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# Ten Facts You Need To Know About Hiring*

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**Abstract**

We provide new empirical evidence regarding the magnitude and the determinants of a firm's costs required to fill a vacancy. The average costs required to fill a vacancy for a skilled worker in Switzerland amount to about 16 weeks of wage payments. The main components of the vacancy costs are initially low productivity, the formal instruction of a new hire (53 percent), disruption costs due to informal instruction of new hires (26 percent), and search costs (21 percent). Furthermore, hiring costs for small firms are associated with labor market tightness (i.e., the vacancy-unemployment ratio).

*JEL Classification:* J32, J63, M53
*Keywords:* adaptation cost, disruption cost, hiring cost, search cost, vacancy-unemployment ratio

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# 1 Introduction

Hiring the right employees is important for a firm's success. To fill a vacancy, a firm incurs direct costs by searching and interviewing suitable candidates, and due to their subsequent training activities, as well as indirect costs related to the initially lower productivity of new hires and the disruption of a firm's production process. The costs incurred to fill a vacancy differ according to the skill requirements for performing certain tasks, but the vacancy costs may also depend on labor market tightness. Thus, in times when skilled labor is scarce, a firm may have to increase its search effort to find a suitable job candidate, or accept a lower match quality at a given level of search effort. However, hiring lower quality workers may prolong the adaptation period, i.e., the time required for a new hire to become fully productive, as well as demanding additional formal training, or increasing the disruption costs due to a greater need for informal instruction by co-workers.

Empirical evidence for how firms recruit employees is still limited, largely due to data limitations. However, in this study, based on unusually rich establishment-level data describing a firm's hiring behavior for middle-skilled jobs, we established 10 important facts about hiring.

**Fact 1:** Filling a vacancy for a middle-skill position is expensive; it costs 16 weeks of wage payments on average.

**Fact 2:** The largest costs associated with filling a vacancy are adaptation costs due to formal training and the initial low productivity of a new hire (53%), followed by disruption costs, i.e., the time required by other workers to instruct a new hire when they cannot perform their own work (26%), and the search and recruitment costs incurred to fill the position with a suitable candidate (21%).

**Fact 3:** Both the level and changes in the vacancy-unemployment ($v/u$) ratios are positively related to hiring costs in the cross-section and over time. A one standard deviation increase in the $v/u$ growth rate is associated with an 11 percent increase in average hiring costs for small firms, but we find no effects for large firms.

**Fact 4:** The structure of the search costs is convex, i.e., marginal search costs increase according to the number of hires per period. However, adaptation and disruption costs

feature a non-convex cost structure.

**Fact 5:** On average, a firm interviews four to five candidates to fill a vacancy successfully.

**Fact 6:** On average, a firm spends 9 hours interviewing a job applicant, including the preparation time and post-interview assessment.

**Fact 7:** The average adaptation period until a newly hired medium-skilled worker reaches full productivity is four months (82 working days).

**Fact 8:** The average productivity loss for a new hire during the adaptation period is 29% compared with a fully productive employee in the same firm and occupation.

**Fact 9:** A new hire disrupts the production process for other workers in a firm due to informal instruction activities for about 100 working hours (2.5 work weeks).

**Fact 10:** Hiring costs increase with the skill requirements, which are measured in hours of workplace training during an apprenticeship program in the corresponding occupation. A 1% increase in the occupational skill requirements was associated with a 0.8% increase in average hiring costs.

We established these facts using Swiss administrative establishment-level survey data for 2000, 2004, and 2009, which contained detailed information about the costs incurred by firms to fill a vacancy. In addition, we matched industry-level vacancy and unemployment data to our survey in order to test how changes in the labor market affected a firm's hiring costs.

The remainder of this article is organized as follows. Section 2 provides an overview of the relevant literature. Section 3 describes the data used for our analysis and extensive descriptive statistics for the components of hiring costs. Section 4 discusses the estimation strategy. Section 5 contains the empirical analysis of the effect of labor market tightness on hiring costs. Section 6 gives our conclusions.

## 2 Relevant Literature

The size and shape of labor adjustment costs play important roles in theoretical search models of the labor market (surveyed by Eckstein and van den Berg, 2007; Rogerson et al.,

2005; Rogerson and Shimer, 2011; Yashiv, 2007). However, there is still a lack of empirical evidence to justify the assumptions of these models.

In the absence of hiring costs, firms can instantly fill a vacancy at zero cost. However, frictions in the labor market may result in costly hiring, as well as forgoing profits because a vacancy may remain unfilled for some time.

To illustrate this problem, as described by Yashiv (2007), we denote the job-worker matching function by $m = m(u, v)$, where $u$ is the unemployment rate and $v$ are job vacancies. Moreover, we denote labor market tightness, which is measured by the vacancy-unemployment ratio $v/u$, by $\theta$. The vacancy matching rate $q(\theta) \equiv \frac{m}{v}$ decreases with the number of vacancies in the labor market and increases with the number of unemployed. By contrast, the job finding rate $p(\theta) \equiv \frac{m}{u}$ decreases with the number of unemployed individuals and increases with the number of vacancies. A profit-maximizing firm creates a job provided that the expected marginal product of labor is higher than the expected marginal labor costs. Thus, a firm creates jobs provided that the expected discounted profits overweigh the excepted vacancy costs. Yashiv (2007) defined the value of a job $J$ as the marginal costs incurred to fill a vacancy ($c$) times the expected vacancy duration ($\frac{1}{q(\theta)}$), as follows.

$$J \equiv c\frac{1}{q(\theta)} \tag{1}$$

Therefore, at equilibrium, the value of the marginal job must increase with the hiring costs and the expected duration of the vacancy. Put differently, a job that only creates a small profit for a firm at low hiring costs and vacancy durations may no longer be profitable if the hiring costs increase substantially. Thus, it is important to understand the magnitude and determinants of the hiring costs parameter $c$.

Search and matching models often focus on a firm's and a worker's costs for finding each other, i.e., the required search effort for firms to advertise a vacancy and the effort of an individual worker to find that vacancy, but a firm's total costs incurred to fill a vacancy also include training costs and indirect costs related to the initially lower productivity of new hires and costs incurred when new hires disrupt the work of other employees in a

firm.

Thus, in the following, we refer to search costs as the costs incurred until a successful match is accomplished, and we refer to hiring costs as the total costs incurred to fill a vacancy, including the costs that arise after a new hire signs a contract with the firm.[1]

## 2.1 Labor market tightness and hiring costs

As first shown by van Ours and Ridder (1991, 1992) based on Dutch data, a firm's vacancy duration, i.e., the average time required to fill a vacancy, varies with the business cycle. Furthermore, they showed that the vacancy duration also varies with the educational requirements of the job, i.e., the vacancy duration is longer for higher educational requirements. Moreover, they found that firms search non-sequentially, i.e., they choose the most suitable candidate from a pool of applicants, rather than evaluating each candidate separately. Finally, van Ours and Ridder (1993) showed that Dutch employers spend much more time selecting rather than searching for employees, and Abbring and van Ours (1994) found that firms search more intensively when the labor market is tight, but they detected no effects of labor market tightness on the selection period.[2]

More recently, Davis et al. (2012) discussed the importance of the recruitment intensity for explaining key outcomes in the labor market. They reported differences in a firm's recruitment intensity during and after the recent Great Recession. Davis et al. (2012) showed that the performance of searching and matching models could be improved greatly if firms can choose their recruitment intensity as well as adjusting the number of vacancies. However, they emphasize that there is a lack of direct empirical data about the recruitment intensity (Davis et al., 2012, p. 588): "*...this paper points to an important role for recruiting intensity in the cyclical relationship among hires, vacancies, and unemployment. Data limitations, however, require an indirect approach to the measurement of recruiting intensity per vacancy. There is a need to develop data that support more direct measures.*" Thus, they suggested that the standard search models need to be extended

[1] Thus, our definition of hiring costs is similar to that of Silva and Toledo (2009), although they also considered separation costs in their definition of post-match labor turnover costs, which is a cost factor that we exclude due to a lack of empirical data.

[2] For a more detailed review of the development of employer search, see Oyer and Schaefer (2011).

according to a firm's recruitment intensity. In our first contribution, we empirically tested whether a firm's recruitment intensity changed in response to labor market tightness (i.e., the within-industry vacancy-unemployment ratio).

Rogerson and Shimer (2011) made a similar point (p.652): "*Unfortunately we are unaware of any time series showing the number of workers (or hours of work) devoted to recruiting, and so the choice of f [the functional form] is somewhat arbitrary.*" To calibrate their search model, they relied on estimates from Hagedorn and Manovskii (2008) and Silva and Toledo (2009). However, Hagedorn and Manovskii (2008) relied on cross-sectional evidence from Barron et al. (1997), who analyzed US firms between 1980 and 1993. The evidence in Barron et al. (1997) points toward small search costs (about 11 percent of the weekly pay), but other studies provide evidence for much higher search costs (e.g., Blatter et al. 2012 found that the average search costs were 369 percent of the weekly pay for skilled workers in Switzerland, whereas Muehlemann and Pfeifer 2015 reported a corresponding proportion of 277 percent for Germany). Moreover, hiring costs include search costs, but they also include costs for initial formal (and informal) training and indirect costs for lost productivity until a new hire reaches full productivity. Thus, after accounting for adaptation costs, the average hiring costs incurred to fill a vacancy are about one quarter of the yearly wage payments in Switzerland and Germany (Blatter et al. 2012, Muehlemann and Pfeifer 2015).[3] Silva and Toledo (2009) used existing survey information about postmatch labor turnover costs for the USA (Barron et al., 1997, Bishop, 1996, Dolfin, 2006), which accounted for workers not being fully productive initially. They found that accounting for such costs substantially improved the performance of their calibrated model. However, to our knowledge, no survey information is available that allows the identification of the effects of changes in labor market tightness (e.g., changes in the vacancy-unemployment ratio) on a firm's total hiring costs.

In addition, Stadin (2012) found that the local labor market conditions in Sweden significantly affected the probability of firms filling a vacancy, thereby affecting the hiring costs if longer vacancy durations are associated with increased expenditure on job

[3]Hagedorn and Manovskii (2008) allowed for wage costs of recruitment personnel to fluctuate over the business cycle, but they did not allow for changes in a firm's recruitment intensity (Davis et al. 2012).

advertisements and unsuccessful (and costly) interviews with job applicants. Moreover, Moscarini and Postel-Vinay (2012) and Moscarini and Postel-Vinay (2013) showed that the effects of the business cycle differ by firm size because large firms create significantly more jobs during an economic expansion than small firms. Thus, they argued that small firms may find it more difficult to hire during an economic upturn because large firms are more attractive to active job seekers due to higher pay as well as providing more stable working conditions, but large firms may also actively poach employees from small firms.

Our study makes two main contributions. First, we obtained detailed empirical information about the various costs of filling a vacancy, including search, selection, and formal as well as informal training. Second, we investigated how the different cost components associated with filling a vacancy varied with labor market tightness.

## 2.2 Economies or diseconomies of scale in recruitment

Many macroeconomic models assume a specific form of labor adjustment costs with respect to the number of hires, so that models fit the aggregate data (Yashiv, 2007). However, there is still an ongoing debate about the shape of these adjustment costs (i.e., whether they are linear, piece-wise linear, convex, or non-convex). Typically, observing firms hiring many workers at once is interpreted as indicating the existence of economies of scale in recruitment, whereas the opposite implies diseconomies of scales. Much of the evidence related to worker flows indicates that there are economies of scale in recruitment because firms seem to group hire.[4] More recently, Cooper and Willis (2009) highlighted the importance of disruption costs, i.e., new hires disrupting a firm's production process during the adaptation period. They found that non-convex disruption costs at the firm level provided the best explanation of the aggregate fluctuations.

In addition to investigating workers flows to infer hiring costs indirectly, a small but growing number of studies have analyzed direct empirical evidence related to hiring costs. Manning (2011) showed that hiring costs with a convex structure imply that a labor market is monopsonistic. Direct evidence of hiring costs points towards a convex cost

[4]The early studies of the shape of labor adjustment costs based on observing worker flows were surveyed by Hamermesh and Pfann (1996).

structure in Germany (Muehlemann and Pfeifer 2015), Switzerland (Blatter et al. 2012), the UK (Manning 2006), and the USA (Dube et al. 2010), as well as linear adjustment costs in France (Kramarz and Michaud 2010). In our study, we investigated individual cost components to test whether they had different cost structures.

# 3 Data and descriptive statistics

To analyze the influence of labor market tightness on a firm's hiring costs, we used three waves (2000, 2004, and 2009) of administrative and representative Swiss establishment-level survey data, which included comprehensive information about the hiring costs and strategies of firms. All three surveys were performed by the Centre for Research in Economics of Education at the University of Bern and the Swiss Federal Statistical Office.[5]

The Federal Statistical office sent a paper-based questionnaire to a sample of selected firms by regular mail.[6] A firm's management (in small firms) or human resources department (in larger firms) supplied information about hiring costs for a specific occupation, which was assigned randomly by the Statistical Office. The data corresponded to occupations that require a vocational qualification at the upper secondary level, which is the most common education pathway in Switzerland and it represents about two-thirds of the Swiss workforce.

Our pooled data set comprised 8,874 firms (2,360 in 2000, 2,567 in 2004, and 3,947 in 2009), which hired at least one worker in the three previous years of the survey.[7] Firms provided detailed information about their hiring activities, particularly search costs (costs for job postings, costs for external placement agencies/headhunters, and time spent conducting interviews), adaptation costs (training costs and reduced productivity for new hires), and disruption costs.[8] Furthermore, we matched industry-level vacancy and unem-

[5]The surveys were originally performed to estimate the expenditure of firms on vocational education and training in Switzerland.

[6]To account for stratified sampling, the results employed in this study were weighted by sampling weights. For more details of the sample design and calculation of the weights, see Renfer (2002); Potterat (2003, 2006, 2011).

[7]That is, 1998, 1999, and 2000 for the survey in 2000; 2002, 2003, and 2004 for the survey in 2004 and 2007, 2008, and 2009 for the survey in 2009.

[8]Disruption costs were only available for the 2009 survey.

ployment data provided by the Swiss State Secretariat for Economic Affairs to our data set, which allowed us to generate our measure of labor market tightness.

### 3.1 Descriptive statistics

Table 1 shows the hiring cost components for small establishments with less than 50 employees and large establishments with 50 or more employees. Table 1 shows that large firms spent more on job postings. Both small and large firms interviewed four to five candidates per vacancy. On average, large firms spent about 11 hours selecting a candidate (including preparation time and post-interview assessment), compared with an average of 8 hours by small firms. New hires required some adaptation time to become fully productive within the working process, where the average period was 82 working days (or about 17 weeks) for both small and large firms. The average decline in productivity during this adaptation period was about 29 percent, but the productivity losses were significantly higher in large firms than small firms.

Table 2 shows the components of hiring costs and the vacancy-unemployment ratio ($v/u$), as well as the $v/u$ growth rate, by industry. We found that there was significant variation in search costs ($s_i$) across sectors, which ranged from less than 500 Swiss francs in the food and beverage industry to almost 3000 Swiss francs for firms that manufactured machinery, a sector that typically has rather high skill requirements. The average number of candidates interviewed ($j_i$) was three to five candidates across industries. The average interview time ($h_i^i$) was between 7 and 13 hours, which tended to be higher in industries with high job advertising expenditures. Similarly, we found that firms in these sectors also spent more resources on external advisors or headhunters ($e_i$). The same pattern held for the different components of adaptation costs, i.e., adaptation time ($d_i^a$), productivity loss ($p_i$), training duration ($d_i^t$) and training costs ($c_i^t$). Moreover, the disruption time ($h_i^d$) was higher in industries with high search and adaptation costs, thereby indicating a rather strong correlation between the different cost components.

Table 1: Descriptive statistics 2009, by firm size

| Component of hiring costs | Small firms | | Large firms | | All firms | |
|---|---|---|---|---|---|---|
| | Mean | Std. dev. | Mean | Std. dev. | Mean | Std. dev. |
| Number of hires | 2.80 | 2.59 | 10.37 | 40.44 | 4.26 | 18.17 |
| Number of skilled workers | 5.80 | 5.56 | 33.39 | 197.69 | 11.13 | 87.68 |
| Costs of job postings | 1,105.10 | 1,935.85 | 1,772.17 | 2,850.41 | 1,233.94 | 2,158.96 |
| Number of applicants interviewed per vacancy ($j_i$) | 4.04 | 2.36 | 4.59 | 2.55 | 4.15 | 2.41 |
| Time for job interviews in hours ($h_i^i$) | 7.86 | 8.40 | 11.18 | 11.26 | 8.50 | 9.12 |
| Costs of external advisors/headhunters ($e_i$) | 745.47 | 2,912 | 1,783.04 | 4,702.02 | 945.86 | 3,357.98 |
| Duration of adaptation period in days ($d_i^a$) | 78.51 | 61.77 | 97.51 | 70.91 | 82.18 | 64.07 |
| Average decline in productivity in % ($p_i$) | 27.95 | 14.93 | 31.80 | 13.93 | 28.70 | 14.82 |
| External training courses in days ($d_i^t$) | 2.07 | 4.03 | 2.77 | 3.25 | 2.21 | 3.90 |
| Training costs ($c_i^t$) | 448.35 | 1,588.94 | 964.05 | 1,948.79 | 547.95 | 1,676.73 |
| Weekly pay of skilled workers ($w_i$) | 1,282.06 | 273.22 | 1,432.99 | 258.39 | 1,311.21 | 276.88 |
| Disruption time in hours ($h_i^d$) | 95.46 | 78.02 | 111.73 | 77.98 | 98.60 | 78.27 |
| *Observations* | 2,656 | | 1,291 | | 3,947 | |

Note: All costs are given in Swiss francs (CHF). Small firms had <50 employees. Large firms had 50+ employees.

Table 2: Descriptive statistics 2009, by industry

| **Industry** | $s_i$ | $J_i$ | $h_i^i$ | $e_i$ | $d_i^a$ | $p_i$ | $d_i^t$ | $c_i^t$ | $w_i$ | $h_i^d$ | $v/u$ | $(v/u)_{t,t-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 812.51 | 2.97 | 7.04 | 496.44 | 82.49 | 21.53 | 1.75 | 390.95 | 1,338.20 | 70.14 | 1.76 | -0.08 |
| 2 | 1,326.75 | 3.67 | 10.34 | 969.29 | 80.74 | 31.71 | 1.89 | 338.20 | 1,218.55 | 133.73 | 2.47 | 0.16 |
| 3 | 916.03 | 4.79 | 7.76 | 890.19 | 94.38 | 34.24 | 1.61 | 116.23 | 1,263.15 | 113.63 | 3.76 | 0.30 |
| 4 | 1,004.45 | 3.33 | 8.41 | 594.54 | 63.90 | 22.19 | 1.33 | 97.72 | 1,300.40 | 77.37 | 2.43 | 0.37 |
| 5 | 2,652.06 | 4.24 | 12.81 | 2,533.00 | 90.57 | 30.55 | 1.91 | 558.20 | 1,353.75 | 135.12 | 2.24 | -0.24 |
| 6 | 1,605.64 | 3.22 | 9.91 | 1,129.42 | 92.44 | 31.13 | 1.79 | 526.36 | 1,391.38 | 118.93 | 3.10 | 0.37 |
| 7 | 2,743.55 | 3.65 | 12.72 | 4,651.15 | 105.13 | 35.28 | 2.20 | 711.54 | 1,406.94 | 133.13 | 3.50 | 0.84 |
| 8 | 2,184.42 | 4.06 | 12.22 | 2,247.07 | 103.85 | 35.26 | 2.31 | 709.79 | 1,446.44 | 133.38 | 2.17 | 2.08 |
| 9 | 1,077.25 | 3.32 | 7.81 | 1,165.04 | 129.98. | 29.47 | 2.14 | 574.15 | 1,258.18 | 131.24 | 1.75 | 0.64 |
| 10 | 1,029.19 | 3.98 | 7.80 | 791.10 | 77.19 | 27.03 | 2.33 | 532.44 | 1,195.21 | 104.19 | 1.44 | 0.79 |
| 11 | 478.05 | 4.31 | 7.09 | 230.43 | 40.29 | 23.44 | 1.30 | 87.49 | 1,074.09 | 72.96 | 0.61 | 0.58 |
| 12 | 1,077.40 | 4.65 | 7.28 | 1,443.07 | 69.41 | 31.67 | 2.10 | 364.51 | 1,292.77 | 120.89 | 2.08 | 0.96 |
| 13 | 2,257.99 | 4.18 | 8.77 | 3,187.74 | 94.64 | 36.66 | 4.72 | 1,262.97 | 1,524.77 | 118.48 | 1.87 | 0.88 |
| 14 | 1,826.12 | 3.68 | 9.40 | 1,175.82 | 90.22 | 29.01 | 2.21 | 820.60 | 1,422.42 | 108.90 | 0.25 | 2.74 |
| 15 | 1,685.94 | 4.78 | 8.90 | 1,182.27 | 81.92 | 31.91 | 2.05 | 552.09 | 1,414.58 | 103.07 | 0.36 | 1.41 |
| 16 | 1,348.70 | 4.07 | 8.99 | 979.60 | 92.08 | 32.38 | 2.90 | 394.23 | 1,432.95 | 126.79 | 2.07 | 0.36 |
| 17 | 627.45 | 5.11 | 8.53 | 97.40 | 63.65 | 29.78 | 2.66 | 954.67 | 1,299.69 | 74.83 | 1.15 | 0.34 |
| 18 | 1,828.64 | 4.72 | 8.08 | 271.77 | 98.16 | 28.63 | 2.33 | 523.73 | 1,477.38 | 101.10 | 1.05 | 1.18 |
| 19 | 810.56 | 4.38 | 9.88 | 328.17 | 137.22 | 29.86 | 1.72 | 254.44 | 1,261.64 | 91.81 | 1.23 | 0.43 |

Industry: 1 Mining and quarrying; energy and water supply, construction; 2 Manufacture of food products, beverages, and tobacco products; 3 Manufacture of textiles and apparel; 4 Manufacture of wood and paper products, and printing; 5 Manufacture of coke, chemicals and chemical products, rubber, and plastics; 6 Manufacture of metal products; 7 Manufacture of machinery and equipment n.e.c.[A1], and transport equipment; 8 Manufacture of electrical equipment, electronic and optical products, watches, and clocks; 9 Other manufacturing; 10 Trade and repair; 11 Food and beverage service activities, accommodation; 12 Transport, telecommunications; 13 Financial service activities and insurance; 14 Real estate activities; 15 IT, publishing, audiovisual and broadcasting activities, R&D, other economic services; 16 Education; 17 Human health activities, social work activities; 18 Public administration; 19 Other service activities

Moreover, Table 2 shows that industries with a high vacancy-unemployment growth (top quartile) tended to pay above average wages, they spent more resources on job postings, and they had above average productivity losses due to new hires during the adaptation period.

Table 3 shows that there were substantial differences between large firms with more than 50 employees and small firms with less than 50 employees within these industries. The costs for job postings did not differ significantly between the top and bottom quartiles for large firms, but small firms spent significantly more on job postings when the labor market was tight in their own sector. Similarly, labor market tightness affected the number of applicants interviewed, the duration of the adaptation period, and the productivity losses only in small firms. Furthermore, small firms in industries with a high vacancy-unemployment growth spent more resources on external training, but there were no effects in large firms. Finally, employees in small firms in the top quartile spent more time providing informal training to new hires compared with firms in the bottom quartile, whereas we did not find these differences in large firms.

### 3.2 A model of hiring costs

The comprehensive information about the components of hiring costs presented in the previous section allowed us to compute the hiring costs $C_i$ for each firm $i$ in 2009. The hiring costs comprise three components: search costs $s_i$, adaptation costs $a_i$, and disruption costs $d_i$.[9] Search costs comprise all of the costs that an establishment incurs until a contract is signed. Adaptation costs $a_i$ reflect the reduced productivity of a new hire during the adaptation period $t$, and disruption costs $d_i$ arise when workers within a firm are disrupted from performing their productive work when introducing the new hires to the production process. Thus, hiring costs are defined as follows.

$$C_i = s_i + a_i + d_i \tag{2}$$

[9]We only obtained disruption costs from the 2009 survey.

Table 3: $v/u$-ratio growth quartiles, by firm size

| Small firms | 1st quartile | | 4th quartile | |
|---|---|---|---|---|
| | Mean | Std. dev. | Mean | Std. dev. |
| Number of hires | 2.64 | 2.08 | 2.85 | 2.23 |
| Number of skilled workers | 5.67 | 5.11 | 6.18 | 5.46 |
| Costs of job postings | 587.01 | 1,023.33 | 1,731.52 | 2,637.82 |
| Number of applicants interviewed per vacancy | 3.52 | 2.25 | 4.46 | 2.37 |
| Time for job interviews in hours | 6.53 | 7.76 | 8.69 | 8.83 |
| Personnel costs for interviews | 1,313.99 | 1,865.08 | 2,534.54 | 3,017.48 |
| Costs for external advisors/headhunters | 264.75 | 1,361.68 | 967.86 | 3,239.58 |
| Duration of adaptation period in days | 71.25 | 61.81 | 87.12 | 62.30 |
| Average decline in productivity (in %) | 23.95 | 14.47 | 31.13 | 14.86 |
| Training courses in days | 1.46 | 2.64 | 2.08 | 3.51 |
| Direct training costs | 213.33 | 1,234.71 | 604.50 | 1,961.83 |
| Weekly wage payments for skilled workers | 1,266.64 | 261.66 | 1,415.86 | 279.52 |
| Disruption time in hours | 67.53 | 70.36 | 105.20 | 79.47 |
| Observations | 641 | | 773 | |
| Large firms | 1st quartile | | 4th quartile | |
| | Mean | Std. dev. | Mean | Std. dev. |
| Number of hires | 5.47 | 12.43 | 15.36 | 56.80 |
| Number of skilled workers | 16.25 | 30.38 | 55.92 | 130.43 |
| Costs of job postings | 1,419.07 | 2,386.83 | 2,005.51 | 2,414.53 |
| Number of applicants interviewed per vacancy | 5.25 | 3.06 | 4.61 | 2.46 |
| Time for job interviews in hours | 11.77 | 9.91 | 11.99 | 10.64 |
| Personnel costs for interviews | 4,871.09 | 6,415.02 | 3,765.24 | 4,512.29 |
| Costs for external advisors/headhunters | 843.43 | 3,088.15 | 2,276.97 | 4,939.44 |
| Duration of adaptation period in days | 81.38 | 55.79 | 87.79 | 58.09 |
| Average decline in productivity (in %) | 31.60 | 13.78 | 30.80 | 14.35 |
| Training courses in days | 3.75 | 3.85 | 2.49 | 2.81 |
| Direct training costs | 1,605.20 | 2,450.35 | 722.08 | 1873.97 |
| Weekly wage payments for skilled workers | 1,421.42 | 216.11 | 1,491.99 | 330.31 |
| Disruption time in hours | 104.29 | 72.46 | 112.50 | 82.49 |
| Observations | 409 | | 333 | |

Note: All of the costs are in Swiss francs (CHF). Small firms had <50 employees. Large firms had 50+ employees.

Search costs can be written as:

$$s_i = v_i + j_i c_i^i + e_i, \tag{3}$$

where $v_i$ are the costs for posting a vacancy, $j_i$ denotes the number of interviewed applicants per vacancy who are invited for a job interview, and $c_i^i$ is the cost for a single interview (time spent on the interview multiplied by wages). Finally, $e_i$ are the costs for external placement agencies or headhunters.

Newly hired workers need some time to reach full productivity, and thus firms incur adaptation costs. These costs can be written as:

$$a_i = d_i^a(1 - p_i)w_i + d_i^t w_i + c_i^t \tag{4}$$

where $d_i^a$ represents the days that the newly hired worker is less productive than an average skilled worker within a firm, $p_i$ is the relative productivity of the newly hired worker compared with an experienced skilled worker in a firm, and $w_i$ denotes the skilled worker's wage. Some firms train workers via external courses during the adaptation period. These courses have direct training costs $c_i^t$ and costs due to the absence of workers from the workplace, where $d_i^t$ is the number of days that the newly hired worker is absent because of external training.

The third component of the hiring costs are disruption costs $d_i$, which are associated with new hires disrupting workers within the firm during the adaptation period. Workers within a firm might be included in the adaptation process for the new hires, where they provide the newly hired workers with relevant information about the production process. Disruption costs can be written as:

$$d_i = h_i^d w_i \tag{5}$$

where $d_i^d$ denotes how many hours all of the workers in a firm provide informal training to new hires (and thus they cannot perform their regular tasks) and $w_i$ denotes the wage. Disruption costs were only available for the 2009 survey, so when we analyzed the hiring

costs across time, we could only investigate the search and adaption costs.

Table 4: Descriptive statistics 2009

| | All firms | | | | | |
|---|---|---|---|---|---|---|
| | Mean | Std. dev. | Min | Max | Share | |
| Search costs ($s_i$) | 4,391.06 | 6,244.29 | 20.00 | 111,845.95 | 21,1% | |
| Adaptation costs ($a_i$) | 11,068.68 | 12,338.48 | 171.72 | 155,265.89 | 53,4% | |
| Disruption costs ($d_i$) | 5,284.55 | 4,711.73 | 0.00 | 44,343.89 | 25,5% | |
| Hiring costs ($C_i$) | 20,744.29 | 17,697.46 | 454.56 | 186,262.72 | 100% | |
| Observations | *3,947* | | | | | |
| | Small firms (<50 employees) | | | Large firms (50+ employees) | | |
| | Mean | Std. dev. | Min | Max | Share | |
| Search costs ($s_i$) | 3,735.01 | 5,442.29 | 19,9% | 7,131.86 | 8,299.75 | 24,7% |
| Adaptation costs ($a_i$) | 10,021.61 | 11,928.54 | 53,3% | 15,443.01 | 13,047.56 | 53,5% |
| Disruption costs ($d_i$) | 5,043.46 | 4,619.01 | 26,8% | 6,291.74 | 4,957.92 | 21,8% |
| Hiring costs ($C_i$) | 18,800.08 | 16,910.77 | 100% | 28,866.61 | 18,587.24 | 100% |
| Observations | *2,656* | | | *1,291* | | |

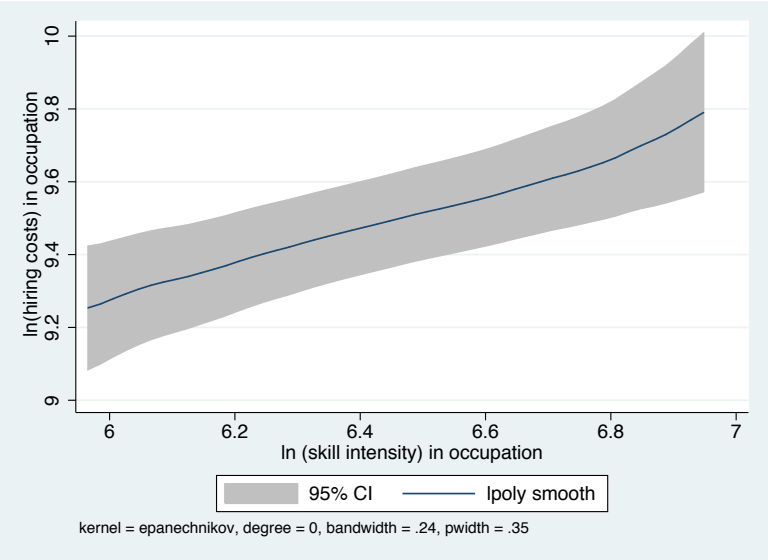
Note: All costs in Swiss francs (CHF)

Table 4 shows that during 2009, small firms in Switzerland had average hiring costs of 18,800 Swiss Francs (CHF)[10] whereas large firms incurred costs of about 28,900 CHF, although with considerable variation between firms. The maximum hiring costs were above 186,000 CHF although the hiring costs were virtually zero for some firms. On average, 53 percent of the hiring costs were adaptation costs, which were incurred mainly due to the initial low productivity of new hires. Search costs accounted for 21 percent (20 percent for small firms and 25 percent for large firms) of the hiring costs, which mainly comprised personnel costs for interviews and costs for job postings. The remaining 26 percent (27 percent for small and 22 percent for large firms) of hiring costs were attributable to new

[10]In 2009, 1 CHF was roughly equal to 1 USD.

hires disrupting the production process because they required informal training from other workers who were unable to perform their regular tasks (average of about 99 hours per new hire).[11]

Figure 1: Hiring costs and skill requirements (measured in hours of workplace training during an apprenticeship) by occupation




Hiring costs also increased according to the skill requirements for an occupation. We used information regarding the average workplace training volume at the occupation-level for apprenticeship programs as a proxy for each occupation's skill requirements. Depending on the training occupation, the average volume of workplace instruction time ranged from 360 to 1120 hours per apprentice. Figure 1 shows that there was a significant positive association between hiring costs and skill requirements at the occupational level. Based on bivariate regression, we estimated the hiring cost elasticity with respect to skill requirements as 0.8, i.e., a 1% increase in skill requirements was associated with a 0.8% increase in the average hiring costs, thereby implying high economic significance.[12]

We used the vacancy-unemployment ($v/u$) ratio as a measure of labor market tightness.

[11]Table A1 in the Appendix shows descriptive statistics regarding the components of the search costs and adaptation costs for the 2000 and 2004 surveys. When we compared surveys across time, we used the costs from 2000.

[12]Our results agree with an earlier study by Barron et al. (1985), who found that firms spent more time searching for qualified applicants when the training requirements were high.

Figure 2: Availability of skilled labor on the labor market


Figure 2 shows the $v/u$ ratio, a subjective measure of a firm's difficulties finding skilled labor, and GDP growth.[13] In 2000, about 50 percent of the firms reported difficulties finding skilled workers in the external labor market. However, in 2004, the economic downturn after the recession at the beginning of the new millennium still affected the labor market, and thus firms had less difficulty finding suitable skilled workers in our second observation period (2002–2004). In 2009, Switzerland had yet another economic downturn as a result of the financial crisis. However, the Swiss economy remained relatively strong compared with other countries and the GDP growth in the previous years produced a rather tight labor market for the period 2007–2009, which was the last period during which we observed firms recruiting new employees.

The main question that we next addressed in this study was the extent to which labor market tightness influenced a firm's hiring costs and whether there were heterogeneous effects across hiring costs components. We answered this question based on the variation in the conditions of the labor market.

[13]GDP change compared with the previous year. Source: http://www.seco.admin.ch/themen/00374/00456/00458/index.html?lang=de, 20.11.2013

# 4 Estimation strategy

We investigated the association between changes in labor market tightness and hiring costs. Thus, we analyzed the association between the growth in the within-industry $v/u$ ratio and a firm's observed hiring costs for a particular occupation.[14] We observed a firm's hiring behavior over a three-year period, so we defined the growth rate of the $v/u$ ratio as $(v_s/u_s)_{t,t-1} = [\overline{(v_s/u_s)}_t - \overline{(v_s/u_s)}_{t-1}]/\overline{(v_s/u_s)}_{t-1}$, where $t$ corresponds to the three-year period from 2007 to 2009 and $t-1$ to the three-year period from 2001 to 2004. Moreover, $\overline{(v_s/u_s)}_t$ corresponds to the average $v/u$ ratio in period $t$ and industry $s$.

To infer the structure of hiring costs, like Manning (2011) we assumed that a firm's total hiring costs $C$ had the form $C = H^{\beta}$. The advantage of this specification is that it allows for both economies and diseconomies of scale during recruitment. A value of $\beta > 1$ implies diseconomies of scale, whereas there are economies of scale if $\beta < 1$. In our estimations, we added further control variables for firm size and wages because the hiring method might differ between small and large firms, while high-wage firms could be more attractive to job-seekers.

Marginal hiring costs are given by $\frac{\partial C}{\partial H} = \beta H^{\beta-1}$. Our estimates were based on the average hiring costs per vacancy, i.e., the ratio of total hiring costs and the number of hires $H$, $\frac{C}{H} = H^{\beta-1}$. Thus, as noted in Manning (2011), $\frac{\partial C}{\partial H} = \beta \frac{C}{H}$, which allowed us to identify $\beta$ by regressing the average hiring costs per vacancy on the number of hires during the period of interest.

Thus, we estimated the following regression:

$$\ln C_i = \lambda + \alpha(v_s/u_s)_{t,t-1} + (\beta - 1)\ln H_i + X_i'\theta + \varepsilon_i, \tag{6}$$

where $\alpha$ denotes the effect of labor market tightness on hiring costs and $\beta$ is the effect of the number of hires in the preceding three years on the total hiring costs. Moreover, $X_i$ includes a firm's characteristics, particularly the firm size, number of skilled employees

[14] We also performed regressions using the level of the $v/u$ ratio, which obtained significant and qualitatively similar results. However, the level of vacancies and unemployment could have been affected by other unobserved (structural) factors within industries, so we focused our analysis on the growth rate of the $v/u$ ratio.

in the chosen occupation, wage of skilled workers, occupation, region, and the year of observation.

As a robustness check, we also estimated a panel based on the aggregated average hiring costs within sectors ($s$) by using fixed effects to account for heterogeneity at the sector level:

$$\ln C_{st} = \kappa_0 + \mu(v_s/u_s)_t + \pi w_{st} + \upsilon_{st}, \tag{7}$$

where $w_{st}$ is the average wage in sector $s$.[15]

# 5 Results

The results are presented as follows. First, we present the estimates obtained for the 2009 sample using the most complete definition of hiring costs, which also included disruption costs as a cost component that was not included in the 2000 and 2004 surveys. We provide separate results for total hiring, search, adaptation, and disruption costs, as well as for individual cost parameters. Second, we present the changes in aggregate hiring costs within sectors and how they were affected by changing labor market conditions over time. We provide separate results for firms with more (less) than 50 employees because we expected that the effects of labor market tightness on hiring costs would differ according to firm size (Moscarini and Postel-Vinay, 2012, 2013). Moreover, human resources departments were prevalent in most firms with more than 50 employees, and thus these firms were able to exploit economies of scale by frequently hiring new employees.

## 5.1 Hiring costs and the vacancy-unemployment rate

The results in Table 5 show the effects of the $v/u$ growth rate during 2007–2009 relative to 2002–2004, and we also estimated separate effects for changes in the growth of unemployment and vacancies.[16] For small firms, the effects of the $v/u$ growth rate were positive and statistically significant throughout the different model specifications. Similarly, as

[15] Industries were weighted according to the number of firms within industry.

[16] We also performed regressions using the level of the $v/u$ rate and we found statistically significant effects. However, a number of unobserved factors could be correlated with the level of vacancies and unemployment in a particular industry, so we do not report these results.

expected, we found a negative and significant effect for unemployment growth, and a positive effect for vacancy growth when we used each of these variables in separate regressions (models 4 and 5).

In our preferred specifications (models 5 and 10), we controlled for state-fixed effects and wages. For small firms, we found that a one standard deviation increase in the $v/u$ growth rate (which corresponds to 0.68) was associated with an 11 percent increase in the average costs incurred to fill a vacancy.[17] However, we found no statistically significant effects for large firms with more than 50 employees.[18]

The association between hiring costs and the labor market tightness may have a number of explanations, so we also analyzed the different subcomponents of the hiring costs. Table 6 provides estimates for the components of search costs for small (models 1–4) and large (models 5–8) firms. For small firms, a one standard deviation increase in the $v/u$ growth rate increased the overall search costs by 15 percent (model 1).[19] This effect can be attributed primarily to higher expenditures on advertisement costs (i.e., to fill a vacancy, a one standard deviation increase in the $v/u$ growth rate was associated with a 29.3 percent increase in the average expenditure for job postings).

[17]We also estimated this regression using an alternative variable for labor market tightness, i.e., a subjective indicator variable that indicated whether a firm had difficulties finding suitable skilled labor. The effect size of this variable was 21 percent and the results are available upon request.

[18]We also estimated a model with an interaction term for skilled worker wage and the $v/u$ growth rate, but the coefficient of the interaction term was not statistically significant. However, we found that an increase in the $v/u$ growth rate was positively associated with the skilled worker wage, but only for small firms with less than 50 employees (Table A4). Thus, a tight labor market also placed an upward pressure on wages, but our results suggested that a tight labor market, conditional on wages, increased hiring costs for small firms. However, the coefficient for wages in the hiring costs regressions did not have a strictly causal interpretation.

[19]These findings agree with the results reported by Russo et al. (2000) who showed that Dutch employers used more advertising as a recruitment channel when labor markets were tight.

Table 5: Labor market tightness and hiring costs

| | Small firms (<50 employees) | | | | | | Large firms (50+ employees) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| $(v/u)_{t,t-1}$ | 0.322*** | 0.193*** | | | 0.162*** | 0.0603 | -0.0420 | | | -0.0336 |
| | (0.0333) | (0.0361) | | | (0.0354) | (0.0787) | (0.0470) | | | (0.0420) |
| $v_{t,t-1}$ | | | | 0.112*** | | | | | -0.0704 | |
| | | | | (0.0401) | | | | | (0.0618) | |
| $u_{t,t-1}$ | | | -0.381*** | | | | | -0.116 | | |
| | | | (0.126) | | | | | (0.180) | | |
| ln Number of hires | | -0.0179 | -0.00660 | -0.0171 | -0.0165 | | -0.0525 | -0.0511 | -0.0488 | -0.0152 |
| | | (0.0317) | (0.0325) | (0.0320) | (0.0310) | | (0.0478) | (0.0474) | (0.0462) | (0.0398) |
| ln Number of skilled employees | | 0.0738** | 0.0742** | 0.0788** | 0.0551* | | 0.0361 | 0.0269 | 0.0316 | 0.00234 |
| | | (0.0318) | (0.0316) | (0.0321) | (0.0315) | | (0.0448) | (0.0419) | (0.0438) | (0.0386) |
| ln wage (weekly) | | | | | 1.228*** | | | | | 1.449*** |
| | | | | | (0.117) | | | | | (0.163) |
| 10–49 employees | | 0.201*** | 0.180*** | 0.195*** | 0.115** | | | | | |
| | | (0.0500) | (0.0489) | (0.0505) | (0.0526) | | | | | |
| 100+ employees | | | | | | | 0.0215 | 0.0191 | 0.0196 | 0.0315 |
| | | | | | | | (0.0746) | (0.0747) | (0.0741) | (0.0635) |
| Constant | 9.225*** | 9.036*** | 9.143*** | 9.096*** | 0.439 | 10.00*** | 9.561*** | 9.565*** | 9.579*** | -0.888 |
| | (0.0328) | (0.0910) | (0.0890) | (0.0917) | (0.826) | (0.127) | (0.167) | (0.168) | (0.169) | (1.138) |
| Observations | 2656 | 2656 | 2656 | 2656 | 2656 | 1291 | 1291 | 1291 | 1291 | 1291 |
| $R^2$ | 0.0646 | 0.261 | 0.253 | 0.252 | 0.318 | 0.00226 | 0.326 | 0.326 | 0.327 | 0.420 |

Note: Dependent variable: $\ln C$. Robust standard errors are shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Models 1–5 are for small firms and models 6–10 are for large firms. Columns 2–5 and 7–10 were controlled for 26 regions and 14 occupations

Moreover, the number of applicants interviewed per vacancy was positively associated with $v/u$ growth, thereby indicating that small firms invited more candidates during periods with a tight labor market. However, for large firms, the effect of the $v/u$ growth rate on search costs was not statistically significant (model 5, Table 6), although the point estimate remained positive. However, large firms were more likely to make use of external placement agencies and headhunters during a tight labor market, thereby indicating that firms poached workers from other firms when workers were otherwise not available (model 9).

Nonetheless, we found a marginally significant effect of the $v/u$ growth rate on the average interview time (models 3 and 8), thereby indicating that large and small firms spent more time evaluating job applicants when there was a tight labor market. Moreover, we found that the number of per-period hires significantly increased the search costs for both small and large firms, which were primarily due to higher costs for job postings and more applicants interviewed per vacancy. Thus, our results imply that search costs are convex, i.e., the marginal costs increased with the number of hires.

However, although large firms spent more on job advertisements, we found a negative association between the number of skilled employees and interview time, which indicates that large firms could conduct interviews more efficiently, conditional on the number of hires (Table 6, model 8).

Table 7 shows the results for the components of adaptation costs in small (models 1–5) and large (models 6–10) firms. For small firms, a one standard deviation increase in the $v/u$ growth rate was associated with an 11 percent increase in the average adaptation costs (model 1). We found that there was a positive association between the $v/u$ growth rate and the productivity losses, where a one standard deviation increase in the $v/u$ growth rate increased the productivity losses in small firms by 4.2 percent. Furthermore, a one standard deviation increase in the $v/u$ growth rate increased the adaptation time by 6.4 percent for small firms. These results suggest that small firms hire new employees with lower ability, and thus they require a longer adaptation period.

Table 6: Labor market environment and search costs

| | Small firms (<50 employees) | | | | | Large firms (50+ employees) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\ln s_i$ | $\ln v_i$ | $\ln h_i^i$ | $e_i$ | $j_i$ | $\ln s_i$ | $\ln v_i$ | $\ln h_i^i$ | $e_i$ | $j_i$ |
| $(v/u)_{t,t-1}$ | 0.227*** | 0.431*** | 0.0660* | 0.00436 | 0.258*** | 0.0889 | -0.0890 | 0.114* | 0.0176 | 0.212 |
| | (0.0470) | (0.150) | (0.0399) | (0.0191) | (0.0996) | (0.0877) | (0.202) | (0.0647) | (0.0329) | (0.203) |
| ln Number of hires | 0.176*** | 0.500*** | 0.00976 | 0.0392*** | 0.331*** | 0.206*** | 0.352* | 0.0733 | 0.0309 | 0.308* |
| | (0.0426) | (0.123) | (0.0358) | (0.0130) | (0.0884) | (0.0681) | (0.180) | (0.0456) | (0.0229) | (0.169) |
| ln Number of skilled | 0.00112 | 0.240** | -0.00239 | -0.0250* | -0.168* | -0.0305 | 0.452** | -0.120** | 0.0430 | -0.299 |
| employees | (0.0397) | (0.121) | (0.0361) | (0.0134) | (0.101) | (0.0652) | (0.207) | (0.0471) | (0.0204) | (0.206) |
| ln wage (weekly) | 1.110*** | 0.461 | 0.336** | 0.149*** | -0.0826 | 1.095*** | -0.0789 | 0.685*** | 0.0165 | -0.0923 |
| | (0.155) | (0.580) | (0.144) | (0.0453) | (0.391) | (0.243) | (0.865) | (0.184) | (0.0910) | (0.599) |
| 10–49 employees | 0.437*** | 0.889*** | 0.238*** | 0.0456** | 0.261 | | | | | |
| | (0.0689) | (0.275) | (0.0574) | (0.0219) | (0.160) | | | | | |
| 100+ employees | | | | | | 0.0312 | 0.620** | 0.0544 | 0.0153 | -0.218 |
| | | | | | | (0.126) | (0.316) | (0.0794) | (0.0376) | (0.275) |
| Constant | -0.960 | 0.169 | -0.898 | -0.989*** | 4.010 | 0.0117 | 5.010 | -2.601** | -2.601** | 4.150 |
| | (1.087) | (4.128) | (1.012) | (0.319) | (2.755) | (1.703) | (5.976) | (1.307) | (1.307) | (4.132) |
| Observations | 2656 | 2656 | 2656 | 2656 | 2656 | 1291 | 1291 | 1291 | 1291 | 1291 |
| $R^2$ | 0.289 | 0.128 | 0.0816 | 0.0889 | 0.120 | 0.260 | 0.340 | 0.178 | 0.178 | 0.287 |

Note: Robust standard errors are shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. All columns were controlled for 26 regions and 14 occupations

Table 7: Labor market environment and adaptation costs

| | Small firms (<50 employees) | | | | | Large firms (50+ employees) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\ln a_i$ | $\ln p_i$ | $\ln d_i^a$ | $d_i^t$ | $c_i^t$ | $\ln a_i$ | $\ln p_i$ | $\ln d_i^a$ | $d_i^t$ | $c_i^t$ |
| $(v/u)_{t,t-1}$ | 0.164*** | 0.0618*** | 0.0948*** | -0.0951 | 107.6 | -0.0784 | 0.0293 | -0.102* | 0.160 | 97.65 |
| | (0.0401) | (0.0212) | (0.0340) | (0.152) | (69.38) | (0.0703) | (0.0359) | (0.0545) | (0.209) | (123.2) |
| ln Number of hires | -0.0768* | 0.0124 | -0.104*** | 0.0436 | -89.30 | -0.0824 | 0.0443* | -0.152*** | 0.268 | 157.7 |
| | (0.0404) | (0.0223) | (0.0354) | (0.135) | (67.31) | (0.0606) | (0.0260) | (0.0509) | (0.193) | (99.97) |
| ln Number of skilled | 0.0965** | -0.00237 | 0.118*** | 0.254 | 98.38 | -0.00556 | -0.0641** | 0.0790** | -0.304 | -243.5 |
| employees | (0.0397) | (0.0228) | (0.0313) | (0.248) | (82.30) | (0.0515) | (0.0274) | (0.0344) | (0.268) | (154.0) |
| ln wage (weekly) | 1.283*** | -0.0640 | 0.312*** | 0.921 | 443.2** | 1.774*** | 0.0729 | 0.658*** | 1.625* | 1505.7*** |
| | (0.147) | (0.0901) | (0.109) | (0.607) | (214.7) | (0.246) | (0.111) | (0.191) | (0.848) | (461.6) |
| 10–49 employees | 0.0318 | 0.0218 | -0.0272 | 0.0782 | 136.6 | | | | | |
| | (0.0610) | (0.0384) | (0.0496) | (0.198) | (93.74) | | | | | |
| 100+ employees | | | | | | 0.0642 | 0.00530 | 0.0407 | -0.702** | -565.3*** |
| | | | | | | (0.104) | (0.0445) | (0.0887) | (0.356) | (192.4) |
| Constant | -0.653 | 3.636*** | 1.733** | -5.142 | -3009.8** | -4.173** | 2.689*** | -0.951 | -9.122 | -9980.1*** |
| | (1.043) | (0.637) | (0.773) | (4.362) | (1498.9) | (1.710) | (0.781) | (1.340) | (5.836) | (3144.5) |
| Observations | 2656 | 2547 | 2656 | 2656 | 2656 | 1291 | 1262 | 1291 | 1291 | 1291 |
| $R^2$ | 0.225 | 0.119 | 0.119 | 0.0450 | 0.0691 | 0.379 | 0.177 | 0.335 | 0.292 | 0.370 |

Robust standard errors are shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. All columns were controlled for 26 regions and 14 occupations.

For the number of hires per period by small firms, we found a negative association between hires and adaptation costs. By contrast, we found that firms with a large number of skilled workers in the hiring occupation had a longer adaptation period. Thus, the results showed that it was important to distinguish between firm size, the number of employees in the hiring occupation, and the number of hires because we found evidence for opposing effects.

Moreover, in small firms, we found a positive association between wages and adaptation costs, mainly because of a longer adaptation period and higher costs for formal training in high-wage firms. These results suggest that high-wage firms may have higher skill requirements compared with low-wage firms, even within a specific occupation.

For large firms, we found no significant association between labor market tightness and adaptation costs (Table 7, models 6–10). Similarly, in terms of the number of hires and the number of skilled employees in the hiring occupations, we found no effect on overall adaptation costs. However, as shown for small firms, wages were positively associated with adaptation time and formal training costs, and thus adaptation costs. Moreover, the training duration and productivity losses during the adaptation period increased with wages, thereby indicating that high-wage firms had higher skill requirements, even when controlling for firm size.

Table 8: Labor market environment and disruption costs

| | Small firms (<50 employees) | | | | Large firms (50+ employees) | | | |
|---|---|---|---|---|---|---|---|---|
| | $\ln d_i$ | $\ln d_i$ | $\ln h_i^d$ | $\ln h_i^d$ | $\ln d_i$ | $\ln d_i$ | $\ln h_i^d$ | $\ln h_i^d$ |
| $(v/u)_{t,t-1}$ | 0.370*** | 0.179*** | 0.239*** | 0.149*** | 0.0323 | -0.0292 | 0.0293 | -0.0272 |
| | (0.0527) | (0.0583) | (0.0418) | (0.0508) | (0.0734) | (0.0623) | (0.0656) | (0.0612) |
| ln Number of hires | | -0.0949 | | -0.0652 | | -0.00176 | | -0.0102 |
| | | (0.0696) | | (0.0481) | | (0.0508) | | (0.0487) |
| ln Number of skilled employees | | 0.0375 | | -0.0203 | | -0.0464 | | -0.0426 |
| | | (0.0631) | | (0.0473) | | (0.0453) | | (0.0427) |
| ln wage (weekly) | | 1.052*** | | 0.359** | | 1.340*** | | 0.537*** |
| | | (0.173) | | (0.147) | | (0.223) | | (0.207) |
| 100+ employees | | | | | | 0.000573 | | 0.0108 |
| | | | | | | (0.0795) | | (0.0766) |
| Constant | 7.662*** | 0.125 | 3.941*** | 1.346 | 8.388*** | -1.403 | 4.410*** | 0.442 |
| | (0.0623) | (1.217) | (0.0475) | (1.039) | (0.0933) | (1.611) | (0.0852) | (1.489) |
| Observations | 2656 | 2656 | 2656 | 2656 | 1291 | 1291 | 1291 | 1291 |
| $R^2$ | 0.0286 | 0.126 | 0.0220 | 0.104 | 0.000364 | 0.198 | 0.000372 | 0.148 |

Note: Robust standard errors are shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Columns 2 and 4 were controlled for 26 regions and 14 occupations

Table 8 provides estimates for the components of disruption costs for small (models 1–4) and large (models 5–8) firms. The disruption costs were associated positively with the tightness of the labor market because a one standard deviation increase in the $v/u$ growth rate led to a 12 percent increase in disruption costs for small firms (Table 8, model 2). Thus, our findings suggest that although small firms spent more on search costs when the labor market was tight, they recruited hires with a lower match quality, as suggested by increased adaptation and disruption costs.

Finally, wages affected the disruption costs in two ways: first, a firm's wage level was positively associated with the disruption time (model 4); and second, an hour of disruption time was valued at a higher price by high-wage firms; thus, a 1 percent increase in the wage level was associated with a 1.05 percent increase in disruption costs for small firms (model 2) and a 1.34 percent increase in disruption costs for large firms (model 6). Moreover, disruption costs were non-convex in the number of hires, which agrees with the results reported by Cooper and Willis (2009).

### 5.2 Panel analysis

As a robustness check, we performed a fixed-effects panel regression analysis for average hiring costs across industries in 2000, 2004, and 2009. Moreover, we conducted a fixed-effects panel regression analysis for a non-random sample of firms from the 2004 and 2009 surveys.

We performed a fixed-effects panel regression analysis for the average hiring costs at the industry-level during 2000, 2004, and 2009. We had the search and adaptation costs but not the disruption costs for 2000 and 2004, so we only analyzed the former two components of the hiring costs in a panel setting.

We found that the $v/u$ ratio was positively associated with search costs, but not with adaptation costs (Table 9). The advantage of running industry-level regressions is that our full data set could be used for all survey periods while considering industry-fixed effects and the wage levels of skilled workers. After controlling for the average skilled worker wage, a one standard deviation increase in the $v/u$ ratio was associated with a 9.5 percent increase in within-sector average search costs.

Table 9: Panel estimates by sectors (2000, 2004, 2009)

| | $\ln(s_{st}+a_{st})$ | $\ln(s_{st}+a_{st})$ | $\ln s_{st}$ | $\ln s_{st}$ | $\ln a_{st}$ | $\ln a_{st}$ |
|---|---|---|---|---|---|---|
| $(v_s/u_s)_t$ | 0.0684*** | 0.0499* | 0.116*** | 0.0956*** | 0.0482 | 0.0303 |
| | (0.0222) | (0.0274) | (0.0333) | (0.0320) | (0.0294) | (0.0356) |
| $\ln w_s$ | | 1.855*** | | 2.053** | | 1.792*** |
| | | (0.547) | | (0.857) | | (0.486) |
| Constant | 9.426*** | -3.720 | 8.107*** | -6.439 | 9.107*** | -3.589 |
| | (0.0272) | (3.873) | (0.0409) | (6.074) | (0.0361) | (3.434) |
| Observations | 57 | 57 | 57 | 57 | 57 | 57 |
| $R^2$ | 0.106 | 0.266 | 0.142 | 0.234 | 0.0579 | 0.222 |
| F-statistic | 9.537 | 10.61 | 12.17 | 10.70 | 2.690 | 9.140 |

Note: Fixed effects estimates. Standard errors are shown in parentheses. Weighted for industry size. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The panel results in Tables A2 and A3 for the firms surveyed in 2004 and 2009 confirm the positive association found in the cross-section between the $v/u$ ratio and search costs for small firms. In particular, we showed that a small firm increased advertisement expenditure and was more likely to use external placement agencies to find skilled workers during periods with a tight labor market. However, although we found a positive association between labor market tightness and adaptation costs for small firms in the cross-section (mainly because of increased productivity losses), there was no significant association in the panel analysis. Thus, unobserved firm-specific effects may have driven our results in the cross-section. However, other parameters such as training duration and training costs obtained similar results compared to the cross-sectional analysis. For large firms, we found a negative association between the $v/u$ ratio and the productivity losses associated with the adaptation period, which may have been attributable to a firm wanting to integrate new hires as quickly as possible into their production process and possibly postponing non-essential training activities.

# 6 Conclusions

In this study, we established empirical facts related to the hiring of skilled workers. We found that the average cost incurred to fill a vacancy for a skilled worker was about 16 weeks of wage payments. The search costs only accounted for 21 percent of the costs incurred to fill a vacancy and most of a firm's hiring expenses occurred after the signing of a contract. Adaptation costs (i.e., training costs and the initially low productivity of a new hire) accounted for 53 percent and disruption costs (i.e., productivity losses because other workers could not perform their regular tasks while providing informal training to new hires) accounted for 26 percent of the total hiring costs.

We also showed that hiring costs were associated with labor market tightness, which was measured by the within-industry growth rate of the vacancy-unemployment ratio ($v/u$). For firms with less than 50 employees, we found that a one standard deviation increase in the $v/u$ growth rate led to an 11 percent increase in average hiring costs, which is an economically substantial effect. In the cross-section, we showed that labor market tightness affected all of the components of hiring costs (search, adaptation, and disruption costs) in small firms, but there were no significant effects for large firms. Using panel estimates for a non-random sample of firms for search costs, the results are in line with our cross-sectional results for search costs. However, we found mixed evidence in terms of the adaptation costs.

Moreover, we showed that the structure of the hiring costs with respect to the number of hires differs across individual cost components. We found that search costs are convex in the number of hires for small and large firms, whereas the adaptation and disruption costs have a non-convex cost structure.

Our results provide a better understanding of the hiring costs in different countries. Most previous empirical studies have not provided a complete picture of hiring costs because of their small sample sizes or missing cost components. Depending on the relative importance of each component of the hiring costs, the underlying data sample (i.e., small or large firms, establishment level or firm level, and recession or boom period) may at least partly drive the results of a particular empirical study. The costs incurred to fill a vacancy

differ according to the skill requirements of an occupation, the firm's size, business cycle, and firm-specific factors, so future research should focus on analyzing the components of hiring costs based on a large-scale panel data set.

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# A Tables

Table A1: Descriptive statistics for 2000 and 2004

| | 2000 | | 2004 | |
|---|---|---|---|---|
| Variable | Mean | Std. dev. | Mean | Std. dev. |
| Number of new hires | 3.06 | 5.82 | 2.90 | 6.45 |
| Number of skilled workers | 7.15 | 27.33 | 6.64 | 25.45 |
| | | | | |
| Costs of job postings | 1,361.36 | 2,166.94 | 939.92 | 1,455.35 |
| Number of applicants interviewed per vacancy | 4.29 | 2.91 | 5.31 | 3.64 |
| Time for job interviews in hours | 6.33 | 6.83 | 9.83 | 10.40 |
| Personnel costs for interviews | 1,512.49 | 2,210.85 | 2,877.24 | 5,524.04 |
| Costs for external advisors/headhunters | 872.52 | 2,685.15 | 565.90 | 2,399.18 |
| Search costs ($s_i$) | 3,746.36 | 5,206.42 | 4,383.06 | 6,723.68 |
| | | | | |
| Duration of adaptation period in days | 79.02 | 68.00 | 79.25 | 53.76 |
| Average decline in productivity (1-p) (in %) | 27.20 | 13.74 | 30.51 | 12.66 |
| Training courses in days | 1.85 | 4.47 | 1.22 | 3.35 |
| Direct training costs | 669.60 | 2,069.18 | 426.44 | 1,606.59 |
| Weekly wage payments for skilled workers | 1,209.75 | 276.43 | 1,258.61 | 204.18 |
| Adaptation costs | 9,850.88 | 12,576.15 | 10,067.38 | 9,600.54 |
| Observations | 2,360 | | 2,567 | |

Note: All costs are in Swiss francs (CHF) based on the prices 2000. In 2000, one CHF was roughly equal to 0.6 USD.

Table A2: Panel estimates (2004 and 2009): small firms with <50 employees

| | $\ln a_i$ | $\ln h_i^i$ | $e_i$ | $\ln p_i$ | $\ln d_i^t$ | $\ln c_i^t$ |
|---|---|---|---|---|---|---|
| $(v/u)_t$ | 1.294*** | 0.131 | 0.169** | -0.128** | 0.0888 | -315.9 |
| | (0.337) | (0.157) | (0.0646) | (0.0533) | (0.469) | (243.2) |
| $\ln w$ (weekly, 2000 prices) | 2.495** | 1.311* | -0.191 | 0.314 | -1.794 | -720.7 |
| | (1.168) | (0.700) | (0.339) | (0.356) | (2.151) | (1116.2) |
| Constant | -13.36 | -7.395 | 1.249 | 1.208 | 13.87 | 5944.2 |
| | (8.302) | (5.015) | (2.428) | (2.543) | (15.35) | (7972.4) |
| Observations | 127 | 127 | 127 | 127 | 127 | 127 |
| $R^2$ | 0.291 | 0.0774 | 0.224 | 0.0986 | 0.0268 | 0.0401 |
| F-statistic | 6.040 | 1.766 | 2.730 | 2.691 | 1.242 | 0.970 |

Note: Fixed effects estimates. Clustered standard errors at establishment level are shown in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Panel estimates (2004 and 2009): large firms with 50+ employees

| | $\ln a_i$ | $\ln h_i^i$ | $e_i$ | $\ln p_i$ | $\ln d_i^t$ | $\ln c_i^t$ |
|---|---|---|---|---|---|---|
| $(v/u)_t$ | -0.0910 | -0.0100 | 0.183*** | -0.0746** | 0.0477 | -57.77 |
| | (0.155) | (0.0797) | (0.0405) | (0.0365) | (0.298) | (160.9) |
| $\ln w$ (weekly, 2000 prices) | -0.329 | -0.287 | 0.181 | -0.330 | -2.852 | -633.4 |
| | (1.145) | (0.419) | (0.181) | (0.295) | (1.846) | (580.1) |
| Constant | 8.650 | 4.133 | -1.484 | 5.706*** | 22.13* | 4901.2 |
| | (8.240) | (2.973) | (1.297) | (2.117) | (13.24) | (4192.6) |
| Observations | 396 | 396 | 396 | 388 | 396 | 396 |
| $R^2$ | 0.0140 | 0.00902 | 0.173 | 0.0213 | 0.0361 | 0.0212 |
| F-statistic | 0.922 | 0.493 | 11.64 | 1.588 | 2.123 | 1.237 |

Note: Fixed effects estimates. Clustered standard errors at the establishment level are shown in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Labor market environment and wages of skilled workers

| Dep. variable: $\ln w$ | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $(v/u)_{t,t-1}$ | 0.0476*** | 0.0193*** | 0.0247*** | -0.00578 |
| | (0.00837) | (0.00660) | (0.00730) | (0.0130) |
| ln Number of hires | | -0.00819 | -0.00115 | -0.0257** |
| | | (0.00568) | (0.00716) | (0.0106) |
| ln Number of skilled employees | | 0.0121** | 0.0152** | 0.0233** |
| | | (0.00560) | (0.00648) | (0.0107) |
| 10–49 employees | | 0.0764*** | 0.0699*** | |
| | | (0.0111) | (0.0114) | |
| 50–99 employees | | 0.127*** | | |
| | | (0.0183) | | |
| 100+ employees | | 0.128*** | | -0.00695 |
| | | (0.0148) | | (0.0160) |
| Constant | 7.119*** | 7.021*** | 7.002*** | 7.212*** |
| | (0.0101) | (0.0178) | (0.0201) | (0.0314) |
| Observations | 3947 | 3947 | 2656 | 1291 |
| $R^2$ | 0.0247 | 0.317 | 0.317 | 0.232 |

Note: Robust standard errors are shown in parentheses. * p<0.1, ** p<0.05, *** p<0.01. Columns 2 to 4 were controlled for 26 regions and 14 occupations. Model 3: small firms. Model 4: large firms.