

Application Flows

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- I. Rich, new database that links employers, vacancy postings, applications and applicants.
- II. New facts about employer and worker search behavior, and the role of online job boards.
- III. Implications for theoretical modelling.
 - Intermediaries play a huge role in the matching process.
 - Employer search is non-sequential.
 - Application flows depart greatly from a random assignment model.
 - The unevenness of application flows remains even after conditioning for various job and employer characteristics.

The DHI Vacancy and Application Database

- Raw data from DHI Group, Inc. Our data derive from the Dice.com online job board.
- Employer-side clients: (a) Direct hire, (b) Recruitment Firms, and (c) Staffing Firms.
- Postings are mainly in technology, software development, and other computer-related occupations, engineering, financial services, business and management consulting, and other jobs requiring technical skills.

High volume, granularity and frequency

- 125 million applications to 7.5 million postings from 5+ million applicants and 57,000 employer-side clients in the US from 2012 to 2017.
- Includes information on:
 - employers' industry and size,
 - job postings' daily time online, job title description, location, compensation (if posted) and more.
 - applicants' IP address (location), (current/desired) job title.

Dice Pricing

Job Seeker Experience

Application Methods

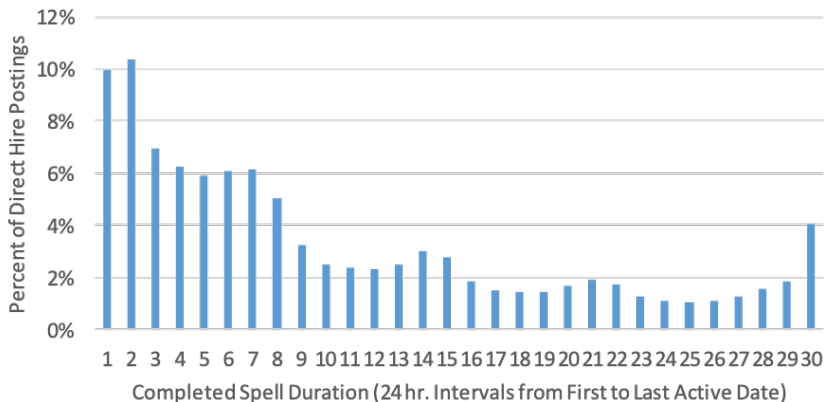
New Facts on Search Behavior

- 1 Posting durations are short, much shorter than vacancy durations.
- 2 Job seekers target new postings for applications, strikingly so.
- 3 Large, growing role for labor market intermediaries.
- 4 Posting durations decrease in slack labor markets, but the effect is tiny.
- 5 Application flows are highly uneven across postings
 - Many vacancies attract very few applicants,
 - The typical applicant competes with many other applicants,
 - Low mean-to-variance application flow ratios, even within narrowly defined job and employer categories.
- 6 Platform functionality greatly affects the volume and distribution of application flows to postings.

1. Short Posting Duration

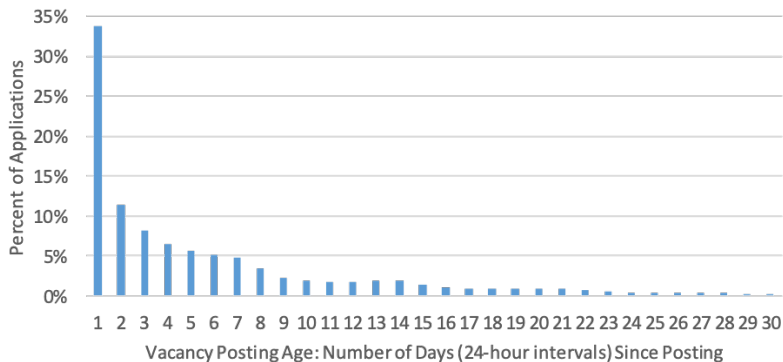
- 20% of all standard postings are active for 48 hours or less.
- Half of all standard postings last one week or less.

Direct Hire Clients Total Posting Duration (First to Last Active Date-Time)



2. Job Seekers Target Younger Postings

Applications Distribution by Posting Age at Time of Arrival

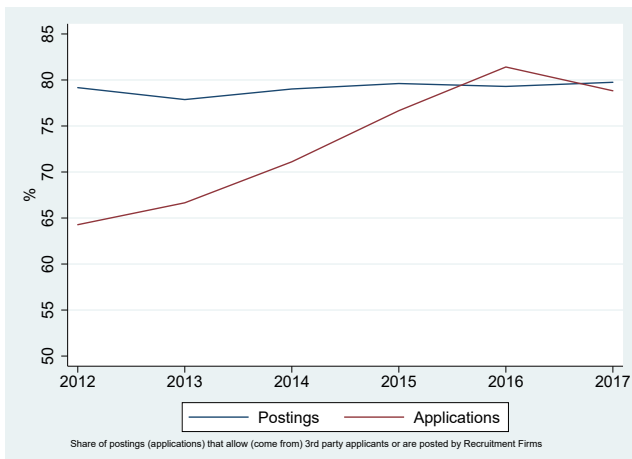


Applications per Vacancy Day, by Age

3. Large, growing role for intermediaries

- 80% of all applications on Dice.com involve an employer-side or worker-side intermediary, or both.

Figure: Percent with intermediaries on at least one side of the market



4. Posting Duration Falls with Tightness, as Measured by Application Flows per Posting, But the Elasticity is Tiny

$$\ln(\overline{duration}_{s,t}) = \alpha_0 + \alpha_1 \ln(\overline{daily_apps}_{s,t}) + \alpha_2 \ln(\overline{daily_apps}_{s,t-1}) + \dots + \epsilon_{s,t}$$

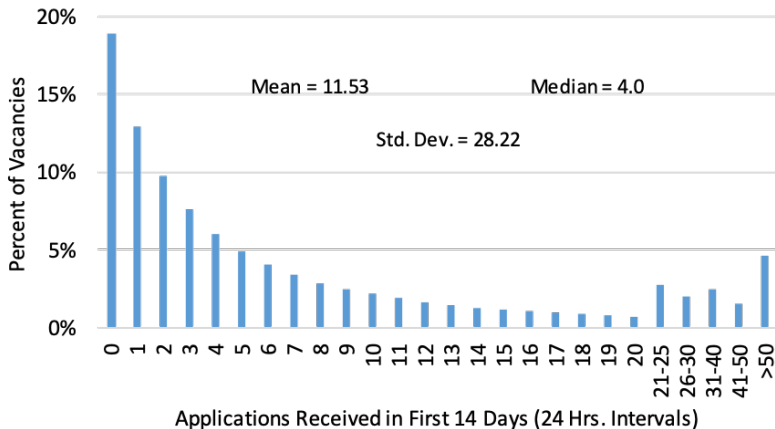
where $\overline{X}_{s,t} = \frac{\sum_{j \in s,t} x_j}{\sum_{j \in s,t} 1}$ and j denotes vacancy postings.

	Dependent Variable: Log Duration			
	(1)	(2)	(3)	(4)
ln_daily_apps	-0.040*** (0.002)	-0.041*** (0.002)	-0.042*** (0.003)	-0.050*** (0.003)
L1.ln_daily_apps		-0.003 (0.002)	-0.004* (0.002)	-0.009*** (0.003)
L2.ln_daily_apps			-0.001 (0.003)	0.002 (0.003)
L3.ln_daily_apps				-0.016*** (0.003)
Constant	2.242*** (0.012)	2.245*** (0.012)	2.247*** (0.012)	2.254*** (0.012)
Observations	2,664	2,627	2,590	2,553

Notes: The standard deviation for log daily applications across skillXtime groups is 1.11.

5. Highly Uneven Distribution of Application Flows

Application Volume in First 14 Days (336 Hours) since Posting



(a) Direct Hire

5. Highly Uneven Distribution of Application Flows

- The distribution of application flows in the DHI data strongly departs from random allocation.
- Overdispersion and excess share of postings with zero applications holds even when controlling for an extensive battery of vacancy and employer characteristics.

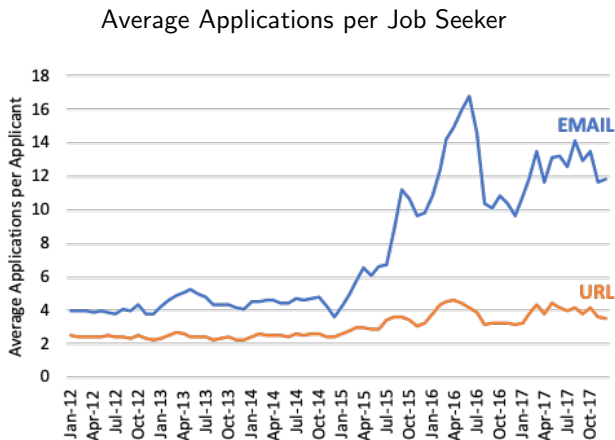
Table: Departure from Random Application Allocation: Direct Hire Postings

	DHI Data	Random	ZINB
Simple Mean	11.8	11.8	18.8
Standard Deviation	28.6	3.4	28.6
Percent with 0 applications	18.9	0.0008	18.9
Percent with 1 application	12.1	0.0089	8.1
Ratio of Median to Simple Mean	0.34	1	0.39

ZINB models parameters are estimated to minimize the squared sum deviations from the data's simple mean, standard deviation, and share of postings with zero applications. The resulting mean (μ), overdispersion (θ), and inflated zero probability (p) parameters are $\mu=18.9$, $\theta=2.2$, and $p=0.005$.

6.Changes in Platform Functionality

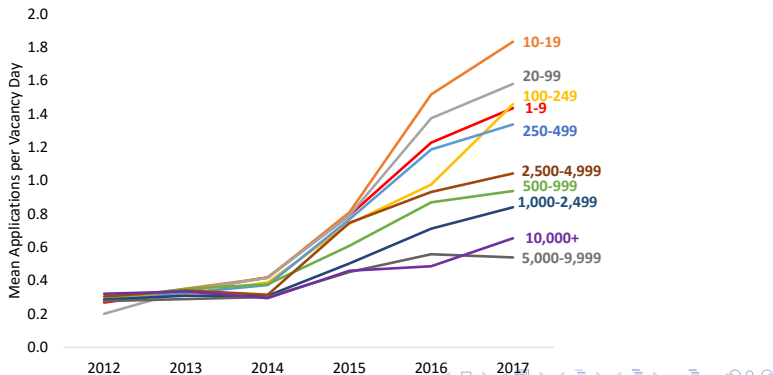
- In Dec. 2014, DHI implemented several changes that facilitated job seekers search and application process, specially for EMAIL applications.



6.Changes in Platform Functionality

- The platform change also included allowing employers to browse through job seekers' resumes and “nudge” them to apply to their job postings.
- Smaller employers benefited more from the platform change.

Applications per Vacancy Day by Employer Size



Concluding Remarks

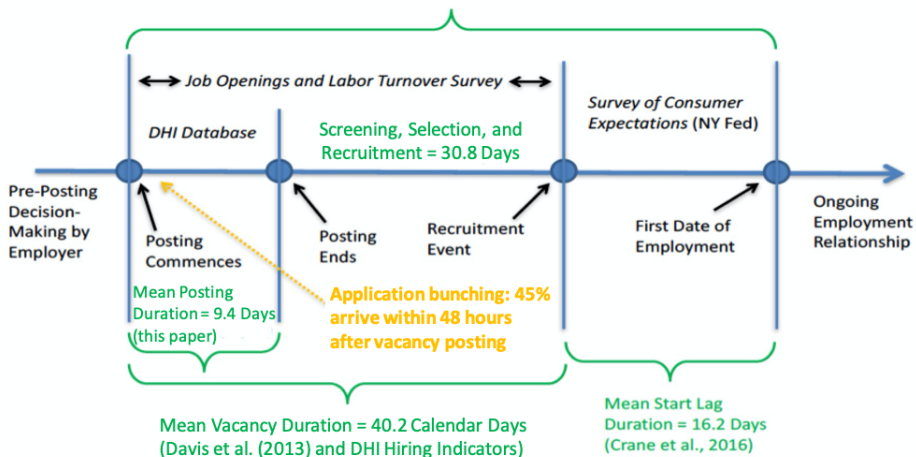
- Stages of the Hiring Process Hiring Process Timeline
- Non-sequential search and Stock-flow matching
 - Short-lived postings with longer vacancy duration.
 - Heavy bunching of applications shortly after posting.
 - Job seekers bunch applications in 7-day intervals. Job Seeker Behavior
- Huge role for intermediaries.
 - 80% of applications in 2016 involved an intermediary on at least one side of the market.
 - Platform functionality has an important role for the volume and distribution of applications.
- Tiny effects of anticipated labor market tightness on posting duration.
 - Procyclical vacancy duration likely reflects variation in the selection phase, rather than in meeting rates.

Concluding Remarks

- Our empirical findings are hard to reconcile with sequential search models and models that feature random search.
- Strong motivation for models where job seekers and employers contact multiple partners, with mediation from intermediaries, before making decisions about whether, and with whom, to initiate an employment relationship.

Theoretical Implications: Stages of the Hiring Process

Mean Duration from Date of First Posting to Start of Employment = 56.2 Calendar Days



DHI Pricing

- Clients typically face a positive (shadow) price to keep a posting in active status and visible to job seekers (reputational costs from responsiveness + opportunity cost of other postings).
- DHI also offers different screening services and applicant quality control.

Team Recruitment Package

- 11 million unique tech candidate profiles
- 2.2 million tech profiles with resumes
- Replaceable job postings

[Learn more](#)

Social Recruiting Platform

- 11 million unique tech candidate profiles
- Get contact info, skills, experience and more
- Data gathered from 180+ social sites

[Learn more](#)

Sourcing Concierge Service

- Cut your time-to-hire with our expert recruiters
- We source and screen. You interview and hire.
- Get pre-screened candidates in 3-4 days

[Learn more](#)

Premium Post

- High-visibility, 60-day job postings

[Learn more](#)

Targeted Hiring Campaign

- Premium Post included
- Banner ads on Dice with 5K impressions
- Custom email to 1,500 candidates




[Learn more](#)

DHI Pricing (2)

- Other pricing methods can yield many “stale” postings.

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| <input checked="" type="radio"/> Single Job Post | \$395 |
| <input type="radio"/> Two Job Posts | \$325 each, save \$140 total (18%!)  |
| <input type="radio"/> Three Job Posts | \$305 each, save \$270 total (23%!)  |
| <input type="radio"/> 5-10 Job Posts | \$250 each, save \$725 – \$1,450 total (up to 37%!)  |

Request info about packages with résumé search

Single Post, \$395

- Promote your job post on Dice and within 3000 partner sites for 30 days
- Gain exposure to our 1.5 million monthly tech professional visitors

[Post Job Now](#)

Job Seeker Experience

- Can browse postings by job title, job location, company name, skill requirements and other job characteristics.
- Must register before applying for a job.
- Job seekers submit applications at no charge.
- By supplying enough information, job seekers can include their profiles in a database searchable to employer-side clients.

The screenshot shows a job search interface with the following elements:

- Search Bar:** Search Term, San Francisco, CA, USA, Search Jobs
- Filters:**
 - Employment Type:** Full-time (1242), Part-time (31), Contract (1415), Third Party (862)
 - Distance:** 30 mi, km
 - radius from San Francisco, CA, USA:** 5, 25, 50, 75, 100
 - Employer Type:** Recruiter (1835)
- Job Listings:**
 - Principal Database Engineer:** Atlas, Oakland, CA, USA. Full-time, 18 days ago. Description: Are you looking to build your career in Data and Analytics and be part of a growing and dynamic team? We've got a great opportunity to be part of a start-up business with the resources and leadership of an experienced...
 - Cloud Data Architect- AWS:** Atlas, Oakland, CA, USA. Full-time, 18 days ago. Description: Are you looking to build your career in data and analytics and be part of a growing and dynamic team? We've got a great opportunity to be part of a start-up business with the resources and leadership of an experienced...
 - Cloud Solution Developer:** Atlas, Oakland, CA, USA. Full-time, 18 days ago. Description: Are you looking to build your career in data and analytics and be part of a growing and dynamic team? We've got a great opportunity to be part of a start-up business with the resources and leadership of an experienced...

The screenshot shows a detailed job listing for a Principal Database Engineer at Atlas, Oakland, CA, USA. The listing includes:

- Job Title:** Principal Database Engineer
- Location:** Atlas, Oakland, CA, USA (12 weeks ago)
- Buttons:** Apply Now, Create Alert, Save, Report a poor listing
- Skills:** Engineering, SQL, Azure, DBA, Spring, Computer science, Cloud architecture, Big data, Microsoft Windows Azure, Database, Capacity management, nosql, sql, aws, cloud
- Job Type:** Full Time
- Salary:** \$175,000 - \$200,000
- Work from home:** not available (Travel required to 10%)
- Job Description:** Are you looking to build your career in Data and Analytics and be part of a growing and dynamic team? We've got a great opportunity to be part of a start-up business with the resources and leadership of an experienced Data and Analytics organization. We believe that people are our greatest asset, so the Atlas Data and Analytics team is absolutely critical to the success of the organization as a whole. As Database Engineer, you will work closely with will work with design and engineering peers to create and manage various cloud hosted data solutions to support traditional analytical as well as a host of machine learning models. Primarily responsible for the implementation and management of database solutions, the administrator will collaborate with development colleagues and leaders as necessary. The administrator will also...
- Similar Positions:** Sr. Mongo DBA - immediate start, Oracle DBA Specialist, Sr. SQL DBA

Application Channels

- For each posting, employers decide whether job seekers submit applications directly via the Dice platform (email) or via an external URL operated by the client or a third party.
- For email applications, we see the number of completed applications. For URL applications, we see how often job seekers click through to the external URL.

Easy Apply

Java with Microservices
Winning Edge Solutions, LLC | San Francisco, CA

Name ✓ ✓

Résumé Select a Résumé
choose one
Profile 32 6/19/2016
 Upload a Résumé

Cover Letter (optional) Select a cover letter
No cover letter on file

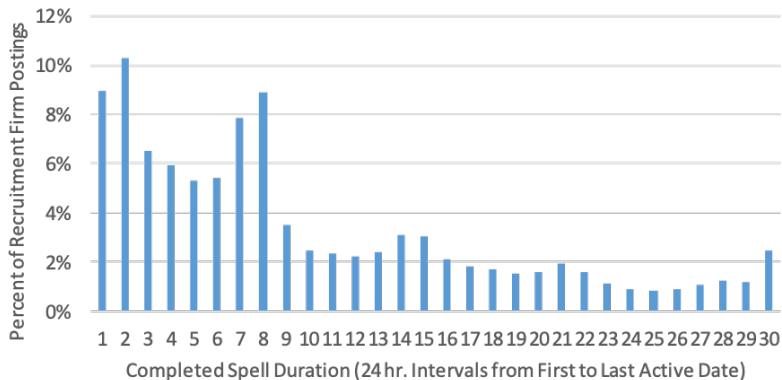
Manage your Cover Letter at Dice.com
Compose a cover letter

[Privacy Policy](#)

[Apply Now](#)

Short Posting Duration (RF/SF)

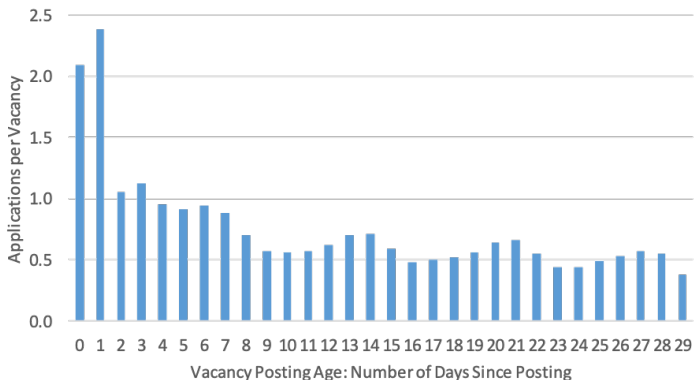
Recruitment and Staffing Firms Total Posting Duration



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Job Seekers Target Younger Postings (2)

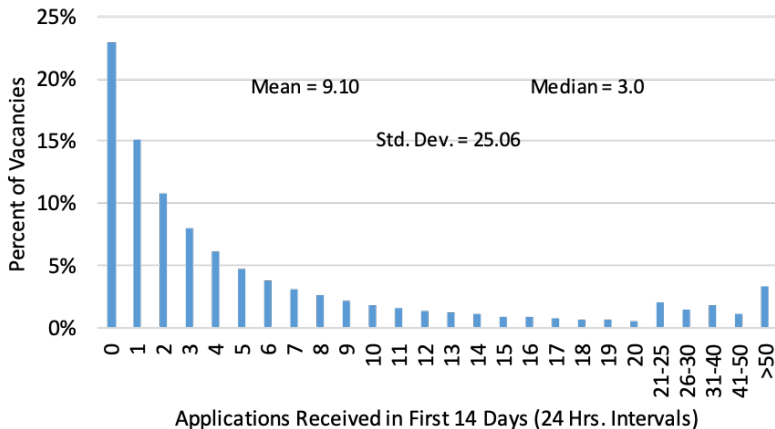
Mean Applications per Vacancy Day, by Posting Age



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Highly Uneven Distribution of Application Flows

Application Volume in First 14 Days (336 Hours) since Posting



(i) Recruitment and Staffing Firms

Highly Uneven Distribution of Application Flows

Table: Departure from Random Application Allocation: Recruitment and Staffing Firm Postings

	DHI Data	Random	ZINB
Simple Mean	9.3	9.3	15.9
Standard Deviation	25.6	3.1	25.5
Percent with 0 applications	22.9	0.0091	22.9
Percent with 1 application	15.1	0.0850	8.9
Ratio of Median to Simple Mean	0.32	1	0.35

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Moments implied by the ZINB model vs. DHI data

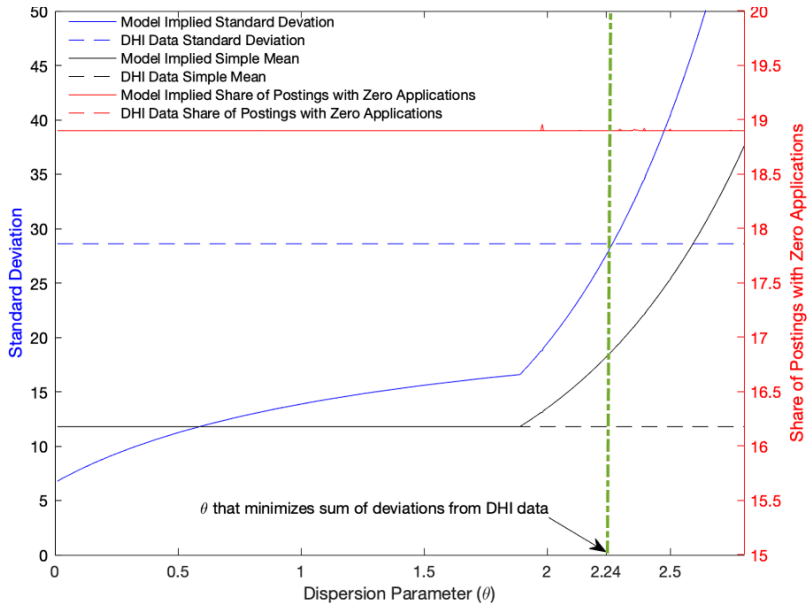
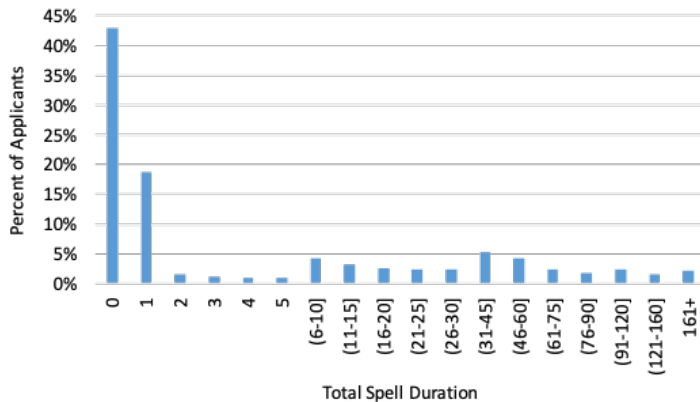
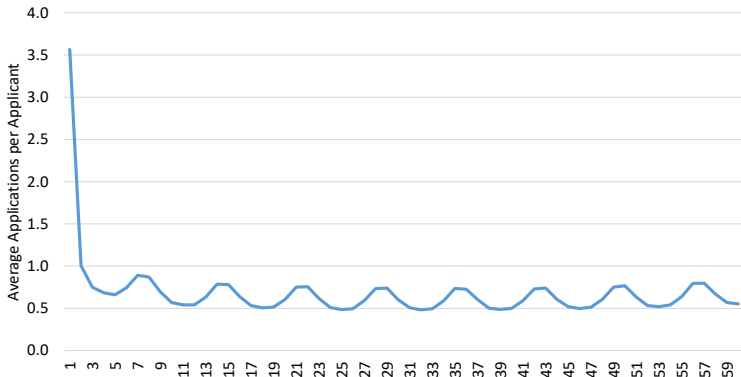


Figure: Job Seekers Distribution by Search Spell Duration



Job Seekers

Mean Applications per Active Job Seeker by Spell Duration at the Time of Application



Note: Active job seekers are those users that submit at least one more application in a future date within the same search spell. This figure excludes job seekers that only submit one application.

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Allocating Applications to Vacancy Postings: Zero-Inflated Negative Binomial Model

- ZINB Model: excess zeros are generated through a separate process that can be modeled independently from the distribution of positive applications.

$$\Pr(A_j = a) = \underbrace{\Pr(\text{views}_j = 0)}_{\text{logit}} \times 0 + \underbrace{\Pr(\text{views}_j > 0)}_{\text{logit}} \times \underbrace{\Pr(A_j = a | \text{views}_j > 0)}_{\text{negative binomial}}$$

$$\mathcal{L} = \begin{cases} \sum_{j=1}^V \left\{ \ln(p_j) + (1 - p_j) \left(\frac{1}{1 + \frac{x_j' \beta}{\theta}} \right)^\theta \right\}, & \text{if } A_j = 0 \\ \sum_{j=1}^V \left\{ \ln(p_j) + \ln \Gamma(\theta + A_j) - \ln \Gamma(A_j + 1) \right. \\ \quad \left. - \ln \Gamma(\theta) + \theta \ln \left(\frac{1}{1 + \frac{x_j' \beta}{\theta}} \right) + A_j \ln \left(1 - \frac{1}{1 + \frac{x_j' \beta}{\theta}} \right) \right\}, & \text{if } A_j > 0 \end{cases}$$

- As $\theta \rightarrow 0$ PDF(A_j) \rightarrow Poisson ($\frac{A}{V}$)

Allocating Applications to Vacancy Postings: Zero-Inflated Negative Binomial Model

Table: Dispersion Estimation

Skill Category	Apps. per Vac.		Time	Employer Type	3rd	State FE	Job title
	Mean	Std.Dev.	FE	, Size & wage	party	& App Channel	FE
DATA	10.9	21.0	1.44	1.38	1.11	0.74	0.62
JAVA	21.3	60.6	1.87	1.80	1.25	0.90	0.81
ORACLE	12.3	24.0	1.30	1.28	1.16	0.79	0.64
SAP	11.5	17.4	1.12	1.11	1.01	0.71	0.68
NETWORK	9.6	25.3	1.93	1.70	1.30	0.80	0.74
SECURITY	4.6	9.7	1.50	1.37	1.15	0.59	0.51
SQL	18.5	38.5	1.46	1.34	0.92	0.67	0.63

All estimates are statistically different from zero at 1% significance levels. All specifications control for posting duration.

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Allocating Applications to Vacancy Postings: Zero-Inflated Negative Binomial Model

Negative Binomial Parameter Estimates

	DH	Wage Dummy	3rd party		URL	EMAIL	Dispersion
			Yes	No			
Skill	0.20***	0.05***	1.06***	0.10***	28.52***	28.41***	1.22***
+ Time	0.22***	0.08***	0.72***	-0.09***	33.63***	33.44***	1.11***
+ State	0.22***	0.08***	0.73***	-0.09***	26.95***	26.75***	1.09***
+ Job Title	0.26***	0.06***	0.71***	-0.11***	27.04***	26.85***	0.98***
+ Employer	0.24***	0.02***	0.90***	-0.03***	21.73***	21.37***	0.84***

All specifications include skill and employer size FE. We also control for posting duration (in 24-hour intervals from first to last posting date-time). [Back](#)