in number of employees and employment growth measured in working hours, we will alternatively measure a start-up's growth as the growth of an establishment's full-time equivalent employment.

As our data do not contain information on the exact number of hours worked, full-time equivalents are calculated under the assumption that two part-time employees equal one full-time employee. Part-time work, thereby, is defined as "not full-time".<sup>14</sup> The classification whether a person works full-time or not is made by the employer and not by the data-collecting authorities. Thus, it is not based on a general working hour's threshold for all industries. However, the data allow distinguishing regular part-time employment liable to social security from marginal employment for which no social security contributions have to be paid.

Based upon our theoretical considerations in section 2, the following explaining variables are included into the model to examine the post-entry performance of start-ups when explaining the above outlined growth variables:

**(1) Establishment-specific initial employment structure**

- To measure the impact of an establishment's employees' initial human capital on its growth, information about the *qualification of the employees* is included. The BHP data allow distinguishing between employees with low qualification levels (neither vocational training degree nor high-school degree), medium qualification levels (workers with either high-school degree or vocational training degree or both) and high qualification levels (technical college and/or university degree). Due to data shortcomings, a fourth category – employees with unknown qualification levels (due to either non-reporting or impossible classification) – is reported as well.<sup>15</sup> Across the BHP, the total share of employees with unknown qualifications amounts to about 16 % in 1999 and 23 % in 2006, respectively. For newly-founded

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<sup>12</sup> Marginal employment is defined as employment with a monthly wage below a certain threshold (currently 400 EURO). It is not subject to social security obligation, but its notification to the Federal Employment Agency is compulsory for employers. It shall not be concealed that this threshold is subject to some variation over time: For the period 1999-2001, it amounts to 322 Euro, afterwards it shifts slightly to 325 Euro in 2002. Since 2003, it totals 400 Euros per month.

<sup>13</sup> Since our variable to fulfil the exclusion restriction of the sample selection models estimated later combines information from the years  $t$  and  $t-1$ , the time period available for our analyses reduces to the years 2000 until 2006.

<sup>14</sup> Studies based on representative data of the IAB Establishment Panel for Germany support the validity of this assumption: Wahse et al. (2010, p. 32) find average working hours for part-time employees of 22 hours in the East German Länder and 18 hours in West Germany.

<sup>15</sup> The declaration of qualification is mandatory for employers, but reporting it incorrectly has no consequences for the employer (Fitzenberger et al. 2005, p. 5).

establishments, it is still a bit more important as about 24 % (East Germany) and 36 % (West Germany) of all employees in young establishments cannot be categorized according to their qualification (for details see Koch and Späth 2009).<sup>16</sup>

As nearly 75% of the start-ups (with employees subject to social security obligation) have an initial size of only one or two employees (see also section 5.1), we abstain from using employment shares as explaining variables in our regression models as these are not really continuous variables. Instead, we use dummy variables which take the value 1 if an establishment had at least one employee within the categories of qualification considered.

Focusing on differences between establishments with low-skilled and high-skilled employees in the year of start-up, we define establishments without any low-skilled or high-skilled employee in the year of start-up as our reference category. Three different dummy variables are then defined for establishments (1) using low-qualified labor, but no high skilled labor, (2) employing high-skilled labor, but no low-skilled labor or (3) employing both high-skilled and low-skilled labor. Additionally, a binary dummy variable controls for the existence of employment of unknown qualification to make sure that our results are not biased by this problem. If we are interested in the total impact of having at least one low-skilled employee in the year of start-up we will have to test whether the sum of the estimated coefficients of the dummy variables (1) and (3) is different from zero. Similar proceedings apply for the case of at least one high-skilled employee and for further regressor variables explained below.

- A possible impact of the *“flexibility” of a start-up’s employment structure* on its post-entry performance is proxied in the following manner: The reference category is establishments that are using neither regular part-time employment nor marginal employment in the year of start-up. Three alternative dummy variables are then defined informing whether (1) an establishment has at least one regular part-time employee in the year of start-up, but no marginal employment, (2) an establishment has no regular part-time employees, but at least one marginally employed employee or (3) an establishment has both regular part-time employment and marginal employment in the year of start-up.
- As a variety of existing studies (see section 2) show that *the age structure of the workforce* might be important for firm performance, we also include three binary dummy variables: A first dummy variable captures all establishments with at least one young employee (<25 years) in the year of start-up, but without older employees (≥50 years). A corresponding second dummy variable takes the value 1 for all establishments with at least one older employee in the start-up year, but without young employees. The reference category is given by all establishments which do neither employ people younger than 25 years nor employees aged 50 years or more. To account for a possible impact of *age diversity* on post-entry performance, a third dummy variable takes the value 1 if an establishment has both at least one young and one older employee in the year of foundation.
- As further characteristics of the initial structure of the workforce, the *gender structure* of employment and information about the *nationality of the employees* are considered. To be able to measure possible *gender diversity* and *nationality diversity* effects, we define the dummy variables as follows: The reference category for gender (resident aliens) are establishments which are not employing women (resident aliens) in the year of start-up. Two dummy variables are then defined in each case to measure whether (1) an establishment employs only women (only resident aliens) in the year of start-up or (2) whether it employs men and women (natives and resident aliens).

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<sup>16</sup> The information about the employees’ qualifications can, in principal, be improved using multiple imputation (see Fitzenberger et al. 2005). However, this requires access to the individual spell data which we do not have.



## (2) Further establishment-specific control variables

- As the vast majority of existing empirical studies on the post-entry performance of firms point to the fact that there is a liability of smallness, we include the natural logarithm of employment in the year of foundation ( $\ln E_0$ ) and its square as standard control variables for establishment size into our regressions (see e.g. Evans 1987 or Dunne et al. 1989 for further information).
- A possible impact of firm age on the growth performance (“liability of newness”) which is predicted e.g. by life cycle models in the tradition of Jovanovic (1982) or Ericson and Pakes (1995) is controlled by including establishment age and its square into the model.
- The firm founder and his/her experiences, qualifications and managerial talent are also known to be of utmost importance for the post-entry performance (see section 2). However, in our data we do not have information about founder-specific characteristics. To examine whether our estimation results may be biased by not taking into account founder-specific information explicitly, we will estimate panel regression models additionally as robustness checks in section 5.3 to control for time-constant unobserved heterogeneity.

## (3) Sector-specific and regional determinants of post-entry performance

To take into account *sector-specific determinants* of post-entry performance as e.g. differences in an industry’s minimum efficient scale, in industry growth, in market size and dynamics, in technological conditions or in R&D-intensities, sector-specific dummy variables are added on the 2-digit-level of the German Industry Classification (*Wirtschaftszweigsystematik – WZ*). To examine a possible *impact of regional market conditions* on the performance of entries, we also include regional dummy variables at the NUTS-2-level into our regression models. They control for e.g. differences in regional supply- and demand-side conditions (see Krumm and Strotmann 2010). A possible impact of the *macroeconomic conditions* on performance is taken into account by the use of annual dummy variables.

Equation (2) summarizes the regression model to be estimated for explaining the employment growth of establishment  $i$  in the period  $[t - 1; t]$ .

$$(2) \quad y_{it} = \beta_1 X_{1i,0} + \gamma_t + \gamma_n + \gamma_m + \varepsilon_{it}$$

$X_{1i,0}$  is the vector of establishment-specific variables in the year of entry including a constant term,  $\beta_1$  is the corresponding vector of coefficients to be estimated.  $\gamma_t$  ( $t = 2001-2006$ ) are annual time fixed effects accounting for macroeconomic conditions and, since establishment age is controlled, for cohort-specific effects, too.  $\gamma_n$  are sector-specific dummy-variables for  $n = 1-48$  two-digit industries,  $\gamma_m$  are regional dummy variables for  $m = 1-38$  German regions at the NUTS-2-level. To account for the fact that the observations are not independent, standard errors are corrected for clustering (see, for instance, Baum 2006, p. 138f.). Moreover, standard errors are robust to heteroskedasticity of unknown form.

To analyze the determinants of post-entry growth and to make sure that our results are robust to a variety of possible statistical problems, we follow a set of different estimation strategies. Our baseline model is a simple pooled OLS estimation of equation (2). However, a relevant problem in estimating growth equations for newly founded establishments is the possibility of a selection bias. A selection bias may occur as the least successful start-ups – those which even dropped out of the market – are systematically selected out of the panel data. To check the robustness of our estimation results against the existence of a selection bias, we additionally estimate a Maximum Likelihood Heckman selection model which corrects for non-randomly selected samples. Thus, we estimate the following two-equation system:

$$(3) \quad y_{1i,t}^* = \beta_1 x_{1i,0} + \beta_2 x_{2i,t} + \varepsilon_{1i,t}$$

$$(4) \quad y_{2i,t}^* = \beta_3 x_{1i,0} + \beta_4 x_{3i,t} + \varepsilon_{2i,t}$$

where the starred quantities,  $y_{1i,t}^*$  and  $y_{2i,t}^*$ , are latent variables used to indicate when and how the measured quantities  $y_{1i,t}$  and  $y_{2i,t}$  can be observed:

$$(5) \quad y_{1i,t} = \begin{cases} 1 & \text{if } y_{1i,t}^* > 0 \\ 0 & \text{if } y_{1i,t}^* \leq 0 \end{cases}$$

$$(6) \quad y_{2i,t} = \begin{cases} y_{2i,t} & \text{if } y_{1i,t}^* > 0 \\ - & \text{if } y_{1i,t}^* \leq 0 \end{cases}$$

The error terms of the two equations are expected to be correlated as effect of the sample selection mechanism described above. Via the standard assumption of joint normality of the two disturbances, it is possible to derive the likelihood function for the model and to estimate it using Maximum Likelihood (see, e.g., Cameron and Trivedi 2009, p. 542).

To fulfill the exclusion restriction, we use the 2-digit sectoral and NUTS-2 regional entry rates:

$$(7) \quad \text{entry rate}_{nmt} = \frac{\text{establishment entries}_{nmt}}{\text{establishments}_{n,m,t-1}}$$

This proceeding is, among others, motivated by the well-known result of Geroski (1995), who concludes as a stylized fact that “[e]ntry and exit rates are highly correlated” (p. 423). Honjo (2004) also uses this variable in his study of Japanese manufacturing firms.<sup>17</sup> Also in our data, this entry rate can be shown to have a negative and significant correlation with the survival indicator  $y_{1i,t}$  and almost no correlation with the different employment growth rates we use as dependent variables. Furthermore, the entry rate is negative and significant in our baseline selection equations, thus it seems valid as an instrument to help identify the equation system.

As an additional robustness check, we also use semiparametric techniques to estimate the two-equation selection model shown above. This is achieved by a two-step procedure: First, we estimate the selection equation using the semiparametric Maximum Likelihood method by Gallant and Nychka (1987), see also De Luca (2008). The distribution of the error term which is not further specified is approximated by a Hermite polynomial expansion. Second, we use the predictions from the survival equation as the nonlinear term in the outcome equation. The nonlinear term can be shown to be a generalization of the inverse Mills ratio and therefore eliminates the selection bias from the second-stage equation (see also Cameron and Trivedi 2005, sections 9.7.3 and 9.7.7). The outcome equation is estimated semiparametrically by differencing out the nonlinear term, i.e. it can be considered as a partially linear model (see Lokshin 2006 as well as Robinson 1988, Hall et al. 1990 and Yatchew 1998).

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<sup>17</sup> Besides the entry rate, he uses another variable to help identify the selection model which is also meant to capture the competitive situation in the respective sector and region.

## 5 Empirical Results

### 5.1 Descriptives

Following the strategy to identify start-ups described in section 3, a total number of 484.000 newly founded establishments can be found in our data from 2000 to 2006.<sup>18</sup> Table 1 informs about the size-distribution of these new entities and illustrates that most of them are very small in the year of foundation: across all entry cohorts, an average of more than 90 % of the entries had only one to five employees liable to social security in the year of start-up. Establishments with an initial size of more than 11 (and less than 20) employees only account for 3.5 % of the start-ups.

As mentioned in section 4, this particular size structure justifies the use of binary dummy variables as regressors in our models instead of shares which would be 0 or 100 % for the vast majority of establishments. An examination of entry cohorts reveals that a large share of the newly-founded establishments leaves the market rather soon, pointing to a revolving door effect. For all cohorts considered, the one-year survival rate is about 71 %.<sup>19</sup> This means that about one out of four entries disappears within the first year either due to plant closure, due to mergers and acquisitions or due to moving the plant to other countries. After three years, the number of surviving establishments has decreased to about half of the initial number. Therefore, it is of utmost importance to make sure in our regression models (see section 5.2) that a possible selection bias does not affect our main conclusions.

**Table 1: Size-distribution of the newly-founded establishments in the respective year of foundation**

	2000	2001	2002	2003	2004	2005	Total
Establishment size <sup>a</sup>	Number: 97,489	Number: 87,314	Number: 79,441	Number: 71,367	Number: 73,822	Number: 74,802	Number: 484,235
1	59.1	58.0	57.8	57.0	59.0	59.8	58.8
2	16.1	16.1	15.9	16.0	15.7	15.7	15.9
3-5	15.1	15.6	16.0	16.5	15.3	15.0	15.6
6-10	6.4	6.7	6.8	6.8	6.5	6.2	6.6
11-20	3.3	3.6	3.6	3.7	3.4	3.3	3.5

<sup>a</sup> Number of employees liable to social security. Shares in percent. The number of establishments refers to our 50% sample

Source: Establishment History Panel, authors' calculations

Table 2 presents descriptive statistics for all regressors used in our regression models. Moreover, aggregate employment shares for the regressor variables are displayed – though we do not use them as explaining variables due to the reasons explained.

<sup>18</sup> The following empirical analyses are based upon the 50%-sample of the BHP (see section 3). As employment liable to social security is only of minor importance in some sectors and as entrepreneurial decision making and the market mechanism are hardly relevant in others, we exclude several industries from our analyses. Concretely, we discard information about the 1-digit industries "agriculture and forestry", "fishing", "mining and quarrying", "public administration and defense; compulsory social security", "activities of households as employers", "extraterritorial organizations", as well as on the 2-digit sector "activities of membership organizations without welfare, culture and sports".

<sup>19</sup> With regard to the sectoral distribution of establishments in our sample, new entities play an above-average role in "real estate & business services" and in "hotels and restaurants", whereas entry rates are below average in the manufacturing and in the trade sectors.

Regarding qualifications, the total share of low qualified employees amounts to nearly 10 % and more than 17 % of the start-ups engaged at least one employee with low qualifications in the year of foundation. Highly qualified people are less common in the start-ups with a total share of less than 4 % and about 7 % of establishments employing at least one high-qualified employee. For almost 42 % of the employees, the level of qualification is unknown in the year of start-up.<sup>20</sup>

46 % of the newly founded establishments between 2000 and 2005 use part-time work in the year of start-up and 30 % engage marginally employed persons. The corresponding employment shares are smaller with 31 and 14 %, respectively. Roughly one third of all start-ups employ at least one person younger than 25 years in the year of start-up, the corresponding share of establishments with at least one employee 50 years or older is similar. The shares of newly-founded establishments with at least one woman respectively at least one man are about two thirds in both cases. Almost every fifth newly founded establishment employs at least one resident alien. With respect to differences between the secondary and the tertiary sector, start-ups in the secondary sector have a higher start-up size which is consistent with many empirical findings formerly achieved (see, e.g., Mata 1996 or Mata and Machado 1996). Furthermore, start-ups in the secondary sector have a lower proportion of high qualified labor and of flexible work forms like marginal or part-time employment, and they employ less women at the time of start-up than new establishments in the tertiary sector.

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<sup>20</sup> Regarding unknown qualifications, Fitzenberger et al. (2005, p. 39f.) show that about 50 % can be classified as “medium qualified”, 20 to 25 % as “low qualified” and about 20 % cannot be assigned a qualification level at all. The imputation rules given in Fitzenberger et al. (2005), however, require access to the individual-level spell data and cannot be pursued with our data.

**Table 2: Descriptive statistics for establishment-specific variables at year of start-up (entry cohorts 2000-2005)**

Variable	Total N=484,235		Secondary Sector N=90,816		Tertiary Sector N=393,419	
	mean	standard deviation	mean	standard deviation	mean	standard deviation
ln (size)	0.7	0.8	0.8	0.9	0.7	0.8
ln <sup>2</sup> (size)	1.3	2.1	1.4	2.1	1.3	2.1
<b>Qualifications</b>						
Share of low qualified employees	9.7	25.6	11.6	27.2	9.2	25.2
Dummy (at least one low qualified employee = 1)	0.174	0.4	0.218	0.4	0.164	0.4
Share of medium qualified employees	44.2	44.6	50.2	44.1	42.8	44.6
Dummy (at least one medium qualified employee = 1)	0.556	0.5	0.628	0.5	0.539	0.5
Share of high qualified employees	3.9	17.0	2.5	13.1	4.2	17.8
Dummy (at least one high qualified employee = 1)	0.071	0.3	0.057	0.2	0.075	0.3
Share of employees with unknown qualification	41.5	45.4	34.8	43.4	43.0	45.7
Dummy (at least one employee with unknown qualification = 1)	0.510	0.5	0.451	0.5	0.523	0.5
<b>Flexible work forms</b>						
Share of part-time (= not full-time) hours per week	31.2	39.2	18.4	31.0	34.2	39.2
Dummy (at least one part-time employee = 1)	0.464	0.5	0.347	0.5	0.491	0.5
Share of employees with marginal employment (wage below threshold)	13.8	23.9	9.8	19.9	14.7	25.0
Dummy (at least one marginally employed employee =1)	0.297	0.6	0.244	0.4	0.304	0.5
<b>Age of employees</b>						
Share of employees younger than 25 years	16.7	30.7	17.6	30.7	16.5	30.0
Dummy ( at least one employee younger than 25 years = 1)	0.323	0.5	0.352	0.5	0.316	0.5
Share of employees 50 years or older	16.6	30.3	15.6	27.9	15.8	30.8
Dummy (at least one employee 50 years or elder = 1)	0.323	0.5	0.343	0.5	0.319	0.5
<b>Sex of employees</b>						
Share of women	49.2	43.8	21.8	34.1	55.5	43.3
Dummy ( at least one woman = 1)	0.636	0.5	0.397	0.5	0.692	0.5
Dummy (at least one man = 1)	0.649	0.5	0.886	0.3	0.594	0.5
<b>Nationalities</b>						
Share of resident aliens	11.4	28.3	9.7	25.9	11.8	28.8
Dummy ( at least one alien resident =1)	0.189	0.4	0.167	0.4	0.194	0.4

*Shares in percent. The number of establishments refers to our 50% sample*

Source: Establishment History Panel, authors' calculations

## 5.2 Empirical results of the regression analyses

In the following, the results of our baseline model estimations are presented for an establishment's post-entry growth measured both as full-time employment and as full-time equivalents. In section 5.3, additional robustness checks to examine the sensitivity of our results are performed.

Table 3 shows the results of our model estimations to explain establishment-level total employment growth after start-up, whereas table 4 presents the corresponding results for the growth of full-time equivalents.<sup>21</sup> To start with the issue of a possible selection bias, the maximum likelihood estimation of the Heckman model shows that there is indeed a significant selection bias due to firm closure.<sup>22</sup> However, it can be seen that the main conclusions with respect to the impact of the initial employment structure on post-entry growth are not affected by the selection bias. This holds also for the more robust semi-parametric estimation of the selection model ("partially linear model").

With regard to a possible *impact of the qualification structure of the workforce* of a newly-founded establishment on its post-entry growth, the results indicate that post-entry growth is indeed related to the *human capital of employees*. The estimation results show that establishments with at least one high-skilled employee, but without low-skilled employees have significantly higher rates of post-entry employment growth than establishments without any low- or high-skilled employees. In contrast, establishments with low-skilled employees, but without high-skilled employees in the first year show a significantly lower post-entry growth. The estimated coefficient of the joint dummy for having both low-skilled and high-skilled employees in the year of start-up is not significantly different from zero in all estimations.

To additionally analyze the impact of having at least one low-skilled employee, it has to be tested whether the sum of the two estimated coefficients (first the dummy for only low-skilled, no high skilled employees and, second, the dummy for low-skilled and high-skilled employees) is significantly different from zero. The results illustrate that having at least one low-skilled employee in the year of start-up significantly coincides with lower post-entry growth. The corresponding test for having at least one high-skilled employee demonstrates that establishments with at least one high-skilled employee show significantly higher post-entry growth, *ceteris paribus*. In the partially linear model, however, where the coefficient of having both high- and low-qualified labor is so large in absolute terms that the effect of high-qualified labor becomes insignificant. Both results hold independently from the measure of employment growth used, i.e. for the number of employees and for employment in full-time equivalents.

The estimated coefficients for the establishments with at least one employee whose qualification is unknown are negative and significantly different from zero in most specifications. This is consistent with the work by Fitzenberger et al. (2005), who conclude that about 50 % of the employees with unknown qualification belong to the medium-qualified employees (see also footnote 19).

Concerning the effect of *"flexibility" of an establishment's initial employment structure* on post-entry performance, a set of dummy variables is included into our models informing whether an establishment (1)

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<sup>21</sup> Results for the corresponding selection equations are available from the authors upon request.

<sup>22</sup> The results for the selection equation (not reported) correspond largely to well-known hypotheses on the determinants of firm survival: having at least one low-qualified employee at the time of entry lowers the probability of survival significantly, whereas the presence of at least one high-qualified employee has a significant positive effect. Establishment size at start-up is found to have a positive and significant linear, but a negative and significant quadratic effect on survival. This suggests that a certain threshold exists, beyond which additional employees decrease rather than increase the probability of survival. Furthermore, we find indications for both a liability of newness and of senescence – establishment age has a positive linear and a negative quadratic effect on the probability of survival.

uses regular part-time, but no marginal employment in the year of foundation, (2) uses marginal employment, but no regular part-time or (3) uses both regular part-time and marginal employment. The reference category is establishments without any part-time or marginal employment in the start-up year. To analyze the total impact of having at least one regular part-time employee on post-entry performance, it has to be tested whether the sum of the estimated coefficients for the dummy variables (1) and (3) is significantly different from zero. The corresponding test for an impact of employing at least one marginally employed person tests whether the sum of the estimated coefficients of (2) and (3) equals zero.

The first observation to be mentioned is that, with respect to the use of regular part-time and marginal employment in the year of start-up, the conclusions for the two different measures of post-entry growth are different: While in the models based on the number of employees the coefficients of all dummy variables considered are significantly negative, the corresponding coefficients are significantly positive when explaining establishment-level growth in terms of full-time equivalents. Thus, if an establishment uses regular part-time and / or marginal employment in the year of start-up, the post-entry growth of the number of employees will be – all other things equal – significantly lower. This holds for both types of flexible employment in a similar manner. These results are plausible as establishments without regular part-time employment and marginal employment may only grow if they hire another employee. Establishments using regular part-time work or marginal employment may in contrast also adjust their labor demand by increasing the total hours of work of the people already engaged before hiring new employees.

Therefore, if we alternatively consider an establishment's growth performance in terms of full-time equivalents, the estimation results demonstrate that establishments which are using regular part-time or marginal employment show – all else equal – a significantly higher post-entry growth of employment in full-time equivalents.

Considering the **age structure** of the workforce of newly founded establishments, a set of dummy variables measures whether an establishment has (1) at least one young employee (<25 years) in the year of start-up, but no older employees (≥50 years), (2) no young employees, but at least one older employee or (3) both at least one young and one older employee in the year of foundation. The reference category is establishments with neither young nor elder employees. The estimation results show that having only young, but no elder employees does not lead to significant positive employment effects regarding the number of employees. Considering the number of hours worked the results are mixed: in two out of three specifications they indicate a positive employment effect of employing younger but no elder employees at the time of start-up. They are, however, only significant at the 10 %-level. Employing both young and older employees in the year of start-up coincides with negative post-entry employment growth both in terms of the number of employees and in terms of full-time equivalents. Our estimation results thus point to a negative effect of age diversity on post-entry employment growth indicating that start-ups might not profit from the collaboration of younger and older employees at the same time. This effect also explains why the test if the sum of the estimated coefficients for the dummy variables (1) and (3) is different from zero leads to the conclusion that establishments with at least one young person in the foundation year show a significantly lower post-entry growth. If a start-up employs only elder, but no young workers, there is a significant negative impact on employment growth for both growth measures. The total marginal effect of employing at least one elder person remains also significantly negative.<sup>23</sup>

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<sup>23</sup> Also, Göbel & Zwick (2009) find that a firm's productivity decreases with the share of employees aged more than 55 years, albeit only very slightly. On the other hand, Bellmann et al. (2003) conclude in an examination of the IAB Establishment Panel, a yearly survey of employers in Germany, that older workers are considered at least as capable by

Considering the control variables for the possible role of gender and nationality of employees, the following conclusions can be derived. Other things equal, establishments with at least one female employee in the year of start-up have significantly lower rates of post-entry employment growth than establishments without women. This confirms a variety of existing empirical studies which also come to the conclusion that firms with women grow less than firms with men, though explanations are ambiguous.<sup>24</sup> Concerning gender diversity, we find that for the majority of the models estimated establishments with both male and female employees at the time of start-up experience lower growth than establishments with men alone (though the estimated coefficient is not always significant): the negative performance effect of female employees alone seems to persist in the gender-diversified establishments.

With respect to the ***nationality structure*** of an establishment's start-up employment, our estimation results indicate that establishments which are only employing resident aliens are having significantly lower rates of post-entry employment growth than establishments which are employing only native Germans. Likewise the results for gender, we find a negative effect of employing both resident aliens and Germans in most cases.

With respect to the impact of the establishment-specific control variables size and age on post-entry growth, our estimation results are consistent with the existing literature: For size, the results point to a negative and non-linear relationship between start-up size and post-entry growth. Thus, small establishments, if surviving, show on average significantly higher rates of post-entry growth. Establishment age can also be shown to have a negative and non-linear impact on growth.

Both the set of dummy variables for the different industries at the two-digit level as controls for a possible impact of different industry conditions and the dummy variables for possible regional determinants of growth performance are each jointly highly significant pointing towards significant industry and regional effects. The estimated coefficients for the annual dummies controlling for a possible impact of the macroeconomic environment are highly plausible as compared to the boom year 2000 the coefficients of the year dummies are mostly significantly negative.<sup>25</sup>

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HR managers as the younger (average across all items). Grund and Westergard-Nielsen (2008) find an inverted u-shaped relationship between employees' age (and age diversity) and firm performance.

<sup>24</sup> Gottschalk and Niefert (2011, p. 3) point to the fact that according to liberal feminist theory the lack of access to relevant resources like education, business experience or financial capital might partly explain this observation. Alternatively, it is sometimes argued that women might adopt a different business approach than men as they have different attitudes and values.

<sup>25</sup> Remember that the year-fixed effects do also measure cohort-specific effects, since firm age is controlled for, too.



**Table 3: Baseline models, all employees**

Dependent variable: growth rate of all employees (outcome equation)			
	OLS	Heckman	partially linear model
year = 2001	-0.0383*** (0.0028)	-0.0391*** (0.0029)	-0.0351*** (0.0035)
year = 2002	-0.0162*** (0.0027)	-0.0399*** (0.0028)	-0.0202 (0.0154)
year = 2003	0.0148*** (0.0027)	0.0124*** (0.0027)	0.0175*** (0.0028)
year = 2004	-0.0252*** (0.0026)	-0.0312*** (0.0027)	-0.0238*** (0.0053)
year = 2005	0.0027 (0.0026)	-0.0082*** (0.0027)	0.0089 (0.0110)
ln(size)	-0.1345*** (0.0019)	-0.0878*** (0.0021)	-0.1188*** (0.0318)
ln <sup>2</sup> (size)	0.0244*** (0.0007)	0.0168*** (0.0007)	0.0185*** (0.0034)
establishment age	-0.0842*** (0.0011)	-0.0577*** (0.0012)	-0.0575*** (0.0199)
establishment age <sup>2</sup>	0.0129*** (0.0002)	0.0099*** (0.0003)	0.0080*** (0.0020)
w. part-time outside m.e., but w/o marg. emp.	-0.0183*** (0.0013)	-0.0168*** (0.0014)	-0.0152*** (0.0024)
w/o part-time outside m.e., but w. marg. emp.	-0.0236*** (0.0015)	-0.0193*** (0.0017)	-0.0200*** (0.0018)
w. part-time in- and outside m.e.	-0.0136*** (0.0017)	-0.0147*** (0.0019)	-0.0105 (0.0074)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0115*** (0.0013)	-0.0161*** (0.0014)	-0.0105*** (0.0039)
w/o low-, but w. high-qualified	0.0202*** (0.0021)	0.0279*** (0.0024)	0.0181** (0.0077)
w. both low- and high-qualified	0.0024 (0.0042)	0.0065 (0.0048)	-0.0099 (0.0122)
unknown qualif. dummy	-0.0080*** (0.0010)	-0.0201*** (0.0011)	-0.0109 (0.0079)
w. younger, but w/o older (ref.: w/o younger and older)	0.0002 (0.0013)	0.0002 (0.0014)	0.0002 (0.0017)
w/o younger, but w. older	-0.0291*** (0.0012)	-0.0302*** (0.0014)	-0.0267*** (0.0019)
w. both younger and older	-0.0125*** (0.0018)	-0.0092*** (0.0021)	-0.0147*** (0.0047)

**Table 3 (continued)**

w. women alone (ref.: w. men alone)	-0.0211*** (0.0013)	-0.0079*** (0.0014)	-0.0125* (0.0066)
w. both men and women	-0.0094*** (0.0015)	0.0002 (0.0017)	-0.0026 (0.0058)
w. resident aliens alone (ref.: with Germans alone)	-0.0139*** (0.0022)	-0.0429*** (0.0024)	-0.0323*** (0.0124)
with both Germans and resident aliens	-0.0086*** (0.0016)	-0.0221*** (0.0019)	-0.0035 (0.0116)
industry dummies	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes
Observations	888,683	1,131,593	888,683
adj. R <sup>2</sup>	0.0411		0.0167
F/chi <sup>2</sup> (model)	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***	***
F/chi <sup>2</sup> (low-qualified, outcome equ.)	**	*	***
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***	***	
F/chi <sup>2</sup> (younger, outcome equ.)	***	***	**
F/chi <sup>2</sup> (older, outcome equ.)	***	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	***	
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***	***	
rho		0.5856	
chi <sup>2</sup> (indep. equations)		***	

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level.

Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

**Table 4: Baseline models, full-time equivalents**

	Dependent variable: growth rate of full-time equivalents (outcome equation)		
	OLS	Heckman	partially linear model
year = 2001	-0.0357*** (0.0029)	-0.0365*** (0.0029)	-0.0345*** (0.0036)
year = 2002	-0.0212*** (0.0027)	-0.0434*** (0.0028)	-0.0307* (0.0180)
year = 2003	0.0037 (0.0027)	0.0016 (0.0028)	0.0058* (0.0032)
year = 2004	-0.0286*** (0.0026)	-0.0341*** (0.0027)	-0.0290*** (0.0062)
year = 2005	0.0034 (0.0026)	-0.0067** (0.0027)	0.0059 (0.0133)
ln(size)	-0.1390*** (0.0018)	-0.0947*** (0.0021)	-0.1173*** (0.0392)
ln <sup>2</sup> (size)	0.0238*** (0.0007)	0.0166*** (0.0007)	0.0182*** (0.0042)
establishment age	-0.0754*** (0.0011)	-0.0506*** (0.0012)	-0.0482** (0.0240)
establishment age <sup>2</sup>	0.0115*** (0.0002)	0.0086*** (0.0003)	0.0068*** (0.0023)
w. part-time outside m.e., but w/o marg. emp.	0.0484*** (0.0014)	0.0491*** (0.0015)	0.0452*** (0.0023)
w/o part-time outside m.e., but w. marg. emp.	0.0293*** (0.0015)	0.0333*** (0.0016)	0.0303*** (0.0018)
w. part-time in- and outside m.e.	0.0578*** (0.0017)	0.0565*** (0.0019)	0.0555*** (0.0096)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0133*** (0.0013)	-0.0177*** (0.0014)	-0.0141*** (0.0047)
w/o low-, but w. high-qualified	0.0219*** (0.0022)	0.0291*** (0.0024)	0.0214** (0.0089)
w. both low- and high-qualified	-0.0022 (0.0042)	0.0016 (0.0047)	-0.0078 (0.0144)
unknown qualif. dummy	-0.0079*** (0.0010)	-0.0193*** (0.0011)	-0.0131 (0.0094)
w. younger, but w/o older (ref.: w/o younger and older)	0.0024* (0.0013)	0.0025* (0.0014)	0.0017 (0.0016)
w/o younger, but w. older	-0.0315*** (0.0012)	-0.0326*** (0.0014)	-0.0315*** (0.0020)
w. both younger and older	-0.0154*** (0.0018)	-0.0123*** (0.0020)	-0.0165*** (0.0058)

**Table 4 (continued)**

w. women alone (ref.: w. men alone)	-0.0284*** (0.0013)	-0.0162*** (0.0014)	-0.0197** (0.0077)
w. both men and women	-0.0156*** (0.0015)	-0.0067*** (0.0017)	-0.0082 (0.0066)
w. resident aliens alone (ref.: with Germans alone)	-0.0135*** (0.0022)	-0.0411*** (0.0024)	-0.0334** (0.0145)
with both Germans and resident aliens	-0.0089*** (0.0016)	-0.0216*** (0.0018)	-0.0082 (0.0144)
industry dummies	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes
Observations	888,683	1,131,593	888,683
adj. R <sup>2</sup>	0.0355		0.0160
F/chi <sup>2</sup> (model)	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***	***
F/chi <sup>2</sup> (low-qualified, outcome equ.)	***	***	***
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***	***	
F/chi <sup>2</sup> (younger, outcome equ.)	***	***	**
F/chi <sup>2</sup> (older, outcome equ.)	***	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	***	**
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***	***	
rho		0.5545	
chi <sup>2</sup> (indep. equations)		***	

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level.

Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

### 5.3 Robustness checks

In order to assess the stability of our findings with respect to possible additional estimation problems, we perform further robustness checks.

A possible problem for the above estimation results could be that the establishments considered differ in important unobserved characteristics. As mentioned before, it is well known in the existing literature on firm survival and firm growth that the personal characteristics of the founder or the team of founders may be of utmost importance for the post-entry performance of firms. While in contrast to the vast majority of existing studies on firm growth our data allow us to take into account possible effects of an establishment's employment structure on post-entry performance, the data do not inform about the characteristics of the founders. This problem of unobserved heterogeneity might bias our estimation results. To check the robustness of our main conclusions against the existence of time-constant unobserved heterogeneity, we therefore additionally estimate panel regression models with establishment-specific fixed effects (see table 5).

The robustness checks were carried out for both definitions of dependent variables. In the following and in the appendix, they are only explicitly presented for employment growth measured in full-time equivalents.<sup>26</sup>

An additional inclusion of individual establishment-level fixed effects into the upper models, however, is not possible as the characteristics of the establishments are only measured in the year of start-up so far and would thus perfectly correlate with the individual fixed effects. We therefore decided to additionally estimate all models also with time-varying explaining variables allowing us to estimate establishment-level individual fixed effects. Column (3) of table 5 gives the results of a simple OLS estimation with time varying regressors to analyze whether regressions with time-constant (column 2) and time-varying regressors are leading to consistent conclusions. Column (4) presents the corresponding results for the estimation of a fixed effects panel regression model.

The estimation results with time-varying explaining variables by pooled OLS lead to the same conclusions as the estimations with time-invariant regressors. Controlling for time-constant unobserved heterogeneity and allowing for time-varying explaining variables does not change the main conclusions of this paper. The conclusions derived seem to be very robust against the existence of time-constant unobserved establishment-level heterogeneity as the estimated coefficients do not differ at the third decimal place.

A second potential problem is that the start-ups' employment structure has so far been measured by dummy variables taking the value one if the establishment has at least one employee of a certain category. As explained above, we follow this strategy as the majority of start-ups are very small and therefore the calculation of shares would not be very meaningful. However, this approach may suffer from the problem that the dummy variables will typically take the value one for entities above a certain size threshold. To examine whether our conclusions are vulnerable in this respect, we additionally estimate our models for different size classes of establishments. Table 6 presents the results for the Heckman model regressions separated by size classes at start-up. The results confirm by and large our findings from the baseline regressions. Particularly for small size classes the results are very stable and consistent. The estimations for larger size classes partly show that variables become insignificant, which is plausible as the dummy variable approach is less meaningful for larger establishments.<sup>27</sup>

Another potential problem that might affect our estimation results is the possible impact of outliers, which exist particularly with respect to our dependent variables: If small entities increase the number of employees from 1 to 2, this already implies an employment growth of 100 %. By using the difference of natural logarithms of employment as a growth measure, this problem may already be mitigated, but we still have to make sure that our main conclusions are robust against the existence of extreme values. In part, this has already been done by the size-class specific regressions, which point out that systematic differences between smaller and larger establishments do not exist. However, we additionally apply robust regression methods (M estimator) to make sure that the outliers do not influence our results in any way (see table 7).<sup>28</sup> The results support our previous findings and we can conclude that outliers do not appear to be relevant drivers of our results.

From a theoretical point of view one might also expect that the role of employment structure for post-entry performance may be very different across industries (see section 2). Particularly, the secondary sector is known to be much more capital-intensive (and hence less labor-intensive) than the services sector. Also, there are

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<sup>26</sup> Corresponding results for the number of employees can be received from the authors upon request.

<sup>27</sup> We also estimated all baseline models excluding start-ups with ten or more employees (instead of 20 in the presented results), but the results are very stable and none of the conclusions drawn was affected.

<sup>28</sup> Of course, this robustness check may suffer from the selection bias, as we cannot tackle both problems at a time. However, as we found earlier, our key results are not affected by the selection bias and this should not be a problem.

substantial economies of scale in manufacturing, whereas they usually play only a minor role in the services sector. Although a detailed analysis of sectoral differences will be left for future research, we also estimated our models separately for both sectors. Table 8 shows the separate estimations by economic sector at start-up for all employees as well as full-time equivalents.

The results demonstrate that the majority of coefficients of all regressors are of the same sign and significance in the two sectors. Thus, the main conclusions of this paper hold both for the manufacturing and the services sector: part-time and marginal employment, *ceteris paribus*, increase employment growth in terms of full-time equivalents (but decrease post-entry growth in terms of the number of employees). Moreover, establishments with high-qualified employees but without low-qualified employees at the time of start-up show a higher post-entry growth with respect to both indicators. Contrariwise, establishments with low-qualified but without high-qualified labor exhibit lower growth rates. The impact of these qualification levels appears to be much more pronounced in the secondary than in the tertiary sector, which might reflect the technological intensity in these industries. While employing high-skilled employees independently of whether additional low-skilled labor is employed or not leads to higher post-entry growth, the analog for low-skilled employees does not hold in the two subsectors.

Interesting differences can be seen with respect to employees' age: for both types of employment growth, establishments with at least one young employee but no elder employees show a significantly higher post-entry growth in the services sector. However, in the secondary sector, the post-entry performance of such establishments is significantly lower. With respect to the nationality structure of employment, our baseline regressions come to the conclusion that establishments with at least one resident alien have significantly lower rates of employment growth. Our regressions for the two sectors demonstrate that this effect is mainly driven by the tertiary sector, while a corresponding effect in the secondary sector does not exist. Concerning gender, the separate regressions for manufacturing and services yield a similar conclusion. Yet, whereas gender diversity has a positive impact on both growth measures in the manufacturing sector, the opposite is true for the service industries.

Differences might also exist between industries with regard to their knowledge intensity – e.g. a qualified workforce might not necessarily be beneficiary for establishments relying on cheap workers rather than on qualified personnel. Within the manufacturing industries, R&D-intensive and non-R&D-intensive industries can be distinguished. We thereby resort to a classification by Legler and Frietsch (2006) which makes use of industry-specific R&D expenditure shares. The results in table 9 show that our findings described before generally also hold for both R&D intensive and non-R&D-intensive industries. Comparing the estimation results reveals that the positive impact of high-skilled employment on post-entry performance is larger in R&D-intensive industries than in non-R&D-intensive industries. The fact that establishments with at least one young employee and establishments with at least one female employee have *ceteris paribus* lower post-entry growth rates in the secondary sector is in both cases driven by non-R&D intensive industries.<sup>29</sup>

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<sup>29</sup> We also ran separate regressions by different types of region (agglomerated, urbanized and rural) which are derived from the German Bundesinstitut für Bau-, Stadt- und Raumforschung ([www.bbsr.bund.de](http://www.bbsr.bund.de)) in order to account for different regional circumstances like, e.g. the availability of high-skilled labor or agglomeration effects. The results confirm our previous findings.

## 6 Conclusions and outlook

Whereas the majority of existing studies on determinants of post-entry firm growth focus on the role of the founders' characteristics or on an impact of firm-specific characteristics like size or age, a possible impact of the characteristics of a start-up's workforce on post-entry growth has been widely neglected so far. Based upon panel data from the Establishment History Panel (BHP), a rich panel dataset of establishments in Germany, this paper contributes to fill this gap and examines the role of a newly founded establishment's initial workforce for post-entry employment growth. With regard to the employment structure, the employees' qualification, age, gender and nationality at the time of start-up are considered. Moreover, it is analyzed whether the use of regular part-time and / or marginal employment in the year of foundation affects post-entry growth.

As in recent years part-time employment has become more important in Germany, it might be misleading to only use the growth of the number of employees as an indicator for establishment-level employment growth. In contrast to the vast majority of existing empirical studies, we therefore not only measure employment growth by the development of total employment, but also by the growth of employment in full-time equivalents. This allows us to investigate whether there are substantial differences concerning direction, size and significance of the effects across the two different dimensions of employment growth.

The main findings of our empirical analyses which have also been validated in a variety of robustness checks are the following:

- *Qualification structure of employees matters for post-entry growth:* Post-entry growth is related to an establishment's initial endowment with human capital of its employees. Employing at least one high-qualified but no low-qualified employees in the year of start-up has a significant positive impact on post-entry growth independent from the growth measure used. Likewise, if a start-up has at least one low-qualified but no high-qualified employees in the year of start-up, this lowers the post-entry employment growth both in terms of the number of employees and in terms of full-time equivalents. A significant impact of the diversity of a start-up's qualification structure cannot be shown in most of our empirical analyses. Independent of whether there are additional high-skilled employees or not, the presence of at least one low-skilled employee lowers post-entry growth significantly. The converse holds for high-skilled labor with the exception that this effect vanishes in the more robust semi-parametric estimations. Qualification structure matters across size classes and sectors and can be shown to be particularly important in R&D-intensive industries.
- *Flexibility of employment structure matters:* Establishments using regular part-time and/or marginal employment in the start-up year show a significantly lower post-entry employment growth if measured as the number of employees. This is plausible as establishments relying exclusively on full-time employees have to hire new employees in case of growth, whereas establishments using flexible employment may also increase the working hours for a given number of employees. Therefore, if employment growth is measured in terms of full-time equivalents, establishments with at least one regular part-time or marginally employed employee have a significantly better growth performance than establishments which are not using any part-time or marginal employment in the year of foundation.
- *Age diversity and gender diversity coincide with lower post-entry growth:* Independently from the model estimated and the estimation methods used, age diversity and gender diversity affect post-entry performance negatively for both growth indicators. Both establishments with at least one employee 50 years or older and at least one employee 25 years or younger in the year of start-up have – other things

equal – a significantly lower post-entry growth compared to establishments with middle-aged employees only. This somewhat surprising result is due to the fact that the effect of employing at least one younger, but no older worker is only slightly positive and mostly not significant. The effect of employing both younger and older employees at the same time, however, is highly negative. Thus, combining the two effects results in an overall negative effect of employing people aged 25 years or less, independently from whether there are further older employees inside the establishment or not. The role of the age structure however seems to differ between the manufacturing and the services sector: while having at least one young employee results in higher growth in the tertiary sector, the corresponding impact in the secondary sector (and in particular in non-R&D-intensive industries) is significantly negative.

- Though the majority of the effects described above hold for both definitions of employment growth, there are substantial differences in particular with respect to the use of flexible employment. Thus, our results indicate that it may be important distinguishing between employment growth measured as the growth of the number of people or growth of the number of hours worked when analyzing the determinants of establishment-level employment growth.

To summarize, our empirical analyses confirm that the initial employment structure of start-ups and the use of flexible employment schemes affects an establishment's post-entry growth in a significant manner. However, although it thereby contributes to fill a gap in the existing literature, there is a substantial need for additional research. As mentioned, the role of the founder(s)' characteristics could not explicitly be analyzed with our data, and we could only control for time-constant unobserved heterogeneity in our robustness checks. Empirical analyses of post-entry performance comprising both founder-specific information and information about the quality structure of an establishment's employees thus have to be left for future research. Moreover, due to data restrictions, we were only able to analyze the use of two basic types of flexible employment: regular part-time work and marginal employment. Obviously, there are further types of flexible employment (e.g. fixed-term contracts, temporary work) which are controversially discussed, but which cannot be identified based upon the BHP. As the data used also do not inform about worker flows at the establishment level, possible worker turnovers which could signify an inflow of further resources in the surviving establishments can also not be analyzed.<sup>30</sup>

Additional research using other data sources should shed more light on these aspects of post-entry performance. While this paper focuses on post-entry growth of establishments and survival was only part of simple selection equations, it is also desirable to undertake more profound duration analyses in which the possible impact of an establishment's initial employment structure on the duration of post-entry survival is examined. Last but not least, for a deeper understanding of the correlations between the structure and the allocation of a start-up's workforce and its performance, complementary qualitative and case-study based research could be a promising method.

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<sup>30</sup> The updated version of the Establishment History Panel comprises information about worker flows and, thus, opens an important path for future research.



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## Appendix

**Table 5: Panel regressions, full-time equivalents**

	Dependent variable: growth rate of full-time equivalents (outcome equation)		
	OLS	OLS <sup>a</sup>	FE <sup>a</sup>
year = 2001	-0.0357*** (0.0029)		
year = 2002	-0.0212*** (0.0027)	0.0130*** (0.0028)	0.0130*** (0.0028)
year = 2003	0.0037 (0.0027)	0.0374*** (0.0026)	0.0374*** (0.0026)
year = 2004	-0.0286*** (0.0026)	0.0030 (0.0025)	0.0030 (0.0025)
year = 2005	0.0034 (0.0026)	0.0407*** (0.0025)	0.0407*** (0.0025)
ln(size)	-0.1390*** (0.0018)	-0.0863*** (0.0024)	-0.0863*** (0.0024)
ln <sup>2</sup> (size)	0.0238*** (0.0007)	0.0111*** (0.0008)	0.0111*** (0.0008)
establishment age	-0.0754*** (0.0011)	-0.0130*** (0.0015)	-0.0130*** (0.0015)
establishment age <sup>2</sup>	0.0115*** (0.0002)	0.0023*** (0.0004)	0.0023*** (0.0004)
w. part-time outside m.e., but w/o marg. emp.	0.0484*** (0.0014)	0.0391*** (0.0017)	0.0391*** (0.0017)
w/o part-time outside m.e., but w. marg. emp.	0.0293*** (0.0015)	0.0496*** (0.0018)	0.0496*** (0.0018)
w. part-time in- and outside m.e.	0.0578*** (0.0017)	0.0638*** (0.0020)	0.0638*** (0.0020)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0133*** (0.0013)	-0.0122*** (0.0015)	-0.0122*** (0.0015)
w/o low-, but w. high-qualified	0.0219*** (0.0022)	0.0047** (0.0023)	0.0047** (0.0023)
w. both low- and high-qualified	-0.0022 (0.0042)	-0.0036 (0.0040)	-0.0036 (0.0040)
unknown qualif. dummy	-0.0079*** (0.0010)	-0.0000 (0.0012)	-0.0000 (0.0012)
w. younger, but w/o older (ref.: w/o younger and older)	0.0024* (0.0013)	0.0018 (0.0017)	0.0018 (0.0017)
w/o younger, but w. older	-0.0315*** (0.0012)	-0.0232*** (0.0015)	-0.0232*** (0.0015)
w. both younger and older	-0.0154*** (0.0018)	-0.0134*** (0.0021)	-0.0134*** (0.0021)

**Table 5 (continued)**

w. women alone (ref.: w. men alone)	-0.0284*** (0.0013)	-0.0171*** (0.0016)	-0.0171*** (0.0016)
w. both men and women	-0.0156*** (0.0015)	-0.0169*** (0.0019)	-0.0169*** (0.0019)
w. resident aliens alone (ref.: with Germans alone)	-0.0135*** (0.0022)	-0.0075** (0.0031)	-0.0075** (0.0031)
with both Germans and resident aliens	-0.0089*** (0.0016)	-0.0014 (0.0019)	-0.0014 (0.0019)
industry dummies	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes
Observations	888,683	538,123	538,123
adj. R <sup>2</sup>	0.0355	0.0170	
F/chi <sup>2</sup> (model)	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***	***
F/chi <sup>2</sup> (low-qualified, outcome equ.)	***	***	***
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***		
F/chi <sup>2</sup> (younger, outcome equ.)	***	***	***
F/chi <sup>2</sup> (older, outcome equ.)	***	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	***	***
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***	**	**
rho			
chi <sup>2</sup> (indep. equations)			

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

<sup>a</sup> With time-varying regressors, lagged one period.

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level.

Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

**Table 6: Estimation by size groups at start-up, full-time equivalents (outcome equation) <sup>a</sup>**

Dependent variable: growth rate of full-time equivalents (outcome equation)					
firm size (number of full-time equiv. at start-up)	all establishments	]0;2]	]2;5]	]5;10]	]10;20]
year = 2001	-0.0365*** (0.0029)	-0.0303*** (0.0038)	-0.0262*** (0.0060)	-0.0535*** (0.0092)	-0.0482*** (0.0139)
year = 2002	-0.0434*** (0.0028)	-0.0621*** (0.0037)	-0.0217*** (0.0057)	-0.0296*** (0.0086)	-0.0355*** (0.0133)
year = 2003	0.0016 (0.0028)	0.0011 (0.0036)	0.0131** (0.0055)	0.0049 (0.0084)	-0.0007 (0.0131)
year = 2004	-0.0341*** (0.0027)	-0.0396*** (0.0035)	-0.0243*** (0.0054)	-0.0274*** (0.0083)	-0.0247* (0.0130)
year = 2005	-0.0067** (0.0027)	-0.0269*** (0.0035)	0.0169*** (0.0053)	0.0143* (0.0081)	0.0149 (0.0130)
ln(size)	-0.0947*** (0.0021)	-0.0961*** (0.0061)	-0.1706*** (0.0282)	-0.0930 (0.0766)	-0.2902* (0.1714)
ln <sup>2</sup> (size)	0.0166*** (0.0007)	0.0530*** (0.0059)	0.0479*** (0.0092)	0.0205 (0.0170)	0.0464 (0.0300)
establishment age	-0.0506*** (0.0012)	-0.0491*** (0.0016)	-0.0243*** (0.0022)	-0.0232*** (0.0033)	-0.0169*** (0.0051)
establishment age <sup>2</sup>	0.0086*** (0.0003)	0.0093*** (0.0004)	0.0032*** (0.0005)	0.0040*** (0.0007)	0.0038*** (0.0011)
w. part-time outside m.e., but w/o marg. emp.	0.0491*** (0.0015)	0.0534*** (0.0019)	0.0266*** (0.0033)	0.0033 (0.0056)	-0.0147* (0.0088)
w/o part-time outside m.e., but w. marg. emp.	0.0333*** (0.0016)	0.0369*** (0.0027)	0.0190*** (0.0026)	-0.0007 (0.0046)	-0.0057 (0.0076)
w. part-time in- and outside m.e.	0.0565*** (0.0019)	0.0345*** (0.0035)	0.0366*** (0.0032)	0.0121** (0.0051)	0.0027 (0.0079)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0177*** (0.0014)	-0.0373*** (0.0023)	-0.0163*** (0.0022)	-0.0071** (0.0032)	0.0060 (0.0053)
w/o low-, but w. high-qualified	0.0291*** (0.0024)	0.0368*** (0.0036)	0.0179*** (0.0040)	0.0127** (0.0055)	0.0048 (0.0086)
w. both low- and high-qualified	0.0016 (0.0047)	-0.0133 (0.0162)	0.0011 (0.0081)	-0.0010 (0.0069)	-0.0024 (0.0089)
unknown qualif. dummy	-0.0193*** (0.0011)	-0.0271*** (0.0015)	-0.0145*** (0.0021)	-0.0201*** (0.0033)	0.0004 (0.0052)
w. younger, but w/o older (ref.: w/o younger and older)	0.0025* (0.0014)	0.0101*** (0.0019)	-0.0073*** (0.0027)	-0.0069 (0.0068)	-0.0476*** (0.0175)
w/o younger, but w. older	-0.0326*** (0.0014)	-0.0347*** (0.0018)	-0.0248*** (0.0027)	-0.0312*** (0.0068)	-0.0925*** (0.0174)
w. both younger and older	-0.0123*** (0.0020)	-0.0188*** (0.0048)	-0.0228*** (0.0030)	-0.0219*** (0.0066)	-0.0615*** (0.0169)



Table 6 (continued)

w. women alone (ref.: w. men alone)	-0.0162*** (0.0014)	-0.0095*** (0.0017)	-0.0177*** (0.0036)	0.0045 (0.0070)	0.0022 (0.0153)
w. both men and women	-0.0067*** (0.0017)	-0.0097*** (0.0026)	-0.0123*** (0.0031)	0.0165*** (0.0059)	0.0165 (0.0106)
w. resident aliens alone (ref.: with Germans alone)	-0.0411*** (0.0024)	-0.0551*** (0.0028)	-0.0331*** (0.0075)	-0.0336 (0.0208)	-0.0820 (0.0887)
with both Germans and resident aliens	-0.0216*** (0.0018)	-0.0407*** (0.0038)	-0.0088*** (0.0026)	-0.0013 (0.0036)	0.0003 (0.0054)
industry dummies	Yes	Yes	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes	Yes	Yes
Observations	1,131,593	740,307	239,141	100,122	49,090
adj. R <sup>2</sup>					
F/chi <sup>2</sup> (model)	***	***	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	***	***	*
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***	***	***	***	***
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***	*	
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***	***		
F/chi <sup>2</sup> (low-qualified, outcome equ.)	***	***	*		
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***		**		
F/chi <sup>2</sup> (younger, outcome equ.)	***		***	**	***
F/chi <sup>2</sup> (older, outcome equ.)	***	***	***	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	***	***	*	
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***	***	***		
Rho	0.5545	0.8163	-0.0096	-0.0078	-0.0077
chi <sup>2</sup> (indep. equations)	***	***	***	***	**

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

<sup>a</sup> Results of the selection equation are available from the authors upon request. Models estimated by Maximum Likelihood. The number of observations in the size-class specific models do not add up exactly to that for all size groups because of establishments with more than 20 employees at start-up for which no separate estimation could be computed due to presence of multicollinearity.

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level.

Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

**Table 7: Robust regression (M estimator)**

Dependent variable: growth rate of full-time equivalents (outcome equation)		
	OLS	M estimator
year = 2001	-0.0357*** (0.0029)	-0.0268*** (0.0022)
year = 2002	-0.0212*** (0.0027)	-0.0146*** (0.0023)
year = 2003	0.0037 (0.0027)	0.0078*** (0.0020)
year = 2004	-0.0286*** (0.0026)	-0.0226*** (0.0023)
year = 2005	0.0034 (0.0026)	0.0054** (0.0021)
ln(size)	-0.1390*** (0.0018)	-0.1066*** (0.0016)
ln <sup>2</sup> (size)	0.0238*** (0.0007)	0.0210*** (0.0005)
establishment age	-0.0754*** (0.0011)	-0.0535*** (0.0010)
establishment age <sup>2</sup>	0.0115*** (0.0002)	0.0079*** (0.0002)
w. part-time outside m.e., but w/o marg. emp.	0.0484*** (0.0014)	0.0409*** (0.0011)
w/o part-time outside m.e., but w. marg. emp.	0.0293*** (0.0015)	0.0251*** (0.0011)
w. part-time in- and outside m.e.	0.0578*** (0.0017)	0.0475*** (0.0013)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0133*** (0.0013)	-0.0154*** (0.0010)
w/o low-, but w. high-qualified	0.0219*** (0.0022)	0.0137*** (0.0015)
w. both low- and high-qualified	-0.0022 (0.0042)	-0.0055 (0.0034)
unknown qualif. dummy	-0.0079*** (0.0010)	-0.0027*** (0.0008)
w. younger, but w/o elderly (ref.: w/o younger and elderly)	0.0024* (0.0013)	0.0050*** -0.0011
w/o younger, but w. elderly	-0.0315*** (0.0012)	-0.0282*** -0.0009
w. both younger and elderly	-0.0154*** (0.0018)	-0.0164*** (0.0015)

**Table 7 (continued)**

w. women alone (ref.: w. men alone)	-0.0284*** (0.0013)	-0.0231*** (0.0009)
w. both men and women	-0.0156*** (0.0015)	-0.0144*** (0.0012)
w. resident aliens alone (ref.: with Germans alone)	-0.0135*** (0.0022)	-0.0069*** (0.0019)
with both Germans and resident aliens	-0.0089*** (0.0016)	-0.0072*** (0.0012)
industry dummies	Yes	Yes
NUTS2 dummies	Yes	Yes
Observations	888,683	888,683
adj. R <sup>2</sup>	0.0355	0.0296
F/chi <sup>2</sup> (model)	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***	***
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***
F/chi <sup>2</sup> (low-qualified, outcome equ.)	***	***
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***	**
F/chi <sup>2</sup> (younger, outcome equ.)	***	***
F/chi <sup>2</sup> (elderly, outcome equ.)	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	***
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***	***
rho		
chi <sup>2</sup> (indep. equations)		

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

<sup>a</sup> The M estimator could not be computed for full-time employees.

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level.

Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

**Table 8: Estimation by economic sectors at start-up (outcome equation) <sup>a</sup>**

	Dependent variable: growth rate of full-time equivalents (outcome equation)					
	all establishments	secondary sector	tertiary sector	all establishments	secondary sector	tertiary sector
year = 2001	-0.0391*** (0.0029)	-0.0390*** (0.0070)	-0.0368*** (0.0031)	-0.0365*** (0.0029)	-0.0394*** (0.0072)	-0.0335*** (0.0031)
year = 2002	-0.0399*** (0.0028)	-0.0070 (0.0067)	-0.0149*** (0.0030)	-0.0434*** (0.0028)	-0.0139** (0.0068)	-0.0191*** (0.0030)
year = 2003	0.0124*** (0.0027)	0.0197*** (0.0065)	0.0176*** (0.0029)	0.0016 (0.0028)	0.0075 (0.0066)	0.0068** (0.0029)
year = 2004	-0.0312*** (0.0027)	-0.0325*** (0.0064)	-0.0196*** (0.0028)	-0.0341*** (0.0027)	-0.0381*** (0.0065)	-0.0224*** (0.0028)
year = 2005	-0.0082*** (0.0027)	0.0158** (0.0063)	0.0035 (0.0028)	-0.0067** (0.0027)	0.0170*** (0.0064)	0.0044 (0.0028)
ln(size)	-0.0878*** (0.0021)	-0.1879*** (0.0042)	-0.1035*** (0.0021)	-0.0947*** (0.0021)	-0.1851*** (0.0042)	-0.1115*** (0.0020)
ln <sup>2</sup> (size)	0.0168*** (0.0007)	0.0347*** (0.0016)	0.0187*** (0.0008)	0.0166*** (0.0007)	0.0324*** (0.0015)	0.0190*** (0.0007)
establishment age	-0.0577*** (0.0012)	-0.1021*** (0.0028)	-0.0789*** (0.0012)	-0.0506*** (0.0012)	-0.0945*** (0.0029)	-0.0701*** (0.0012)
establishment age <sup>2</sup>	0.0099*** (0.0003)	0.0161*** (0.0006)	0.0121*** (0.0003)	0.0086*** (0.0003)	0.0149*** (0.0006)	0.0106*** (0.0003)
w. part-time outside m.e., but w/o marg. emp.	-0.0168*** (0.0014)	-0.0200*** (0.0037)	-0.0215*** (0.0014)	0.0491*** (0.0015)	0.0439*** (0.0040)	0.0444*** (0.0014)
w/o part-time outside m.e., but w. marg. emp.	-0.0193*** (0.0017)	-0.0133*** (0.0033)	-0.0293*** (0.0017)	0.0333*** (0.0016)	0.0379*** (0.0033)	0.0226*** (0.0016)
w. part-time in- and outside m.e.	-0.0147*** (0.0019)	-0.0025 (0.0046)	-0.0223*** (0.0018)	0.0565*** (0.0019)	0.0623*** (0.0047)	0.0475*** (0.0018)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0161*** (0.0014)	-0.0186*** (0.0029)	-0.0088*** (0.0014)	-0.0177*** (0.0014)	-0.0202*** (0.0029)	-0.0113*** (0.0014)
w/o low-, but w. high-qualified	0.0279*** (0.0024)	0.0585*** (0.0068)	0.0203*** (0.0022)	0.0291*** (0.0024)	0.0626*** (0.0068)	0.0233*** (0.0022)
w. both low- and high-qualified	0.0065 (0.0048)	0.0123 (0.0110)	0.0061 (0.0045)	0.0016 (0.0047)	0.0108 (0.0112)	0.0017 (0.0045)
unknown qualif. dummy	-0.0201*** (0.0011)	-0.0045* (0.0024)	-0.0106*** (0.0011)	-0.0193*** (0.0011)	-0.0053** (0.0024)	-0.0108*** (0.0011)
w. younger, but w/o elderly (ref.: w/o younger and elderly)	0.0002 (0.0014)	-0.0217*** (0.0030)	0.0050*** (0.0014)	0.0025* (0.0014)	-0.0195*** (0.0030)	0.0068*** (0.0014)
w/o younger, but w. elderly	-0.0302*** (0.0014)	-0.0207*** (0.0033)	-0.0334*** (0.0013)	-0.0326*** (0.0014)	-0.0233*** (0.0033)	-0.0359*** (0.0013)
w. both younger and elderly	-0.0092*** (0.0021)	-0.0131*** (0.0043)	-0.0086*** (0.0020)	-0.0123*** (0.0020)	-0.0170*** (0.0043)	-0.0121*** (0.0020)

**Table 8 (continued)**

w. women alone (ref.: w. men alone)	-0.0079*** (0.0014)	0.0313*** (0.0038)	-0.0157*** (0.0013)	-0.0162*** (0.0014)	-0.0372*** (0.0039)	-0.0263*** (0.0013)
w. both men and women	0.0002 (0.0017)	0.0177*** (0.0032)	-0.0232*** (0.0017)	-0.0067*** (0.0017)	0.0062* (0.0032)	-0.0286*** (0.0017)
w. resident aliens alone (ref.: with Germans alone)	-0.0429*** (0.0024)	0.0099 (0.0067)	-0.0231*** (0.0022)	-0.0411*** (0.0024)	0.0074 (0.0066)	-0.0255*** (0.0022)
with both Germans and resident aliens	-0.0221*** (0.0019)	-0.0048 (0.0041)	-0.0147*** (0.0017)	-0.0216*** (0.0018)	-0.0044 (0.0041)	-0.0163*** (0.0017)
industry dummies	Yes	No	No	Yes	No	No
NUTS2 dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,131,593	214,769	916,824	1,131,593	214,769	916,824
adj. R <sup>2</sup>						
F/chi <sup>2</sup> (model)	***	***	***	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	***	***	***	***
F/chi <sup>2</sup> (industry dummies, outcome equ.)	***			***		
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***	***	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	**	***	***	***	***
F/chi <sup>2</sup> (low-qualified, outcome equ.)	*			***		*
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***	***	***	***	***	***
F/chi <sup>2</sup> (younger, outcome equ.)	***	***		***	***	*
F/chi <sup>2</sup> (elderly, outcome equ.)	***	***	***	***	***	***
F/chi <sup>2</sup> (female, outcome equ.)	***	**	***	***	***	***
F/chi <sup>2</sup> (resident aliens, outcome equ.)	***		***	***		***
rho	0.5856	0.0483	0.0028	0.5545	0.0391	-0.0026
chi <sup>2</sup> (indep. equations)	***	***		***	***	

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

<sup>a</sup> Results of the selection equations are available from the authors upon request.

Models estimated by Maximum Likelihood.

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level. Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.

**Table 9: Estimations for (non-)R&D-intensive industries within the manufacturing sector (outcome equation)<sup>a</sup>**

Dependent variable: growth rate of full-time equivalents (outcome equation)

firm size (number of all employees at start-up)	secondary sector	R&D-non-intensive	R&D-intensive
year = 2001	-0.0394*** (0.0072)	-0.0373*** (0.0074)	-0.0766*** (0.0268)
year = 2002	-0.0139** (0.0068)	-0.0097 (0.0070)	-0.0807*** (0.0255)
year = 2003	0.0075 (0.0066)	0.0112 (0.0069)	-0.0450* (0.0251)
year = 2004	-0.0381*** (0.0065)	-0.0345*** (0.0067)	-0.0953*** (0.0250)
year = 2005	0.0170*** (0.0064)	0.0243*** (0.0065)	-0.0791*** (0.0253)
ln(size)	-0.1851*** (0.0042)	-0.1872*** (0.0043)	-0.1077*** (0.0173)
ln <sup>2</sup> (size)	0.0324*** (0.0015)	0.0333*** (0.0016)	0.0079 (0.0059)
establishment age	-0.0945*** (0.0029)	-0.0908*** (0.0030)	-0.1066*** (0.0094)
establishment age <sup>2</sup>	0.0149*** (0.0006)	0.0144*** (0.0007)	0.0174*** (0.0020)
w. part-time outside m.e., but w/o marg. emp.	0.0439*** (0.0040)	0.0466*** (0.0042)	0.0311** (0.0140)
w/o part-time outside m.e., but w. marg. emp.	0.0379*** (0.0033)	0.0413*** (0.0035)	0.0267** (0.0123)
w. part-time in- and outside m.e.	0.0623*** (0.0047)	0.0681*** (0.0051)	0.0320** (0.0150)
w. low-, but w/o high-qualified (ref.: w/o low- and high-qualified)	-0.0202*** (0.0029)	-0.0195*** (0.0030)	-0.0117 (0.0117)
w/o low-, but w. high-qualified	0.0626*** (0.0068)	0.0454*** (0.0079)	0.0728*** (0.0156)
w. both low- and high-qualified	0.0108 (0.0112)	0.0018 (0.0122)	0.0176 (0.0319)
unknown qualif. dummy	-0.0053** (0.0024)	-0.0070*** (0.0025)	0.0116 (0.0092)
w. younger, but w/o elderly (ref.: w/o younger and elderly)	-0.0195*** (0.0030)	-0.0191*** (0.0031)	-0.0092 (0.0122)
w/o younger, but w. elderly	-0.0233*** (0.0033)	-0.0223*** (0.0034)	-0.0410*** (0.0124)
w. both younger and elderly	-0.0170*** (0.0043)	-0.0171*** (0.0045)	-0.0035 (0.0163)

**Table 9 (continued)**

w. women alone (ref.: w. men alone)	-0.0372*** (0.0039)	-0.0440*** (0.0041)	-0.0228* (0.0135)
w. both men and women	0.0062* (0.0032)	0.0033 (0.0034)	0.0032 (0.0128)
w. resident aliens alone (ref.: with Germans alone)	0.0074 (0.0066)	0.0104 (0.0066)	-0.0192 (0.0428)
with both Germans and resident aliens	-0.0044 (0.0041)	-0.0079* (0.0043)	0.0236 (0.0146)
industry dummies	No	No	No
NUTS2 dummies	Yes	Yes	Yes
Observations	214,769	194,604	20,165
adj. R <sup>2</sup>			
F/chi <sup>2</sup> (model)	***	***	***
F/chi <sup>2</sup> (year dummies, outcome equ.)	***	***	***
F/chi <sup>2</sup> (NUTS2 dummies, outcome equ.)	***	***	
F/chi <sup>2</sup> (industry dummies, outcome equ.)			
F/chi <sup>2</sup> (part-time outside m.e., outcome equ.)	***	***	***
F/chi <sup>2</sup> (marg. emp., outcome equ.)	***	***	**
F/chi <sup>2</sup> (low-qualified, outcome equ.)			
F/chi <sup>2</sup> (high-qualified, outcome equ.)	***	***	**
F/chi <sup>2</sup> (younger, outcome equ.)	***	***	
F/chi <sup>2</sup> (elderly, outcome equ.)	***	***	*
F/chi <sup>2</sup> (female, outcome equ.)	***	***	
F/chi <sup>2</sup> (resident aliens, outcome equ.)			
rho	0.0391	0.0466	0.6469
chi <sup>2</sup> (indep. equations)	***	***	***

\* p < 0.1, \*\* p < 0.05 \*\*\* p < 0.01

<sup>a</sup> Results of the selection equation are available from the authors upon request.

Models estimated by Maximum Likelihood.

Source: Establishment History Panel, authors' calculations. Standard errors in parentheses, clustered at the establishment level. Regressions included 2-digit industry and NUTS2-regional dummies as well as an intercept.





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