Modernizing America's Workforce Data Architecture

Using Open Data Standards to Enhance the Quality and Availability of Online Job Postings

By Aneesh Chopra and Ethan Gurwitz   August 2017

Center for American Progress

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Introduction and summary

Economists have long recognized the importance of high-quality information to the labor market. Without knowledge of opportunities available or skills in demand, searching for a job can become costly, not to mention miserable. By contrast, widely available and high-quality labor market information can make the process of finding new opportunities easier and more efficient.[1] Accessing and utilizing such relevant and granular information, however, has long proved challenging. Going at least as far back as the 1930s, the public and private sectors have experimented with innovative ways to reduce search costs and informational frictions.[2] Ideas have included greater use of public and private intermediaries to gather and disseminate information on the labor market, better end-user services that match workers with employers, and, more recently, efforts to enhance and/or supplement publicly available information with richer private sector data.[3] Few, however, have considered more fundamental refoms aimed at how real-time labor market data is published and shared in the first place.

Over the past two decades, online job postings have emerged as a principal mechanism for signaling real-time information about the labor market. Their movement to the web has reduced the costs of advertising openings, enabled more functionality for employers to convey information, and made it easier to aggregate postings into central repositories.[4] Together, these advances have transitioned online job postings from mere advertisements to increasingly informative signals of real-time labor market demand. Yet, more can be done for online job postings to reach their full potential. First, while they have become a commodity of sorts for online job search tools, online postings have also become concentrated in a small number of third-party applications that constrain easy data sharing and reuse. Second, postings frequently leave out pertinent information such as wage and skill requirements. And third, postings are seldom published in consistent, machine-readable formats that would make it easier for algorithms and third-party applications to make better use of them. These constraints hinder not just the quality of available data arising from online job postings, but also competition and innovation among the job search-and-match services that rely on such data.

The labor market would benefit from a collaborative data governance strategy that mitigates the influence of data monopolies—in which a few companies have unparalleled access to job postings—and that enables a more seamless exchange of high-quality real-time data. In other sectors of equivalent national importance, a powerful policy instrument has been the encouragement and implementation of open data standards—consistent machine-readable formats for how information is published online.[5] From health care to energy to education—all industries where data is a critical asset—the use of open standards has made information easier to access, query, and share. This, in turn, has enabled more competitive markets for third-party applications and services.[6]

A similar opportunity now exists for the labor market. The broad adoption by employers of an open data standard would make online job postings better sensors of real-time labor market demand. Specifically, it would ensure that postings are more widely disseminated; it would nudge job descriptions to be more consistent, detailed, and precise articulations of employers' needs; and it would make algorithmically curating specific information from a posting—such as skill keywords or evolving technology requirements—substantially easier.

From job seekers and businesses to education providers, policymakers, and innovators, this would benefit nearly all labor market stakeholders. For one, the resulting data could serve as a critical building block for a more robust and responsive public support system for job changes and job training. It could also be a boon to researchers studying evolving trends in skills and labor markets.[7] It may even accelerate advances in machine learning and artificial intelligence being applied for better job matching, improved recommendation services, and more sophisticated local labor market insights.[8]

This report first reviews the limitations of online job postings as real-time sensors of labor market demand, describes the benefits of open data standards, and explains why the public sector is well-suited to facilitate their adoption. Second, it examines two pilot efforts that are currently testing potential policy approaches. Finally, it provides a set of policy recommendations through which federal and state governments can facilitate the development of an open data standard and encourage its adoption.

The limitations of online job postings and real-time labor market data

Job postings are a crucial but not well-understood aspect of the job search process.[9] Signaling job titles, job locations, and required skills and credentials, online job postings are powerful indicators of labor market demand. Over the past several decades, through technical innovations, postings have become cheaper to advertise, revise, and amass. This has subsequently increased their value as a resource for online job search tools. Yet, for several reasons, job postings have yet to reach their full potential as a definitive primary source of real-time labor market information.

Restrictions on reuse

First, there are problems with access. The past two decades have been marked by an emerging market for third-party job search tools.[10] These applications have improved the job search experience in important ways.[11] Employers upload ads for job openings to these platforms knowing that they will reach a robust network of job seekers. Platforms may also harvest postings by regularly scraping the web. In building out these job listing repositories, these entities cultivate some of the richest labor market information available. However, third parties can also apply frictions on the reuse of those aggregated postings, largely on account of valuable intellectual property used in the curation, normalization, and organization of that data. These frictions, however, can be applied to the pre-processed data—the initial aggregation of raw job postings. Through technical mechanisms, legal restrictions, or expensive fees, these frictions can end up stifling the broad dissemination of online job postings.[12]

Labor market data are best utilized when widely available. Proprietary restrictions can make accessing such real-time data either difficult or prohibitively expensive. This, in turn, hinders utility. As Woods and O'Leary write, "while a proprietary firm rightly would desire to maximize profits from selling [labor market information], such an approach would not likely optimize use of the information

to improve efficiencies in the overall labour market."[13] Moreover, Woods and O'Leary caution that proprietary data may poorly cover important parts of the labor market—"particular niches" but not "a nationwide system."[14] There is some evidence of this. A comparison of online job postings by the private job board CareerBuilder and the monthly U.S. Bureau of Labor Statistics's Job Openings and Labor Turnover Survey found that the CareerBuilder data overrepresented fields such as finance and insurance and underrepresented state and local government, food services, accommodation, and construction.[15] This may be attributable to the distribution of jobs that can be found online, with some sectors still unlikely to use the web as a primary method for recruitment. However, the potential of a gap provides another reason for a more open data architecture.

Finally, restrictions on reuse can stymie the development of new products, services, or analysis, while serving as a competitive moat for existing platforms and aggregators. Greater burdens on accessing critical job posting data can pose a barrier to innovators and entrepreneurs who might wish to enter the market for providing real-time labor market services and applications.[16] This entry barrier is further compounded by the fact that third-party platforms have grown fairly concentrated. A 2014 report published in the *American Economic Review* found that "about 60 percent of all ads appear on five job boards," while a forthcoming paper in the *Journal of Public Economics* reports that a single private sector job board included more than a third of all U.S. job postings.[17] Improving the overall utility of job postings as signals of labor market demand will mean ensuring that postings are more widely available and interoperable across third-party applications.

Insufficient and inconsistent quality

Next, online job postings could be more informative signals of labor market demand. Evidence points to a generally low level of quality marked by the frequent absences of critical information, inconsistent descriptions, as well as a tendency for postings to be outdated or misleading. Economist Vera Brencic, for example, has looked at job listings from several countries, finding that employers differ widely in the amount of information they include, such as required skills and wages.[18] A separate analysis of a large U.S. private job board found that only a fifth of the online job postings included projected wages.[19] A 2015 survey of several hundred U.K. postings found that just 12 percent met the minimum job quality standard used by the nation's Advertising Standards Authority.[20]

Although it may be the case that employers are simply choosing not to include this information, the variability for what is included and how such information is defined may be in part a function of the way employers post ads for vacancies.[21] Most employers, be they large or small, post job listings on their own, with little sense of, or no standardized template for, what constitutes a high-quality listing. This decentralized process avoids the costly latency that would come with someone dictating job descriptions from on high, but nonetheless contributes to the inconsistency—not to mention the insufficiency—of the information found in job postings. Adding to this challenge, as economist Peter Diamond has noted, "a central element in the labor market is that workers and jobs vary greatly."[22] This heterogeneity among skills, industries, and credentials makes preserving a consistent level of quality across all job postings naturally more difficult.[23] Some have even argued that skills in demand may be evolving at an accelerated rate due to changes in technology, a trend that could make the task of capturing nuance more formidable as well as more important.[24]

If employers and job seekers continue to rely on online job postings as sensors of real-time labor market demand, the consistency and detail of job postings must be improved. Indeed, job seekers should be well-served by such an improvement. New research, for example, shows that relative to other factors, the words contained in job titles play a powerful function in guiding job applicant behavior.[25] Similar benefits may accrue if employers were to adopt more appropriately standardized and detailed skill and competency requirements.

Inadequate access to standardized, structured data

The final limitation on online job postings is that a narrow number consistently adhere to a standardized, open, and machine-readable format or structure. This makes postings less useful as signals of labor market demand.

When job seekers read a posting online, they easily discern various elements of the ad, such as skills, wages, and/or benefits. However, when a machine queries the web for postings, without the benefit of a standardized data structure or markup that provides context for what is included in the text—metadata—this task inevitably becomes more difficult.[26] To roughly analogize, imagine reading a tax return without a format clearly delineating different types of income, exemptions, credits, and deductions. It would be nearly incomprehensible. Similarly,

without a consistant format or structure, algorithmically making sense of postings becomes harder. Although dominant third-party applications have in some cases begun to use techniques such as natural language processing and machine learning to parse unstructured data, these advances are limited to a small number of firms.

Separately, even when online job postings are structured, different postings frequently have different markups. Unless third-party applications are familiar with the specific markup, they are hard-pressed to use those postings.[27] This constrains the interoperability of a job posting once it is published and ultimately leads to siloed data or reduced job board quality.[28] If online job postings are to fully realize their potential as machine-readable and interoperable sensors of labor market demand, broader technical reforms are needed for how postings are published, accessed, and used.

Open data standards for online job postings

One potential approach to improve online job posting quality and availability would be for labor market stakeholders to reach consensus on an open data standard for online job postings. This would not be a standard for the specific job titles or tasks that are unique to each employer, but rather for how such categories of information are published on the web.

What is an open data standard?

From screws and fire hydrants to telephone networks and internet protocols, standards ensure compatibility between products and services. As studies of standardization efforts have shown, such compatibility can result in "considerable gains to consumer welfare."[29] By harmonizing the interactions within a system, standards create opportunities for innovation and entrepreneurship as well as greater consumer choice.[30] This is especially true of the exchange of real-time information across the internet. As data have grown more valuable and third-party applications that make use of data feeds have proliferated, there is a growing demand for data to be structured and seamlessly exchanged in a neutral way across platforms and applications.[31]

This has led to the creation of voluntary, industry-led data standards for online content. A data standard "describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource."[32] Inconsistent publishing formats are akin to mismatched fire hoses and hydrants; the incongruence stymies the flow of the information. By comparison, a consistent data standard makes it easier for third-party applications to find, parse, and utilize content regardless of where it is published. As a 2016 Obama administration report noted, data standards can "reduce the cost and difficulty of making new data sets useful."[33]

One such effort is Schema.org, an initiative among leading search engines to standardize the back-end framework for specific types of web and app content.[34] Categories include blogs, movies, and restaurants.[35] For each category, Schema.org has established generic but standardized technical structures—schema—underlying the text of a webpage.[36] By adding context, or structure, to the text of a webpage, the schema makes it easier for such content to be identified and used.[37]

Applied to online job postings, a data standard would enable stakeholders—from innovators to developers of state-based workforce development systems—to more seamlessly take advantage of online job postings as real-time signals of demand.[38] First, it could serve as a template for employers, providing suggestive parameters for what to include in postings. This could nudge employers toward more consistent and precise job posting descriptions, while preserving their autonomy to advertise as they deem fit. Second, if broadly adopted by employers, a data standard could make online postings more widely available, resulting in more robust competition and variation among third-party applications that put job postings to use. This could also support researchers and policymakers, allowing them to be less reliant on vendors or aggregators for raw labor market data or to more efficiently use such firms for value-added insights or services.

TABLE 1
Example of the JobPosting schema, recreated from Schema.org

Property	Expected type	Description
Properties from JobPosting		
baseSalary	MonetaryAmount or Number or PriceSpecification	The base salary of the job or of an employee in an EmployeeRole.
datePosted	Date	Publication date for the job posting.
educationRequirements	Text	Educational background needed for the position.
employmentType	Text	Type of employment (e.g. full time, part time, contract, temporary, seasonal, or internship).
experienceRequirements	Text	Description of skills and experience needed for the position.
hiringOrganization	Organization	Organization offering the job position.
incentiveCompensation	Text	Description of bonus and commission compensation aspects of the job. Supersedes incentives.
industry	Text	The industry associated with the job position.
jobBenefits	Text	Description of benefits associated with the job. Supersedes benefits.
jobLocation	Place	A (typically single) geographic location associated with the job position.
occupationalCategory	Text	Category or categories describing the job. Use BLS O*NET-SOC taxonomy: http://www.onetcenter.org/taxonomy.html. Ideally includes textual label and formal code, with the property repeated for each applicable value.
qualifications	Text	Specific qualifications required for this role.
responsibilities	Text	Responsibilities associated with this role.
salaryCurrency	Text	The currency (coded using ISO 4217) used for the main salary information in this job posting or for this employee.
skills	Text	Skills required to fulfill this role.
specialCommitments	Text	Any special commitments associated with this job posting. Valid entries include VeteranCommit, MilitarySpouseCommit, etc.
title	Text	The title of the job.
validThrough	DateTime	The date after which the item is not valid. For example, the end of an offer, salary period, or a period of opening hours.
workHours	Text	The typical working hours for this job (e.g. first shift, night shift, or 8:00 a.m. – 5:00 p.m.).
sameAs	URL	URL of a reference webpage that unambiguously indicates the item's identity. E.g. the URL of the item's Wikipedia page, Wikidata entry, or official website.
url	URL	URL of the item.

Note: This is a slightly edited reproduction of a table designed by Schema.org, found at the source below.

Source: Schema.org, "JobPosting," available at http://schema.org/JobPosting (last accessed July 2017).

The public sector's role in standard setting and labor market information

The public sector, with its experience facilitating standards development and its long-held role providing timely labor market information, is well suited to organize a consensus-seeking effort to design and adopt a job posting data standard.

First, going back to the early 20th century and the development of the National Bureau of Standards—now known as the National Institute for Standards and Technology (NIST)—the U.S. government has played a role in facilitating sectorwide norms and guidelines.[39] The Obama administration was particularly active in convening outside stakeholders to design and adopt standards aligned with key policy priorities. Examples of these efforts include NIST and the U.S. Department of Energy working with industry to make energy consumption data available to consumers, as well as a NIST-facilitated effort encouraging the adoption of voluntary industry-led standards and best practices for cybersecurity.[40] The authority for these efforts was articulated in a 2012 White House memorandum outlining the involvement of the federal government in encouraging and facilitating standards for "national priorities."[41]

In addition to facilitating standards, since as far back as the passage of the Wagner-Peyser Act of 1933, the public sector has also been a critical player in the provision of real-time labor market information.[42] Over the years, government has frequently harnessed new technologies to enhance the quality and dissemination of these data. During the 1970s, for example, state employment services began to collect and share labor market information with other states through such innovations as the Employment Security Automated Reporting System.[43] This ended up being the antecedent of the more formulized Interstate Job Bank: "a national database containing state job openings from employers who requested nationwide listings," and, later, America's Job Bank, a web-based interface for job and resume posting.[44]

While America's Job Bank is no longer in operation and, in many cases, public actors from state governments to community college systems are purchasing granular labor market insights from third-party vendors, there remains a general recognition that "providing information to the public is one of the primary rather than ancillary functions of the public workforce investment system."[45] Specifically, the secretary of the U.S. Department of Labor (DOL) is required to "oversee the development, maintenance, and continuous improvement of a nationwide workforce and labor market information system," including ensuring the "dissemination of

such data, information, and analysis in a user-friendly manner and voluntary technical standards for dissemination mechanisms."[46] Additionally, states are required to administer labor exchange systems that, among other things, "assist job seekers in finding employment … assist employers in filling jobs; [and] facilitate the match between job seekers and employers."[47]

The combination of these policy legacies, unique capabilities, and existing authorities makes the federal government a natural fit to bring together requisite stakeholders and accelerate the design of an open data standard for online job vacancies.

Case studies

Two case studies are already showing progress toward the development, adoption, and use of an open data standard for online job postings. These pilot projects show how a data standard for job postings can be implemented as well as how the resulting data can be harnessed for new applications and analysis.

The United Kingdom: Adopting a schema

Spurred by a 2015 survey finding that just 12 percent of U.K.-based job postings included sufficient information to meet country-certified quality standards, the British government began to search for ways to enforce a baseline level of quality for job posting content.[48] Research by the country's Government Digital Service resulted in an initiative to have civil service job listings adopt a data standard.[49]

The idea for an open data standard was inspired by an initiative championed by the Obama administration back in 2011 called the Veterans Job Bank.[50] The job bank was a repository of job postings from employers making an explicit commitment to prioritize the hiring of veterans. To create a relevant and up-to-date list of postings, the Executive Office of the President partnered with Schema.org to design and adopt an open data standard.[51] Built with industry participation, the resulting JobPosting schema (see Table 1) enabled employers to mark up, or tag, job postings where the employer had made a commitment to hiring veterans, thus making it easier to algorithmically find, aggregate, and publish these postings in real time and at low cost.[52]

In researching this effort, the United Kingdom saw the potential for a broader goal: using the schema as an overall template for what should be included in job listings.[53] The government realized that such an intervention would make data on job postings easier for third-party websites and applications to algorithmically parse, query, and reuse.[54] Excited about the potential, the Government Digital Service began a

thorough review process to determine whether or not this information technology standard should be implemented. The review included a preliminary exam by a panel of open standards experts followed by a subsequent review by the Open Standards Board, a government-appointed coalition.[55]

As of 2017, the United Kingdom has been implementing the schema's adoption across all central government openings.[56] Agencies not under the direct jurisdiction of the central government are also being encouraged to adopt the schema. The U.K. Government Digital Service is assisting with the adoption by providing implementation guidelines, informal trainings, and a communication channel.[57] Meanwhile, Britain's Department for Work and Pensions has prototyped a series of different citizen-facing services that could take advantage of the schema.[58] The government's expectation is that over time, the private sector will also take steps to adopt the open data standard.

Virginia: Publishing real-time data on labor market demand

The second case study comes from Virginia. The state is showing what is possible if a data standard were to be broadly adopted. In 2014, the governor of Virginia signed Executive Order 23: "Establishing the New Virginia Economy Workforce Initiative."[59] The order led to the creation of the Commonwealth Consortium for Advanced Research and Statistics (CCARS).[60] Working together with the Discovery Analytics Center at Virginia Tech, CCARS coordinated the development of a new pilot project with which one of this report's authors is affiliated. Called the Open Data, Open Jobs Initiative, the goal was to capture and publish a real-time structured data feed of all online job postings in Virginia that would serve as a proof of concept.[61]

Building this feed involved several steps. First, it required establishing data-sharing agreements with three major data sources of Virginia job postings. These included the state-based job board Virginia Workforce Connection, the DirectEmployers Association's National Labor Exchange, and job postings that continued to use the JobPostings schema initiated under the 2011 Veterans Job Bank initiative highlighted above. Together, this provided the Virginia Tech team with a sufficient pool of Virginia's job openings.[62]

From this repository, the team removed duplicative postings and transformed unstructured ads into structured job postings. The resulting structured job postings were then enriched and normalized, a process whereby missing information—such as job location—was filled in and information such as job title or industry sector was matched to a standardized identifier from public classifications such as the North American Industry Classification System (NAICS) or the Occupational Information Network (O*NET).[63] The result was a single, machine-readable, publicly available dataset of Virginia's job postings: a snapshot of the labor market from which anyone, from workforce practitioners to developers, could create visualizations, generate research insights, and even develop new job search-and-match tools. The feed is available via an open data portal hosted by Virginia Tech.

In 2016, developers used this dataset during Virginia's Workforce Innovation Challenge Datathon.[64] During the two-day challenge, industry professionals and students were charged with developing applications. At least three new applications are presently using the initiative's data.[65] The project is now working with economists and other partners to add insights to the data such as median wage information, normalized job titles, industry and organization codes, and geolocation information.[66] It is also continuing to look for new data-sharing partners to improve coverage.

Policy recommendations

This section outlines several policy recommendations for how federal and state governments can develop a data standard, encourage its adoption, and take advantage of the resulting infrastructure. Recommendations include facilitating an industry-led open data standard, encouraging employer adoption of that standard, and harnessing the resulting data for new tools and research.

Facilitating an industry-led open data standard

First, a broad set of labor market stakeholders needs to find consensus around what a quality job posting should look like on the web. What are the fields—salary, location, hours, education requirements, and skill keywords—that should consistently define job postings? The U.S. government, with its power to convene outside entities and its prior experience facilitating standards development, is well-suited to bring together the requisite stakeholders to accelerate this design.[67] In the spirit of internet-based standards efforts, this initiative would benefit from agile development—encouraging employers and application developers to publish information according to initial consensus recommendations, gathering feedback from early adopters to recommend changes, and iterating on an implementation guide. Moreover, as the U.K. case study above demonstrates, any such process should be transparent and inclusive in order to ensure that all voices are heard.[68]

Encouraging employer adoption

Once an open data standard and accompanying implementation guide are published, the next step is facilitating broad adoption. The decentralized nature of the labor market makes for a challenging collective action problem. How does one encourage small and medium-sized enterprises to adopt a technical standard for online job postings that conforms to industry-led guidelines? The public sector has many tools it can use to galvanize support.

- **Target key stakeholders to mark up job postings with a consensus standard.**
Standards work when stakeholders realize benefits from participation and use.
To generate participation, the public sector should encourage "early adopters"
among stakeholders that already collect job postings data across the coun-
try—including private sector job search-and-match tools, educational institu-
tions, regulators, and labor unions—to contribute the initial data feeds. At a
minimum, the largest private and public job boards could mark up their post-
ings using an open, consensus format, as the Virginia pilot project described
above is doing. Such an approach would capture a large share of existing
online postings and may even help spur employers to adopt a data standard
when they post a job ad in the future. However, such an approach is premised
on the idea that the resulting structured data would be publicly accessible
without intellectual property restrictions.

- **Lead the way with federal and state job postings.** Getting industry to adopt a
schema will be harder if governments are not leading by example. Following in
the footsteps of the U.K. government, federal, state, and local U.S. governments
should apply the industry-led job posting standard to their own postings. The
sheer size of the public sector workforce could spur broader adoption of the
schema within the private sector.

- **Incentivize federal contractors to adopt the schema through VEVRAA.** The
federal government could use current regulations associated with the Vietnam
Era Veterans' Readjustment Assistance Act of 1974 (VEVRAA) to incentivize
all federal contractors to adopt a schema. VEVRAA requires that when listing
job openings, "contractors must provide information about the job vacancy
in any manner and format ... which will allow that system to provide priority
referral of veterans protected by VEVRAA."[69] By taking advantage of the data
standard to help meet the regulatory requirements for priority referrals, govern-
ment can ease the costs and difficulty associated with regulatory compliance and
get better outcomes as a result. It could both improve posting quality and make
it easier for application developers to help veterans find better job matches.

- **Provide aid to small and medium-sized employers.** While unlikely to be
a significant sum, there may be costs associated with adopting a standard.
Allocating a small portion of funding from existing workforce data system
budgets to assist small and medium-sized businesses with adoption could
encourage further participation. Additionally, states should consider building

out data science and developer expertise to help with schema adoption and maintenance. Just as the Virginia case study above harnessed the talent of the data science team at Virginia Tech, states could rely on existing talent networks from local colleges and universities.

Harnessing new data for new tools and research

The goal of public sector-led standardization is to establish a consistent infrastructure that can support new services and applications.[70] Easy to access, timely, and structured job posting data could lower barriers to entry for innovators and, in doing so, spur novel workforce tools and services. Below are several ideas for how to ensure that resulting data are utilized.

- **Encourage states to build out their own repositories.** The public nature of labor market information ensures that "there can be a productive role for government services to provide labor market information to workers."[71] States have long served as information clearinghouses for the labor market. And Virginia is now demonstrating that states can even curate their own real-time data feed. Rich, clean, up-to-date data would benefit local and state-level workforce practitioners, not to mention innovators. In providing this service, states can strengthen their existing role as crucial intermediaries for real-time labor market data.[72]

- **Continue to sponsor opportunities to engage developers and innovators.** The Obama administration worked to engage the developer community through initiatives such as "hackathons" and "data jams."[73] These events brought together developers in order to introduce them to new datasets and let them design proof of concepts with such data. The current administration, states, and nonprofits should each continue these efforts to encourage broader usage of raw job postings data. Again, Virginia provides a good model for this effort.

- **Continue to build out a real-time occupational taxonomy.** A recent report from the National Academies of Sciences, Engineering, and Medicine made clear that "policy makers and researchers would benefit significantly from a better understanding of evolving IT options and their implications for the workforce."[74] Job postings often signal these changes, with skill descriptions evolving as new technologies emerge. The broad adoption of a data standard would make it easier to mine postings for new occupational titles, skills, and associated technologies. In fact, this effort is already underway. The DOL in partnership with

the University of Chicago has an ongoing effort called the Open Skills Project to rethink how occupational classifications are built. The team is presently working on a real-time occupational classification curated from employers' own job descriptions.[75] An effort to get employers of all sizes to adopt a schema would greatly benefit initiatives such as this one.

Broader takeaways

- **Competition in data-intensive markets.** Real-time labor market information with its "public good" characteristics offers an opportunity to think more broadly about the competitive effects of data and how to enhance competition where digital platforms abound.[76] Ensuring frictionless access to online job postings will encourage applications to distinguish themselves through innovative interfaces or new methods of curation, rather than simply the size of their job listing network. This should further enhance competition in the job search-and-match market. Although the degree to which such an intervention can be applied to other cases remains unknown, the template seems worth further investigation.

- **Encouragement of standard setting through convening diverse stakeholders.** This report shows the potential of an underutilized policy lever: working with industry and other stakeholders to encourage the broad adoption of uniform standards for national priorities short of formal regulation or government operation. Additional research is needed to better understand the incentives required for collaboration, but the approach provides a flexible tool for policymakers, especially in sectors subject to rapid technological innovation.

Conclusion

Back in 1966, economist Albert Rees published "Information Networks in Labor Markets." In the article, he noted the following:

> *For the major portion of the [labor] market, the crucial characteristic of an effective formal information system is not the length or the number of interconnections between geographical locations or the number of applications and openings that can be brought together at one place. Rather, it is the richness and reliability of the information carried over each link. The crucial component of such a system will not in our lifetimes be built by I.B.M. or Western Electric.*[77]

Much has changed since Rees first made these observations, yet in many ways his comment still holds true. Over the past few decades, online job postings have become a primary source for real-time information on the labor market as well as a currency for new job search tools and applications. However, access to online job postings is increasingly concentrated within a few companies and postings themselves are frequently of low quality. Far from being sensors of real-time data, today's postings seem far more reminiscent of their newspaper predecessors.

There is now a substantial opportunity to enhance the availability and quality of real-time labor market data by improving how job postings are published online. This report calls for the adoption of an open data standard for all online job postings. A standard would make online postings clearer signals of real-time demand and would help avoid the creation of data monopolies by making postings more widely available. Furthermore, facilitating the adoption of such standards would be largely in line with existing government policy to work with outside stakeholders toward "a shared commitment to a defined level of responsible behavior" and to provide rich labor market information.[78] An open data standard will ensure that information on labor market demand is more timely, accessible, and of higher quality. With luck, we may even establish that "crucial component" that Rees first mentioned so many decades ago.

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Acknowledgments

Endnotes

1 As James Woods and Christopher O'Leary make clear, "the summary of existent studies is consistent with a logic model concept, in which information on the key needs of the market, e.g., skills, knowledge, abilities, job openings, wage rates, etc. can facilitate a more efficient market." See James F. Woods, and Christopher J. O'Leary, "Conceptual Framework for an Optimal Labour Market Information System: Final Report" (Kalamazoo, MI: WE. Upjohn Institute for Employment Research, 2006), available at http://research.upjohn.org/cgi/viewcontent.cgi?article=1025&context=up_technicalreports.

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