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Search Cost and Search Duration for New Hires*

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Abstract

Fixed search costs, i.e. costs that don't vary with search duration, can amplify the cyclical volatility of the labor market. To assess the size of fixed costs, we analyse the relation of search costs and search duration with data from Germany. We find that fixed search costs are about one half of total search costs, but this is not enough to solve the labor market volatility puzzle completely.

1 Introduction and Background

The cyclical variation of vacancies, unemployment and labor market tightness is empirically much larger than explained by the standard search and matching model (Shimer, 2005). A way to solve this puzzle is suggested by Pissarides (2009). He extends the standard model by distinguishing two types of search costs: search costs that depend on the duration of the vacancy, mainly related to the posting activity, and search costs that are fixed, connected to the screening process and independent from the duration of the vacancy. The first is labeled as variable search costs and the second as fixed search costs. Pissarides shows that a high share of fixed costs on the total search costs is able to generate the elasticity of tightness observed in the data. In this paper we assess empirically the proportion of the two types of cost and give some further insights into the cost structure.

The argument of Pissarides (2009) can be pinned down analytically as follows. The job creation condition in the canonical model is

$$\frac{p - w}{r + s} = \frac{c}{q(\theta)}, \quad (1)$$

where p is the labour productivity, w is the wage, r is risk-free interest rate, s is the separation rate, c is the generic search cost per period and $q(\theta)$ the vacancy filling rate. Note that $1/q(\theta)$ is the search duration and $c/q(\theta)$ is the total search cost. It follows that the total search costs move one to one with the duration of a vacancy. The elasticity of tightness with respect to p can be expressed as,

$$\varepsilon_{\theta} = \frac{1}{\eta} \frac{p - \varepsilon_w w}{p - w}, \quad (2)$$

*The survey data used are confidential but not exclusive. Access to the data is provided by the Research Data Centre of the German Federal Employment Agency. For details, see: http://fdz.iab.de/en/FDZ_Establishment_Data/IAB_Job_Vacancy_Survey.aspx.

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where ε_w is the elasticity of the wage with respect to productivity shocks. η is the elasticity of new matches with respect to unemployment. Under the standard parametrization with flexible wages, $\eta = 0.5$, $p = 1$ and equilibrium values of $w = 0.983$ and $\varepsilon_w = 0.985$, ε_θ takes a value of 3.7, while the observed elasticity in the U.S. is around 7.56.¹ According to Pissarides, fixed search costs H enter the model without modifying the Nash-bargained wage, because this is a cost that is not taken into account at the moment of the bargain, but it enters the value of a new vacancy. The job creation condition becomes

$$\frac{p - w}{r + s} = \frac{c}{q(\theta)} + H. \quad (3)$$

The elasticity of θ with respect to p computed from (3) is

$$\varepsilon_\theta = \frac{1}{\eta} \frac{p - \varepsilon_w w}{p - w - (r + s)H}. \quad (4)$$

A positive productivity shock leads to more vacancies created by firms. This increases the tightness on the labor market as well as the vacancy duration. A higher duration also raises the search costs and thereby dampens the incentive to create vacancies. The higher the share of fixed search costs, the smaller is this dampening effect and the higher is the elasticity of θ . Pissarides shows in a calibration exercise that if the share of H on the total search costs is about 93%, we end up with an elasticity consistent with the data.²

Search cost represents a wide range of expenditures, such as the vacancy posting, the screening and negotiation activity with candidates, the headhunters or the personal human resources staff. Despite the important implications for the search models, there is scarce research on the size and structure of search costs. Exceptions are for example Dolfin (2006), Barron, Berger, and Black (1997) or for Germany Muehlemann and Pfeifer (2016), but they all do not distinguish fixed and variable costs.

2 Empirical evidence

We use of the German Job Vacancy Survey conducted by the Institute for Employment Research (IAB), a random sample of establishments with at least one employee, stratified by 23 economic sectors and 7 firm size classes (see Moczall, Müller, Rebien, and Vogler-Ludwig, 2015). The yearly survey started 1989 and reports information on establishment characteristics and on the most recent hiring.

In the wave 2014 we included two further questions: "What is the total number of hours spent on this recruitment?" and "If you add up all other costs, including ads, headhunters, travel expenses, etc., which further costs (without labor costs) emerged for this recruiting?" The first question refers to what we call the *search hours*. The second to the *monetary search costs*. Moreover, we compute the vacancy duration as the time span between the date when the search started and the date when the applicant is selected. Lastly, we build a measure of search costs that

¹Note that in Germany, where our data came from, the volatility of tightness relative to productivity is even twice as large as in U.S. (see Gartner, Merkl, and Rothe, 2012).

²See also Silva and Toledo (2013) for an extensive discussion of the Pissarides (2009) calibration. They highlight the difference between sunk and non-sunk (i.e. training) fixed costs.

account for both the monetary search costs and the costs of the recruiting staff of the establishment, that we call *compounded search costs*. Hence, we multiply the hours spent on recruiting by the average hourly cost of labour in 2014 taken from the German Federal Statistical Office, that is 31.80 Euro, and we add that up to the monetary search costs.

Before we present our econometric results on the relation of search costs and search duration, we give some descriptive evidence. Table 1 provides statistics of our main variables and is sorted on the monetary search costs across sectors. It turns out that machinery and equipment, electrical equipment and motor vehicles experience the highest average monetary search cost, while the cheapest hiring process is faced by construction. Concerning the relation between search costs and duration, the table shows that those sectors affected by high search costs need also more working hours and a longer search to find the right staff (in days). Nevertheless, time search costs and search duration have a much lower dispersion compared to the monetary search costs.

Table 2 displays our main variables across some characteristics on vacancies, establishments and search channels. Some striking facts emerge. First, all the three measures relative to the cost and time of the vacancy increases with the size of the establishment and the qualification of the new employee. Second, additional skill requirements, such as experience and leadership, imply longer duration and higher costs. Third, searching workers for part-time or temporary contract requires less time and money for search. Finally, the channels used to find the workers reveal some unexpected results³: searching among the internal market or using internet is associated with the highest costs, after using a private employment agency. More intuitive are the consequences of hiring a trainee or through a social contact. It is worthwhile to notice that the use of the Employment Agency represents a rather cheap search channel for the employers, but it is not related to shorter vacancy duration.

We now move to the econometric analysis to check whether and to what extent search duration correlates with the search costs conditionally on other observables. Monetary search costs are non-negative skewed and include some zeros. Therefore we adopt a Box-Cox transformation, $\ln(x + 1)$, which maps zeros to zero and converges with rising costs to log values. In Table 3, we regress the transformed monetary search costs on the logarithm of search duration and on other characteristics. We add subsets of covariates progressively, to provide information on the specific contribution. Firstly, the elasticity of search costs with respect to search duration is positive and significant in all specifications;⁴ looking at Model 4 where we account for all the controls, a 10% increase in search duration is associated with an increase of the search costs by 1%. This result reveals a positive but limited relation of search costs and duration. The canonical search and matching model asserts an elasticity of one.

The rest of the table confirms substantially the descriptive evidence, with more plausible results for the search channels - the inclusion of which improves the explained variability of the monetary search costs. In particular, when the hiring originates from a social contact or an unsolicited application, the correlation with the search costs is negative. Finally, we include two measures for skill mismatch:

³Note that the use of multiple channels is possible.

⁴Note that because of potential endogeneity we interpret the results as correlations, not as causation.

Table 1: Descriptive statistics across industries

Sectors	Monetary Search Costs (Euros)		Search Hours (H)		Search Duration (D)		Comp. Search Costs (Euros)	
Machinery and equipment, electrical equipment and motor vehicles	1950	(5740)	19	(19)	66	(63)	1110	(1915)
Electricity, gas, steam and air conditioning supply	1369	(2839)	25	(24)	70	(78)	1669	(3394)
Information and communication	1339	(2976)	23	(25)	68	(61)	1348	(2831)
Mining and quarrying	1099	(3057)	18	(19)	68	(70)	1305	(2858)
Coke and refined petroleum products, chemicals and plastic products	1050	(3667)	17	(22)	57	(65)	1594	(3908)
Financial Services, Insurance	1015	(5901)	18	(22)	76	(90)	1028	(1644)
Arts, entertainment, recreation	876	(2609)	20	(23)	52	(49)	2562	(5970)
Professional, scientific and technical activities	873	(2058)	17	(15)	73	(84)	2175	(3041)
Food; textile, clothes and furniture	734	(2504)	19	(26)	59	(59)	1130	(1816)
Wood, paper and printing	734	(2663)	18	(20)	73	(88)	776	(1073)
Water supply; sewerage, waste management and remediation activities	635	(1586)	16	(20)	69	(72)	761	(1541)
Real estate activities	608	(1454)	21	(21)	60	(59)	914	(2065)
Other services	503	(1183)	17	(14)	77	(87)	854	(1794)
Basic metals, fabricated metal products	471	(1495)	18	(17)	83	(91)	2083	(3159)
Education	467	(1532)	17	(20)	58	(71)	1591	(6099)
Public administration and defense; compulsory social security	454	(896)	19	(20)	51	(48)	1278	(1741)
Human health and social work activities	385	(1078)	17	(17)	57	(55)	1423	(2231)
Agriculture, forestry and fishing	372	(1521)	23	(24)	53	(60)	1237	(3507)
Transportation and storage	366	(1882)	17	(25)	48	(50)	1048	(1244)
Administrative and support service activities	326	(964)	29	(96)	55	(53)	1017	(1816)
Wholesale and retail trade; repair of motor vehicles and motorcycles	308	(1171)	14	(23)	67	(79)	913	(1337)
Accommodation and food service activities	237	(1245)	19	(35)	53	(53)	1507	(2669)
Construction	205	(763)	18	(22)	72	(66)	1041	(1442)
Total	519	(2034)	18	(32)	64	(70)	1091	(2402)

Mean and standard deviation (in parenthesis), weighted values. 4.346 observations. Source: German Job Vacancy Survey 2014. The survey weights are based on strata for 23 economic sectors and 7 firm size classes.

Table 2: Descriptive statistics according to plant and vacancy characteristics

Characteristics	Monetary Search Costs (Euros)		Search Hours (H)		Search Duration (D)		Comp. Search Costs (Euros)		
Plant size (# employees)	<20	372	(1390)	18	(35)	66	(73)	943	(1886)
	20-49	623	(1945)	17	(22)	59	(61)	1174	(2216)
	50-199	934	(3064)	19	(24)	62	(67)	1528	(3371)
	200-499	2162	(6990)	18	(18)	63	(68)	2745	(7282)
	>500	2169	(5363)	22	(27)	60	(67)	2879	(5717)
Qualification	Unskilled, max. 1 year of training	148	(388)	18	(31)	49	(53)	722	(1058)
	Vocational qualification	335	(1167)	17	(34)	64	(71)	879	(1712)
	Master craftsman, technician	1227	(2635)	18	(25)	70	(75)	1786	(3152)
	Bachelor's degree	1967	(5383)	20	(21)	69	(56)	2618	(5486)
	Master's degree or similar, PhD	1468	(4054)	23	(22)	79	(80)	2193	(4303)
Additional skills	Long Experience	901	(3008)	19	(22)	82	(88)	1505	(3290)
	Leadership skills	1831	(5266)	37	(90)	68	(70)	2994	(6252)
Type of contract	Part-time	214	(641)	12	(13)	52	(64)	603	(855)
	Temporary Contract	357	(1016)	17	(20)	64	(76)	901	(1301)
Search channels	Newspaper	839	(2075)	22	(43)	75	(67)	1535	(2611)
	BA	630	(2053)	24	(43)	74	(73)	1388	(2607)
	Own web site	939	(2752)	23	(46)	74	(77)	1680	(3265)
	Internet	1000	(2674)	26	(48)	88	(80)	1838	(3212)
	Unsolicited Application	584	(2827)	19	(22)	60	(60)	1180	(3041)
	Private job placement	2784	(6104)	26	(27)	92	(95)	3610	(6421)
	Internal job advertisements	1175	(3862)	27	(74)	73	(81)	2047	(4708)
	Social contact	342	(1537)	18	(37)	69	(78)	907	(2061)
	Trainee	538	(1959)	18	(17)	72	(71)	1116	(2148)
Total	519	(2034)	18	(32)	64	(70)	1091	(2402)	

Mean and standard deviation (in parenthesis), weighted values. 4.346 observations. Source: German Job Vacancy Survey 2014. The survey weights are based on strata for 23 economic sectors and 7 firm size classes.

two dummy-variables indicating whether the level of qualification or experience is lower than expected. A possible idea is when employers face high search costs they are more willing to hire underqualified staff to conclude the search as soon as possible (see Brenčič and Norris, 2009). The coefficient is however not significant.

So far, we didn't consider the cost of the recruiting staff. Table 4 displays the results for the compounded search costs. Some variables loses explanatory power but in general the estimates do not remarkably differ from the previous table. It is interesting to notice that in this regression the coefficient of the Federal Employment Agency *BA* is significant and the smallest among the positive estimates of the channels. The coefficient of underexperience is also significant and positive, what is in line with Brenčič and Norris (2009). We can conclude so far that also the elasticity of compounded search costs with respect to search duration is much lower than one.

As argued above, our main interest is to quantify the portion of fixed search costs on the total search costs. To do that, we run a weighted regression of model 5 and predict the total search costs for the average search duration.⁵ The resulting total search costs amount to 912 euros. The size is smaller than the one of Muehleemann and Pfeifer (2016), however their measure for the search costs refers to vacancies for apprenticeship in firms with more than 4 employees. To calculate the fixed costs, we predict the total search costs when the search duration is one day. It turns out that the fixed search costs amount to 480 euros. Thus, the share of fixed costs on the total costs is around 53%.

Finally, we relate our results to the calibration exercise of Pissarides (2009). He calculates the elasticity of labor market tightness with respect to productivity, among others, for a fixed cost value of $H = 0.2$ and $H = 0.3$. Given that the total costs in the calibration amount to 0.43, the corresponding shares of fixed cost are 0.47 and 0.70, respectively. The elasticity of labor market tightness with respect to productivity for these parameters is 4.87 and 5.82. The share of fixed costs we found in the data, 0.53, ranges within this calibration interval. Thus, the elasticity of labor market tightness that agrees with our results is higher than 3.67 resulting from the canonical calibration, but it is lower than 7.65 as observed in the U.S. economy.

3 Conclusion

We compute the size of the search costs and analyse the relation of search costs with search duration. Using new information from the German Job Vacancy Survey, we measure the cost of advertising the job, paying the headhunters, inviting and screening the candidates as well as the cost of the staff within the establishment that cares about the hiring process. We found that the elasticity between search costs and search duration is 0.15, what is much smaller than one as assumed in the canonical search and matching model. The fixed costs, i. e. costs that do not vary with the search duration are 53% of the total costs. The existence of fixed search costs can according to Pissarides (2009) amplify the volatility of labor market to some degree, but the fixed costs are not large enough to solve the volatility puzzle completely.

⁵We use a variant of the Duan smearing estimate for predictions when the dependend variable is in logs. See the Appendix for details.

Table 3: Regression: monetary search costs

Dependent variable: log of monetary search costs		Model 1		Model 2		Model 3		Model 4	
log of search duration		0.422***	(0.04)	0.364***	(0.04)	0.105**	(0.03)	0.102**	(0.03)
Plant size (# employees)	<20	-0.268*	(0.12)	-0.261*	(0.12)	0.098	(0.10)	0.090	(0.10)
	50-199	0.312*	(0.13)	0.296*	(0.13)	0.090	(0.11)	0.095	(0.11)
	200-499	0.874***	(0.23)	0.714***	(0.22)	0.211	(0.19)	0.228	(0.19)
	>500	1.081***	(0.26)	0.701**	(0.25)	0.439*	(0.22)	0.459*	(0.22)
Qualification	Unskilled, max. 1 year of training			-0.340*	(0.14)	-0.068	(0.12)	-0.068	(0.12)
	Master craftsman, technician			0.851***	(0.24)	0.513**	(0.20)	0.511**	(0.20)
	Bachelor's degree			0.680**	(0.24)	0.576**	(0.20)	0.566**	(0.20)
	Master's degree or similar, PhD			1.155***	(0.18)	1.072***	(0.15)	1.073***	(0.15)
Additional skills	Long Experience			0.478***	(0.12)	0.359***	(0.10)	0.364***	(0.10)
	Leadership skills			0.749***	(0.21)	0.498**	(0.17)	0.496**	(0.17)
Type of contract	Part-time			-0.270	(0.15)	-0.292*	(0.12)	-0.286*	(0.12)
	Temporary Contract			-0.591***	(0.11)	-0.378***	(0.09)	-0.384***	(0.09)
	Newspaper					2.832***	(0.10)	2.827***	(0.10)
	BA					-0.024	(0.09)	-0.028	(0.09)
Search channels	Own web site					0.616***	(0.10)	0.610***	(0.10)
	Internet					1.330***	(0.11)	1.323***	(0.11)
	Unsolicited Application					-0.144	(0.10)	-0.151	(0.10)
	Private job placement					1.730	(0.20)	1.729	(0.20)
	Internal job advertisements					0.530***	(0.12)	0.531***	(0.12)
	Social contact					-0.362***	(0.09)	-0.365***	(0.09)
Mismatch	Trainee					-0.264	(0.17)	-0.267	(0.17)
	Underqualification							-0.083	(0.21)
	Underexperience							0.272	(0.19)
Sectors			YES	YES	YES	YES	YES	YES	
	R ²	0.06		0.11		0.38		0.38	

Robust standard errors in parentheses. 4.346 observations. Reference group: Plant size 20-49, Vocational qualification.

Significance levels: *, ** and *** indicate significance at 0.05, 0.01 and 0.001

Table 4: Regression: compounded search costs

Dependent variable: log of compounded search costs		Model 5	
log of search duration		0.151***	(0.01)
	<20	-0.009	(0.04)
Plant size (# employees)	50-199	0.017	(0.04)
	200-499	0.058	(0.07)
	>500	0.230**	(0.08)
	Unskilled, max. 1 year of training	-0.214***	(0.05)
Qualification	Master craftsman, technician	0.258***	(0.07)
	Bachelor's degree	0.316***	(0.07)
	Master's degree or similar, PhD	0.490	(0.05)
Additional skills	Long Experience	0.178***	(0.04)
	Leadership skills	0.310***	(0.07)
Type of contract	Part-time	-0.117*	(0.05)
	Temporary Contract	-0.124***	(0.04)
	Newspaper	0.646***	(0.04)
	BA	0.195***	(0.03)
Search channels	Own web site	0.231***	(0.04)
	Internet	0.439***	(0.04)
	Unsolicited Application	-0.042	(0.04)
	Private job placement	0.792***	(0.08)
	Internal job advertisements	0.279***	(0.04)
Mismatch	Social contact	-0.188***	(0.03)
	Trainee	-0.093	(0.07)
	Underqualification	-0.029	(0.08)
	Underexperience	0.153*	(0.07)
Sectors		YES	
	R^2	0.38	

Robust standard errors in parentheses. 4.346 observations. Reference group: Plant size 20-49, Vocational qualification. Results for sectors see appendix.

Significance levels: *, ** and *** indicate significance at 0.05, 0.01 and 0.001

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Appendix

Calculation of predicted search costs

To calculate the total search costs we use a version of the Duan smearing estimate for predictions when the dependent variable is in logs as explained in Wooldridge (2009), page 210-215. We estimate model 5,

$$\ln CSC_i = \alpha + \beta \ln SD_i + \gamma C_i + u_i, \quad (5)$$

where CSC are the compounded search costs, SD is the search duration, C is the vector of control variables and calculate the residuals \hat{u}_i s. Then we predict $\ln CSC$ given the log of the average search duration \overline{SD} and compute the average total search costs as

$$\widehat{CSC} = \left(n^{-1} \sum_{n=1}^n \hat{u}_i \right) \exp(\widehat{\ln CSC}) \quad (6)$$

Table 5: Appendix: Sector coefficients of Model 5

Dependent variable:	log of compounded search costs
Agriculture, forestry and fishing	-0.519*** (0.12)
Mining and quarrying	-0.209 (0.15)
Food; textile, clothes and furniture	-0.266* (0.11)
Wood, paper and printing	-0.062 (0.11)
Coke and refined petroleum products, chemicals and plastic products	-0.155 (0.11)
Basic metals, fabricated metal products	-0.218* (0.10)
Electricity, gas, steam and air conditioning supply	0.203 (0.11)
Water supply; sewerage, waste management and remediation activities	-0.271* (0.11)
Construction	-0.490*** (0.10)
Wholesale and retail trade; repair of motor vehicles and motorcycles	-0.288** (0.10)
Transportation and storage	-0.339** (0.11)
Transportation and storage	-0.452*** (0.10)
Information and communication	0.124 (0.10)
Financial Services, Insurance	-0.169 (0.12)
Real estate activities	0.094 (0.11)
Professional, scientific and technical activities	-0.095 (0.10)
Administrative and support service activities	-0.444*** (0.11)
Public administration and defense; compulsory social security	-0.217* (0.09)
Education	-0.344*** (0.10)
Human health and social work activities	-0.382*** (0.10)
Arts, entertainment, recreation	-0.214 (0.11)
Other services	-0.154 (0.10)

Robust standard errors in parentheses. Reference group: Machinery and equipment, electrical equipment and motor vehicles.
Significance levels: *, ** and *** indicate significance at 0.05, 0.01 and 0.001