The reorganization of knowledge when firms go public

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Abstract

We examine how firms adapt the composition and organization of their labor force when they go public. We find that IPO firms reorganize into a more hierarchical structure with smaller departments. Hiring and reorganization begin two years ahead of the IPO. Hiring is strongest in high-skill jobs requiring knowledge in finance, accounting, and internal governance. IPO firms hire many young, highly skilled, but inexperienced employees to fill the middle ranks in this organization. Two-thirds of top management are replaced in the process of going public. Going public is associated with a comprehensive transformation of the firm's labor force which becomes geared towards exploiting available technologies rather than generating innovation.

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1. Introduction

An IPO marks a major milestone in the life cycle of a firm. Going public brings along much higher requirements of disclosure, access to capital markets, a more dispersed ownership, and new stakeholders such as analysts, activists, and the media. After going public, information on the firm's operations has to be continuously collected, processed, verified, and disseminated to ensure compliance with securities regulation.[1] To operate a publicly traded firm, the firm will thus have to internalize expertise on finance, accounting, and internal governance; and the firm will also to build an organizational structure that accommodates compliance and cooperation of a more specialized labor force. These investments into labor and its management appear to be of first-order importance for understanding how costly it is to go public and how the firm's comparative advantage changes in the process of going public.[2]

In this paper, we investigate how firms adapt the composition and organization of their labor force when they go public. Our main hypothesis posits that IPO firms restructure into a more hierarchical organization with smaller departments in order to economize on newly recruited, highly-skilled employees with knowledge of operating a public firm. We analyze employee inflows and outflows around the IPO and break these flows down into groups with expertise related to operating a public firm, middle managers, and top managers. We describe how these flows change the hierarchical structure of the organization and the characteristics of the workforce. We find that going public has a significant impact on how the firm's labor force is composed and organised, driven by an influx of employees with expertise not directly related to production such as expertise in accounting, finance, and management.

Our analysis is guided by theoretical work on the hierarchical organization of labor in the presence of specialization, i.e., when employees differ with respect to their knowledge. (Gari-

[1]Going public, firms need to ensure compliance with a number of additional laws and regulations. For example, public firms need to produce and disclose substantially more information on a regular basis, disclose new, material information as soon as possible, and implement a risk management system that identifies and reports risk exposures. See Section 3 for a detailed discussion.

[2]Earlier studies have looked at the consequences of going public on labor by focusing on post-IPO departures of highly-skilled employees (Babina, Ouimet, and Zarutskie, 2020) or post-IPO changes in total employment (Borisov, Ellul, and Sevilir, 2021). By choice of research design, these studies cannot observe labor flows ahead of the IPO date. Both studies had no access to data on occupations or hierarchical structure of the labor force.

cano, 2000, and Garicano and Rossi-Hansberg, 2006). In knowledge-based hierarchies, firms are organized in hierarchical layers and employees in higher layers solve more complex problems. The central trade-off in forming these hierarchies is between higher communication costs caused by specialized employees (experts) organized in more layers and higher knowledge acquisition costs incurred by more generalist employees organized in fewer layers.[3] An intriguing prediction of the theory is that when the costs of knowledge acquisition increase, the organization will shift towards a more hierarchical structure with smaller control spans, i.e., a more specialized labor force, with more formal reporting lines and smaller departments will emerge. As a consequence, the utilization of knowledge increases in added layers and decreases in all other layers, which will be reflected in the employees' wages.

We argue that going public introduces a new set of problems related to operating a public firm (e.g., problems related to capital markets, securities regulation, compliance or internal governance) which requires the firm's employees to broaden their knowledge base, increasing the costs of knowledge acquisition. We expect the firm to respond to the increase in knowledge acquisition costs by hiring additional experts and to consequently move towards a more hierarchical organization that economizes on the knowledge of a more specialized labor force.

We collect data on 325 IPOs listed in Germany between 1984 and 2015. For each IPO, we obtain detailed data on establishment and employee characteristics from social security records provided by the German Institute for Employment Research. Our identification strategy relies on a matched control sample of private firms, which are comparable in terms of size, pre-matching period growth, industry affiliation, and a range of employment characteristics. We match based on characteristics observed two years before the IPO year, allowing us to identify systematic differences between the IPO firm and the control firm in the two years prior to the IPO. We compute growth rates, separation rates, and hiring rates and estimate difference-in-difference effects in line with earlier studies using similar data (cf., Davis, Haltiwanger, Handley,

[3]We think of knowledge acquisition costs as costs for training an employee to solve a certain set of problems. One can also think of knowledge acquisition costs in terms of having to pay higher wages for an employee with a higher level of education. If the costs of knowledge acquisition increase above a certain threshold, the firm will not provide training to all employees, but only to the most skilled employee(s) in that department. To facilitate coordination, the employee(s) who receive(s) training will be promoted.

Jarmin, Lerner, and Miranda, 2014; Antoni, Maug, and Obernberger, 2019). Our data allow us to further decompose the labor force into hierarchical layers and occupations, providing us with a unique view on the changes imposed on the organization of labor while going public.

We find that going public is associated with strong employment growth, starting 12 to 24 months before the IPO. We document the highest growth of employment in high-skill jobs not directly related to production. The share of the jobs that require expertise in finance or accounting in the labor force increases by roughly 50% relative to control group; the share of middle managers, employed for monitoring and supervision of employees and processes, doubles. The abnormal growth in these groups relative to their control groups cannot be explained by growth in total employment, establishments, operated industries, or regions.

In the next step, we examine how firms change their internal organizational structure when they become a public firm. We find that the number of hierarchical layers increases. Firms that have less than the maximum amount of observable layers before the IPO add one full layer on average; only about half of the increase in layers relative to control group can be explained by growth in employment, establishments, operated industries, or regions. We attribute the remaining growth in hierarchical layers to higher knowledge acquisition costs after the IPO. The middle layers furthermore increase in relative size, in particular the layer below the top layer, where many of the newly hired experts are placed. The number of middle managers increases dramatically in order to facilitate the coordination among experts within and across hierarchical layers. When IPO firms add an additional hierarchical layer, the most-skilled managers move up to the new top layer, the other managers stay behind as middle managers. We find that the control span of top managers increases and the control span of middle managers decreases when IPO firms become more hierarchical. In other words, top managers gain responsibility, middle managers get more specialized assignments in smaller departments.

The changes in net employment and organizational structure do not reveal the full extent of reorganization. Employee turnover is half of net employment growth. Hence, the IPO firm has to hire one and a half employees in order to fill one additional position. Turnover is much more dramatic for managers. To fill one additional top management position, the firm has to

hire three top managers. Turnover rates for middle managers are just slightly lower.

We find that managerial turnover is associated with changes in the organizational structure of the firm: managerial turnover at the top layer increases by 58 percentage points if firms add one hierarchical layer. More than 60% of top managers employed in the firm two years before the IPO have left the firm two years after the IPO. The leaving top managers tend to continue to work for smaller firms, in other industries, and in non-managerial occupations. In general, these observations are consistent with the notion that entrepreneurial-minded managers leave the firm because they are unhappy with their new roles in a more bureaucratic organization or because they lack the managerial capabilities required under the new organizational structure of the public firm.

The developments described above have significant impact on the characteristics of the IPO firm's labor force. New hires are younger and they have worked fewer years in the same job and industry than the incumbents. The majority of these hires is highly skilled and they fill the middle ranks in the organization. Overall, the new hires increase the share of highly-skilled, upper-layer experts, but they decrease the average work experience in the labor force. These results are consistent with the economics of knowledge-based hierarchies because the hierarchical structure provides supervision, which substitutes for experience.

We find systematic differences between new hires in the IPO firms and their control firms in two important dimensions. New hires increase the IPO firm's expertise in accounting and finance. Furthermore, the IPO firm attracts relatively more employees from other public firms. This result is consistent with increased demand for employees with public firm experience. Because we observe the inflow from public firms mostly after the IPO, employees from public firms might also find the IPO firm more interesting, increasing the supply of labor with public firm experience.

Wages grow stronger in IPO firms than in their matched control firms. Over a five year period starting two years before the IPO, wages grow by 11.0%, which is 3.5 percent higher than the wage growth in the control group. This effect is driven by highly-skilled new hires in the year before the IPO, who are offered much higher wages than employees hired two years earlier,

both relative to the IPO firm and relative to their control firm. Notably, wages of new hires are roughly 20% lower than the wages of incumbents because new hires are on average much younger and have less work experience. These results confirm our earlier observation that hierarchical organizations economize on the utilization of knowledge by hiring many highly skilled employees with relatively little (work) experience, which is less costly than hiring employees with more work experience into a less hierarchical organization.

The layering of management also has implications for managerial compensation because it changes the utilization rates of knowledge of middle managers (lower utilization) and top managers (higher utilization): middle managers display the lowest growth in wages and, over a five year period, their wages grow less than half of the wages of the middle managers in the control group. Meanwhile, managers making it to the top layer of the IPO firm see the largest increase in their wages, which amounts to 2.5 times the wage increase in the control group.

Overall, we find that going public is associated with significant hiring into jobs that require knowledge of operating a public firm, increases in hierarchical layers, and excessive turnover among managers. Our results are consistent with the economics of knowledge-based hierarchies, which hold that higher knowledge acquisition costs lead to a more hierarchical organization in order to economize on the costs of a more specialized labor force. Increased knowledge utilization in the top layer of the more hierarchical, public firm leads to higher wages for top managers. The majority of jobs, however, is created in the middle layers of the organization. For these jobs, the firm recruits young, highly skilled, but inexperienced employees, who earn lower wages than the incumbent employees thus economizing on the knowledge of top managers.

To the best of our knowledge, our paper is the first to highlight the extent to which going public requires the firm to adapt the composition and organization of its labor force. We provide a novel perspective on the consequences of IPOs on labor, documented in Borisov et al. (2021) and Babina et al. (2020), by showing that firms begin adapting and extending their labor force ahead of the IPO, integrate knowledge required for going public, and restructure into a more formal organization which has first-order implications for labor flows and wages.

More generally, our paper contributes to research on the costs and benefits of going public

(Zingales, 1995; Pagano, Panetta, and Zingales, 1998; Kim and Weisbach, 2008; Brav, 2009; Celikyurt, Sevilir, and Shivdasani, 2010; Saunders and Steffen, 2011; Bernstein, 2015). Before going public, the firm will need to invest into human capital and its organization, which might prove difficult for financially constrained firms or small firms. Being public, the firm will have to pay for a more specialized labor force and high-profile top managers to run it. Finally, a more hierarchical organization will incur higher costs of coordination and communication. Our results, therefore, suggest that investments into human capital and its organization are a first-order cost of going public.

The finding that firms become more hierarchical and departmentalized also offers a new perspective on the widely documented observation that going public is associated with a decrease in innovation and a shift towards commercialization. Pástor, Taylor, and Veronesi (2009) argue that an IPO coincides with a strategy to commercialize its products on a larger scale. Bernstein (2015) reports an "exodus of skilled inventors" and a strategic shift from internal innovation to exploiting innovation through acquisitions. Larrain, Phillips, Sertsios, and Urzúa I (2021) associate the shift towards commercialization with increases in firm profitability. Our results resonate well with these studies because our results suggest that going public helps to build a more efficient, product-market oriented organization, gearing IPO firms towards commercializing available technologies. It is also well established that bureaucracy increases organizational efficiency, but hampers innovation (cf., e.g., Thompson, 1965). Furthermore, Tåg, Åstebro, and Thompson (2016) document that the number of hierarchical layers is negatively correlated with the likelihood of entrepreneurship among the firm's employees. Hence, the organizational changes associated with going public, in addition to agency problems in public firms in the spirit of Jensen and Meckling (1976) and Jensen (1989), might help to explain the changes in the firm's innovation and investment policies.

Our results also resonate well with Celikyurt et al. (2010) who report that firms perform a high number of acquisitions shortly after going public. We find that, after the IPO, the organization is loaded with financial expertise, enabling IPO firms to acquire private firms who lack the organizational capabilities to commercialize their innovation.

Finally, our paper also adds to research on how corporate finance affects the internal organization of labor. In this literature, recent contributions have looked at the organization of business groups (Huneeus, Huneeus, Larrain, Larrain, and Prem, 2018) and mergers and acquisitions (Gehrke, Maug, Obernberger, and Schneider, 2021). Gehrke et al. (2021) argue that "acquirers seek growth options from targets and provide managerial capabilities to organize production more efficiently", which corresponds well with our argument that going public builds out managerial capabilities that put IPO firms in a comparatively better position to pursue acquisitions.

2. Theoretical framework

In this section, we discuss theoretical work on knowledge-based hierarchies, which studies the efficient organization of labor in the presence of specialization. We use the the work on knowledge-based hierarchies to examine how changes to knowledge acquisition costs, employment size, and geographic scope should affect the composition, organization, and compensation of the labor force.

2.1. The organization of knowledge in knowledge-based hierarchies

Garicano (2000) studies the organization of knowledge in a model where communication across different hierarchical layers facilitates the cooperation of employees with heterogeneous skills to solve problems related to production. The author demonstrates that it is optimal to organize the acquisition of knowledge required to solve the problems encountered by the organization in a "knowledge-based hierarchy." In this structure, routine tasks are performed by production workers who possess knowledge of how to solve the most common problems. Production workers who encounter problems they cannot solve refer them to the next layer of the organization, formed by specialist problem solvers. Problems are then passed on until someone can solve them.

In knowledge-based hierarchies, the organization faces a key trade-off between communica-

tion and knowledge acquisition costs. By adding layers of problem solvers, the organization increases the utilization rate of knowledge, thus reducing the cost of knowledge acquisition, at the cost of increasing the communication required. The limited availability of time counters the increasing returns arising from fixed knowledge costs, resulting in a limited span of control of problem solvers. Changes to the costs of the acquisition of knowledge affect the control span of problem solvers: if the acquisition of knowledge becomes more costly, production workers need to rely more often on help from specialized problem solvers. This decreases the span of control of each problem solver, increases the number of layers of problem solvers required to solve a given proportion of problems, and increases the delay needed to obtain solutions to problems.

IPOs are likely to increase the acquisition costs of knowledge because knowledge about operating a public firm is hardly available in private firms. It will thus be more efficient to add another set of problem solvers with knowledge of operating a public firm. In this case, the model of Garicano (2000) predicts that firms will add hierarchical layers and reduce the control span per problem solver.

2.2. Knowledge-based hierarchies and growth

There is empirical evidence that IPOs spur employment growth and geographic expansion (cf., e.g., Babina et al., 2020, Borisov et al., 2021, and Cornaggia, Gustafson, Kotter, and Pisciotta, 2020). Therefore, it is instructive to understand how employment growth and geographic expansion affect the firm's hierarchical organization of labor. Caliendo, Monte, and Rossi-Hansberg (2015) study the internal organization of French manufacturing firms and divide the employees of each firm into "layers" using occupational categories. The authors show that reorganization, through changes in layers, is a salient feature of how firms grow. Firms that expand substantially add layers and pay lower average wages in all preexisting layers. In contrast, firms that expand little and do not reorganize pay higher average wages in all preexisting layers.

Garicano and Rossi-Hansberg (2012) highlight how organizational growth usually allows the firm to generate higher returns from exploiting existing innovations, but also hampers radical innovation because it would devalue the expertise accumulated in the labor force of the existing knowledge-based organization. An insight that blends in well with Arrow (1974) who points out that organizations are specific to a particular technology. The reorganization of knowledge when firms go public as predicted by the theory will therefore gear the organization towards exploiting a specific, existing technology. This organization will not be able to generate similar returns from developing new technologies. Gumpert, Steimer, and Antoni (2018) show that geographic frictions affect a firm's organization because travelling from one location to another one takes time and managers have only limited time available. Relying on this argument, the authors demonstrate that geographic frictions increase the number of middle managers in multi-establishment firms.

2.3. Knowledge-based hierarchies, knowledge utilization, and wages

Garicano and Rossi-Hansberg (2006) provide an equilibrium theory of work in an economy where knowledge is an essential input in production and agents are heterogenous in skill. Their model shares many of the key features presented in Garicano (2000), but it provides one additional important insight in the context of our paper: relative to autarky, hierarchical organization leads to larger cross-sectional differences in knowledge and wages. The resulting earnings structure compensates employees for moving upwards in the hierarchy.

3. Regulation of publicly traded firms in Germany

Over the past 30 years, security market regulation in Germany has been moving closer to U.S. regulation, which has always served as a role model. While the specific rules have changed over the years and there are still differences between German and U.S. regulation, both markets have always shared similar principles requiring regular disclosures, ad-hoc disclosures,

and professional risk and information management systems.[4] Below, we discuss the rules and regulations applying to German IPOs. Our main conclusion from this discussion is that firms going public face qualitatively similar challenges as firms in the U.S.. However, U.S. firms seem to have always been subject to stricter regulation, suggesting that the implications of going public documented in this study are likely to be less severe than the implications of going public are for U.S. firms.[5]

3.1. Disclosure regulation

In Germany, firms can opt to list their stocks in the regulated market or the open market ("Freiverkehr"). Since May 1987, the regulated market is split into two segments, official market ("amtlicher Markt") and regular market ("geregelter Markt"). Firms trading in the regulated market are required by law (§3 Abs. 2 AktG10) to publish consolidated financial statements with appendix (§264 Abs. 1 HGB) and an annual report at the end of the fiscal year (§290 Abs. 1 HGB). Firms trading in the official market also have to publish an intermediate report after six months (§44b Abs. 1 BörsG). Until 2016, German security law (§15 WpHG) required firms to disclose and disseminate inside information potentially impacting the firm's stock price as soon as possible (ad-hoc). Since 2016, a EU-wide directive on market abuse (MAR) replaced German law, but kept the general principles in place (Article 7a MAR).

The Frankfurt Stock Exchange imposes additional disclosure requirements on firms listing in their prime market. In 2007, the Frankfurt Stock Exchange reorganized its market structure into three distinct segments: Prime Standard, General Standard, and Open Market. Firms listed in Prime Standard are required to publish quarterly reports according to IAS or US-GAAP, disclose a corporate calendar, hold at least one analyst conference per year, and release ad-hoc statements in German and English (see "Börsenordnung der Frankfurter Wertpapierbörse"

[4]For a detailed discussion of the evolution of German disclosure regulation of public firms and the differences between German regulation and US regulation on the matter, see von Kirchbach (2007).

[5]Leuz and Wysocki (2016) provide an overview on the literature that aims to assess the economic consequences of public firm regulation. In a recent study, Ewens, Xiao, and Xu (2020) find "that various disclosure and internal governance rules lead to a total compliance cost of 4.3% of the market capitalization for a median U.S. public firm".

§§47-57). Before 2007, additional disclosure requirements were tied to being a member of one of the stock exchange's indices DAX (large caps), MDAX (mid caps), SDAX (small caps), TecDAX (high technology firms, many of which were previously listed in the "Neuer Markt", which preceded TecDAX). Firms listed in one of the indices had to publish quarterly reports and all of these firms were transferred to Prime Standard in 2007.[6] Other German stock exchanges use similar rules to differentiate market segments, but considering the very small number of listings at these exchanges we refrain from discussing these here in detail.

3.2. Risk management

According to German law, a firm's executive board is required to take measures ensuring that risks are identified and minimized in a risk monitoring system (§91 Abs. 2 AktG). Non-compliance has significant implications for the executives because they will be liable to the firm for any damages as a result of the non-compliance (§93 Abs. 2 Satz 1 AktG). The risk monitoring system has to be audited in the statutory audit (§317 Abs. 4 HGB).

3.3. Corporate governance codex

In 2002, the German Corporate Governance codex was introduced as the outcome of an initiative to improve corporate governance and transparency of German companies and to make them more attractive for international investors. The codex is not legally binding but publicly listed firms have to disclose in their annual reports to what extent they comply with the codex (§161 AktG). The codex formulates additional requirements regarding the provision of information to the advisory board (part D), the timely disclosure of regular reports to the public (part G), and compensation (part F).

[6]The differences in disclosure requirements appear to be rather small. For example, firms listed at the Neuer Markt were required to publish their annual report within three months after the end of the fiscal year, whereas firms listed in other indices were offered a period of four months. For a more detailed discussion of these differences, see Feinendegen and Nowak (2001).

4. Data and methodology

4.1. Construction of IPO firm-level dataset

The construction of our IPO firm-level dataset proceeds in the following steps. First, we combine information on German IPOs from Thomson Reuter's Securities Data Corporation (SDC), the Deutsche Börse AG, the Bloomberg database, and a list of German IPOs provided by Christoph Kaserer from the Technical University Munich. This procedure results in a comprehensive list of 883 German IPOs between 1984 and 2015. Second, for all these IPOs, we identify the BvD firm identifiers from Orbis. Third, we utilize the Orbis-ADIAB linking table to identify IPO firms in the employment data provided by the the Institute for Employment Research (Institut für Arbeitsmarkt- und Berufsforschung, IAB). This linking table maps the IAB internal (system-free) establishment identifiers to Bureau van Dijk (BvD) firm identifiers.[7] Finally, we combine the IPO data with the employment data. For the latter, we rely on the IAB establishment history panel (Betriebs-Historik-Panel, BHP), which covers the universe of establishments in Germany. In total, we obtain establishment-year data for 583 IPO firms.

From the establishment-year data, we construct a firm-year dataset using the BvD identifiers. In the final step, we restrict our sample to IPO firms with employment data from five years before the IPO to two years thereafter because our research focus lies on firms' labor reorganization around an IPO. In the end, we are left with data for 327 IPOs, which we can then use for our matching approach.

4.2. Matching algorithm and statistics

We follow a matching approach to construct a control group of private firms with similar characteristics three-years before the IPO firms go public.[8] We proceed in four steps: First, to

[7] Comprehensive documentation of the linking process is provided by Antoni, Koller, Laible, and Zimmermann (2018). The most important variables for the record linkage are the establishment and the company name, the legal form, the industry code, and the postal code. The record linkage is carried out separately for the years 2014 and 2016. We make the assumption that these links of establishments to firms are valid for earlier periods.

[8] We considered using withdrawn IPOs as the basis of our identification strategy in line with earlier studies (cf., e.g., Bernstein, 2015 and Borisov et al., 2021). However, we decided against this approach for a number

rule out substantial differences in the number of total employees, we restrict our set of potential control firms to those deviating not more than 50% in size from the IPO firms. Second, we match on the IPO year, the two-digit national industry code (WZ2008), and a categorical variable of firms' number of establishments, differentiating between single, two, three to five, five to ten, and more than ten-establishment firms. Third, we construct the normalized Euclidean distance over the total number of employees, the one-year growth of total employees, the firm age, the mean imputed wage, the mean employee age, and the shares of medium-qualified employees and high-qualified employees. Fourth, we choose for each IPO firm the matched control firm with the lowest Euclidean distance.

This matching approach returns a matched control firm for 325 of the 327 IPO firms. Table 1 provides statistics on the matching quality. We use the normalized differences proposed by Imbens and Wooldridge (2009) and used by Imbens and Rubin (2015) to examine the average differences between the IPO firms and the matched control firms. Imbens and Rubin (2015) suggest that the normalized differences should be below 0.25. The normalized differences for the total number of employees and the one-year growth rate of total employees are 0.004 and 0.043. For all other matching variables, this statistic does not exceed 0.074. We conclude that the control group matches closely the employment characteristics of IPO firms.

4.3. Construction of employee-level data

We obtain employee-level information from the Integrated Employment Biographies (IEB) provided by the IAB. The IEB covers the majority of individuals working in Germany between 1975 and 2017, only excluding civil servants and the self-employed. The data contain day-to-day information on each employment period in all jobs that are covered by social security. Unique worker and establishment identifiers allow to follow workers over time and across different employers. In addition, in these data, we observe important worker characteristics such as

of reasons. First, the number of withdrawn IPOs is very small in Germany (N=88) and even smaller in our sample (N=34). Second, we find that a matched sample is more suitable for the purpose of this study because it allows us to begin the "treatment period" years ahead of the IPO. Withdrawn IPOs should develop similarly to successful IPOs up to the point of the withdrawal, which usually is very shortly before the scheduled IPO date.

gender, birth dates, nationality, place of residence and work, educational attainment, as well as job characteristics such as occupational and industry codes, and the average daily wage. For each IPO and matched control firm, we observe information on the full workforce from five years before the IPO to two years thereafter. For all employees employed at these firms during this time period, we obtain the full employment history from ten years before the IPO to three years thereafter to investigate the origins and destinations of moving employees and to measure employees' experience.

4.4. Variable construction

We group employees into hierarchical layers and major occupational groups using occupational codes. For the assignment of employees into four hierarchical layers, we build on previous work by Caliendo et al. (2015) who develop the approach using French occupation codes and Gumpert et al. (2018) who translate the mapping to German occupation codes. For the formation of the major occupational groups, our starting point is Blossfeld (1987) who defines twelve occupational groups based on the Occupational Classification Codes of 1988 (KldB1988). We ignore the group of agricultural occupations due to the low relevance for IPO firms. Next, we combine the other eleven groups into the major occupational groups blue-collar workers, white-collar workers, R&D employees, and managers. Additionally, we define three focus occupation groups to examine: finance and accounting employees, middle managers as managers below the highest hierarchical layer, and top managers defined as managers in the highest hierarchical layer of the firm.

Our definition of growth, hiring and separation rates of firms builds on the work by Davis et al. (2014) and Antoni et al. (2019). We define the growth rate of employment from time t to $t+k$ as $g_{f,t,t+k} = \frac{E_{f,t+k}-E_{f,t}}{0.5*(E_{f,t+k}+E_{f,t})}$, where $E_{f,t}$ denotes level of employment in firm f at time t. To decompose the growth rate into the hiring rate and the separation rate ($g_{f,t,t+k} = h_{f,t,t+k} - s_{f,t,t+k}$), we define $h_{f,t} = \frac{H_{f,t}}{0.5*(E_{f,t+k}+E_{f,t})}$ and $s_{f,t,t+k} = \frac{S_{f,t}}{0.5*(E_{f,t+k}+E_{f,t})}$, where $H_{f,t}$ and $S_{f,t}$ denote the number of employees entering and leaving the firm at time t. The administrative individual-level

data reports the total wage sum over workers' employment spells. We hence are able to calculate average daily wages for each individual worker. These wage sums, however, are right censored at the contribution assessment ceiling ('Beitragsbemessungsgrenze'). The censoring limit is given by the statutory pension fund and varies over time and region. We follow Dustmann, Ludsteck, and Schönberg (2009) and fit a series of Tobit regression to impute the right tail of the wage distribution. To this end, wages are first deflated using the CPI. Then, we perform Tobit regressions separately for Eastern and Western Germany as well as male and females, where we define a wage observation as censored whenever the reported wage is higher than 99% of the censoring threshold. In all regressions we control for age-categories, education categories, and all possible interactions.[9]

We construct a variable for workers' educational attainment by using information on both schooling and education in terms of the German vocational system. We first impute these input variables using the method proposed by Fitzenberger, Osikominu, and Völter (2006), correcting for misreporting and inconsistencies. We then build an indicator variable with five distinct values: 1) intermediate school leaving certificate without vocational training, 2) intermediate school leaving certificate with vocational training, 3) upper secondary school leaving certificate without vocational training, 4) upper secondary with vocational training, 5) College or university degree.

4.5. Descriptive statistics

Table 2 provides descriptive statistics on our sample. The sample consists of 325 IPO firms and 325 matched control firms over over eight periods around the IPO (t-5 to t+2). On average, a firm has 556 employees organized in 3.38 layers.[10] The mean employment growth rate is 9%.

[9]Wages can only be imputed for full-time workers since the social security data only indicates whether an individual works full-time or part-time, but lacks details on hours worked. The share of part-time observations with censored wages is however negligibly small (less than 1%).

[10]For 14 out of 2,600 IPO firm-year observations, we observe a total employment of one employee. These 14 firm-year observations can be traced back to five firms. Two of the firms are spin-offs, which might start out with very low numbers of employment. One firm went bankrupt shortly after the end of the observation period. We have no information about the remaining two firms. While we cannot rule out data errors, we find that these numbers are not implausible either.

The mean imputed real daily wage is 118 EUR. For our sample, the number of top managers is higher than the number of middle managers. By definition, any firm must have top managers because top managers are defined as all managers in the top layer. Only firms with middle layers will thus have middle managers according to our definition. In reality, the hierarchical structure of management will be more sophisticated than what our variables can capture. Nevertheless, we find that our approach provides a meaningful decomposition of management within a firm.

4.6. Research Design

We apply a matched-sample difference-in-differences approach at the firm level by regressing one-year and multi-year growth rates on an IPO indicator, the log number of total employees in year four before the IPO, and the one-year growth rate of total employees from year five to year four before the IPO, plus a set of fixed effects:

$$\begin{aligned} g_{f,t-1+k,t+k} = \alpha_t + \theta_k \cdot IPO_f + \beta_1 \cdot g_{f,t-5,t-4} + \beta_2 \cdot ln(E_{f,t-4}) \\ + \lambda_t + \eta_f + \pi_f + \epsilon_{f,t+k}, k = -3, ..., 2, \end{aligned} \tag{1}$$

where λ_t denotes year fixed effects, η_f industry fixed effects, and π_f four region dummies for the Northern, Southern, Western, and Eastern part of Germany. The standard errors are clustered at the firm level, and regressions are unweighted.

5. Results

In this section, we discuss the results of our empirical analysis. In Section 5.1, we analyze employment and wage growth around the IPO and provide a breakdown of these growth rates into inflows and outflows as well as into hierarchical layers, groups with expertise in finance and accounting, middle managers, and top managers. In Section 5.2, we describe how a broader knowledge base and employment growth changes the internal organization of labor. In Section 5.3, we look at the consequences of this reorganization for the characteristics of the labor force.

In Section 5.4, we analyze how incumbent management is restructured and look at the future career paths of incumbent managers.

5.1. Employment and wage growth

The starting point of our analysis is the presumption that IPO firms have to integrate expertise required to run a public company, ahead of the IPO. We also expect significant employment growth, reflecting the growth in assets associated with IPOs. Therefore, we begin our analysis by examining employment growth, hiring, and separations from two years before the IPO to two years after the IPO. We furthermore blend in a discussion of wage growth to fully understand the dynamics of employment growth. In the final step, we decompose employment growth into growth per hierarchical layer and growth for several occupational groups such as R&D employees, finance and accounting (F&A) employees, sales and marketing employees (S&M), middle managers, and top managers.

5.1.1. Growth of the labor force

Table 3 provides a detailed picture of employment growth from three years before the IPO to two years after the IPO. There is no abnormal growth in period t-3, which suggests parallel trends between IPO firms and control firms in the year before matching, affirming the visual impression we obtained from Figure 1.

We find abnormal employment growth in all years from t-2 to t+1. Over the full period, IPO firms grow 39 percentage points more than the control group. In the year of the IPO, employment growth is at its peak. The growth in employment is primarily driven by new hires, but also fewer separations drive employment growth before the IPO. Around the time of the IPO and in the twelve months thereafter, we observe abnormal turnover, indicating that some employees leave the firm around the IPO and these employees get replaced immediately.

Our results confirm our presumption that the employment growth associated with going public is not confined to the period after the IPO. Employment growth begins well ahead of the IPO. In light of the recent literature, the order of magnitude of employment growth

before the IPO both in absolute terms and relative to the employment growth after the IPO is surprising. However, the results are consistent with the results in Pagano et al. (1998) that firms go public after high investment and high asset growth. The authors argue that growth in assets anticipates the funds raised in the IPO. Our results are also consistent with the notion that firms may need to showcase a compelling growth story in order to be able to go public in Europe. In the next section, we will investigate the driving forces of pre-IPO growth further.

5.1.2. Growth per hierarchical layers and focus groups

In Table 4, we decompose employment growth into growth for each hierarchical layer and growth for several occupational groups. We use employment growth over the whole period from t-2 to t+2 as our dependent variable in Panel A. In Panel B, we use the same dependent variable but control for total employment growth and several measures of geographic expansion such as the increase in regions with establishments, in establishments, and in industries in order to isolate the effect of going public beyond what growth in employment and growth in firm complexity would predict.

We document significant employment growth for all groups, but the differences in growth among these groups are significant, too. We find that the middle ranks in the organization (layer 2 and layer 3) and F&A employees and middle managers grow by 15 to 25 percentage points more than production workers (layer 1) and R&D employees. Panel B confirms that the middle ranks in the organization, mostly due to the hiring of large numbers of F&A employees and middle managers, grow by more than growth in employment, establishments, and operated regions or industries would normally predict. Overall, these results confirm our presumption that firms integrate expertise on finance, accounting, and governance by hiring experts in these fields.

In Panel C of Table 4, we control for growth in production workers (layer 1) instead of total employment growth. This analysis reveals that all layers and focus groups grow more strongly in IPO firms than what growth in production would normally predict. This observation resonates well with the observation made in earlier studies that IPOs are associated with a strategic shift

towards the commercialization of products (cf. Pástor et al., 2009, Bernstein, 2015, and Larrain et al., 2021).

Table 5 describes how hiring of public firm and governance experts into the middle ranks of the organization changes the composition of the labor force. Panel A presents the employment share of each hierarchical layer over time. Layer 2 and layer 3 gain in relative importance. Layer 3 increases by 15.6% relative to control group (this result also holds for firms with four layers, see Figure in Appendix B). From Panel B, it becomes apparent which groups drive the increase in employment in the middle ranks of the organization. Hiring of F&A employees and middle managers, by 47% and 100% respectively, dramatically increases the administrative overhead. The results of Panel B also work out more clearly that employment growth does not proportionally affect layers and occupational groups. Production workers placed in layer 1 decline relative to control group, when accounting for total employment growth. Staff in R&D and in sales and marketing (S&M) does not grow more than in the control group when controlling for total employment growth. Panel D of Table 4 highlights the full dimension of employee inflows. In this analysis, we use employee turnover as the dependent variables, which we define as the minimum of employee separations and employee hirings. Thus, we want to understand how many employees have to be hired to replace a leaving employee. For most occupational groups shown in Panel C, turnover is of the same order of magnitude as net employment growth in Panel A. Thus, in order to fill one additional position, two employees have to be hired. It turns out that R&D employees display the lowest turnover rates, in absolute terms and relative to net employment growth. The highest turnover rates can be found for layer 4 and top managers. For these categories almost three employees have to be hired to fill one new position.[11] This observation is consistent with the notion that entrepreneurial-minded managers leave the firm because they lack the managerial capabilities required under the new organizational structure, because they are unhappy with their new roles in a more bureaucratic

[11] We arrive at the ratio of three-to-one in the following way. We take net employment growth for top managers from Panel A, 0.36, and add it to turnover from Panel D, 0.63, to arrive at the hiring rate of top managers. Dividing the hiring rate of 0.99 (=0.36+0.63) by 0.36, we arrive at 2.75 hires per additional top management job created.

organization (Babina et al., 2020, show that skilled employees leave IPO firms to startups), or because they use the IPO to exit the company (Zingales, 1995).

5.1.3. Wage growth

We expect that the reorganization of labor into more formal hierarchies with smaller control spans to also have significant implications for wage growth and wage inequality. As relatively more hires are placed in higher layers, we expect the wages of new hires to be relatively high when compared to new hires in the control firms. Furthermore, by adding hierarchical layers, the firm will increase the utilization rate of knowledge of the employees in the (added) top layer. The employees in added layers should see an increase of their wages relative to employees in existing layers. As a consequence, wage inequality should increase.

Table 6 confirms all our predictions. For IPO firms, we observe a growth in wages from t-3 to t+2 of 11.0%, which is 3.76% more than in the control group. This increase is primarily driven by the wages for hires. Most notably, IPO firms offer new recruits much higher wages shortly before the IPO than they did two years earlier. Over the full observational period, wages of hires increase by 15.2%, 7.22% more than in the control group. In Section 5.3, we will show that these hires are predominantly young, highly-skilled individuals with little work experience, explaining why they earn relatively high wages for new hires, but relatively low wages when compared to incumbents. Meanwhile, wages of incumbents increase by 8.77%, which is only about 2.03% above the wage increase in the control group. Wages in all layers increase, but in line with the control group; wages in the top layer make the only exception. IPO employees in the top layer see the most increases in their wages, both in absolute terms and relative to control group, in line with the notion that the utilization rate of knowledge increases in the top layer when firms expand. As a result, wage inequality increases in the firm, too.

5.2. Organizational restructuring

In this section, we examine how firms reorganize their labor force when they go public. We describe the firm's organization in terms of the firm's number of hierarchical layers and the

firm's control spans across layers.

5.2.1. Hierarchies and layers

In this section, we determine to what extent going public is associated with changes in the hierarchical organization of the firm. The number of hierarchical layers may change when firms go public for three reasons. First, as we argue and document above, going public increases the costs of knowledge acquisition, which increases the degree of specialization in the labor force. Garicano (2000)'s model of knowledge-based hierarchies predicts that firms with higher knowledge acquisition costs have a larger number of hierarchical layers to economize on the costs of knowledge acquisition. Second, firms tend to add hierarchical layers when their labor force grows (cf. Caliendo et al., 2015). Third, firms also tend to add hierarchical layers when they expand geographically because travelling takes up time and managers have limited time resources (cf. Gumpert et al., 2018).

Figure 2, Panel A, depicts the growth in hierarchical layers from t-4 to t+2. We observe an increase relative to the control group. Figure 2, Panel B, shows the growth in layers of IPO firms with less than four layers at t-3 (the point at which we perform our matching of IPO firms to control firms). The firms add one full layer in the process of going public. Table 7 provides a statistical test of these differences. In column (1), we regress changes in layers from t-3 to t+2 on an IPO-indicator. Relative to control group, IPO firms add an additional 0.67 layers. Going public is associated with a period of growth and some of the changes in layers will thus be the consequence of employment growth or geographic expansion. We would like to distinguish the effect of growth around going public from the effect of a broader knowledge base and specialization. Therefore, we control for the growth in total employment in column (2) and, alternatively, the growth in production workers in column (3), both measured over the same time period as the growth in layers. In addition, we control for the growth in establishments, regions with establishments, and industries. Controlling for the growth in employment reduces the differences between both groups to 0.30 layers. Put differently, 44% of the layer increase in IPO firms cannot be explained by employment growth. The total number of employees contains

employees who have been hired in order to broaden the knowledge-base of the firm. The growth in production workers therefore might be a better predictor of the increase in hierarchies per increase in unit of production output, in the absence of going public. Using this measure, the differences in layer growth between both groups is 0.45% of layers. Thus, 67% of the layer increase in IPO firms cannot be explained by the growth in production. 0.45 layers amount to 52% (=0.45/0.86 where 0.86 is the standard deviation of the number of layers reported in Table 2) of the standard deviation in layers observed for our sample. We conclude that a substantial and economically meaningful fraction of the layer increase is associated with the required increase in knowledge base to run a public firm.

5.2.2. Departments and control spans

In this section, we ask how the restructuring into a more hierarchical organization affects the departmental structure of the IPO firm. We define a department as a group of people working closely together to solve assigned problems. In knowledge-based hierarchies, there is no distinction between problem solvers employed in the same hierarchical layer. Each problem solver is equally likely to be assigned a problem that cannot be solved at a lower layer. The measure closest to describing departmental size in the context of the theory is control span. Control span is defined as the ratio of lower-level-employees to higher-level employees. The theory predicts that control spans decrease when the costs of knowledge acquisition increase. We, therefore, expect that firms going public reduce control spans or, put differently, reorganize into smaller departments with more narrow defined competences based on the employees' knowledge in the department. In addition, we implement a second measure of department size: Because our data allows to distinguish rank in terms of skill from managerial ranks, we can also look at the number of employees supervised per manager to measure the size of departments.

We rely on Table 5 to compute control spans over layers and between managers and non-managers. In t=-3, the control spans of layer 4, layer 3, and layer 2 are 3.5 (=15.2%/4.3%), 1.5 (=22.2%/15.2%), and 2.6 (=58.2%/22.2%), respectively. Based on the changes relative to control group indicated in the last column of Table 5, the control span of layer 4 increases by

51.9%. Meanwhile, the control spans of the middle layers decrease (layer 3: -8.05%; layer 2: -11.9%). In t=-3, the control span of middle managers in IPO firms is equal to 19.7 (relative to layer 2 and layer 3) and 50.3 (relative to layer 2, layer 3, and layer 4), i.e, each middle manager oversees on average 50.3 employees if production workers are included. Based on the changes relative to control group indicated in the last column of Table 5, this number drops by half to 25.3 employees per middle manager at the end of year 2. These results are consistent with many of the requirements of operating a public firm. Smaller departments reflect the shift towards a more specialized labor force, where dedicated experts solve problems specific to their area of expertise. The drop in middle-manager to employee ratio by half also reflects the requirement to monitor and report the firm's operations more carefully. Furthermore, the control span of top managers increases dramatically, highlighting that knowledge of managers at the top of the organization is leveraged dramatically.

5.3. Reorganization and the characteristics of the labor force

In this section, we examine the consequences of these drivers on the characteristics of the labor force. In Section 5.1, we document that the restructuring into a more hierarchical organization is driven by employment growth and a substantial influx of additional expertise into the third layer. From Table 5 and the discussions above, we have already learned that the share of highly skilled labor in the workforce increases. In Figure 3, we further examine the characteristics of new hires and how they change the characteristics of the labor force. In Panel A and Panel B, we plot the average tenure of the labor force and of new hires, respectively. The tenure of IPO hires is substantially lower in all years than the tenure of the incumbent work force. As a consequence of this difference and the much higher hiring rates, the IPO firm becomes relatively less experienced over time. The IPO hires are not much different from the hires of the control firms in terms of tenure. The one remarkable difference is that tenure of IPO hires peaks shortly before the IPO, whereas tenure of control firm hires continuously increases over time. Similar patterns can be observed in Panel C and Panel D where we examine

employee age. Because hires are much younger and because the high level of hirings relative to control group, IPO firms grow older at a lower pace than the control firms. Again, new hirings are oldest shortly before the IPO and around that time they are also older than the hirings of the control firm, which indicates that IPO firm is looking for mature employees, a characteristic that is not picked up by tenure industry experience or job experience, which we examine in Panels E, F, G, and H. We measure industry experience in terms of work experience in the same 2-digit industry as the IPO (control) firm operates. Panel E and Panel F confirm earlier observations that IPO hires are not different from hires of the control firms, but because hires are less experienced and because of the high levels of hiring, the IPO workforce becomes relatively less experienced. These insights are very similar if we measure experience in terms of working in the occupation for which the employee gets hired (cf. Panel G and Panel H) However, IPO hires have more experience in finance and accounting jobs and at public firms than incumbents. Consequently, the labor force of the IPO firm shows stronger increases in experience in these categories than the control group (cf. Panel I and Panel K). Most notably, the recruiting of employees with experience in public firms picks up strongly around the time of the IPO. This insight could point towards increased demand from the firm's side. Given the observation that most of the increase happens after the IPO, an alternative explanation could be that the firm, once public, became a more interesting destination for employees from public firms.

5.4. Going public and the reorganization of management

Managers constitute a particularly interesting occupational group. The founders of the firm going public are usually part of the management team. Founders are known for being very entrepreneurial minded and might not like to work in a bureaucratic organization. Founders usually also have ownership in the firm, at least partly, and the IPO is a great opportunity for owners to cash out. Even if the owners have to hold onto their stock during the IPO, they might still use an opportunity to cash out soon thereafter, by selling their shares in the open

market or via a secondary offering. Furthermore, some incumbent managers will face changes to their standing in the organization, as a another breed of managers with a different set of expertise enters the company. In this section, we examine how management is restructured in the process of going public and what happens to the incumbent top managers who leave the firm.

We find that the reorganization of the firm has tremendous impact on management. As discussed in Section 5.2.2 and presented in Table 5, the control span of top managers doubles relative to control group (the share of top managers decreases by 36.83 percent. Thus, the control span increases by the factor 1/(1-0.3683), which is equal to 58%) and the control span of middle managers drops by half (the share of middle managers increases by 95.88 percent. Thus, the control span increases by the factor 1/(1+0.9588), which is equal to -51%) (cf. Section 5.2.2). These results suggest that the knowledge of top managers is leveraged, while middle managers become more specialized assignments and oversee much smaller departments.

These developments are also reflected in the development of wages as documented in Table 6. From t=-3 to t=+2, top managers in IPO firms increase their wages by 12.3% (=(191.50-170.47)/170.47), which is double the increase of the wages in the control group. Middle managers increase their wages only by half, both relative to top managers and relative to their control group. Accounting for the developments in the control group, the wage gap between middle managers and top managers increases from 14.61 Euros (=170.47-155.86) to 42.82 Euros (=170.47 x (1+0.064) - 155.86 x (1-0.111)), an increase of 193%.

Overall, these findings are consistent with the economics of knowledge hierarchies which predict that additional layers increase the utilization rate of knowledge of those employees who stay in the top layer, when a new layer is introduced, while the utilization rate of knowledge decreases in all other layers.

The net employment changes discussed above do not reveal the full dimension of the reorganization of management. As discussed above in Table 4, Panel C, turnover among middle managers and top managers is tremendous. For every additional top management position created, on average 2.72 top managers had to be hired (0.64 from Panel C plus net employment

growth 0.37 from Panel A equals total hiring of 1.01. Total hiring divided by net employment growth is equal to 2.72). In Table 8, we examine to what extent turnover is driven by adding additional layers. We find that adding one layer increases top management turnover by 40 percentage points, suggesting that a substantial share of managers is not compatible with or unwilling to adapt to the new, more hierarchical organization.

The tremendous reorganization of management raises the question of how incumbent managers fare during and after the IPO. Figure 4 depicts the changes to the incumbent management, which we observe at the end of t-3. We find that 60% of top managers leave the IPO firm until the end of year two, which is 10 percentage points or 20% more than in the control group (Panel A). Remarkably, the share of incumbent female top managers was much higher in IPO firms than in the control group, and the retention of these female top managers is higher than in the control group afterwards.

Looking at the destinations of leaving top managers, we conclude that leaving managers are looking for more entrepreneurial destinations: Most leaving top managers directly start a new job, but this job is less likely to be a management job again; more managers end up at a smaller destination in t+2 and the destination is always much smaller than the destination of leaving control top managers. Finally, managers work at a younger establishment afterwards and they are more likely to leave to another industry (Figure 5)

6. Discussion and conclusion

We examine how firms change organization and composition of their labor force when they go public. IPO firms exhibit a significant growth in the size of their labor force starting two years before the IPO. They hire a large number of employees with accounting and finance expertise to operate under the requirements of being a public firm. They also hire a large number of employees with work experience in public firms. To accommodate the significant growth in their labor force, firms move towards a more hierarchical structure and greater specialization. Incumbent management is reorganized into fewer top managers and more middle managers

where top managers gain more responsibility and middle managers become more specialized. As a result, the wage gap between the two groups widens. The resulting more efficient structure facilitates the firm's ability to acquire innovation from outside, mitigating the decline in its ability to generate internal innovation.

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Figures

Figure 1
Mean number of total employees

This figure presents the development of the mean number of total employees for IPO firms and matched control firms separately. A detailed description of all variables can be found in Appendix A.

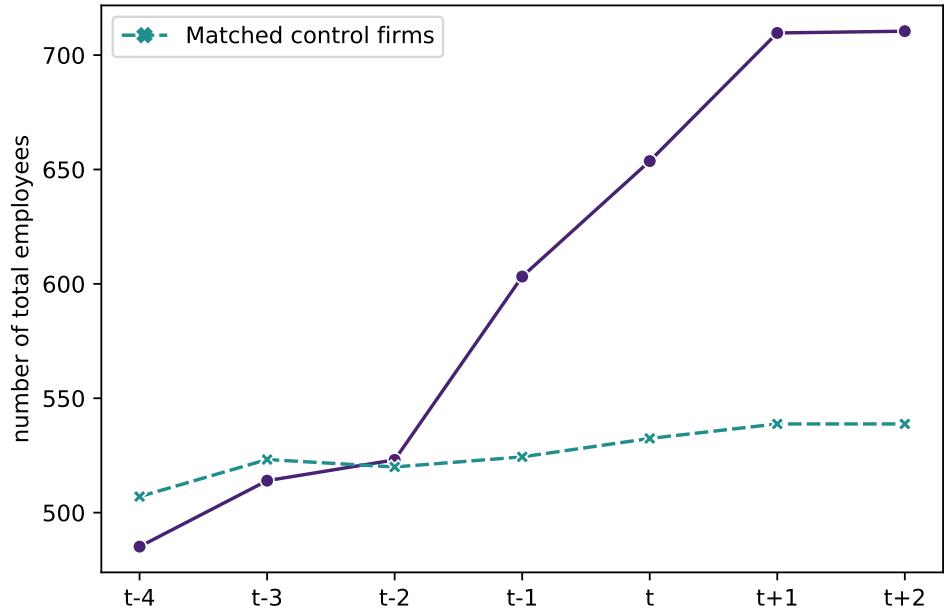
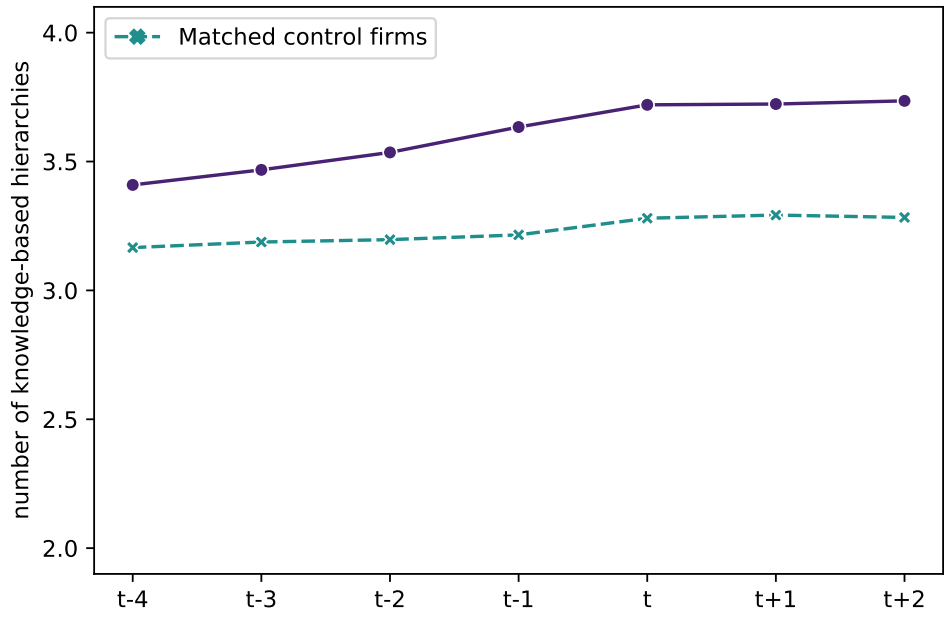


Figure 2
Mean number of knowledge hierarchies

This figure presents the development of the mean number of knowledge hierarchies for IPO firms and matched control firms separately. Subfigure (a) presents the number of knowledge hierarchies for all firms, and Subfigure (b) for firms with less than four layers in t-3. A detailed description of all variables can be found in Appendix A.

(a) All firms



(b) Firms with less than four layers in t-3

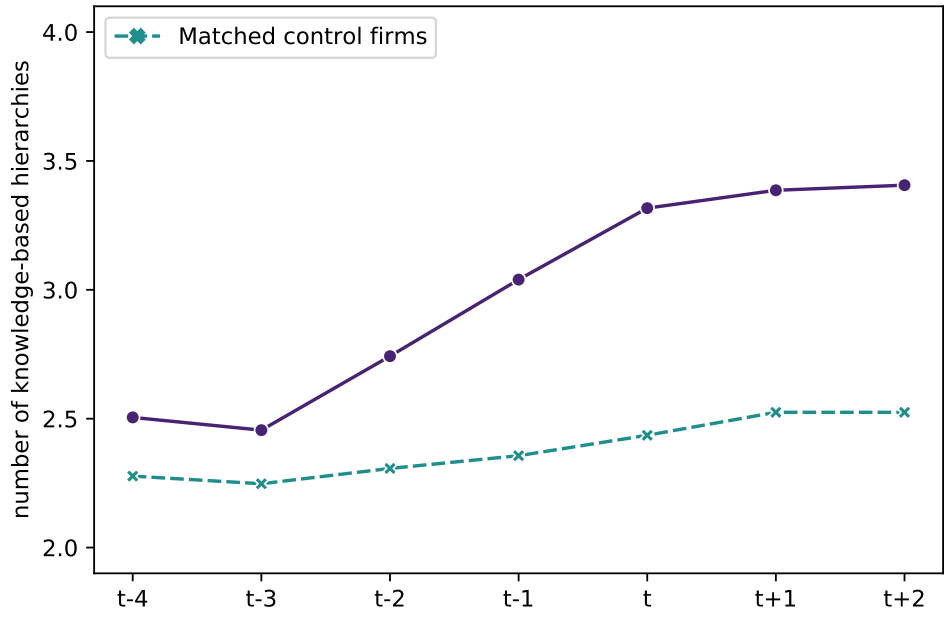
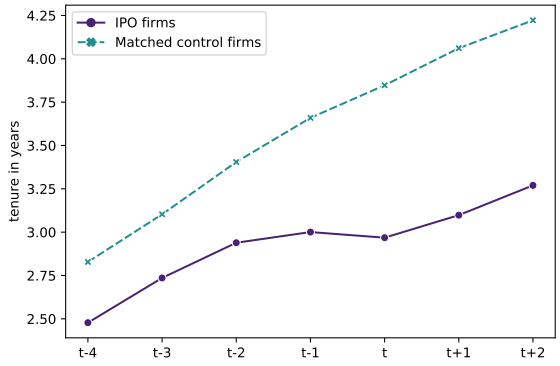


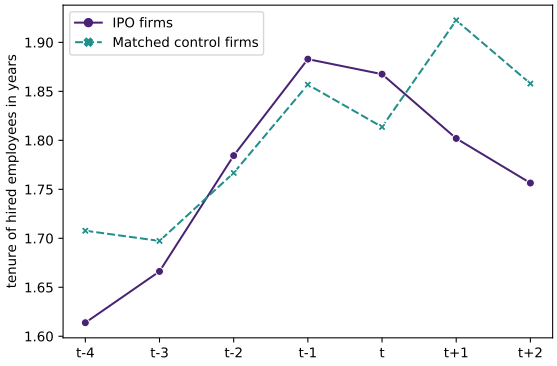
Figure 3
What happens to the expertise of the labor force?

This figure illustrates the expertise of the labor force for IPO firms and matched control firms separately. Subfigures (a) and (b) present the mean tenure of all employees and of new hires before the move. Analogously, Subfigures (c) and (d) present the mean age, Subfigures (e) and (f) the mean occupation experience, Subfigures (g) and (h) mean industry experience, Subfiures (i) and (j) the mean finance & accounting (F&A) experence, and Subfigures (k) and (l) the mean listed firm experience A.

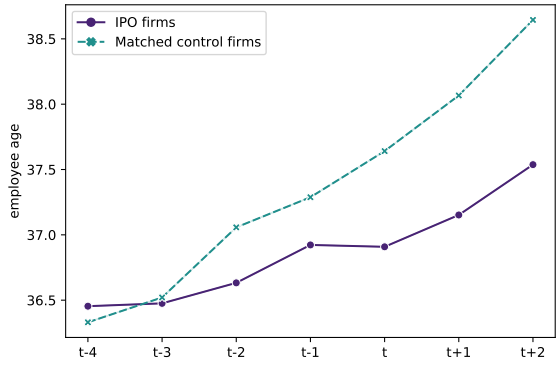
(a) Tenure of employees



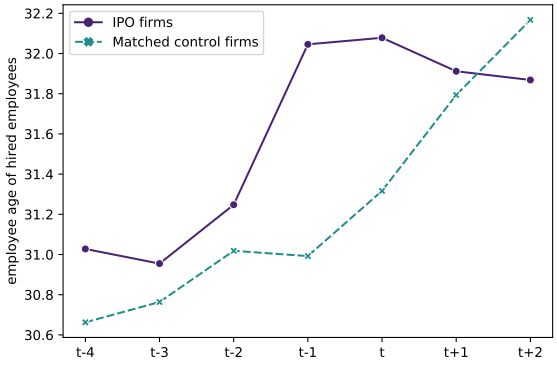
(b) Tenure of hires



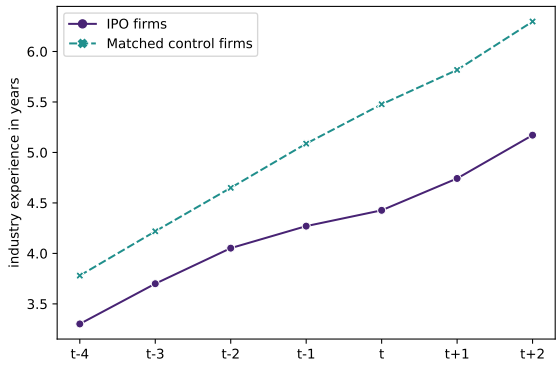
(c) Age of employees



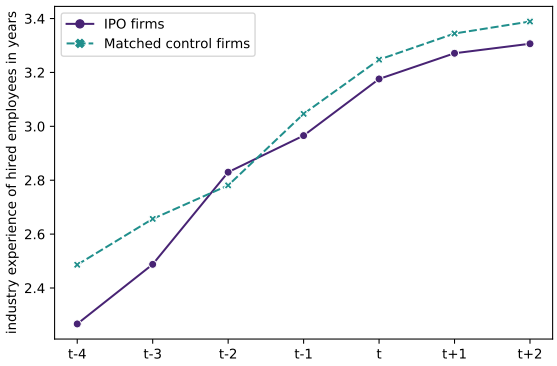
(d) Age of hires



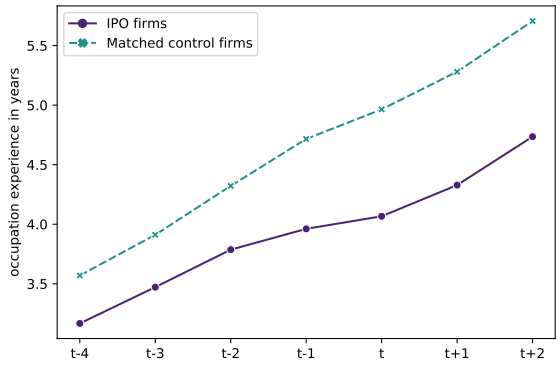
(e) Industry experience of employees



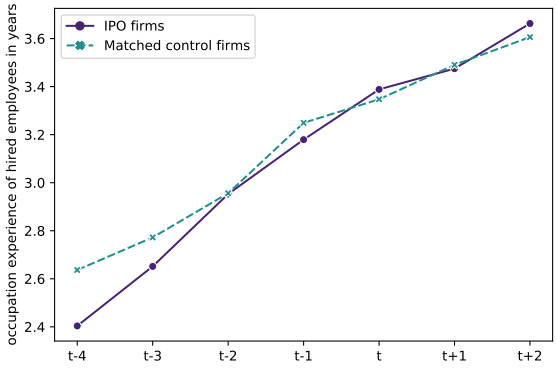
(f) Industry experience of hires



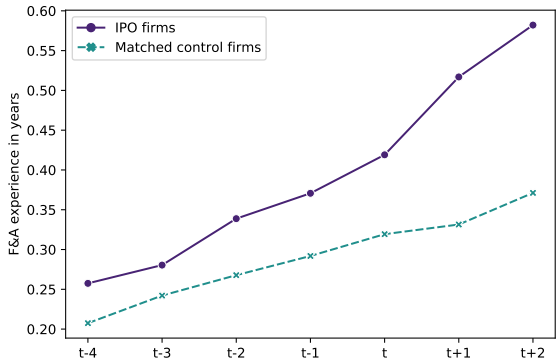
(g) Occupation experience of employees



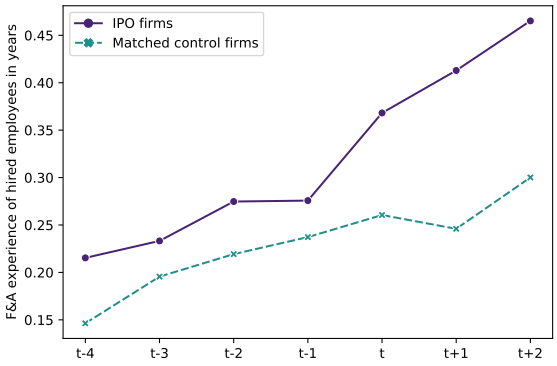
(h) Occupation experience of hires



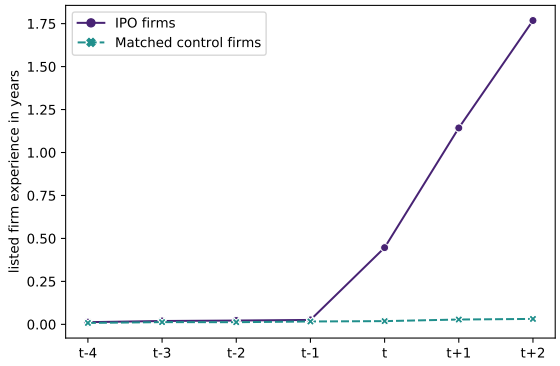
(i) F&A experience of employees



(j) F&A experience of hires



(k) Listed firm experience of employees



(l) Listed firm experience of hires

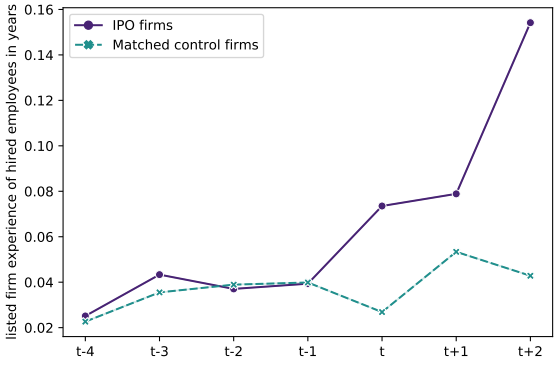
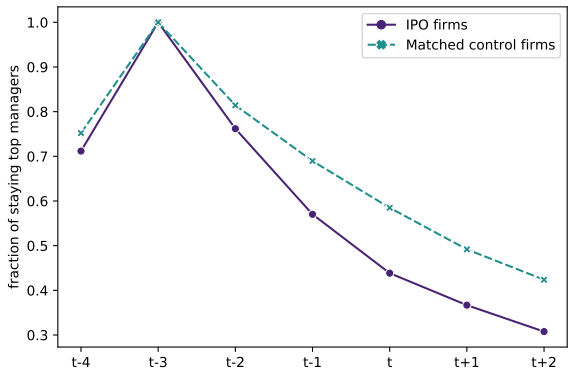


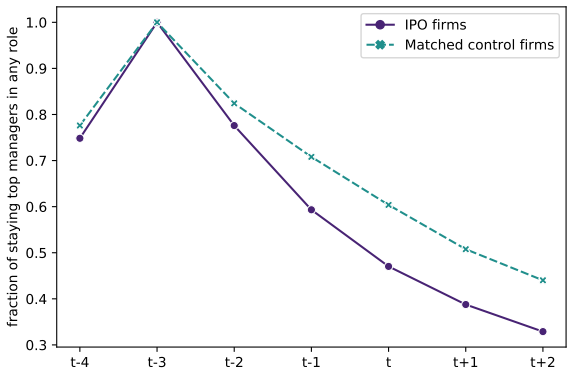
Figure 4
What happens to the firm's top managers employed in t-3?

This figure illustrates the characteristics of top managers employed in t-3 over time for IPO firms and matched control firms separately. Subfigure (a) presents the fraction of top managers staying in the firm. Subfigure (b) presents their mean tenure, Subfiure (c) their mean age, and Subfigure (d) the mean fraction of females. A detailed description of all variables can be found in Appendix A.

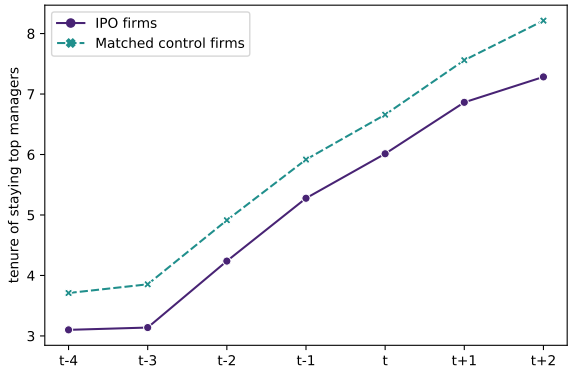
(a) Share of staying top managers



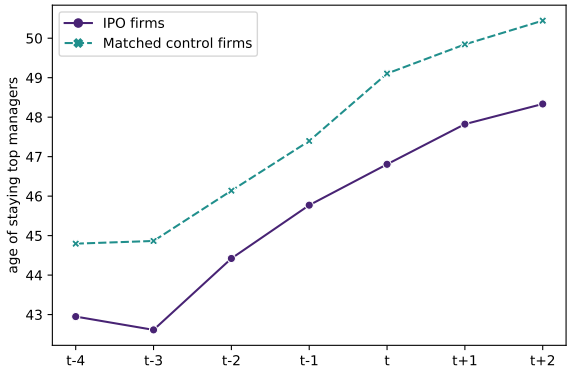
(b) Share of staying top managers in any role



(c) Tenure of top managers



(d) Age of top managers



(e) Female among top managers

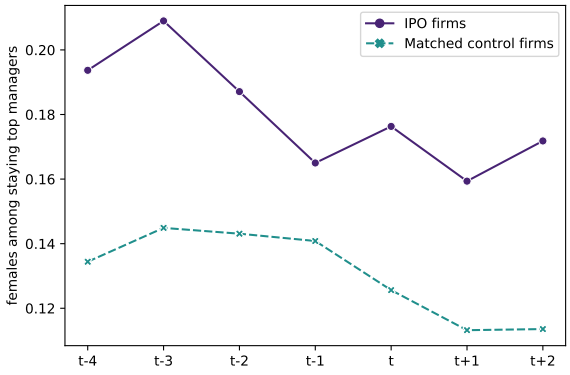
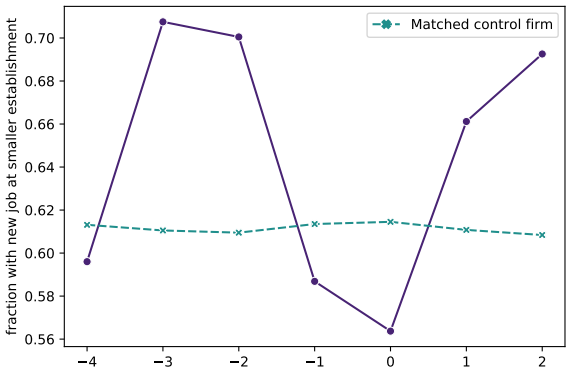


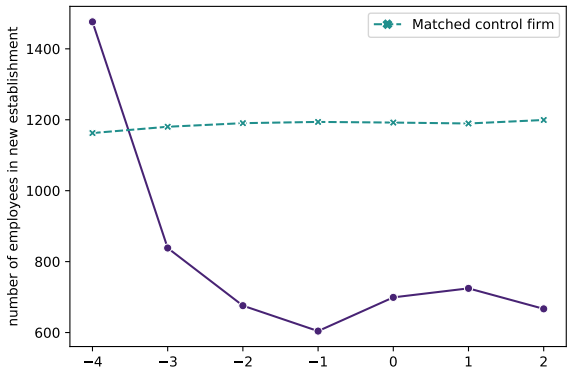
Figure 5
What are the destination of top managers leaving the firm?

This figure illustrates the characteristics of new jobs and new employers of top managers leaving the IPO firms and matched control firms. Subfigure (a) presents the fraction of top managers leaving to a smaller establishment, Subfigure (b) the new establishments' mean number of employees, Subfigure (c) fraction leaving to a younger establishment, Subfigure (d) the new establishments' mean age, Subfigure (e) the fraction with a new job in layer 4, Subfigure (f) the fraction with a new job as managers, and Subfigure (g) the fraction with a new job in the same industry. A detailed description of all variables can be found in Appendix A.

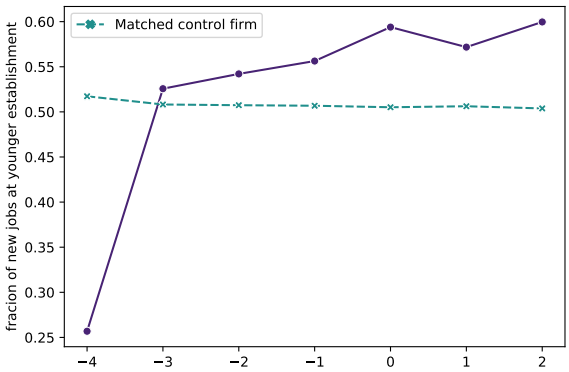
(a) New job at smaller establishment



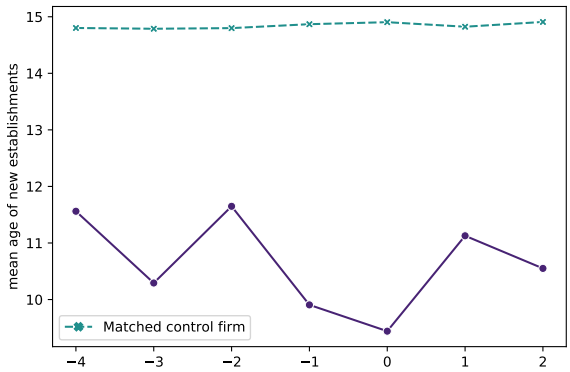
(b) New establishment's no. employees



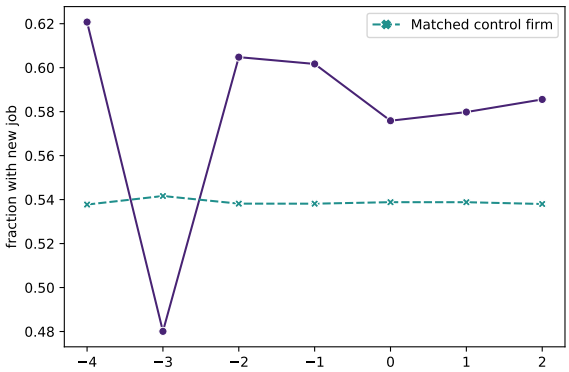
(c) New job at younger establishment



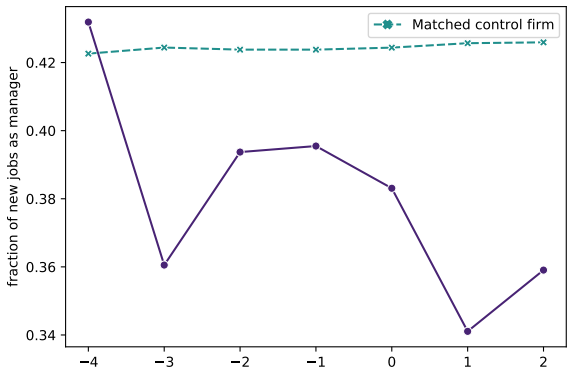
(d) New establishment's age



(e) New job in layer 4



(f) New job as manager



(g) New job in same industry

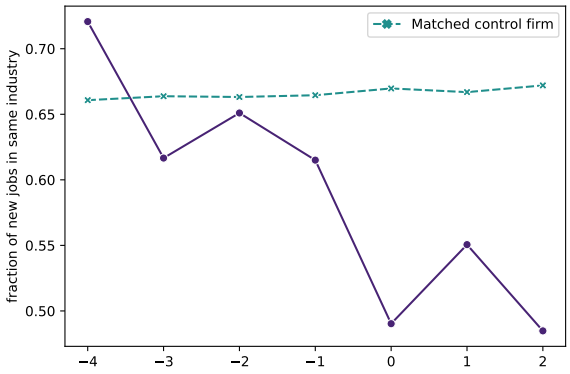


Table 1

Matching statistics

This table presents the matching statistics on the 325 IPO firms and the 325 matched control firms in t-3. A detailed description of all variables can be found in Appendix A.

	employees	growth rate empl.	wage	empl. age	share medium-qualified	share high-qualified	firm age
Panel A: IPO firms (N=325)							
matched treated - mean	511.12	0.14	115.11	35.99	0.61	0.25	11.95
matched treated - SD	1411.51	0.32	30.07	4.64	0.22	0.24	7.70
Panel B: Matched control firms (N=325)							
matched control - mean	520.41	0.12	114.64	36.04	0.62	0.23	12.27
matched control - SD	1594.12	0.28	30.19	4.39	0.20	0.23	7.58
Panel C: Differences in means							
relative difference of mean	0.02	0.13	0.00	0.00	0.02	0.10	0.03
Imbens-Wooldridge test	0.00	0.04	0.01	0.01	0.04	0.07	0.03

Table 2

Descriptive statistics

This table presents descriptive statistics. The sample consists of 5,200 firm-years for 325 IPO firms and 325 matched control firms over eight periods around the IPO (t-5 to t+2). Reported are the number of observations (Obs), mean value (Mean), standard deviation (SD), median (50th), minimum (Min), and maximum (Max). A detailed description of all variables can be found in Appendix A.

	Obs	Mean	SD	Min	50th	Max
number of employees	5,200	556	1593	1	111	20999
growth rate of employees	4,554	0.090	0.306	-1.937	0.053	1.995
hiring rate of employees	4,554	0.286	0.255	0.000	0.215	1.995
separation rate of employees	4,554	0.196	0.197	0.000	0.144	1.961
wage	5,188	118	33	23	115	303
log wage	5,188	4.666	0.290	3.132	4.685	5.662
share of employees with censored wages	5,200	0.143	0.145	0.000	0.103	1.000
number of layers	5,200	3.388	0.861	1.000	4.000	4.000
share of layer 1 (production workers)	5,200	0.602	0.281	0.000	0.667	1.000
share of layer 2 (problem solver - level 1)	5,200	0.215	0.198	0.000	0.164	1.000
share of layer 3 (problem solver - level 2)	5,200	0.147	0.237	0.000	0.030	1.000
share of layer 4 (problem solver - level 3)	5,200	0.035	0.075	0.000	0.015	1.000
share of F&A employees	5,200	0.053	0.105	0.000	0.018	1.000
share of middle managers	5,200	0.017	0.053	0.000	0.000	0.886
share of top managers	5,200	0.041	0.086	0.000	0.017	1.000
share of R&D personnel	5,200	0.133	0.184	0.000	0.062	1.000
share of S&M employees	5,200	0.056	0.134	0.000	0.003	1.000
number of establishments	5,200	4	17	1	1	364
number of regions	5,200	1.327	0.730	1.000	1.000	4.000
number of industries	5,200	1.213	0.565	1.000	1.000	6.000

Table 3

Analysis of employment growth over the periods t-3 to t+2

The table reports estimated differences in employment growth, hiring, separation, and turnover rates between IPO firms and matched control firms, for the periods t-3 to t+2. Panel A presents the rates for period t-3 and Panel B over the five periods t-2 to t+2. Panel C presents a decomposition of the five-period rates from Panel B into yearly rates. The yearly coefficients for the growth, hiring, and separation rates add up to the cofficient over five-periods. This decomposition does not hold for the turnover rate as it is defined as the minimum between the hiring and the separation rate. The regression specification follows Eq. 1. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, and the log number of employees in t-4, $ln(E_{f,t-4})$. In addition, we control for year fixed effects, two-digit industry fixed effects, region fixed effects, and number-establishment fixed effects. See Section 4.6 for further details. The number of observations is 650 (325 IPO firms and 325 matched control firms). [t-2;t], [t+1;t+2], and [t-2;t+2] report the estimated differences over multi-period windows. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	growth rate	separation rate	hiring rate	turnover rate
Panel A: Employment growth in t-3				
t-3 (pre-matching period)	0.014	0.016	0.030	0.0046
	(0.67)	(1.34)	(1.60)	(0.46)
	650	650	650	650
Panel B: Employment growth over the periods t-2 to t+2				
[t-2; t+2]	0.39***	0.17**	0.56***	0.23***
	(8.81)	(2.34)	(8.49)	(3.52)
	650	650	650	650
Panel C: Decomposition of employment growth from t-2 to t+2				
t-2	0.037**	-0.040***	-0.0027	-0.021***
	(2.09)	(-2.67)	(-0.22)	(-2.91)
	650	650	650	650
t-1	0.14***	-0.054***	0.088***	-0.013
	(7.21)	(-3.73)	(5.10)	(-1.40)
	650	650	650	650
t	0.21***	0.020	0.23***	0.050***
	(6.09)	(1.00)	(7.09)	(4.05)
	650	650	650	650
t+1	0.069**	0.090***	0.16***	0.064***
	(2.13)	(3.55)	(5.40)	(4.69)
	650	650	650	650
t+2	-0.062	0.15***	0.092***	0.052***
	(-1.43)	(3.75)	(6.06)	(4.71)
	650	650	650	650

Table 4

Analysis of layers' and focus groups' growth and turnover rate over the period t-2 to t+2

The table reports estimated differences in employment growth and turnover rates between IPO firms and matched control firms controls, for the period t-2 to t+2. The regression specification in Panel A follows Eq. 1. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, and the log number of employees in t-4, $ln(E_{f,t-4})$. In addition, we control for year fixed effects, two-digit industry fixed effects, region fixed effects, and number-establishment fixed effects. See Section 4.6 for further details. In Panel A, the dependent variables are growth rates over the periods t-2 to t+2 for the employment categories indicated in each column. In Panel B, the dependent variables are also the growth rates of the five-period window. As further controls for firm growth, we add the growth rate of total employees over the periods t-2 to t+2, the change in the log number of establishments, the change in the number of regions in which the firm has establishments, and the change in the number of industries in which the firm operates. In Panel C, we replace the growth rate of total employees by the growth rate of layer 1. In Panel C, the dependent variables are the turnover rates over the periods t-2 to t+2 for the employment categories indicated in each column. The turnover rate is defined as the minimum of the hiring rate and the separation rate. Compared to Panel B, we replace the five-period growth rate of total employees by growth rates of the respective employment categories. The number of observations is 650 (325 IPO firms and 325 matched control firms). T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	Layers				Focus groups				
	layer 1	layer 2	layer 3	layer 4	F&A	middle man.	top man.	R&D	S&M
Panel A: Growth rates over [t-2;t+2]: basic controls									
IPO	0.33***	0.46***	0.49***	0.36***	0.55***	0.48***	0.37***	0.29***	0.31***
	(6.45)	(7.59)	(7.16)	(4.59)	(7.75)	(5.99)	(4.93)	(4.28)	(4.26)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	650	650	650	650	650	650	650	650	650
R2	0.31	0.22	0.18	0.14	0.19	0.13	0.17	0.12	0.12

Continued on next page

Table 4 continued

	Layers				Focus groups				
	layer 1	layer 2	layer 3	layer 4	F&A	middle man.	top man.	R&D	S&M
Panel B: Growth rates over [t-2;t+2]: controls for firm growth									
IPO	-0.053*	0.17***	0.14**	0.089	0.26***	0.23***	0.100	0.014	0.11
	(-1.94)	(3.05)	(2.15)	(1.10)	(3.58)	(2.85)	(1.30)	(0.22)	(1.51)
growth rate of employees$_{[t-2;t+2]}$	0.99***	0.77***	0.85***	0.63***	0.72***	0.63***	0.59***	0.70***	0.50***
	(30.87)	(12.87)	(13.07)	(7.99)	(9.53)	(8.42)	(8.02)	(9.87)	(6.56)
Δlog establishments$_{[t-2;t+2]}$	-0.0063	-0.089	-0.21**	-0.13	-0.11	-0.28	0.036	0.20*	-0.016
	(-0.19)	(-1.00)	(-2.37)	(-0.99)	(-0.98)	(-1.58)	(0.30)	(1.84)	(-0.10)
Δregions$_{[t-2;t+2]}$	-0.024	-0.047	0.19***	0.24**	0.096	0.24*	0.21**	-0.13	-0.039
	(-0.89)	(-0.71)	(2.65)	(2.20)	(1.05)	(1.95)	(2.44)	(-1.29)	(-0.30)
Δindustries$_{[t-2;t+2]}$	-0.011	0.094*	0.16**	-0.030	0.088	0.018	-0.079	0.016	0.13
	(-0.53)	(1.66)	(2.41)	(-0.39)	(1.37)	(0.17)	(-0.94)	(0.25)	(1.30)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	650	650	650	650	650	650	650	650	650
R2	0.82	0.46	0.43	0.26	0.36	0.23	0.30	0.31	0.21

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Table 4 continued

	Layers				Focus groups				
	layer 1	layer 2	layer 3	layer 4	F&A	middle man.	top man.	R&D	S&M
Panel C: Growth rates over [t-2;t+2]: alternative controls for firm growth									
IPO	n/a	0.32***	0.28***	0.19**	0.38***	0.33***	0.20***	0.13*	0.18**
	n/a	(4.97)	(4.04)	(2.36)	(4.99)	(4.07)	(2.62)	(1.90)	(2.39)
growth rate of layer $1_{[t-2;t+2]}$	n/a	0.39***	0.53***	0.38***	0.45***	0.38***	0.35***	0.44***	0.37***
	n/a	(5.79)	(8.70)	(5.19)	(5.90)	(5.67)	(4.93)	(6.58)	(5.69)
Δlog establishments$_{[t-2;t+2]}$	n/a	0.047	-0.096	-0.038	-0.016	-0.19	0.13	0.30**	0.032
	n/a	(0.46)	(-0.97)	(-0.28)	(-0.13)	(-1.06)	(1.01)	(2.51)	(0.20)
Δregions$_{[t-2;t+2]}$	n/a	-0.011	0.23***	0.27**	0.13	0.26**	0.24***	-0.095	-0.021
	n/a	(-0.15)	(2.93)	(2.39)	(1.37)	(2.16)	(2.59)	(-0.94)	(-0.16)
Δindustries$_{[t-2;t+2]}$	n/a	0.12*	0.18***	-0.0092	0.11*	0.039	-0.058	0.039	0.15
	n/a	(1.87)	(2.70)	(-0.11)	(1.74)	(0.35)	(-0.64)	(0.56)	(1.38)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	650	650	650	650	650	650	650	650	650
R2	0.32	0.32	0.33	0.21	0.29	0.19	0.25	0.23	0.19

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Table 4 continued

	Layers				Focus groups				
	layer 1	layer 2	layer 3	layer 4	F&A	middle man.	top man.	R&D	S&M
Panel D: Turnover rates over [t-2;t+2]: additional controls for firm growth									
IPO	0.29***	0.37***	0.58***	0.63***	0.57***	0.60***	0.65***	0.26**	0.41***
	(4.05)	(4.15)	(4.59)	(5.68)	(2.74)	(5.36)	(5.60)	(2.23)	(3.74)
growth rate of employee category$_{[t-2;t+2]}$	-0.16**	-0.090	-0.17**	0.089	-0.092	0.22***	0.18**	-0.14	0.31***
	(-2.10)	(-1.10)	(-1.99)	(1.05)	(-0.51)	(2.79)	(2.00)	(-1.16)	(2.80)
Δlog establishments$_{[t-2;t+2]}$	0.19	0.10	0.29	0.54	0.23	0.089	0.58	-0.10	0.096
	(1.42)	(0.66)	(1.51)	(1.52)	(1.23)	(0.44)	(1.09)	(-0.40)	(0.40)
Δregions$_{[t-2;t+2]}$	-0.22**	-0.15	-0.18	-0.36**	-0.18	-0.17	-0.21	0.046	-0.35*
	(-2.11)	(-1.15)	(-1.38)	(-2.43)	(-1.39)	(-1.12)	(-1.28)	(0.18)	(-1.84)
Δindustries$_{[t-2;t+2]}$	-0.016	-0.0075	0.0030	-0.18	-0.044	0.017	-0.17	0.11	-0.022
	(-0.12)	(-0.06)	(0.02)	(-0.88)	(-0.35)	(0.12)	(-0.58)	(0.62)	(-0.14)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	650	650	650	650	650	650	650	650	650
R2	0.31	0.17	0.18	0.19	0.11	0.15	0.18	0.14	0.14

Table 5

Analysis of changes in workforce composition from year t=-3 to t=2

This table presents the change in employment shares for employees from year t=-3 to year t=2 in the four layers, for the IPO firms and the IPO firms compared to the matched control firm. Panel A presents the change in employment shares for the four layers and Panel B for the occupation focus groups. The percentage change is calculated relative to the value of year t=-3. A detailed description of all variables can be found in Appendix A.

	IPO		ΔIPO	ΔIPO - ΔMatched		
	t=-3	t=2	t=2 - t=-3 in %	DiD	t-stat	DiD in %
Panel A: Layers						
layer 1 (production workers)	0.582	0.570	-2.02%	-0.031**	-2.427	-5.14%
layer 2 (problem solvers - lvl 1)	0.222	0.217	-2.45%	0.014	1.297	6.38%
layer 3 (problem solvers - lvl 2)	0.152	0.172	12.90%	0.024***	2.867	16.12%
layer 4 (problem solvers - lvl 3)	0.043	0.041	-5.67%	-0.007	-1.185	-22.89%
Panel B: Focus groups						
F&A employees	0.055	0.079	43.92%	0.025***	3.484	45.66%
middle managers	0.019	0.032	69.78%	0.017***	4.418	95.88%
top managers	0.051	0.044	-13.20%	-0.014**	-2.090	-36.83%
R&D employees	0.148	0.129	-12.47%	-0.010	-1.489	-6.10%
S&M employees	0.052	0.049	-5.73%	-0.008	-1.485	-13.82%

Table 6

Analysis of changes in wages from year t=-3 to t=2

This table presents the change in log wages from year t=-3 to year t=-1 and from year t=-3 to year t=2, for the IPO firms and the IPO firms compared to the matched control firms. Panel A present the change in log wages for all employees, hires and incumbents, Panel B for the layers, Panel C for the wage percentiles over all employees, and Panel D for the focus groups. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	IPO			ΔIPO - ΔMatched		ΔIPO - ΔMatched	
	t=-3	t=-1	t=2	[t=-3,t=-1]		[t=-3,t=2]	
	mean	mean	mean	DiD	t-stat	DiD	t-stat
Panel A: All employees							
all employees	115.11	122.21	127.74	0.028***	2.67	0.035***	2.66
hired employees	101.78	109.22	117.20	0.042*	1.93	0.051**	2.29
incumbent employees	120.10	127.42	130.64	0.030***	2.83	0.017	1.26
Panel B: Layers							
layer 1	99.46	104.38	109.00	0.010	0.81	0.008	0.50
layer 2	127.96	136.19	141.26	0.034**	2.11	0.023	1.29
layer 3	146.88	153.84	159.74	0.024	1.28	-0.009	-0.37
layer 4	172.90	185.30	194.17	0.004	0.19	0.038	1.44
Panel C: Percentiles of all employees							
10th percentile	75.08	78.34	81.25	0.057**	2.48	0.035	1.55
25th percentile	89.27	92.58	96.32	0.019	1.20	0.016	0.96
50th percentile	108.06	113.47	118.06	0.024**	2.29	0.033**	2.47
75th percentile	133.38	142.29	148.74	0.031***	3.13	0.047***	3.43
90th percentile	164.83	177.73	187.76	0.032***	2.77	0.053***	3.39
Panel D: Focus groups							
F&A employees	137.07	145.82	149.22	0.028	1.31	-0.008	-0.30
middle mangers	155.86	165.78	166.40	0.029	0.91	-0.111***	-2.67
top managers	170.47	183.17	191.50	0.020	0.85	0.064**	2.32
R&D employees	133.92	141.86	148.39	0.000	0.02	0.016	0.84
S&M employees	131.54	138.41	147.21	-0.010	-0.48	0.001	0.03

Table 7

Analysis of the change in the number of layers over the periods t-2 to t+2

The dependent variable is the change in the number of layers over the five-period window t-2 to t+2 ([t-2;t2]). IPO is a dummy variable that indicates IPO firms. Δlog employees$_{[t-2;t+2]}$ is the change of the log number of employees over the periods [t-2;t+2], Δlog production workers$_{[t-2;t+2]}$ is the change in the log number of employees in layer 1 (production workers), Δlog establishments$_{[t-2;t+2]}$ is the change in the log number of establishments, Δregions$_{[t-2;t+2]}$ is the change in the number of regions in which the firm has establishments, and Δindustries$_{[t-2;t+2]}$ is the number of industries in which the firm operates. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, the log number of employees in t-4, $ln(E_{f,t-4})$, year fixed effects, two-digit industry fixed effects, region fixed effects, and number-establishment fixed effects. The regression models are estimated on the subsample of firms with less than four layers in year t=-3. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively. A detailed description of all variables can be found in Appendix A. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	(1)	(2)	(3)
IPO	0.67***	0.30***	0.45***
	(6.25)	(2.67)	(4.06)
Δlog employees$_{[t-2;t+2]}$		0.48***	
		(6.53)	
Δlog production workers$_{[t-2;t+2]}$			0.34***
			(4.71)
Δlog establishments$_{[t-2;t+2]}$		-0.38	-0.28
		(-1.24)	(-0.85)
Δregions$_{[t-2;t+2]}$		0.29	0.30
		(1.29)	(1.25)
Δindustries$_{[t-2;t+2]}$		0.062	0.023
		(0.23)	(0.08)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes
Obs	202	202	202
R2	0.37	0.51	0.46

Table 8

Analysis of the turnover of middle and top managers over the periods t-2 to t+2

The table reports estimated differences in turnover rates of middle and top maangers between IPO firms and matched control firms controls, for the periods t-2 to t+2. We interact the IPO dummy with the change in the number of layers over the periods t-2 to t+2, which is centered at its mean.We control for the five-period growth rates of the respective employment categories. As controls for firm growth, we add the change in the log number of establishments over the periods t-2 to t+2, the change in the number of regions in which the firm has establishments, and the change in the number of industries in which the firm operates. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, the log number of employees in t-4, $ln(E_{f,t-4})$, year fixed effects, two-digit industry fixed effects, region fixed effects, and number-establishment fixed effects. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	middle managers	top managers
IPO	0.58***	0.54***
	(4.91)	(4.21)
Δlayers$_{[t-2;t+2]}$	0.066	0.074
	(0.52)	(0.56)
IPO x Δlayers$_{[t-2;t+2]}$	0.47***	0.58***
	(2.91)	(3.30)
growth rate of employee category$_{[t-2;t+2]}$	-0.062	0.022
	(-0.86)	(0.33)
Δlog establishments$_{[t-2;t+2]}$	0.10	0.64**
	(0.41)	(2.45)
Δregions$_{[t-2;t+2]}$	-0.13	-0.22
	(-0.71)	(-1.11)
Δindustries$_{[t-2;t+2]}$	-0.017	-0.23
	(-0.11)	(-1.31)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Region FE	Yes	Yes
Number estab. FE	Yes	Yes
Obs	650	650
R2	0.16	0.21

Appendix A
Definition of Variables

Variable	Description
Firm and employment characteristics	
IPO	Dummy variables that indicates IPO firms.
number of employees	Number of total employees of a firm.
employment growth rate	Employment growth rate of a firm from time t to time $t+k$.
hiring rate	Hiring rate of a firm from time t to time $t+k$.
separation rate	Separation rate of a firm from time t to time $t+k$.
wage	Mean imputed real daily wage of a firm. The base year for the inflation adjustment using the Consumer Price Index is 2015.
log wage	Mean imputed log real daily wage of a firm. The base year for the inflation adjustment using the Consumer Price Index is 2015.
firm age	Age of a firm measured by the first occurence of an establishment in the employment data.
share of medium-qualified	Share of medium-skilled employees in a firm, i.e. employees with a lower secondary, intermediate sec-ondary or upper secondary school leaving certificate and a vocational qualification.
share of high-qualified	Share of high-skilled employees in a firm, i.e. employees with a degree from a university of applied sciences or a university.
number of establishments	Number of establishments of a firm.
number of industries	Number of industries in which a firm operates. It is measured by the number of unique two-digits industry codes of a firm's establishments.
number of regions	Number of establishments in which a firm has an establishment. We differentiate between four regions. These are South, North, East, and West Germany.
Knowledge hierarchies	
number of layers	Number of layers in a firm, ranging from 1 to 4.
layer 1	Employees in occupations belonging to layer 1 (production workers).
layer 2	Employees in occupations belonging to layer 2 (problem solvers - level 1).
layer 3	Employees in occupations belonging to layer 3 (problem solvers - level 2).
layer 4	Employees in occupations belonging to layer 4 (problem solvers - level 3).
Focus occupation groups	
F&A employees	Finance & accounting employees, defined by the 2010 Occupation Classification Codes (KldB2010) 721 (occupations in insurance and financial services), 722 (occupations in accounting, controlling and auditing), and 723 (occupations in tax consultancy), as well as the 1988 Occupation Classification Codes 691 (bank specialists), 694 (life, property insurance specialists), 752 (management consultants, organisors), 753 (chartered accountants, tax advisers), 771 (cost accountants, valuers), 772 (acccountants), and 881 (economic and social scientists, statisticians).
middle managers	Managers below the highest layer of a firm.
top managers	Managers in the highest layer of a firm.

continued on next page

Appendix A continued

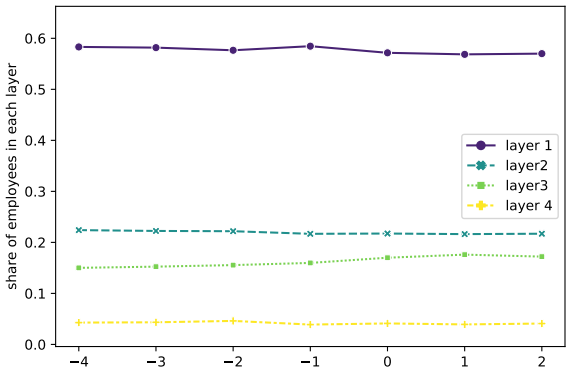
Variable	**Description**
R&D employees	Employees in the occupation groups technicians and engineers.
S&M employees	Employes in sales and marketing occupations.
Employee characteristics	
age	Employee age.
female	Dummy variable that indicates female employees.
tenure	Number of years that an employee is employed at the establishment
industry experience	Number of years that an employee is employed at an establishment in the two-digit industry.
occupation experience	Number of years that an employee is employed in the twelve occupation groups defined by Blossfeld (1987).
F&A experience	Number of years that an employee is employed in a finance & accounting occupation.
listed firm experience	Number of years that an employee is employed at a listed firm.

Appendix B

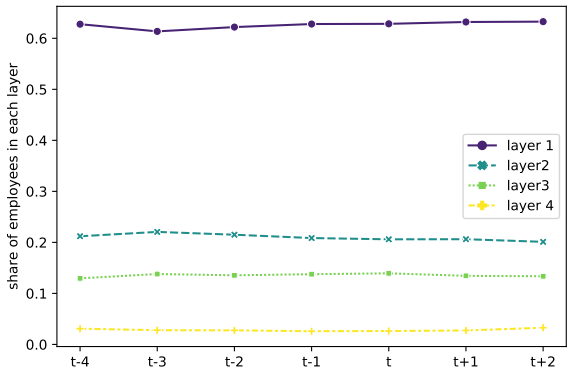
Analysis of layers' employment share

This figure illustrates the employment shares for layer 1 (production workers), layer 2 (problem solvers - level 1), layer 3(problem solvers - level 2), and layer 4 (problem solvers - level 3) for IPO firms in Subfigure (a) and Matched Control Firms in Subfigure (b). A detailed description of all variables can be found in Appendix A.

(a) IPO firms



(b) Matched control firms



Appendix C

Analysis of layer growth over the periods t-2 to t+2

The table reports estimated differences in employment growth, hiring, and separation rates of the layers between IPO firms and matched control firms controls. [t-2;t] reports the estimated difference over t-2, t+1, and t, [t+1;t+2] over t+1 and t+2, and [t-2;t+2] over the t-2, t-1, t, t+1, and t+2. The regression specification follows Eq. 1. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, and the log number of employees in t-4, $ln(E_{f,t-4})$. In addition, we control for year fixed effects, two-digit industry fixed effects, and region fixed effects. See Section 4.6 for further details. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	growth rate	separation rate	hiring rate	turnover rate
Panel A: Layer 1 (production workers)				
t-2	0.051*	0.0060	0.057***	0.0062
	(1.76)	(0.33)	(2.59)	(0.63)
	650	650	650	650
t-1	0.19***	-0.054***	0.13***	0.00049
	(6.69)	(-2.89)	(6.20)	(0.05)
	650	650	650	650
t	0.13***	0.0078	0.13***	0.043***
	(4.13)	(0.39)	(6.39)	(4.16)
	650	650	650	650
t+1	0.053**	0.027*	0.079***	0.033***
	(2.20)	(1.86)	(4.19)	(3.57)
	650	650	650	650
t+2	0.015	0.031	0.045***	0.020**
	(0.61)	(1.63)	(2.91)	(2.11)
	650	650	650	650
[t-2; t]	0.30***	-0.036	0.26***	0.0048
	(7.00)	(-0.92)	(6.58)	(0.16)
	650	650	650	650
[t+1; t+2]	0.058*	0.039	0.096**	0.025
	(1.81)	(0.80)	(2.03)	(0.58)
	650	650	650	650
[t-2; t+2]	0.33***	0.16**	0.49***	0.22***
	(6.45)	(2.36)	(7.32)	(3.59)
	650	650	650	650

Continued on next page

Table C continued

Panel B: Layer 2 (problem solvers - lvl 1)				
t-2	0.12***	-0.0093	0.11***	0.025***
	(2.93)	(-0.34)	(4.01)	(2.89)
	650	650	650	650
t-1	0.17***	-0.015	0.15***	0.029**
	(4.48)	(-0.75)	(4.84)	(2.46)
	650	650	650	650
t	0.14***	-0.00042	0.14***	0.030***
	(3.66)	(-0.02)	(4.89)	(2.62)
	650	650	650	650
t+1	0.076**	0.017	0.093***	0.024**
	(2.15)	(0.74)	(3.86)	(2.40)
	650	650	650	650
t+2	0.041	0.031	0.072***	0.024**
	(1.42)	(1.36)	(3.59)	(2.14)
	650	650	650	650
[t-2; t]	0.36***	0.0057	0.37***	0.065
	(6.80)	(0.11)	(6.58)	(1.57)
	650	650	650	650
[t+1; t+2]	0.11***	0.055	0.17***	0.064***
	(2.66)	(1.45)	(4.90)	(2.71)
	650	650	650	650
[t-2; t+2]	0.46***	0.21**	0.66***	0.31***
	(7.59)	(2.19)	(7.07)	(3.74)
	650	650	650	650

Continued on next page

Table C continued

Panel C: Layer 3 (problem solvers - lvl 2)				
t-2	0.10**	0.023	0.13***	0.030***
	(2.41)	(0.83)	(3.96)	(2.84)
	650	650	650	650
t-1	0.18***	0.020	0.20***	0.031***
	(4.09)	(0.83)	(5.48)	(2.65)
	650	650	650	650
t	0.23***	0.019	0.25***	0.044***
	(4.93)	(0.70)	(6.87)	(3.95)
	650	650	650	650
t+1	0.12***	0.033	0.15***	0.061***
	(2.74)	(1.27)	(4.68)	(5.61)
	650	650	650	650
t+2	0.013	0.058*	0.071**	0.054***
	(0.30)	(1.95)	(2.45)	(5.71)
	650	650	650	650
[t-2; t]	0.44***	0.063	0.50***	0.12***
	(7.16)	(1.12)	(7.53)	(2.82)
	650	650	650	650
[t+1; t+2]	0.12**	0.13***	0.25***	0.15***
	(2.24)	(2.69)	(5.15)	(5.01)
	650	650	650	650
[t-2; t+2]	0.49***	0.42***	0.92***	0.49***
	(7.16)	(3.83)	(8.43)	(5.01)
	650	650	650	650

Continued on next page

Table C continued

Panel D: Layer 4 (problem solvers - lvl 3)				
t-2	0.075	0.061**	0.14***	0.029***
	(1.64)	(2.00)	(4.10)	(2.64)
	650	650	650	650
t-1	0.11**	0.085**	0.19***	0.026**
	(1.98)	(2.45)	(4.95)	(2.04)
	650	650	650	650
t	0.19***	0.094***	0.28***	0.090***
	(3.66)	(3.48)	(6.77)	(7.23)
	650	650	650	650
t+1	0.031	0.11***	0.14***	0.059***
	(0.61)	(3.07)	(4.17)	(4.43)
	650	650	650	650
t+2	0.043	0.083***	0.13***	0.043***
	(0.93)	(2.59)	(3.95)	(3.39)
	650	650	650	650
[t-2; t]	0.30***	0.18***	0.48***	0.18***
	(4.47)	(3.18)	(7.39)	(4.29)
	650	650	650	650
[t+1; t+2]	0.073	0.20***	0.28***	0.16***
	(1.16)	(4.02)	(5.47)	(5.44)
	650	650	650	650
[t-2; t+2]	0.36***	0.62***	0.98***	0.65***
	(4.59)	(5.42)	(8.03)	(6.39)
	650	650	650	650

Appendix D

Analysis of focus groups' growth over the periods t-2 to t+2

The table reports estimated differences in employment growth, hiring, and separation rates of the occupation focus groups between IPO firms and matched control firms controls, for the periods from t-2 to t+2. The regression specification follows Eq. 1. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, and the log number of employees in t-4, $ln(E_{f,t-4})$. In addition, we control for year fixed effects, two-digit industry fixed effects, and region fixed effects. See Section 4.6 for further details. [t-2;t], [t+1;t+2], and [t-2;t+2] report the estimated differences over multi-period windows. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	growth rate	separation rate	hiring rate	turnover rate
Panel A: F&A employees				
t-2	0.042	0.034	0.077**	0.016
	(0.95)	(1.36)	(2.07)	(1.33)
	650	650	650	650
t-1	0.17***	0.022	0.19***	0.039***
	(3.94)	(0.83)	(5.44)	(2.87)
	650	650	650	650
t	0.19***	0.025	0.22***	0.052***
	(4.18)	(1.00)	(5.87)	(4.13)
	650	650	650	650
t+1	0.21***	0.016	0.22***	0.049***
	(4.82)	(0.61)	(6.74)	(3.99)
	650	650	650	650
t+2	0.057	0.072***	0.13***	0.049***
	(1.46)	(2.59)	(4.77)	(4.03)
	650	650	650	650
[t-2; t]	0.35***	0.063	0.42***	0.12**
	(5.87)	(1.12)	(6.00)	(2.56)
	650	650	650	650
[t+1; t+2]	0.24***	0.11**	0.35***	0.17***
	(4.38)	(2.56)	(7.49)	(6.02)
	650	650	650	650
[t-2; t+2]	0.55***	0.40***	0.95***	0.51***
	(7.75)	(2.67)	(6.26)	(3.67)
	650	650	650	650

Continued on next page

Table D continued

Panel B: P&R employees				
t-2	0.012	0.0023	0.014	0.00017
	(1.35)	(1.05)	(1.62)	(0.18)
	650	650	650	650
t-1	0.0057	0.0014	0.0071	-0.00031
	(1.10)	(0.98)	(1.38)	(-0.33)
	650	650	650	650
t	0.019	0.014*	0.033***	0.0030
	(1.41)	(1.90)	(2.66)	(0.73)
	650	650	650	650
t+1	0.0028	0.0014	0.0042*	0.0026
	(0.88)	(0.35)	(1.86)	(1.47)
	650	650	650	650
t+2	-0.010	0.023**	0.013**	0.0089**
	(-1.02)	(2.35)	(2.24)	(2.38)
	650	650	650	650
[t-2; t]	0.034**	0.022*	0.056***	0.014
	(2.12)	(1.91)	(2.77)	(1.37)
	650	650	650	650
[t+1; t+2]	-0.0074	0.025**	0.018***	0.011**
	(-0.71)	(2.22)	(2.63)	(2.12)
	650	650	650	650
[t-2; t+2]	0.030*	0.069	0.098*	0.061
	(1.89)	(1.51)	(1.82)	(1.33)
	650	650	650	650

Continued on next page

Table D continued

Panel C: Middle managers				
t-2	0.054	0.063**	0.12***	0.022***
	(1.01)	(2.04)	(2.84)	(2.63)
	650	650	650	650
t-1	0.20***	0.048	0.25***	0.028***
	(3.90)	(1.59)	(6.12)	(2.69)
	650	650	650	650
t	0.26***	0.061*	0.33***	0.078***
	(4.47)	(1.93)	(6.86)	(5.99)
	650	650	650	650
t+1	0.073	0.082**	0.16***	0.061***
	(1.34)	(2.33)	(3.83)	(4.62)
	650	650	650	650
t+2	0.00058	0.15***	0.15***	0.065***
	(0.01)	(4.50)	(3.97)	(5.33)
	650	650	650	650
[t-2; t]	0.46***	0.16***	0.62***	0.24***
	(6.28)	(3.12)	(8.45)	(6.13)
	650	650	650	650
[t+1; t+2]	0.073	0.24***	0.31***	0.21***
	(1.11)	(4.65)	(5.32)	(6.78)
	650	650	650	650
[t-2; t+2]	0.48***	0.60***	1.08***	0.68***
	(5.99)	(5.04)	(7.77)	(6.10)
	650	650	650	650

Continued on next page

Table D continued

Panel D: Top managers				
t-2	0.068	0.069**	0.14***	0.059***
	(1.63)	(2.43)	(4.12)	(3.87)
	650	650	650	650
t-1	0.089*	0.10***	0.19***	0.066***
	(1.79)	(3.13)	(5.14)	(3.78)
	650	650	650	650
t	0.15***	0.10***	0.25***	0.10***
	(2.81)	(3.44)	(6.10)	(6.91)
	650	650	650	650
t+1	0.093*	0.079**	0.17***	0.052***
	(1.90)	(2.35)	(4.84)	(3.20)
	650	650	650	650
t+2	0.022	0.11***	0.13***	0.062***
	(0.52)	(3.29)	(4.36)	(3.91)
	650	650	650	650
[t-2; t]	0.27***	0.21***	0.48***	0.23***
	(4.05)	(3.37)	(6.66)	(4.46)
	650	650	650	650
[t+1; t+2]	0.11*	0.22***	0.32***	0.19***
	(1.78)	(4.32)	(6.10)	(5.18)
	650	650	650	650
[t-2; t+2]	0.37***	0.68***	1.05***	0.74***
	(4.93)	(5.24)	(7.43)	(6.07)
	650	650	650	650

Continued on next page

Table D continued

Panel E: R&D employees				
t-2	0.063	0.0091	0.072***	0.0079
	(1.59)	(0.32)	(2.71)	(0.86)
	650	650	650	650
t-1	0.091**	0.0040	0.095***	0.015
	(2.38)	(0.17)	(3.06)	(1.39)
	650	650	650	650
t	0.11***	0.0018	0.11***	0.018
	(2.78)	(0.08)	(3.38)	(1.58)
	650	650	650	650
t+1	0.064	0.062**	0.13***	0.037***
	(1.39)	(2.00)	(4.09)	(3.81)
	650	650	650	650
t+2	0.044	0.014	0.058**	0.0072
	(1.08)	(0.48)	(2.21)	(0.87)
	650	650	650	650
[t-2; t]	0.23***	0.075	0.30***	0.12
	(3.85)	(0.90)	(3.35)	(1.52)
	650	650	650	650
[t+1; t+2]	0.10*	0.058	0.16***	0.029
	(1.92)	(1.01)	(3.00)	(0.69)
	650	650	650	650
[t-2; t+2]	0.29***	0.17	0.47***	0.22**
	(4.28)	(1.47)	(4.10)	(2.15)
	650	650	650	650

Continued on next page

Table D continued

Panel F: S&M employees				
t-2	0.014	0.043	0.057*	0.0074
	(0.32)	(1.40)	(1.89)	(0.81)
	650	650	650	650
t-1	0.14***	0.00031	0.14***	0.0061
	(2.85)	(0.01)	(3.61)	(0.68)
	650	650	650	650
t	0.098*	0.044	0.14***	0.033***
	(1.94)	(1.57)	(3.39)	(2.81)
	650	650	650	650
t+1	0.091*	0.088***	0.18***	0.016
	(1.84)	(2.93)	(4.76)	(1.40)
	650	650	650	650
t+2	0.036	0.060*	0.096***	0.029**
	(0.83)	(1.86)	(3.17)	(2.44)
	650	650	650	650
[t-2; t]	0.20***	0.15***	0.35***	0.14***
	(3.07)	(2.67)	(5.17)	(3.43)
	650	650	650	650
[t+1; t+2]	0.12**	0.18***	0.30***	0.11***
	(2.04)	(4.17)	(6.31)	(4.19)
	650	650	650	650
[t-2; t+2]	0.31***	0.47***	0.77***	0.46***
	(4.26)	(3.59)	(5.28)	(3.74)
	650	650	650	650

Appendix E

Analysis of layers' and focus groups' growth and turnover rate over the period t-2 to t+2

The table reports estimated differences in employment growth and turnover rates between IPO firms and matched control firms controls, for the periods t-2 to t+2 The regression specification in Panel A follows Eq. 1. In every regression, we control for the growth rate of t-4, $g_{f,t-5,t-4}$, and the log number of employees in t-4, $ln(E_{f,t-4})$. In addition, we control for year fixed effects, two-digit industry fixed effects, region fixed effects, and number-establishment fixed effects. See Section 4.6 for further details. In Panel A, the dependent variables are growth rates over the periods t-2 to t+2 for the employment categories indicated in each column. In Panel B, the dependent variables are also the growth rates of the five-period window. As further controls for firm growth, we add the change in the log number of establishments over the periods t-2 to t+2, the change in the number of regions in which the firm has establishments, and the change in the number of industries in which the firm operates. In Panel C, the dependent variables are the turnover rates over the periods t-2 to t+2 for the employment categories indicated in each column. The turnover rate is defined as the minimum of the hiring rate and the separation rate. We further control for the five-period growth rates of the respective employment categories. The number of observations is 650 (325 IPO firms and 325 matched control firms). T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	Layers				Focus groups					
	layer 1	layer 2	layer 3	layer 4	F&A	P&R	middle man.	top man.	R&D	S&M
Panel A: Growth rates over [t-2;t+2]: basic controls										
[t-2;t]	0.30***	0.36***	0.44***	0.30***	0.35***	0.034**	0.46***	0.27***	0.23***	0.20***
	(7.00)	(6.80)	(7.16)	(4.47)	(5.87)	(2.12)	(6.28)	(4.05)	(3.85)	(3.07)
[t+1;t+2]	0.058*	0.11***	0.12**	0.073	0.24***	-0.0074	0.073	0.11*	0.10*	0.12**
	(1.81)	(2.66)	(2.24)	(1.16)	(4.38)	(-0.71)	(1.11)	(1.78)	(1.92)	(2.04)
[t-2;t+2]	0.33***	0.46***	0.49***	0.36***	0.55***	0.030*	0.48***	0.37***	0.29***	0.31***
	(6.45)	(7.59)	(7.16)	(4.59)	(7.75)	(1.89)	(5.99)	(4.93)	(4.28)	(4.26)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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Table E continued

	Layers				Focus groups					
	layer 1	layer 2	layer 3	layer 4	F&A	P&R	middle man.	top man.	R&D	S&M
Panel B: Growth rates over [t-2;t+2]: controls for firm growth										
[t-2;t]	-0.045*	0.069	0.15**	0.0026	0.074	0.027	0.21***	-0.0013	0.013	0.034
	(-1.89)	(1.36)	(2.34)	(0.04)	(1.16)	(1.37)	(2.91)	(-0.02)	(0.20)	(0.51)
[t+1;t+2]	0.00063	0.065*	0.058	0.026	0.18***	-0.0060	0.023	0.058	0.051	0.082
	(0.03)	(1.81)	(1.22)	(0.42)	(3.64)	(-0.58)	(0.36)	(0.99)	(1.00)	(1.46)
[t-2;t+2]	-0.053*	0.17***	0.14**	0.089	0.26***	0.025	0.23***	0.100	0.014	0.11
	(-1.94)	(3.05)	(2.15)	(1.10)	(3.58)	(1.56)	(2.85)	(1.30)	(0.22)	(1.51)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel C: Growth rates over [t-2;t+2]: alternative controls for firm growth										
[t-2;t]	n/a	0.24***	0.30***	0.17**	0.22***	0.033*	0.34***	0.15**	0.12*	0.088
	n/a	(4.01)	(4.60)	(2.33)	(3.33)	(1.77)	(4.75)	(2.14)	(1.83)	(1.37)
[t+1;t+2]	n/a	0.087**	0.087	0.042	0.20***	-0.0061	0.035	0.077	0.070	0.090
	n/a	(2.15)	(1.61)	(0.66)	(3.79)	(-0.58)	(0.53)	(1.26)	(1.29)	(1.58)
[t-2;t+2]	n/a	0.32***	0.28***	0.19**	0.38***	0.033*	0.33***	0.20***	0.13*	0.18**
	n/a	(4.97)	(4.04)	(2.36)	(4.99)	(1.86)	(4.07)	(2.62)	(1.90)	(2.39)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix F

Analysis of the change in the total wage bill for F&A employees from year t=-3 to t=2

This table presents the change in the total wage bill for F&A employees from year t=-3 to year t=2 and from year t=-3 to year t=2, for the IPO firms and the IPO firms compared to the matched control firms. Panel A present the change in log wages for all employees, hires and incumbents, Panel B for the layers, Panel C for the wage percentiles over all employees, and Panel D for the focus groups. T-statistics based on robust standard errors clustered at the firm level are presented in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. A detailed description of all variables can be found in Appendix A.

	(1)	(2)	(3)	(4)
	wages	wages	imp. wages	imp. wages
IPO	1.07***	0.41**	1.13***	0.55***
	(6.30)	(2.45)	(6.22)	(3.01)
Δlog total wage bill$_{[t-2;t+2]}$		1.13***		1.11***
		(6.90)		(6.46)
Δlog establishments$_{[t-2;t+2]}$		-0.33		-0.48
		(-1.11)		(-1.55)
Δregions$_{[t-2;t+2]}$		0.29		0.21
		(1.26)		(0.83)
Δindustries$_{[t-2;t+2]}$		0.11		0.24
		(0.64)		(1.21)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Number estab. FE	Yes	Yes	Yes	Yes
Obs	650	650	650	648
R2	0.14	0.31	0.14	0.27