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Report 35

DHI Releases New Statistics on Labor Market Tightness by Skill Categories

This edition of the ***DHI Hiring Indicators*** introduces new labor market tightness measures for 20 job categories that require specific software and programming skills. Section I contains highlights. Section II explains how we construct the tightness measures using the **DHI Vacancy and Application Flow Database**. Section III draws on the Job Openings and Labor Turnover Survey to present statistics on vacancy duration and recruiting intensity per vacancy. Section IV provides additional information about the ***DHI Hiring Indicators*** and DHI Group, Inc.

I. Highlights

1. This month's report introduces new labor market tightness measures for jobs that require software and programming skills. We focus on 20 specific skills that appear often in vacancy postings.
2. Our tightness measures reflect the daily flow of applications per vacancy posting during the month. The measures are available with a short lag, which makes them useful for diagnosing labor market developments in near real time.
3. Labor market conditions for jobs that require skills in the "C" programming language or development software, Informatica's data integration software and the PHP programming language have tightened greatly since 2012 relative to the average of all jobs in the DHI Database. That is, vacancy postings that specify one of these skill requirements experienced a large fall in the daily flow of applications per posting compared to the average for all postings.
4. Conditions for jobs requiring data analytic, storage and administration skills also tightened in recent years compared to the average for all jobs.
5. In contrast, conditions for jobs that require skills in SSIS, Java or Javascript, iOS and User Interface functions slackened considerably since 2012 relative to the average for all jobs in the DHI Database. Vacancy postings that specify these skill requirements experienced a large rise in the relative daily flow of applications per posting.
6. The **DHI-DFH Mean Vacancy Duration Measure** fell to 26.7 working days in January, 0.6 days below its revised value for December and 2.9 days below its historical peak in April 2016.

"The new DHI tightness measures by skill category offer a novel and highly granular look at U.S. labor market conditions for jobs that require software and programming skills," said Dr. Steven Davis, William H. Abbott Professor of International Business and Economics at the University of Chicago Booth School of Business. "These new measures provide information about which skills have become harder for employers to find, and which have become easier." Davis is a co-developer of the DHI Database and co-creator of the DHI-DFH Mean Vacancy Duration Measure and Recruiting Intensity Index.

"The market for highly skilled talent in select industries remains tight, particularly for technology professionals who freshen their skillset through continued education or ongoing trainings," said Michael Durney, President and CEO of DHI Group, Inc. "Those tech professionals who are adaptable and learn new skills in the areas of big data and programming are in high demand among employers and are earning outsized salaries for their technical abilities."

II. Results Based on the DHI Vacancy and Application Flow Database

The **DHI Vacancy and Application Flow Database** links daily application flows to millions of online vacancy postings. The raw data come from DHI Group, Inc., which owns and operates several specialized online platforms for posting job vacancies and attracting applications. Employer-side clients comprise organizations that directly hire their own employees, recruitment firms that solicit applicants for third parties, and staffing firms that hire workers to lease to other firms. Vacancy postings are concentrated in technology sectors, software development, other computer-related occupations, engineering, financial services, and certain other professional occupations. The DHI Database currently contains nearly 8 million unique vacancy postings from more than 50,000 employer-side clients.[1] These postings have attracted 66 million applications since January 2012.[2] More than half the applications went to positions posted by recruitment and staffing firms.

When job openings are plentiful and few people seek new jobs, each vacancy posting tends to attract few applicants. In this situation, we say labor markets are "tight." Conversely, when job openings are scarce relative to job seekers, each posting tends to attract many applicants, and we say labor markets are "slack." We use DHI data on the daily flow of applications per vacancy posting to operationalize this concept of labor market tightness. Of course, applicant numbers also depend on job characteristics. Partly for this reason, we focus on tightness measures for particular job titles such as "C Developer," "Database Administrator," "Business Analyst" and "Quality Assurance Tester" or – as in this report – jobs that specify particular skill requirements such as "C," "Java," "SAP," "SAS" or "UNIX."

Figure II.1 plots the daily flow of applications per active vacancy posting in the DHI Database from February 2012 to November 2016. Three results stand out. First, there is a clear seasonal pattern, with a seasonal trough in December, as analyzed in detail in the December 2016 edition of the ***DHI Hiring Indicators***. Second, there are strong upward moves in the daily flow of applications per posting in 2015 and the first half of 2016, followed by a partial reversal. Third, we find a nearly identical time-series pattern when we control for changes over time in the mix of postings across job titles. This result tells us that shifts in the mix of vacancy postings do not explain the large moves in daily application flows per posting. Other forces must be at work.

For example, DHI modified the functionality of its Dice.com platform during our sample period in ways that affect application flows. It streamlined the registration and application process for job seekers, improved the search engine available to job seekers, and made it possible for employers to signal particular jobseekers and solicit an application. DHI implemented the most important of these changes in December 2014, and they probably account for much of the growth in applications per posting during 2015.[3] DHI also removed information from vacancy postings that, in some cases, had facilitated applications outside the DHI system. Changes to Dice.com market shares of postings and applications could also affect our measures. Finally, as discussed above, changes in market tightness affect the flow of applications per vacancy posting.

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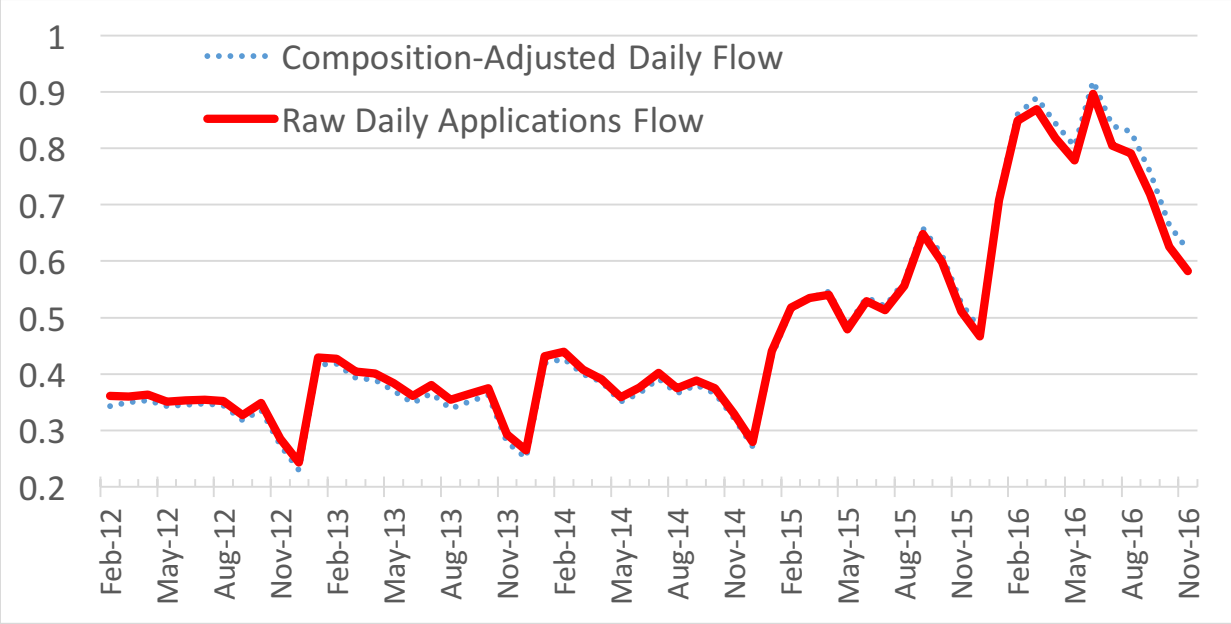
[1] Currently, the DHI Database draws mainly from DHI's Dice.com platform. Other DHI platforms include eFinancialCareers, Biospace, Rigzone, ClearanceJobs, Health eCareers.com, and Hcareers. Analysis of the DHI Database in this report draws on "Application Flows" by Steven J. Davis and Brenda Samaniego de la Parra.

[2] When posting a vacancy, the DHI client decides whether job seekers must file an application via email through the DHI platform or through an external URL operated by the client or a third party. In the first case, the DHI database records the number of completed email applications. In the second case, the database records how often job seekers click through to the external URL. We pool these two classes of vacancies and applications in this report.

[3] See Davis and Samaniego de la Parra (2017) for additional discussion.

Since it is not possible to confidently disentangle the various forces that drive changes in the daily application flows, we simply remove them from our tightness measures for specific skill categories. To do so, we proceed as follows. First, we compute the raw daily flow of applications per posting at a monthly frequency for each skill category. Second, we deflate the raw measure for each skill category by the composition-adjusted flow in Figure II.1. Third, we multiply each deflated series by the 2015 average value of the composition-adjusted flow. This third step restores information about the level of daily applications per vacancy posting.

Figure II.1 Daily Application Flows Per Vacancy Posting, February 2012 to November 2016



Note: This figure reflects data for job titles with at least 100 distinct vacancy postings in the DHI Database. The sample covers more than 3,000 job titles and contains about 5.8 million distinct vacancy postings. The "Composition-Adjusted Daily Flow" uses a regression method to control for changes in the mix of vacancy postings across job titles, as described in "Application Flows" by Davis and Samaniego de la Parra (2017).

Table II.1 reports annual relative tightness measures for jobs that require one of the 20 listed software and programming skills. To construct tightness measures by skill type, we first sort vacancies into categories based on the first skill requirement specified in the posting. We selected the skill categories in Table II.1, because they appear often in the DHI Database. Each listed skill typically appears first in a few hundred to a few thousand postings per month.

The skill types listed in Table II.1 differ considerably with respect to (a) the average daily flow of applications per active posting, and (b) the evolution of the average daily flow from 2012 to 2016. Several skill types show a ratio value greater than one in the rightmost column, which indicates a decline in relative tightness from 2012 to 2016. The largest drop in relative tightness (largest increase in relative slackness) occurred for jobs that require User Interface (UI) skills. Several skill types have a ratio value less than one, which indicates an increase in relative tightness from 2012 to 2016. The largest increase in relative tightness occurred for jobs that require skill in Informatica's data integration software.

Table II.1 Relative Tightness Measures for 20 Software and Programming Skills, Annual Averages of Monthly Values

	2012	2013	2014	2015	2016	2016 to 2012 Ratio
C	0.39	0.37	0.38	0.32	0.30	0.77
DATA	0.51	0.49	0.46	0.41	0.39	0.76
ETL	0.85	0.90	0.97	1.11	1.09	1.28
IBM	0.37	0.36	0.33	0.30	0.33	0.91
INFORMATICA	0.31	0.32	0.15	0.12	0.10	0.33
IOS	0.23	0.23	0.23	0.35	0.52	2.28
JAVA	0.40	0.49	0.52	0.74	0.88	2.23
NET	0.40	0.46	0.43	0.59	0.64	1.62
PERL	0.29	0.28	0.32	0.28	0.24	0.81
PHP	0.24	0.21	0.19	0.19	0.19	0.80
RUBY	0.09	0.11	0.11	0.14	0.17	1.82
SAP	0.44	0.57	0.68	0.70	0.55	1.27
SAS	0.55	0.59	0.50	0.53	0.55	1.00
SOA	0.37	0.39	0.50	0.52	0.44	1.19
SQL	0.73	0.77	0.80	0.91	0.98	1.34
SSIS	0.92	0.99	1.16	1.58	1.68	1.84
UI	0.22	0.24	0.26	0.67	0.93	4.22
UNIX	0.39	0.39	0.41	0.39	0.46	1.19
UX	0.21	0.19	0.19	0.21	0.18	0.85
WEB	0.28	0.27	0.25	0.30	0.32	1.17

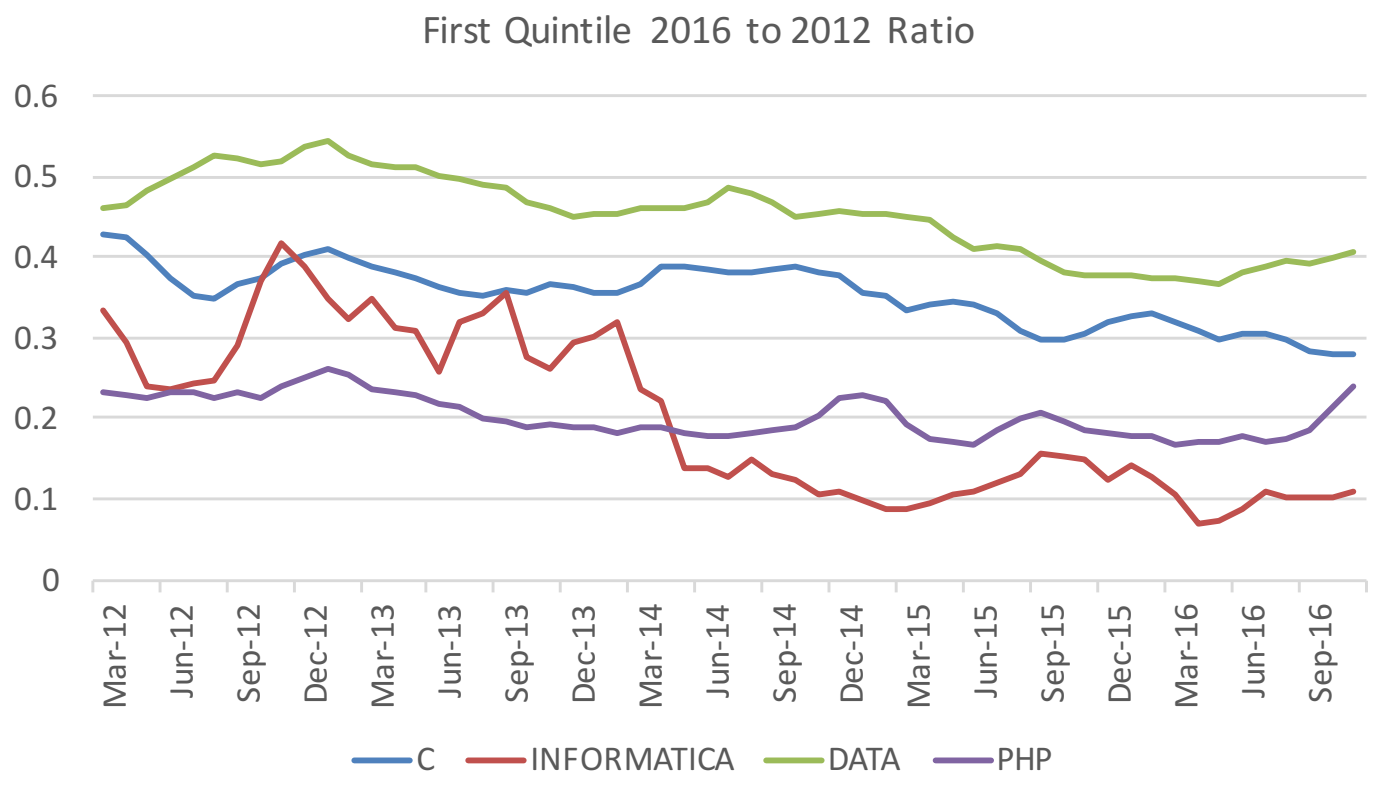
Note: Postings are grouped into categories based on the first skill mentioned in the job description. "C" can refer to the programming language or the development software. "Data" refers to any posting that requires data analysis, administration, storing, etc. "ETL" refers to the processes of Extracting, Transforming, and Loading data. "IBM" includes postings that require skill in using IBM's software and/or hardware. "Informatica" refers to postings requiring the use of any of Informatica's data integration software. "iOS" refers to Apple's mobile operating system. "Java" includes postings that mention either Java or Javascript programming languages. "Perl" and "PHP" covers jobs that mention these programming languages. "Ruby" refers to Ruby on Rails or RoR, a server-side web application framework. "SAP" (**S**ystems, **A**pplications & **P**roducts in Data Processing) refers to any of the company's software products. "SAS" refers to the **S**tatistical **A**nalysis **S**ystem software. "SOA" covers jobs that require Service-Oriented Architecture software design. "SQL" can refer to either the structured query programming language or Microsoft's database management system, SQL Server. "SSIS" is a particular component of Microsoft's SQL Server used for data migration. "UI" and "UX" refer, respectively, to postings for jobs that require User Interface and User Experience skills. "UNIX" refers to the operating system. "Web" covers postings that require website development skills. For more information on the types of skills mentioned in the job descriptions that appear in the DHI Database, see "Application Flows" by Davis and Samaniego de la Parra (2017). The rightmost column reports the ratio of the tightness value in 2016 to its value in 2012. In the other columns, a higher numerical value corresponds to a lower level of relative tightness.

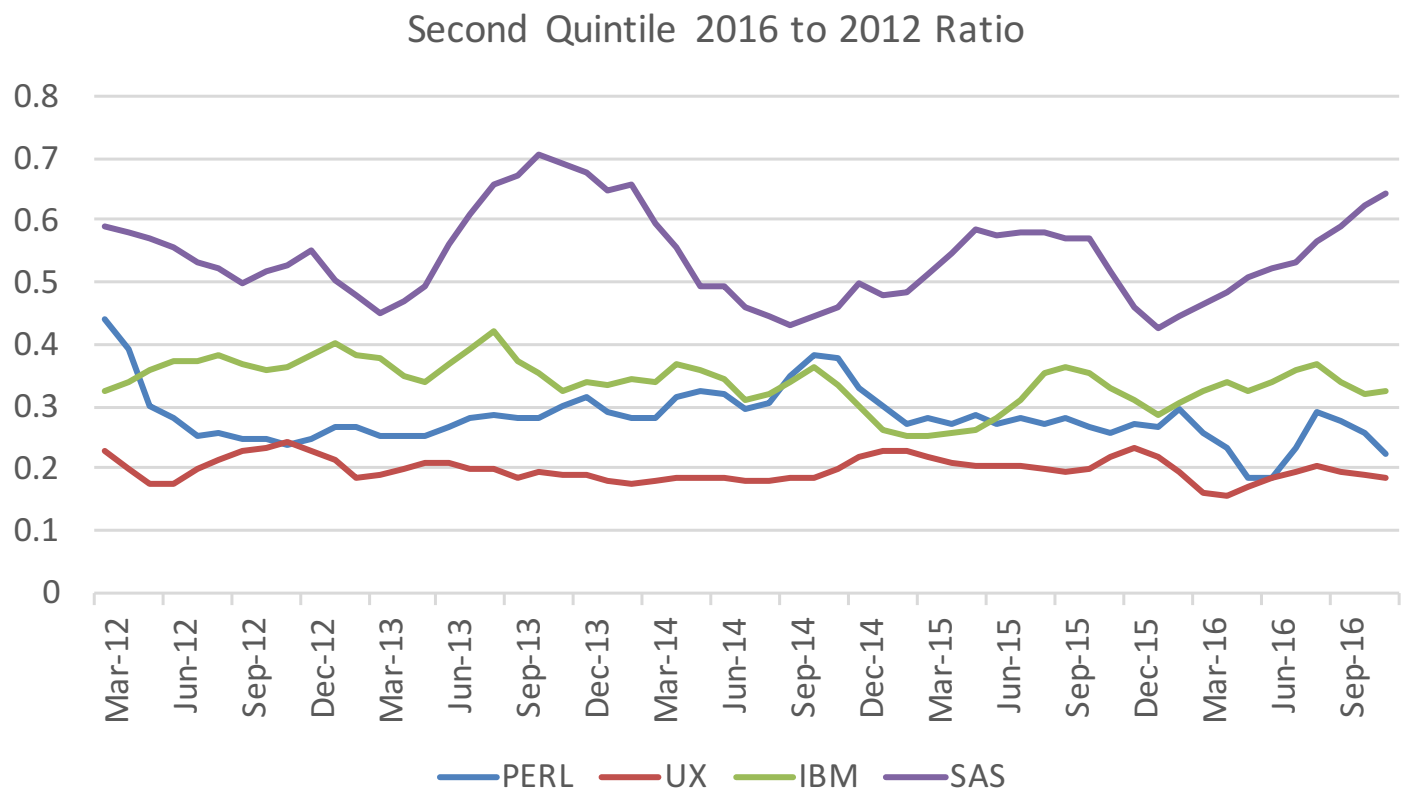
Figures II.2 displays the evolution of the relative tightness measures from February 2012 to November 2016 for each skill type. We group skills into quintiles based on the ratio values reported in the rightmost column of Table II.1. The top panel shows the four skill categories with the smallest ratio – in other words, the greatest increase in relative tightness. The second panel shows the four skill categories with the next smallest ratio

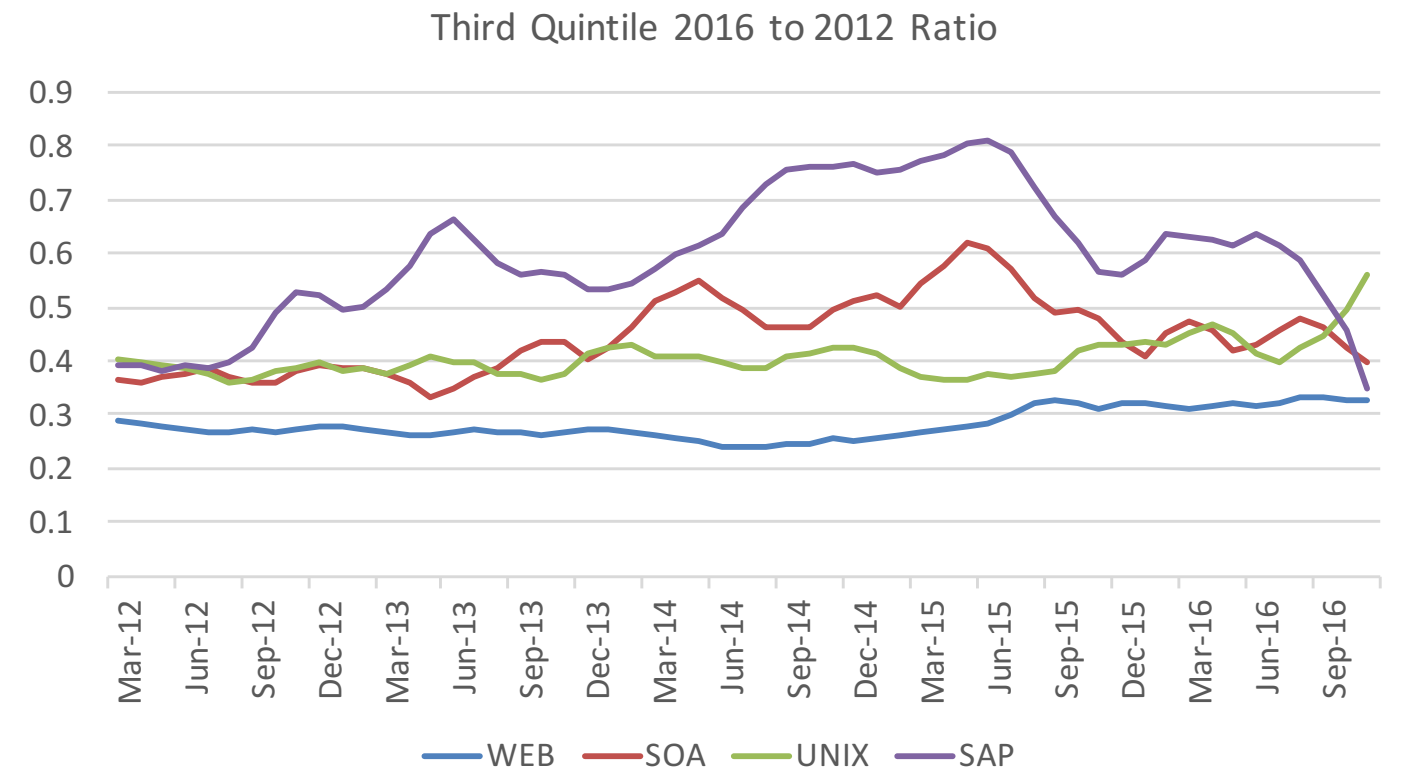
values, and so on. The bottom panel shows the four skill categories with the largest ratio values – that is, the ones that experienced the largest declines in relative tightness from 2012 to 2016.

According to the top panel in Figure II.2, labor market conditions for jobs that require skills in the "C" programming language or development software, Informatica's data integration software and the PHP programming language have tightened greatly since 2012 relative to the average of all jobs in the DHI Database. That is, vacancy postings that specify one of these skill requirements experienced a large fall in the daily flow of applications per posting compared to the average for all postings. Conditions for jobs requiring data analytic, storage and administration skills also tightened in recent years compared to the average for all jobs. According to the bottom panel in Figure II.2, conditions for jobs that require skills in SSIS, Java or Javascript, iOS and User Interface functions slackened considerably since 2012 relative to the average for all jobs in the DHI Database. Vacancy postings that specify these skill requirements experienced a large rise in the relative daily flow of applications per posting. The other three panels in Figure II.2 show the evolution of relation tightness for skill categories that experienced more moderate changes in relative tightness from 2012 to 2016.

Figure II.1 Selected Skills Labor Market Tightness, February 2012 to November 2016
(3-Month Moving Averages)




Second Quintile 2016 to 2012 Ratio
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
PERL
UX
IBM
SAS


Third Quintile 2016 to 2012 Ratio
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
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Dec-15
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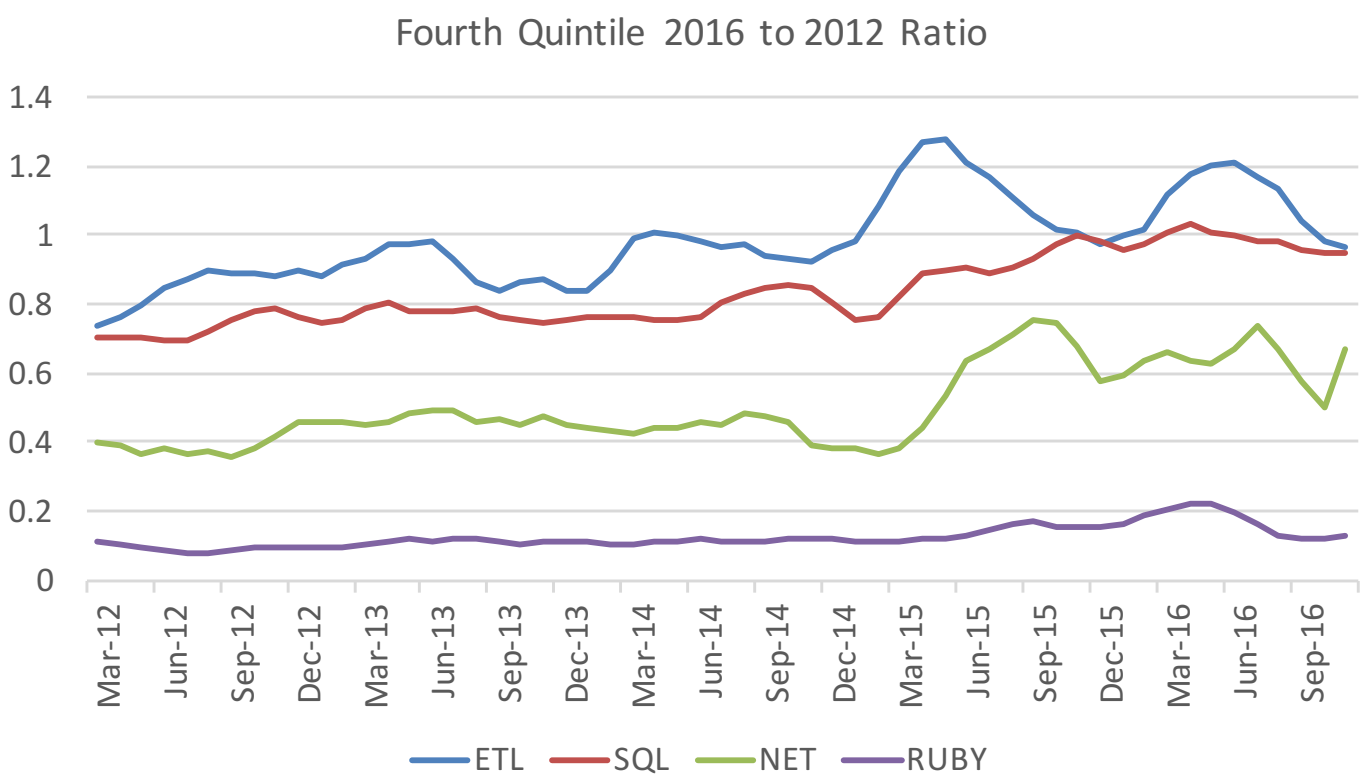
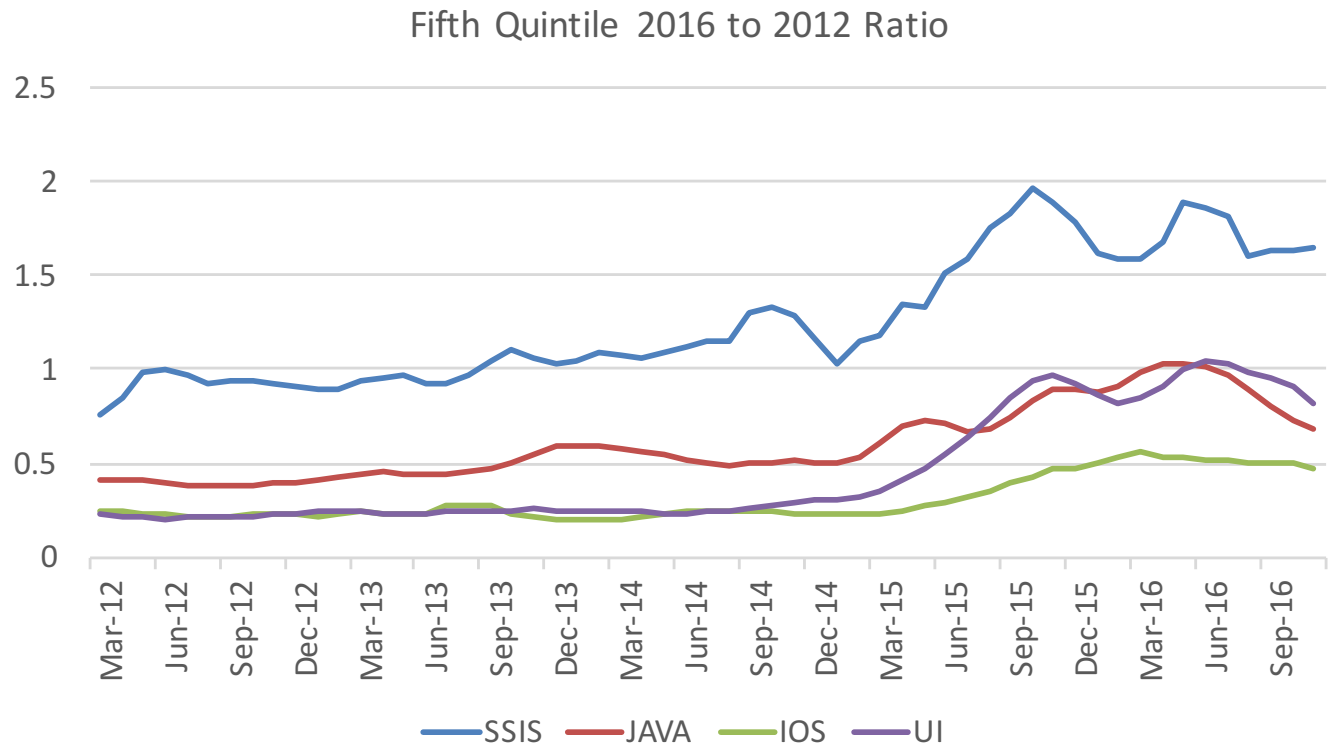
Jun-16
Sep-16
WEB
SOA
UNIX
SAP


Fourth Quintile 2016 to 2012 Ratio
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
ETL
SQL
NET
RUBY


Fifth Quintile 2016 to 2012 Ratio
2.5
2
1.5
1
0.5
0
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15
Dec-15
Mar-16
Jun-16
Sep-16
SSIS
JAVA
IOS
UI

III. Results Based on the Job Openings and Labor Turnover Survey

The **DHI-DFH Mean Vacancy Duration Measure** fell to 26.7 working days in January, 0.6 days below its revised value for December and 2.9 days below its historical peak in April 2016. Figure III.1 shows the evolution of the mean vacancy duration in the United States since 2001. This vacancy duration measure reflects the vacancy concept in the Job Openings and Labor Turnover Survey (JOLTS). Specifically, a job opening gets "filled" according to JOLTS when a job offer for the open position is accepted. So, the vacancy duration statistics refer to the average length of time required to fill open positions. Typically, there is also a lag between the fill date and the new hire's start date on the new job.

Figure III.2 displays four other indicators of labor market slack alongside the mean vacancy duration. All five measures show a pronounced tightening of U.S. labor markets since 2009. Three of the measures – mean vacancy duration, the vacancy-unemployment ratio, and the ratio of vacancies to the number of persons unemployed for 26 weeks or less – now exceed their peak values prior to the recession of 2008-2009. The post-recession rise in the mean vacancy duration is especially pronounced.

The **DHI-DFH Recruiting Intensity Index,** plotted in Figure III.3, increased to 1.05 in January from a revised level of 1.03 in December. Tables III.1 and III.2 below report industry-level statistics for mean vacancy duration and recruiting intensity per vacancy, respectively.

Figure III.1. DHI-DFH Measure of National Mean Vacancy Duration, January 2001 to January 2017

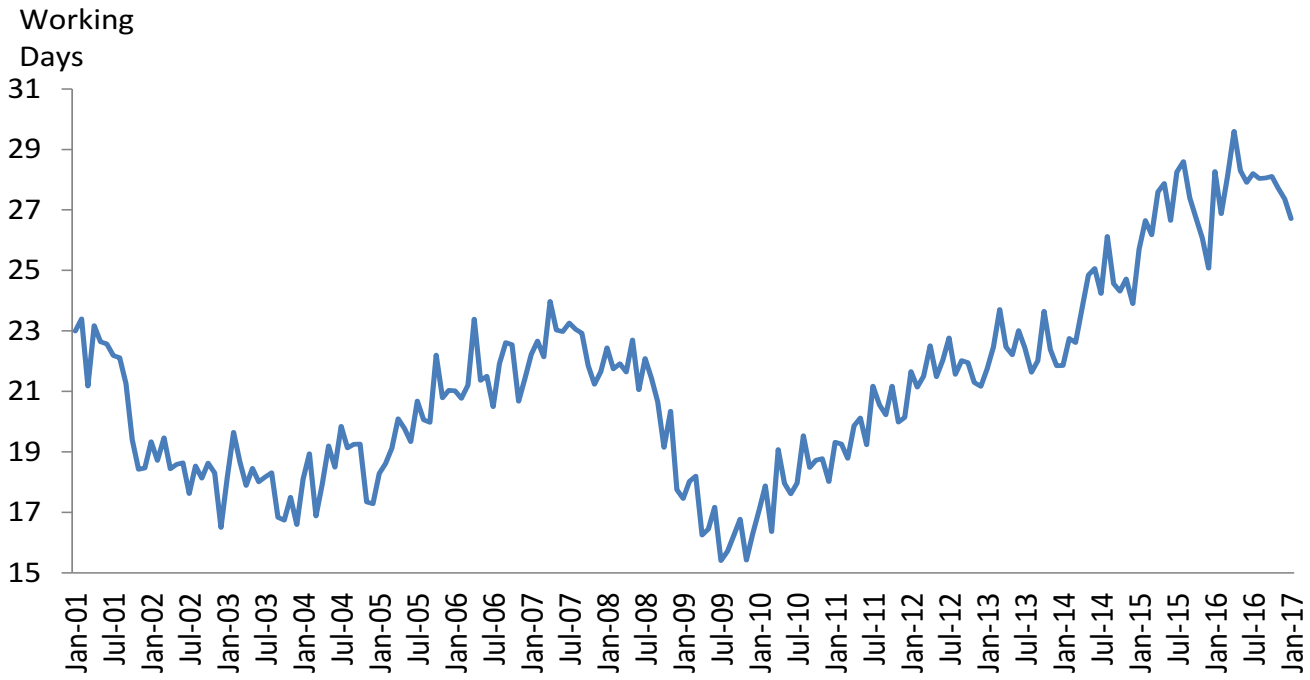
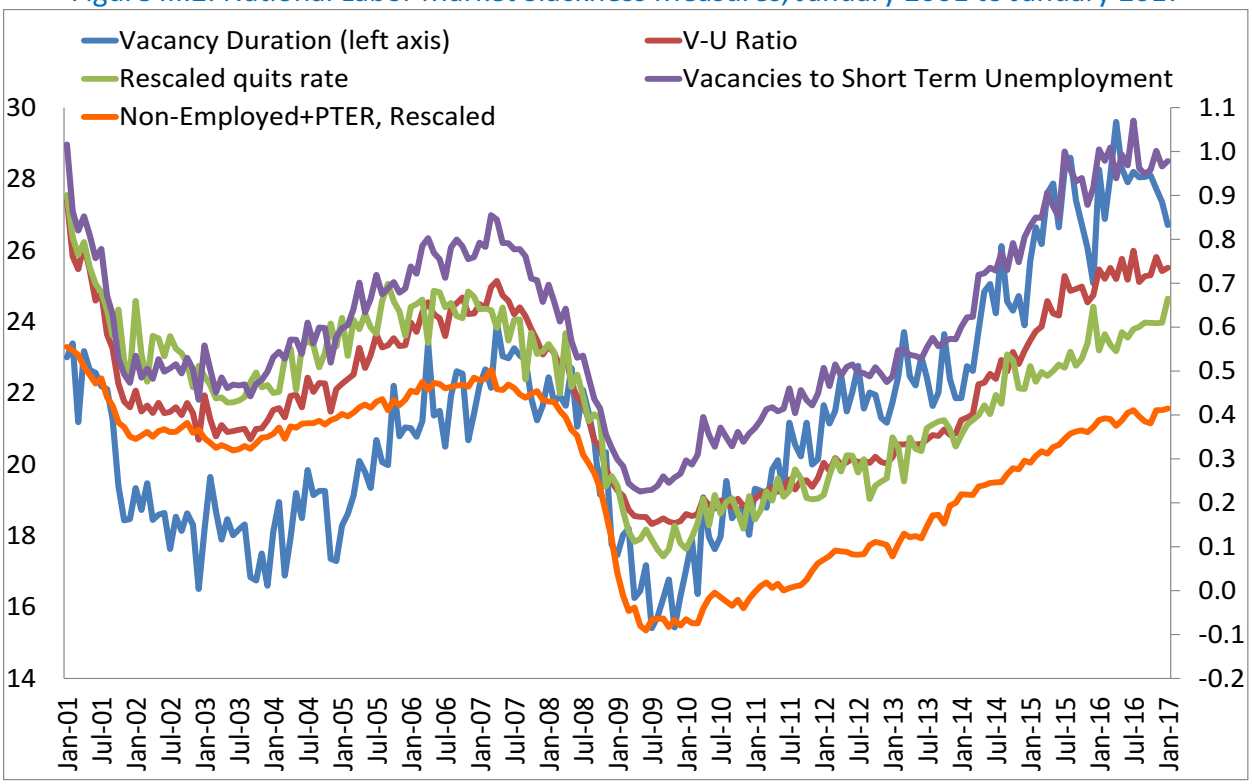


Figure III.2. National Labor Market Slackness Measures, January 2001 to January 2017



Notes: Short Term Unemployment is the number of persons unemployed 26 weeks or less. The Quit Rate is rescaled to have the same mean and variance as the Vacancy-Unemployment Ratio from January 2001 to date. Non-Employment + PTER, an index developed by Hornstein, Kudlyak and Lange, reflects all persons who are not employed (weighted by labor force attachment) plus persons working part time for economic reasons who would prefer full-time work full. Here, their index is multiplied by minus one and then rescaled to have the standard deviation as the Vacancy-Unemployment Ratio from January 2001 to date.

Figure III.3.DHI-DFH Index of Recruiting Intensity per Vacancy, January 2001 to January 2017

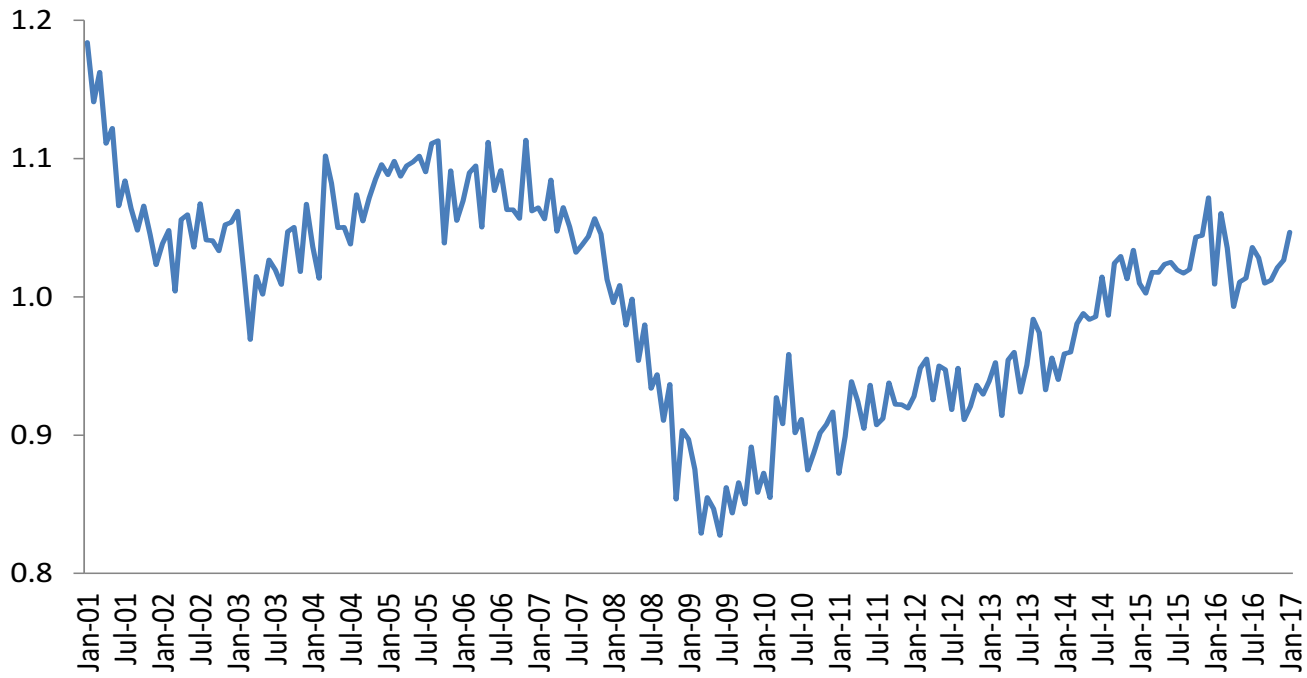


Table III.1. DHI-DFH Measure of Mean Vacancy Duration by Industry and Time Period, No. of Working Days, January 2001 to January 2017

	2001 to 2003	2004 to 2006	2008	2009	2010 to 2012	2013	2014	2015	2016	Jan. 2017
Resources	12.0	14.0	18.1	13.5	18.7	17.4	22.4	17.5	12.9	16.1
Construction	7.9	8.8	7.3	4.3	6.1	9.5	10.9	11.4	14.9	10.0
Manufacturing	17.4	20.9	21.6	13.8	23.4	28.4	29.2	30.4	32.1	31.3
Wholesale and Retail Trade	14.2	15.8	15.5	13.1	15.9	19.8	18.6	21.0	24.1	25.7
Warehouse, Trans. & Utilities	18.6	17.0	20.6	11.3	18.2	22.4	23.9	29.1	27.4	24.1
Information	25.8	36.0	34.5	23.4	40.9	36.4	36.8	35.6	29.1	27.3
Financial Services	28.0	32.1	27.6	25.7	33.3	36.1	37.1	43.2	44.8	41.8
Professional and Business Services	18.3	19.9	21.3	16.6	18.8	19.6	22.0	27.0	26.3	24.2
Education	21.3	25.0	22.0	18.5	21.1	23.7	26.6	29.9	28.9	29.7
Health Services	39.1	35.8	36.4	29.8	33.5	34.6	38.4	44.6	47.7	47.7
Leisure and Hospitality	13.7	14.8	14.9	10.4	13.3	16.6	19.3	19.6	19.7	18.0
Other Services	22.5	18.6	25.2	16.9	18.9	20.1	21.0	22.2	30.1	26.7
Government	33.2	30.7	35.7	32.2	33.0	35.9	37.7	37.8	37.8	35.8
Non-Farm	19.3	20.0	21.1	16.6	20.0	22.5	24.1	26.9	28.0	26.7

Table III.2. DHI-DFH Recruiting Intensity Index by Industry and Time Period, January 2001 to January 2017

	2001 to 2003	2004 to 2006	2008	2009	2010 to 2012	2013	2014	2015	2016	Jan. 2017
Resources	0.99	1.06	1.05	0.70	1.00	0.98	1.04	0.89	1.03	1.11
Construction	1.07	1.04	0.89	0.90	1.01	0.94	0.89	0.88	0.87	0.94
Manufacturing	1.02	1.09	0.95	0.85	0.94	0.88	0.92	0.93	0.96	1.00
Wholesale and Retail Trade	1.05	1.10	0.96	0.84	0.89	0.94	1.04	1.04	1.00	0.96
Warehouse, Trans. & Utilities	0.96	1.13	0.94	0.92	0.96	1.01	1.11	1.12	1.09	1.17
Information	1.10	1.08	0.87	0.83	0.91	1.06	1.11	1.16	1.12	1.18
Financial Services	1.06	1.09	0.99	0.84	0.87	0.99	0.95	0.95	0.92	1.09
Professional and Business Services	1.08	1.07	0.90	0.83	0.94	0.96	1.00	1.01	1.03	1.05
Education	1.00	0.99	1.04	0.96	0.99	0.95	1.00	1.07	1.07	0.93
Health Services	1.08	1.04	1.01	0.93	0.89	0.92	0.97	1.01	1.00	1.05
Leisure and Hospitality	1.08	1.08	0.97	0.84	0.88	0.92	0.96	1.01	1.01	1.03
Other Services	1.02	1.07	0.94	0.96	0.95	0.98	0.96	1.04	0.93	1.13
Government	1.05	1.05	0.94	0.87	0.93	0.93	0.99	1.10	1.13	1.06
Non-Farm	1.05	1.08	0.95	0.86	0.92	0.95	1.00	1.03	1.02	1.05

IV. About the DHI Hiring Indicators

The creation of the **DHI Vacancy and Application Flow Database** is a cooperative effort between DHI Group, Inc. and two researchers at the University of Chicago, Professor Steven J. Davis and Brenda Samaniego de la Parra, a Ph.D. student. Their research paper on "Application Flows" contains additional information about the DHI Database and the analysis of the DHI data in this report.

The **DHI-DFH Recruiting Intensity Index** quantifies the effective intensity of recruiting efforts per vacancy by employers with vacant job positions. The index is normalized to an average value of 1.0 for the period from January 2001 to December 2012. It complements the monthly Job Openings Rate produced by the U.S. Bureau of Labor Statistics (BLS) from the Job Openings and Labor Turnover Survey.

The pace of new hires in the economy depends on the number and types of job seekers, the number and types of job vacancies, and employer actions that affect how quickly vacant jobs are filled. These actions include the choice of recruiting methods, expenditures on help-wanted ads, how rapidly employers screen job applicants, hiring standards, and the attractiveness of compensation packages offered to prospective new hires. The BLS Job Openings Rate captures the availability of job vacancies in the economy, while the **DHI-DFH Recruiting Intensity Index** captures the intensity of employer efforts to fill those vacancies. The index is available at the national, regional and industry levels and by establishment size class (number of employees).

The index construction follows the method developed by Steven J. Davis, R. Jason Faberman and John Haltiwanger (DFH) in "The Establishment-Level Behavior of Vacancies and Hiring," published in the May 2013 issue of the *Quarterly Journal of Economics,* and extended to industry and regional indices in "Recruiting Intensity during and after the Great Recession: National and Industry Evidence," published in the May 2012 issue of the *American Economic Review.*

The **DHI-DFH Vacancy Duration Measure** quantifies the average number of working days taken to fill vacant job positions. It supplements other measures often used to assess the tightness of labor market conditions such as the ratio of vacant jobs to unemployed workers.

Vacancy durations depend on the relative numbers of job seekers and job vacancies, the recruiting and search methods available to employers and job seekers, employer recruiting intensity per vacancy, the search intensity of job seekers, and the degree to which the requirements of jobs on offer match the skills, locations and preferences of job seekers. Other things equal, a larger ratio of job vacancies to job seekers yields longer vacancy durations.

The **DHI-DFH Vacancy Duration Measure** follows the method developed by Steven J. Davis, R. Jason Faberman and John Haltiwanger (DFH) in "The Establishment-Level Behavior of Vacancies and Hiring," published in the May 2013 issue of the *Quarterly Journal of Economics.* That method combines a simple model of hiring dynamics with data on hires and vacancies from the Job Openings and Labor Turnover Survey (JOLTS) conducted by the U.S. Bureau of Labor Statistics. Using their model and the JOLTS data, DFH estimate an average daily job-filling rate for vacant job positions in each month. Taking the reciprocal of the daily job-filling rate yields the **DHI-DFH Vacancy Duration Measure**, which is available at the national, regional and industry levels and by establishment size class.

The average daily job-filling rate is closely related to the "vacancy yield," the ratio of hires during the month to the stock of vacancies on the last business day of the previous month. Unlike the vacancy yield, however, the

daily job-filling rate (and the **DHI-DFH Vacancy Duration Measure**) adjusts for job vacancies that are posted and filled within the month. Working days are defined as Mondays through Saturdays, excluding major national holidays.

About DHI Group, Inc.

DHI Group, Inc. (NYSE: DHX) is a leading provider of data, insights and connections through our specialized services for professional communities including technology and security clearance, financial services, energy, healthcare and hospitality. Our mission is to empower professionals and organizations to compete and win through expert insights and relevant employment connections. Employers and recruiters use our websites and services to source and hire the most qualified professionals in select and highly-skilled occupations, while professionals use our websites and services to find the best employment opportunities in and the most timely news and information about their respective areas of expertise. For over 25 years, we have built our company on providing employers and recruiters with efficient access to high-quality, unique professional communities, and offering the professionals in those communities access to highly-relevant career opportunities, news, tools and information. Today, we serve multiple markets located throughout North America, Europe, the Middle East and the Asia Pacific region.

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