Education, Job Openings, and Unemployment in Metropolitan America

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"Less educated regional labor markets may lack entrepreneurs who start or expand businesses, leading to fewer overall openings and fewer openings for less educated workers."

Findings

An analysis of labor markets using data on adult educational attainment, occupations, and job openings in the 100 largest metropolitan areas from January of 2006 to February of 2012 finds that:

- **Advertised job openings in large metropolitan areas require more education than all existing jobs, and more education than the average adult has attained.** In the 100 largest metropolitan areas, 43 percent of job openings typically require at least a bachelor's degree, but just 32 percent of adults 25 and older have earned one.

- **Metro areas vary considerably in the level of education required by job openings posted online.** Roughly half of openings in San Jose, San Francisco, and Washington, D.C. require a bachelor's degree or higher, while fewer than one-third of openings require a bachelor's degree in metropolitan McAllen, TX and Youngstown, OH.

- **Unemployment rates are 2 percentage points higher in large metro areas with a shortage of educated workers relative to demand and have been consistently higher since before the recession.** The gap between education demand and supply is small in Madison, Washington, Raleigh, and Minneapolis, and large in metro areas throughout California's Central Valley. Both less educated and younger workers are much more likely to be working if they live in metropolitan areas with a smaller education gap.

- **Declines in industry demand and housing prices explain most of the recent cyclical increases in metropolitan unemployment rates, but education gaps explain most of the structural level of metropolitan unemployment over the past few years.** Changes in house prices (prompting a reverse wealth effect) and industrial demand explain roughly three-quarters of the trend in unemployment rates across large metropolitan areas since the recession began. However, metropolitan education gaps explain roughly two-thirds of variation in the level of unemployment across metro areas, posing a longer-run challenge for many regional labor markets.

- **Metro areas with higher education gaps have experienced lower rates of job creation and job openings over the past few years.** Educational attainment, overall and relative to existing demand, benefits metro areas by making workers more employable and firms more competitive and entrepreneurial—thus leading to more job openings for less educated workers. By contrast, education gaps do not appear to be related to employer difficulty in filling job openings in metro areas.

In the short-term, unemployment rates are unlikely to come down to their pre-recession levels without improvements in housing markets and consumer demand. Yet high educational attainment is essential for the health of metropolitan labor markets before, during, and after recessions. Educational attainment makes workers more employable, creates demand for complementary less educated workers, and facilitates entrepreneurship. To better train less educated adults, non-profit organizations, community colleges, and governments can use detailed job openings data to align training curricula and certifiable skills with employer demand.

Introduction

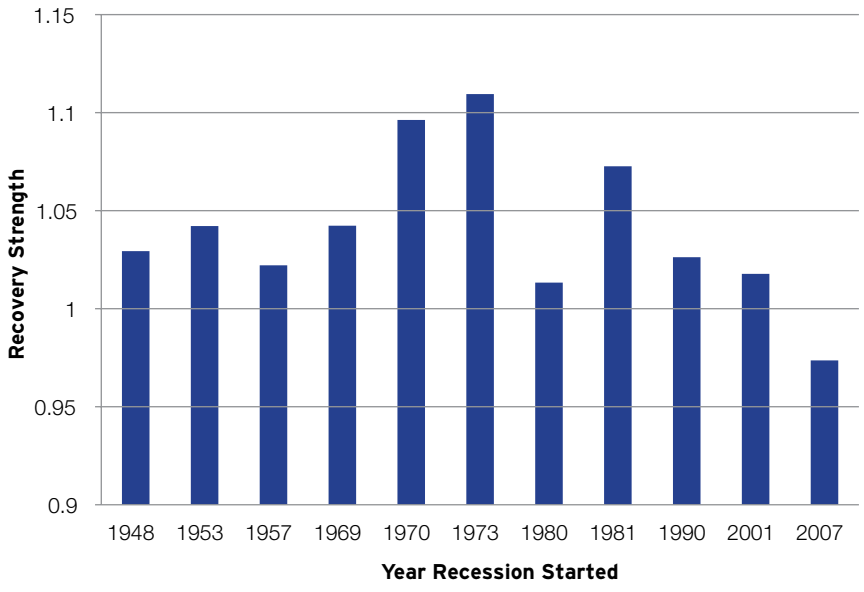
The national picture of economic recovery is ambiguous and frustrating in its inconsistency, as evidenced in the varied paths of the nation's metropolitan areas. Some metropolitan labor markets have nearly recovered their pre-recession unemployment rates. For example, in 19 large metropolitan areas, the unemployment rate, as of May 2012, is less than 2 percentage points above its pre-recession minimum. In another group of 31 metro areas, the unemployment rate is at least 4 percentage points above its pre-recession minimum.

Despite the wide variation in economic health across the country, economic policies in Washington are generally debated and formulated as if all regions had the same economic experience. The federal policy debate about what can be done to address the slow recovery (and stave off a disaster if Europe falters) has been highly polarized between those who support more stimulus (monetary or fiscal) and those calling for regulatory and tax reform, in the context of a smaller public sector.[1] Other ideas relevant to housing, education, and training have been largely ignored or faltered politically, despite the possibility of readily adapting them to regional circumstances.

Central to this discussion is the need to distinguish between short-term (i.e. cyclical) and long-term (i.e. structural) characteristics.[2] Over the short term, severe financial crisis and subsequent public sector debt crisis in Europe have dragged down U.S. GDP growth and the demand for goods and services. Over the long term, there has been a shift in developed countries towards higher skilled non-routine labor since the 1960s and 1970s. The creation and adoption of new information technologies have displaced routine work while making educated workers more productive.[3]

The slow recovery has raised concerns that the Great Recession exacerbated structural issues in the labor market. As Figure 1 shows, the jobs recovery since the Great Recession ended has been the weakest in the post-World War II era. Using National Bureau of Economic Analysis recession dates, the current period is the only recovery since 1948 in which jobs have not recovered their pre-recession level after three years.[4]

Figure 1. Level of U.S. employment three years after end of recession divided by level of employment at the start of recession, 1948-2012



Source: Brookings analysis of Bureau of Labor Statistics data, using NBER recession dates. Start of recession is first month of recession, and three years after recession is three years after the last month of recession.

Observing the labor market difficulties of less educated workers and various other factors, a number of economists have suggested that employers may be finding it difficult to find qualified candidates to fill jobs openings, causing higher unemployment.[5] Indeed, surveys of employers find that many report difficulty filling vacancies.[6]

The importance of education to the labor market notwithstanding, the evidence suggests that the need for higher education is mostly a long-term problem that is not the primary factor responsible for increasing unemployment rates since the recession began; the fall in demand for goods and services has played a stronger role in recent changes in unemployment.[7] The problem is a lack of job openings, rather than difficulty filling available jobs. Given that more than half of new jobs typically come from establishments started within five years, the lack of openings implies a need for more entrepreneurship, as well as higher demand.[8]

Yet, beyond difficulty filling existing jobs, inadequate education can have other important short-term consequences, weakening recovery. A number of scholars have documented the strong relationship between education and entrepreneurship and various metrics of economic dynamism.[9] A lack of job openings is typically considered a cyclical problem, but it may have structural roots as well. Less educated regional labor markets may lack entrepreneurs who start or expand businesses, leading to fewer overall openings and fewer openings for less educated workers. Educated workers create demand for less educated workers in two ways: by buying goods and services provided by less educated workers and by employing them directly in businesses they start.

To investigate these issues, this study focuses on how the degree of balance between the supply of and demand for education affects unemployment and job openings in metropolitan labor markets. Given the wide variation in economic health across regions, an analysis of metropolitan areas has the potential to uncover patterns that are lost in national data. The goal is to distinguish educational matching issues from cyclical and other structural issues that may also be of significance in prolonging this recession.

This paper aims to provide metro, state, and national policy makers and voters with a better sense of the specific problems facing metropolitan labor markets. It analyzes job openings data in the nation's 100 largest metropolitan areas, in combination with a variety of other economic indicators. It updates a Brookings study from September 2011 focused on the educational requirements of existing jobs in metro areas.[10] After explaining the methodology, the report examines trends in the demand for educated labor and how a gap between education supply and demand is related to unemployment. Next, the analysis attempts to distinguish between cyclical and structural effects before turning to an explanation of how an education gap might affect both by limiting job creation. It concludes with a discussion of the implications of these findings for public policy.

Methodology

This section provides a basic summary of the data and methods used to create the key variables employed in this analysis. The methodological appendix presents more detailed information on technical aspects of the analysis, as well as some of the metrics used in the report.

Job Openings

Data on job openings come from the Conference Board Help Wanted Online Data Series (HWOL). These data represent all online advertised job vacancies, which are accumulated from a large number of job boards before removing duplicate announcements. Data used in this report cover the period from January of 2006 to February of 2012 for only the 100 largest metropolitan areas in the United States. The data were aggregated to detailed occupational codes (using the six digit Standard Occupational Classification system from the Bureau of Labor Statistics) for each metropolitan area.

Most labor market studies look at existing jobs, and track net job creation and destruction to examine progress over time. However, for most people looking for a job, the most important set of jobs are vacancies, which are driven in large part by turnover.[11] Openings data track jobs that are currently available.

The fact that the HWOL database is based on advertised online vacancies raises questions as to whether or not certain kinds of jobs are more or less likely to be advertised online. The appendix analyzes the potential bias.[12] The reader should keep in mind that metro areas with a disproportionate number of jobs in computer, restaurant, or retail occupations may see the educational requirements of their jobs over-stated by these data. For that reason, alternative education gap measures will also be reported based on all existing jobs (i.e. those already filled) and a comprehensive measure that considers the educational requirements of both vacant and filled jobs.

Educational requirements of Job Openings

To measure education demand per occupation, the distribution of educated workers is calculated across six education categories (less than high school, high school, some college, Associate's degree, Bachelors degree, Masters, Doctorate/Professional degree) for every minor occupational category in the United States.[13] The data required to do this come from various years of the Census Bureau's American Community Survey, with the most recent year being 2010.[14]

This approach assumes that the education attained by the average U.S. worker for a given occupation indicates the years of education demanded by employers for that same occupation across regions. Levels of educational attainment, such as less than high school, are assigned years of education based on the median years of education for people in each educational category.[15] The educational requirements for each occupation were calculated for each year, and then matched to job openings data. A metropolitan area-level measure of education demand is then generated based on the occupational category of every job opening in that metro area. In other words, the average years of education demanded by all job openings in a metro area is the weighted average of the educational requirements of each individual job opening in that metro area.

Consider the example of construction trade workers.[16] In 2007, 27 percent had less than a high school diploma; 44 percent had a diploma or equivalent; 5 percent had an associate's degree; 19 percent had some college; 4 percent had a bachelor's degree; 1 percent had a master's degree; and 0 percent had a Ph.D or professional degree. Therefore, a metropolitan economy consisting of only 100 construction trade openings exhibits demand for 27 people without diplomas; 44 with diplomas; five with associate's degree, etc. To calculate the average skill years demanded by the metropolitan economy, one would multiply the percentages quoted above by the number of years of schooling implied by each educational category. The sum of those products is the years of education demanded. The result is 12 years of education for the average construction trade workers in 2007, compared to an average of 13.7 for all occupations. The equation below shows the formula.

Average education demanded for worker in a given occupation = 10 x (share with less than high school diploma) + 12 x (share with high school diploma) +13 x (share with some college) +14 x (share with associate's degree) + 16 x (share with bachelor's degree) + 18 x (share with master's degree) + 20 x (share with doctorate or professional degree).

Education gap for metropolitan areas

The education gap is defined in this report as the extent to which demand for educated workers, as revealed in data on job openings and occupations, exceeds the supply of those workers, as revealed in data on adult educational attainment, in a given regional labor market.[17]

The ***education gap index*** is calculated as the years of education required by the average job vacancy in a metropolitan area divided by the years of education attained by the average working-age person in that metropolitan area. Subtracting by one and multiplying by 100 yields the percentage gap between supply and demand. Index values greater than zero signal an insufficient supply of educated workers in the regional labor market relative to demand. Values below zero indicate that the average worker has enough formal education to do the average job. A value below zero does not mean that all workers have enough education.

Aside from fact that this measure is a rough estimate of the balance between education supply and demand in a metro area labor market, it has other limitations. It ignores informal skills learned from on-the-job-training, non-academic learning, and experience. These would be much more difficult to measure and compare across metropolitan areas, whereas measures of formal educational attainment

are fairly standardized.

Measuring education supply is more straightforward. The Census Bureau's American Community Survey reports the share of working-age metropolitan residents with each level of educational attainment.[18] The percentages are multiplied by the corresponding years of education to get a measure of years of education attained (or supplied) by the average metropolitan worker.

This education gap index uses job openings to measure the demand for education, but those are only a fraction of total demand. So, the report also includes alternative measures of education demand—one using filled jobs and one using both filled and vacant jobs. These measures combine data from the Bureau of Labor Statistics and HWOL. For the combined measure, only new vacancies are considered from HWOL to avoid over-counting openings that are available for more than one month. The number of jobs in each minor occupation (three-digit SOC code) are combined across the two data sources and matched to the Census data on educational requirements.

Predicted industry job growth

Alongside education gaps, this report also examines how shifts in industry demand may have affected metropolitan unemployment rates, particularly during the Great Recession.

To account for the potential impact of metropolitan industrial profiles on metropolitan unemployment rates, this report constructs a single index to predict total metropolitan job growth based on U.S. job growth in each of the metropolitan area's significant industries.[19]

The predicted job growth index how a metropolitan area's employment level would change if each of its industries grew at the same rate as national employment for those industries.

In practice, the index multiplies the share of total metropolitan jobs for each metro area industry by the national growth rate of jobs in that industry over the period of interest (e.g. the recession); then, the metropolitan-specific products are summed to total predicted job growth for the metropolitan area, weighted by the area's industry shares. In plain language, the index measures how national trends affect a metro area, given the metro area's unique mix of industries.

A key advantage of this index is that it is unlikely to be biased by other aspects of the metropolitan area, including its unemployment rate, and it concentrates information for roughly 100 industries in 100 metro areas into one single measure for every metropolitan area. To be sure, metropolitan area trends in industry employment depend on that area's specific companies and enterprises, only some of which may track their industry peers in other parts of the country.[20] Thus, the results discussed below should not be not be interpreted as the effect of job growth on unemployment, but rather the effect of a metro area's industry mix on unemployment.[21]

Housing Market Dynamics

The Federal Housing Finance Agency (FHFA) provides time series data on housing prices (using repeated sales of all mortgages securitized by Fannie Mae or Freddie Mac) by quarter for each metropolitan area. The report uses these data to show how changes in housing prices have affected metropolitan unemployment. The underlying calculations from the FHFA include all conforming conventional mortgages purchased or securitized by Fannie Mae or Freddie Mac, and are based on repeat transactions to adjust for differences in housing quality. An annual growth rate in the housing price index was calculated for each metropolitan area from 2006 up through the first quarter of 2012 for the regression analyses shown in the appendix. The summary measures reported in tables below show the housing growth rate over that entire period, 2006 until the first quarter of 2012.

Control variables

Other control variables are used to account for the fact that metro areas vary in their demographic compositions, which affects their unemployment rates. Thus, the formal analysis, which is described in the methods appendix, adjusts for the percentage of workers aged 65 and older, the median age of the population, and the share of population that is white, black, and foreign-born. These data were gathered for recent years from the U.S. Census Bureau's American Community Survey.

Data on unemployment rates were obtained from the U.S. Bureau of Labor Statistics (BLS). The data are annual except for the latest available observation, which is from January of 2012 and not seasonally adjusted because of data limitations.[22] U.S. and metropolitan employment statistics were obtained from Moody's Analytics and calculated at the three-digit NAICS level.

Analysis

To analyze the data, the report employs a regression analysis to understand the effects of a potential education gap, housing depreciation, and trends in predicted industry demand, while holding other factors constant, such as unchanging metropolitan area characteristics and year to year trends that affect all metros. The main findings here are supported by that background analysis. The methods appendix describes the details of the more formal techniques.[23] Data were collected and analyzed for 100 largest U.S. metropolitan areas by population in 2010. Those metro areas are home to roughly 65 percent of all Americans.

Findings

Advertised job openings in large metropolitan areas require more education than all existing jobs and more education than the average adult has attained.

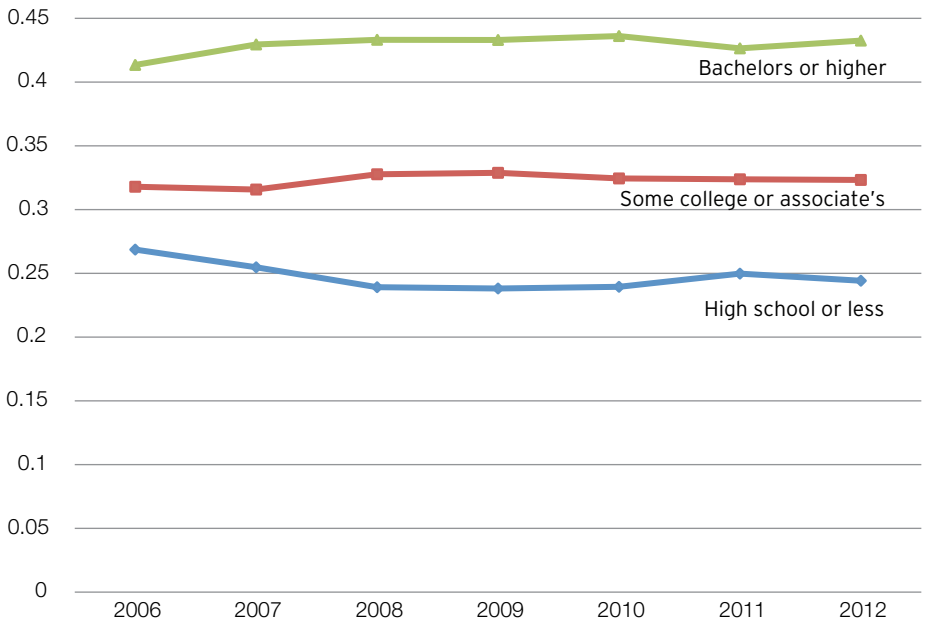
As of May 2012, the unemployment rate of workers with a high school diploma or less education is 9.9 percent, whereas the unemployment rate of workers with a bachelor's degree or higher is 3.9 percent. More educated adults are also much more likely to be in the labor force. The labor force participation rate for those with a high school diploma or less is just 55 percent, compared to 77 percent for those with a bachelor's degree.

One explanation as to why less educated workers struggle to find work is that there just are not enough job openings available for them. Figure 2 below shows the trend in the educational requirements of job vacancies since 2006. A mere 24 percent of all jobs in 2012 are available to workers without at least some post-secondary education. The plurality of jobs—43 percent—are available only to highly educated workers with at least a four-year college degree. These trends held fairly steady during the recession, after a slight increase in the educational requirements of the average job beginning in 2007. The housing market crash that began in 2006 lowered demand for less educated construction workers in particular. The proportional shift towards higher education is modest but notable—the share of vacant jobs for workers with a high school diploma or less decreased by three percentage points, from 27 percent to 24 percent.

The struggles of less educated workers are more apparent when openings data are compared with data on the educational attainment of the unemployed. Figure 3 shows how job opportunities for the unemployed varied by education group both before and after the recession, in 2007 and 2011. In both years, highly educated unemployed workers had many more openings available to them. In 2007, there were 12.0 jobs available (over the entire year) for every one job seeker with a bachelor's degree or higher. This compares to just 2.9 jobs for workers with a high school diploma or less and 6.5 jobs for those with some college or an associate's degree. In 2011, there were many fewer jobs available overall, but the gap by education remained. For those with no post-secondary education, the rate was just 1.6 annual openings for every unemployed worker, compared to 5.6 openings for unemployed workers with a bachelor's degree. These findings suggest that the recession did not significantly alter the underlying labor market trend that favors workers with more education.

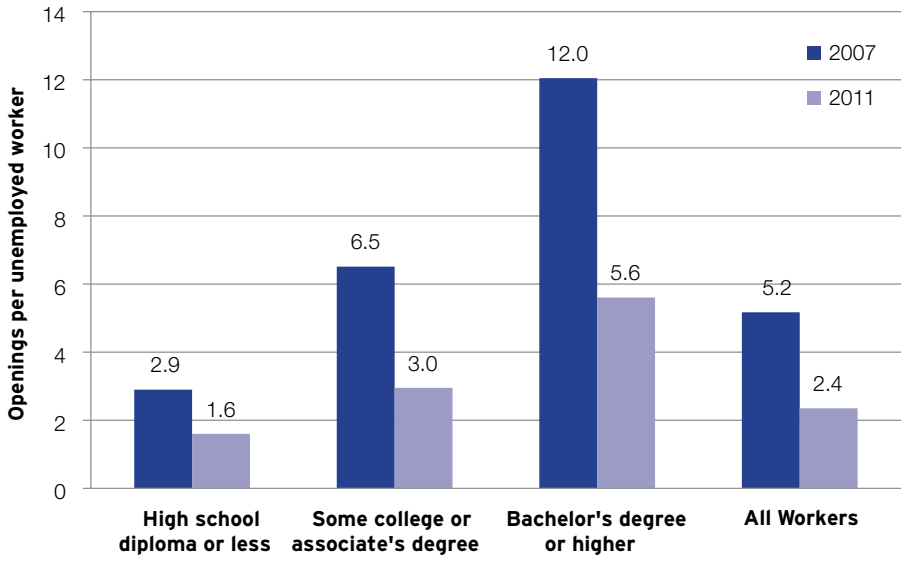
While roughly 40 percent of the U.S. population aged 25 and older living in large metro areas has a high school diploma or less, only 25 percent of jobs advertised online are available for workers with that level of education. A somewhat higher share (34 percent) of all jobs—vacancies and existing

Figure 2. Job openings in the 100 largest metropolitan areas by level of education required, 2006 to February 2012



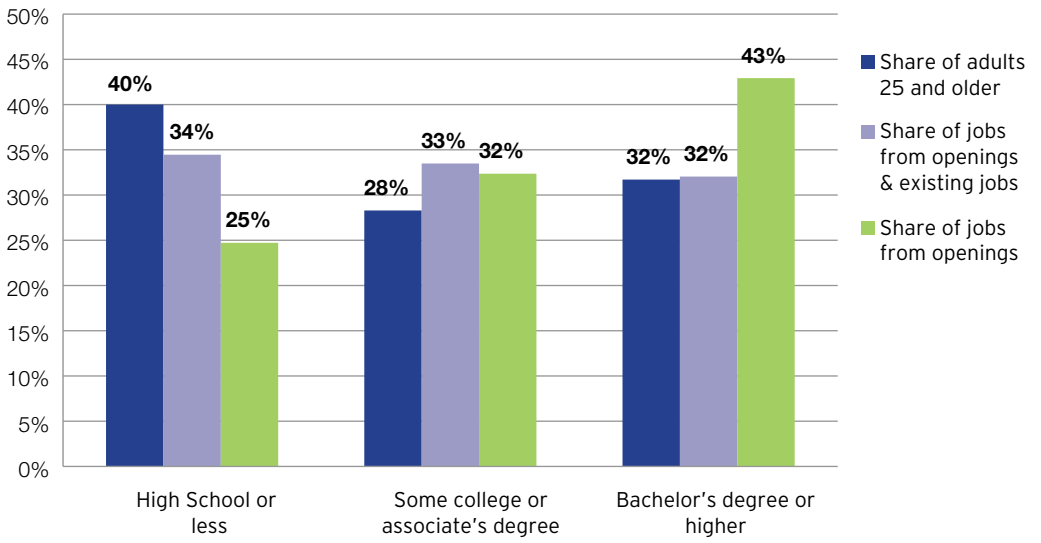
Source: Brookings analysis of Conference Board HWOL. Low refers to jobs that require a high school diploma or less, medium refers to some college or an Associate's degree, and high refers to a bachelor's degree or higher.

Figure 3. New Annual Job Openings per Unemployed Worker by Education Level



Source: Brookings analysis of Conference Board HWOL, Census Bureau American Community Surveys, and Bureau of Labor Statistics. Population of unemployed workers is limited to those between the ages of 25 and 64. Openings are only new openings to avoid over-counting reposted openings.

Figure 4. The share of adults aged 25 and older by level of education in large metro areas compared to the share of 2012 job openings by level of education



Source: Brookings analysis of Conference Board HWOL data, the Bureau of Labor Statistics (BLS), and the 2010 American Community Survey. Metro area educational attainment rates are weighted by population. Openings refers to all online vacancies, while openings and existing jobs also includes all jobs currently filled, as reported by the BLS.

Table 1. Job vacancies in January and February of 2012 by Educational Requirements and Minor Occupation

	Number of openings	Average year of education, 2012	Percent of workers with bachelor's degree or higher education, 2012
Computer Occupations	859,833	15.4	63%
Health Diagnosing and Treating Practitioners	443,611	16.7	71%
Other Management Occupations	196,199	14.6	47%
Financial Specialists	184,312	15.6	71%
Business Operations Specialists	183,574	15.0	56%
Sales Representatives, Services	178,859	14.5	48%
Engineers	177,581	16.0	79%
Information and Record Clerks	177,194	13.3	19%
Advertising, Marketing, Promotions, Public Relations, and Sales Managers	168,646	15.3	66%
Supervisors of Sales Workers	164,610	13.6	28%

Source: Brookings analysis of data from the Conference Board's HWOL series, and the 2010 American Community Survey. Roughly two-thirds of of these openings are new; the rest are repeated for at least one month and so overstate the total number of eventual jobs.

jobs—are available to these workers. Similarly, while about 32 percent of all adults have a bachelor's degree, and 32 percent of all jobs are in occupations that typically require that degree, the same is true for fully 43 percent of advertised vacancies. Insofar as online vacancies have higher-than-average educational requirements, less educated jobseekers may have to depend more on physical searching and social networks, and will have a harder time relying on computer-based methods for job search.

Many of the occupations advertised most online have relatively high educational requirements. Table 1 lists the 10 minor occupations with the largest number of job openings in the first two months of 2012 in large metro areas. For eight of these ten occupations, the share of workers with a bachelor's degree or higher is above the share of adults aged 25 and older in large metropolitan areas with a bachelor's degree or higher (32 percent). The most heavily advertised online job vacancies are in Computer Occupations, which typically demand at least a bachelor's degree. Other heavily demanded and high-education occupations include Health Diagnosing and Treating Practitioners (in which more than half of the jobs are for registered nurses), Financial Specialists, and Engineers.

Metro areas vary considerably in the level of education required by job openings posted online.

Even within the 100 largest metropolitan areas, demand for education varies considerably. As Table 2 shows, 56 percent of advertised openings in San Jose and 49 percent in San Francisco, Washington, and Bridgeport metro areas require a bachelor's degree or higher, while less than one-third do in McAllen, Texas, Honolulu, Youngstown, Ohio, and Cape Coral, Florida.

Current demand for workers with at least a bachelor's degree—as indicated by online job vacancies—exceeds supply in all but one large metro area, Madison; even there, the margin is just two percentage points. In the average large metro area, the rate of college degree attainment is 10 percentage points

Table 2. Metro area with the highest and lowest level of demand for workers with a bachelor's degree or higher, relative to all existing jobs and educational attainment rates, 2012

	Share of job openings requiring a bachelor's degree or higher, 2012	Share of existing jobs requiring a bachelor's degree or higher, 2011	Bachelor's degree or higher attainment rate, 2010
Large metro areas with the highest level of demand for workers with a bachelor's degree or higher			
San Jose-Sunnyvale-Santa Clara, CA	56%	36%	45%
San Francisco-Oakland-Fremont, CA	49%	32%	43%
Washington-Arlington-Alexandria, DC-VA-MD-WV	49%	37%	47%
Bridgeport-Stamford-Norwalk, CT	49%	31%	44%
Seattle-Tacoma-Bellevue, WA	48%	31%	37%
Boston-Cambridge-Quincy, MA-NH	48%	33%	43%
Atlanta-Sandy Springs-Marietta, GA	47%	30%	34%
New York-Northern New Jersey-Long Island, NY-NJ-PA	46%	31%	36%
Chicago-Joliet-Naperville, IL-IN-WI	46%	29%	34%
Hartford-West Hartford-East Hartford, CT	45%	32%	35%
Large metro areas with the lowest level of demand for workers with a bachelor's degree or higher			
Oklahoma City, OK	34%	27%	28%
New Orleans-Metairie-Kenner, LA	34%	26%	27%
Toledo, OH	34%	26%	24%
North Port-Bradenton-Sarasota, FL	33%	25%	27%
Scranton--Wilkes-Barre, PA	33%	25%	22%
Tulsa, OK	33%	26%	25%
McAllen-Edinburg-Mission, TX	32%	27%	16%
Honolulu, HI	32%	28%	32%
Youngstown-Warren-Boardman, OH-PA	31%	23%	19%
Cape Coral-Fort Myers, FL	29%	22%	23%
Average 100 largest metro area	**39%**	**28%**	**29%**

Source: Brookings analysis of data from the Conference Board's HWOL series, the BLS, and the 2010 American Community Survey. Job openings are vacancies advertised online. Attainment rate applies to adults 25 years and older.

Table 3. Metropolitan areas with the most job openings per unemployed worker in 2011 by educational attainment

	All workers	Workers with high school diploma or less, 2011	Worker with bachelor's degree or higher, 2011
Metro areas with most vacancies per unemployed worker with bachelor's degree or higher			
Harrisburg-Carlisle, PA	4.0	4.3	14.5
Des Moines-West Des Moines, IA	4.4	4.1	13.0
Omaha-Council Bluffs, NE-IA	5.6	3.6	12.4
Little Rock-North Little Rock-Conway, AR	3.1	2.5	11.9
Greenville-Mauldin-Easley, SC	2.8	2.1	11.9
Bakersfield-Delano, CA	1.1	0.7	11.5
Tulsa, OK	3.6	3.0	10.7
Honolulu, HI	5.1	4.1	10.3
Baltimore-Towson, MD	3.8	2.4	10.0
Modesto, CA	1.1	0.8	9.9
Metro areas with most vacancies per unemployed worker with high school diploma or less			
Madison, WI	4.7	5.0	7.9
Harrisburg-Carlisle, PA	4.0	4.3	14.5
Honolulu, HI	5.1	4.1	10.3
Des Moines-West Des Moines, IA	4.4	4.1	13.0
Minneapolis-St. Paul-Bloomington, MN-WI	4.1	3.9	7.4
Omaha-Council Bluffs, NE-IA	5.6	3.6	12.4
Raleigh-Cary, NC	4.5	3.5	6.6
Oklahoma City, OK	4.3	3.3	8.7
Rochester, NY	2.5	3.1	4.7
Pittsburgh, PA	3.4	3.0	8.0
Average of all 100 large metros	**2.6**	**1.9**	**6.8**

Source: Brookings analysis of data from the Conference Board's HWOL series, the BLS, and the 2010 American Community Survey. Workers refer to adults between the ages of 25 and 64. Vacancies refer to only new vacancies, advertised online, such that openings reposted after one month were not included.

lower than the share of advertised vacancies that require a college degree. The gap between supply and demand for each metro is explored more directly in the next section.

A more direct way to measure job opportunities and job competition is through openings per unemployed worker, which also varies widely across metro areas. Metropolitan Omaha, Nebraska, for example, has the most annual job openings per unemployed worker at 5.6. For workers with bachelor's degrees, the rate is 12.4. Yet, even in this market, there are only 3.6 job openings per worker for those with a high school diploma or less. Table 3 compares the number of job openings by education to the number of workers by education for the metro areas with the 10 most vacancies per unemployed worker—for high and less educated workers in 2011.

A surprising mix of metro areas that includes both healthy and struggling labor markets have the most job vacancies for workers with a bachelor's degree or higher per unemployed worker. The list includes some metro areas with a large number of overall openings relative to unemployed workers—like Omaha and Des Moines. In these metro areas, all unemployed job seekers tend to have a large number of openings available to them, not just the highly educated. Yet, in Bakersfield and Modesto there are roughly 10 times more job openings per unemployed worker for the highly educated than there are for the less educated. In Greenville, there are four times as many. Even in troubled metro economies, there are opportunities for highly educated workers.

The bottom of the table lists the metro areas with the most job openings for every less educated unemployed worker. These are the metro areas with the most job opportunities for unemployed workers who have not attended college. They tend to be areas that are generally doing well, like Madison, Raleigh, and Pittsburgh.

The results have largely focused on demand from the perspective of job vacancies advertised online. It is worth noting that existing jobs tend to require considerably less education than those advertised online; this partly due to the fact that some businesses—like restaurants—are less likely to advertise on-line, but it also represents a shift in demand. The difference in education requirements between existing jobs and open jobs means that many metro areas will have to adjust to the reality that for every retirement, layoff, or expansion, the replacement jobs or new jobs will require more education. This presents a major challenge to many less educated workers and less educated metros.

Unemployment rates are 2 percentage points higher in large metro areas with a shortage of educated workers relative to demand, and have been consistently higher since before the recession.

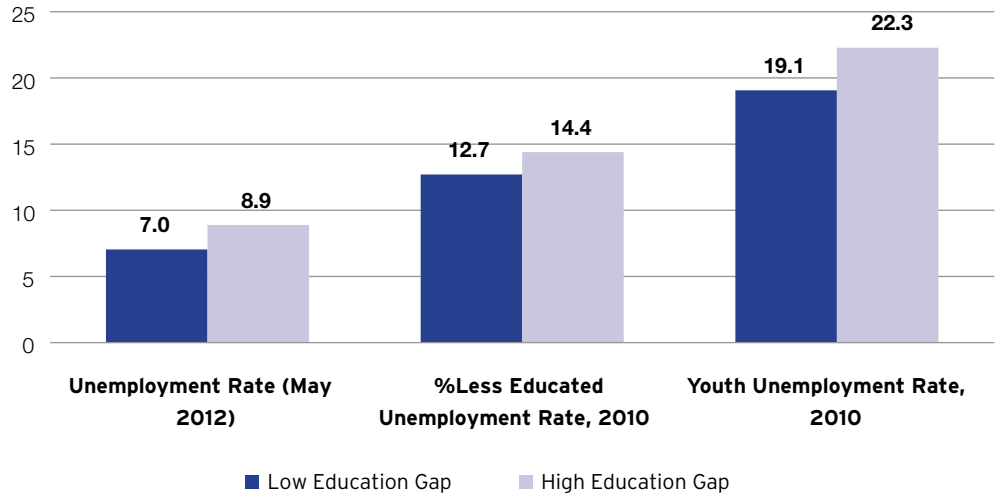
The preceding analysis implies that there are large mismatches in the supply of and demand for educated workers in many metropolitan areas. The question is: Does this mismatch translate into higher unemployment? The answer appears to be yes.

Metro areas were classified into those with high or low education gaps, depending on whether they were above or below the average of all large metro areas on the education gap index. Those with a high education gap—where demand is much larger than supply—have an average unemployment rate, as of in May 2012. This compares to just 7 percent for metro areas with below average education gaps. Figure 5 presents these results.

Even if the aggregate unemployment rate is lower in metro areas that are well educated for their jobs, some might predict that the unemployment rate for less educated or less experienced workers might be higher. Indeed, it would seem that in metro labor markets with a high share of educated workers, less educated or experienced workers would have a difficult time competing.

Paradoxically, however, metro areas with the most highly educated workers relative to demand also have the lowest unemployment rates for both less educated and less experienced workers, as Figure 5 shows. The opportunities for those with the least education are often in the metro area labor markets with the most education. This is not an entirely novel finding. Urban economists have shown that higher-educated workers in high-tech and other exporting sectors stimulate demand for local service jobs that employ less educated workers.[24] Moreover, college educated workers are much more likely to employ others in their own business.[25] To be sure, living in a metro area with

Figure 5. Average unemployment rates overall, for less educated workers, and for the youth, by Education Gap, in the 100 largest metropolitan areas



Source: Brookings analysis of Conference Board HWOL, BLS, and 2010 American Community Survey. Unemployment rate of less educated workers refers to those with a high diploma or less education. Youth refers to adults between and including the ages of 18 and 24.

Table 4. The education gap and unemployment rates for all workers, less educated workers, and youth by large metro area, 2010

	Education gap for openings, 2012	Unemployment rate, January 2012	Less educated unemployment rate, 2010	Youth unemployment rate, 2010
Metro areas with smallest education gap for job openings				
Madison, WI	-1.1%	5.3	9.2	10.8
Honolulu, HI	0.2%	5.7	8.9	14.3
Provo-Orem, UT	0.5%	5.9	12.8	14.2
Raleigh-Cary, NC	1.3%	8.4	14.6	19.4
Washington-Arlington-Alexandria, DC-VA-MD-WV	1.4%	5.7	10.6	19.3
Rochester, NY	1.8%	8.6	8.8	17.3
Colorado Springs, CO	1.9%	9.6	13.7	19.7
Poughkeepsie-Newburgh-Middletown, NY	2.0%	8.3	9.6	21.3
Charleston-North Charleston-Summerville, SC	2.1%	7.7	14.9	22.9
Minneapolis-St. Paul-Bloomington, MN-WI	2.4%	5.9	10.4	17.8
Average of 10 metro areas with smallest gap	**1.3%**	**7.1**	**11.4**	**17.7**
Metro areas with largest education gap for job openings				
Houston-Sugar Land-Baytown, TX	8.3%	7.6	9.9	17.9
Augusta-Richmond County, GA-SC	8.5%	9.1	14.1	25.3
Riverside-San Bernardino-Ontario, CA	8.9%	12.4	18.3	27.5
Stockton, CA	9.7%	16.6	20.5	28.3
Lakeland-Winter Haven, FL	10.8%	10.5	17.6	23.4
Fresno, CA	11.0%	16.9	18.7	24.1
Modesto, CA	11.8%	16.9	20.1	32.2
El Paso, TX	13.0%	10	9	18
Bakersfield-Delano, CA	13.7%	15	17.4	24.3
McAllen-Edinburg-Mission, TX	13.9%	11.7	11.9	21
Average of 10 metro areas with largest gap	**11.0%**	**12.7**	**15.8**	**24.2**
Average of 100 largest metro areas	**5.1%**	**8.7**	**13.5**	**20.5**

Source: Brookings analysis of Conference Board HWOL, BLS, and 2010 American Community Survey. Unemployment rate of less educated workers refers to those with a high diploma or less education. Youth refers to adults between and including the ages of 18 and 24.

a relatively low education gap does not solve unemployment. The youth unemployment rate—a measure of inexperienced workers—is still a startling 19.1 percent in metro areas with low education gaps, and the unemployment rate for workers with no college is still 12.7. Yet, both of these are significantly below—by 3.2 and 1.7 percentage points respectively—comparable unemployment rates in metro areas with high education gaps.

This pattern can be further illustrated by looking at specific metro areas. As Table 4 shows, the 10 metro areas with the lowest education gaps have relatively low unemployment rates for less educated and less experienced workers. Some of these metro areas are not particularly high-skilled labor markets, but they have a strong balance. These include Honolulu, Provo, Rochester, Poughkeepsie, and Charleston.[26] The other five metro areas are characterized by both high demand and high supply of education, exemplified by Washington, D.C. The implication is that metro areas succeed when their workers have high educational attainment for their occupations. Whether that is a PhD or Associate's degree depends on the occupation.

Madison is the only large metro area with more than enough educated workers to meet demand in job openings, but this competition for high-skilled jobs does not appear to harm the highly educated, much less the labor market. The unemployment rate of those with a bachelor's degree or higher is just

3.7 percent in Madison—well below the large metro average of 4.8 percent. There is no evidence that a metro area can suffer from being too educated.

At the bottom of the table, metro areas with large education gaps all have low educational attainment rates. Again, five exhibit below-average demand for educated labor, and five exhibit above-average demand. Job openings in Houston, for example, require an average of 14.5 years of education, which is above the average for all metro areas, but the average worker in Houston has just 13.3 years (slightly below the metro average of 13.6). In McAllen, by contrast, vacancies require an average of just 13.9 years of education, but the average worker has obtained a mere 12.2 years.

In metro areas with low education gaps, unemployment rates are considerably lower for the average worker, for the less educated, and for young adults. The differences are large, between 4 and 6 percentage points. In healthy labor markets, characterized by a highly educated workforce, all groups do better, even those with the least education and experience.

Notably, a metro area's education gap does a better job explaining its rate of unemployment than more straightforward measures of educational attainment alone. The simple correlation coefficient between a metro area's rate of bachelor's degree attainment and unemployment rate in 2010 is -0.53; the higher the attainment rate, the lower the unemployment rate. The correlation coefficient between its education gap and unemployment rate using openings is stronger, at 0.66. The correlation with the alternative education gap measures—using filled jobs and filled jobs combined with vacant jobs—is also high, at 0.55 and 0.59 respectively. The appendix analyzes these relationships in more detail.

Declines in industry demand and housing prices explain most of the recent cyclical *increases* in metropolitan unemployment rates, but education gaps explain most of the structural level of metropolitan unemployment over the past few years.

The education gap between job openings and workers clearly relates to unemployment in metropolitan areas. This section explores how its importance ranks alongside other factors that have contributed to recent metropolitan economic woes, notably industry demand and house prices.

Industry performance

Cyclical national trends in demand for employment by industry can strongly affect unemployment at the metropolitan level, depending on each metro area's unique industrial composition. Job growth has varied widely across national sectors since 2006, translating to potentially considerable variation across metropolitan economies.

For example, manufacturing has been strong recently, with 430,000 net jobs added over those two years, but is still very far from its pre-recession peak. Thus, manufacturing-oriented metro areas like Akron and Detroit fell a long way down but have seen a strong rebound, however incomplete. The energy sector—mining, oil, and gas—is one of the few sectors to fully recover and even surpass pre-recession employment levels, boosting job growth in places like Oklahoma City. Health care and education were the only major sectors with consistent growth throughout the recession and recovery, giving an advantage to metropolitan areas concentrated in those industries, like Pittsburgh.

While specific companies do better or worse than their same-industry peers, to a large extent, a metro area's industry dynamics are like stock market prices, in that metro companies have limited influence over national and international market trends. Metropolitan areas with employment in growing industries (those with above-average growth rates) limited the increase in unemployment rates by 0.5 points each year from 2007 to 2012 relative to metro areas with slumping industries (those with below-average growth rates). Moreover, the level of unemployment was 0.3 percentage points lower in metro areas with growing industries over a one-year period, relative to metro areas concentrated in industries with below-average performance.

Housing

Aside from cyclical industry demand, the housing market has greatly affected the depth of recession and pace of recovery. Some parts of the country—namely California, Florida, and Nevada—were hit particularly hard by subprime lending and subsequent foreclosures. Foreclosures and rising unemployment combined to dramatically weaken housing prices, and falling housing prices reduced consumer demand and local tax revenues.[27]

Metro areas experiencing larger-than average housing price declines from 2006 to 2012 saw unemployment rates increase by half a percentage point more than other metro areas for each year they had large price declines. Throughout the recession, but especially in 2008, unemployment rate levels were also significantly higher in metro areas with below average annual housing price growth—by 0.8 percentage points in 2008, and 0.4 percentage points from 2006 to 2012.

Education Gap

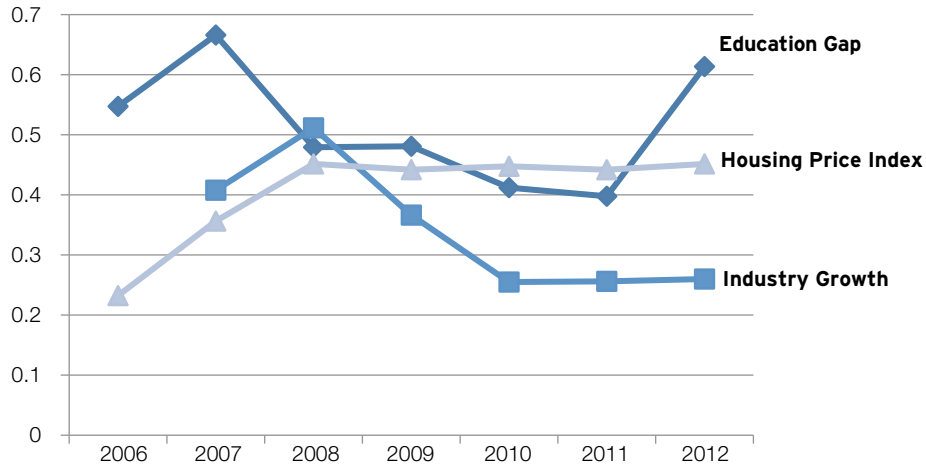
How do metropolitan education gaps rank against industry demand and housing price factors in determining metropolitan unemployment? To answer this question, this analysis employs a regression that calculates the individual effect of each factor on unemployment, while holding the other factors constant. To gauge the relative size of the effects of each factor, the analysis compares metro areas that score well (above average) on each indicator to those that score badly (below average).

The analysis separates short-term unemployment rate changes from the long-term unemployment rate.[28] Figure 6 focuses on annual changes in unemployment, by comparing large metro areas that are above and below average on each measure. This can be interpreted as the effect on cyclical or short-term unemployment.

Overall, changes in industry demand and house prices account for the bulk of recent increases in metropolitan unemployment rates. One can see that the housing market effect peaked in 2008, when metro areas with below average housing market growth (in the preceding year) experienced a half percentage point increase in unemployment relative to metro areas with above average housing price growth. The industry demand and education effects peaked in 2007, adding nearly 0.7 percentage points. Across 2006 to 2012, the housing effect explains roughly 34 percent of the increase in unemployment, while the industry demand effect explains roughly 40 percent, and the education gap accounts for 27 percent. In short, education gaps have been less important than housing and industry demand in explaining short-term unemployment rate changes in metro areas.

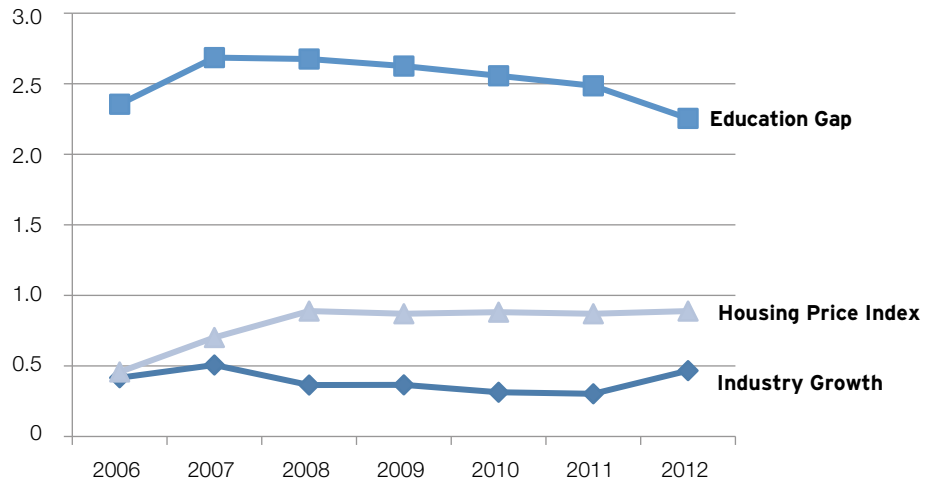
The education gap has a much stronger relationship with the level of unemployment (i.e., the unemployment rate), as opposed to yearly changes in the measure (Figure 7). Before, during, and after the recession, metro areas with an above-average education gap had unemployment rates that were an average of at least two percentage points higher than metro areas with below-average gaps. Here, the

Figure 6. Cyclical Unemployment: Estimated effect of industry demand, education matching, and housing markets on annual changes in metro area unemployment rates by percentage point, 2007-2012



Source: Brookings analysis of Conference Board HWOL, BLS, Moody's Economy.com, the Federal Housing Finance Agency and 2010 American Community Survey. Effect compares unemployment in metro areas that score above average on each metric to metro areas that score below average.

Figure 7. Structural Unemployment: Estimated effect of industry demand, education matching, and housing markets on metro area unemployment rates by percentage point, 2006-2012



Source: Brookings analysis of Conference Board HWOL, BLS, Moody's Economy.com, the Federal Housing Finance Agency and 2010 American Community Survey. Effect compares unemployment in metro areas that score above average on each metric to metro areas that score below average.

housing and industry demand effects are more muted, though still significant; they have also gained in importance over the last year as industrial recovery has helped lower unemployment. Over the entire period, the education gap accounts for 67 percent of the level of unemployment, while housing accounts for 22 percent and industry demand just 10 percent. In this way, the education gap exerts more of a long-run impact on metropolitan unemployment.

Each metro area can be ranked on the three main factors.[29] As one can see in the figures showed above, the relative importance of each depends on whether one is looking at changes in the unemployment rate (short-term performance since the recession started) or the level of unemployment (overall labor market strength).

On recent changes in unemployment, house-price dynamics clearly separate those metro areas at the top and bottom of the list. Table 5 shows the metro areas with the smallest and largest rises in unemployment as predicted by their education gap, house-price trend, and industry growth.[30] The top 10 saw unemployment rise an average of 2.5 percentage points from its pre-recession minimum, compared to 6.4 percentage points in the bottom 10. Pittsburgh has the most resilient labor market characteristics of any large metropolitan area. While it scores in the top quintile on all three measures, its greatest strength is in housing prices, which rose 7.3 percent since 2006, even as prices decreased by 15 percent in the average large metro area. All of the metro areas ranked in the top 10 on resilience are in the top 20 on house price growth. Likewise, in the metro areas with the lowest predicted unemployment rates—exemplified by Central Valley California—prices have plummeted since 2006.

Turning to the predicted level of unemployment in May of 2012 (Table 6), the rankings change for most metro areas compared to those based on changes in unemployment. Now, the education gap has larger weight, and so Rochester moves into the top spot, because of its well-matched labor force and stable, if low priced, housing markets. Madison is third, despite being hobbled by jobs losses in state government. The major difference between high-ranking metro areas and low-ranking metro areas is the education gap, which is roughly 8 percentage points lower in high-ranking metro areas. This compares to a difference of just 5 percentage points in Table 5.

Inland California is home to the six of the ten metro areas with the weakest labor market fundamentals, including the four with the lowest scores. Joining them are metro areas in Nevada, Florida, and Texas that are also plagued by relatively low educational attainment rates and weak housing markets,

Table 5. Large metro areas with most recession resilient short-term labor markets based on education matching, housing market performance, and industry demand

	Average education gap, 2010-2012	Housing Price Growth, 2006-2012Q1	Predicted Industry Growth, 2010Q1-2012Q1	Change in unemployment rate since pre-recession minimum	Predicted change in unemployment rate since pre-recession minimum
10 metro areas with most resilient labor markets based on predicted change in unemployment rate					
Pittsburgh, PA	3.1%	7.3%	3.0%	2.3	1.6
Tulsa, OK	4.5%	6.1%	3.3%	1.6	1.6
Oklahoma City, OK	3.7%	5.8%	3.0%	0.7	1.8
Buffalo-Niagara Falls, NY	2.6%	9.1%	2.6%	3.6	1.9
Houston-Sugar Land-Baytown, TX	8.7%	9.1%	3.6%	2.6	1.9
Rochester, NY	1.6%	4.0%	2.6%	3.4	1.9
Wichita, KS	6.1%	5.4%	3.2%	2.9	2
Knoxville, TN	3.3%	1.2%	2.8%	2.6	2.1
Austin-Round Rock-San Marcos, TX	3.3%	12.7%	2.2%	2.1	2.2
Greenville-Mauldin-Easley, SC	6.1%	2.6%	3.1%	3	2.3
Average of strongest metros	**4.3%**	**6.3%**	**2.9%**	**2.5**	**1.9**
10 metro areas with least resilient labor markets based on predicted change in unemployment rate					
Miami-Fort Lauderdale-Pompano Beach, FL	6.8%	-44.6%	2.6%	5.1	5.1
Cape Coral-Fort Myers, FL	4.1%	-52.2%	2.2%	5.8	5.4
Las Vegas-Paradise, NV	8.0%	-60.0%	2.8%	7.6	5.8
Lakeland-Winter Haven, FL	11.4%	-43.2%	2.6%	5.6	5.8
Sacramento--Arden-Arcade--Roseville, CA	6.4%	-45.3%	1.7%	5.7	5.9
Riverside-San Bernardino-Ontario, CA	9.2%	-48.3%	2.3%	6.9	6
Bakersfield-Delano, CA	13.9%	-49.9%	2.6%	6.1	6.5
Stockton, CA	10.0%	-58.6%	2.0%	7.1	6.9
Fresno, CA	11.1%	-48.0%	1.6%	6.9	6.9
Modesto, CA	11.9%	-59.7%	2.1%	7.6	7.1
Average of weakest metros	**9.3%**	**-51.0%**	**2.3%**	**6.4**	**6.1**
Average of 100 largest metro areas	**5.3%**	**-15.1%**	**2.6%**	**3.5**	**3.5**

Source: Brookings analysis of Conference Board HWOL, BLS, Moody's Economy.com, the Federal Housing Finance Agency and 2010 American Community Survey. Metro areas are ranked according to the predicted change in unemployment from each metro area's pre-recession minimum annual unemployment rate to the most current rate as of writing (May of 2012). The education gap measure displayed here uses 2010, 2011, and 2012 openings data but only 2010 educational attainment data.

namely Las Vegas, Lakeland, El Paso, and McAllen. Theses metro all have wide education gaps, and with the exception of the Texas metros, their housing markets have suffered severely in recent years. For three of them—Bakersfield, Lakeland, and Las Vegas—the good news is that their main industries have bounced back somewhat during the recovery, but it has not been enough to overcome their other challenges and lower unemployment rates to single digits.

The predicted unemployment rates fit well overall but differ significantly from actual rates for certain metro areas. For Rochester, Buffalo, and Raleigh, the predicted unemployment rates are considerably below their actual unemployment rates. There are many reasons why this might be the case, including long-term industrial decline in up-state New York of companies whose industrial peers are doing better in other locations. Another factor is related to state banking laws. North Carolina—along with Rhode Island, California, and Nevada—were among the first states to allow banking consolidations, a regulatory decision that resulted in more aggressive sub-prime lending during the most current housing bubble.[31] For similar reasons, metro areas in Texas, which only very recently allowed

Table 6. The long-term strongest and weakest large metro areas based on education matching, housing market performance, and industry demand

	Average education gap, 2010-2012	Housing Price Growth, 2006-2012Q1	Predicted Industry Growth, 2010Q1-2012Q1	Unemployment Rate, May 2012	Predicted Unemployment Rate, May 2012
10 metro areas with the strongest labor markets based on predicted unemployment rate					
Rochester, NY	1.6%	4.0%	2.6%	8	5.5
Pittsburgh, PA	3.1%	7.3%	3.0%	6.6	5.5
Madison, WI	-1.2%	-4.3%	1.8%	4.9	5.6
Buffalo-Niagara Falls, NY	2.6%	9.1%	2.6%	8.5	5.7
Raleigh-Cary, NC	1.2%	0.4%	2.3%	7.7	5.8
Provo-Orem, UT	1.1%	-11.0%	2.7%	5.7	5.9
Tulsa, OK	4.5%	6.1%	3.3%	5.3	5.9
Oklahoma City, OK	3.7%	5.8%	3.0%	4.5	5.9
Knoxville, TN	3.3%	1.2%	2.8%	6.3	6.1
Honolulu, HI	0.9%	-4.0%	2.1%	5.6	6.1
Average of strongest metros	**2.1%**	**1.5%**	**2.6%**	**6.3**	**5.8**
10 metro areas with the strongest labor markets based on predicted unemployment rate					
Sacramento--Arden-Arcade--Roseville, CA	6.4%	-45.3%	1.7%	10.4	10.5
El Paso, TX	12.9%	3.5%	2.1%	9.3	10.5
Las Vegas-Paradise, NV	8.0%	-60.0%	2.8%	11.8	10.7
McAllen-Edinburg-Mission, TX	15.0%	0.5%	2.5%	10.8	11.2
Riverside-San Bernardino-Ontario, CA	9.2%	-48.3%	2.3%	11.8	11.2
Lakeland-Winter Haven, FL	11.4%	-43.2%	2.6%	9.2	11.6
Stockton, CA	10.0%	-58.6%	2.0%	14.5	12.2
Fresno, CA	11.1%	-48.0%	1.6%	14.9	12.6
Bakersfield-Delano, CA	13.9%	-49.9%	2.6%	13.6	12.8
Modesto, CA	11.9%	-59.7%	2.1%	15.6	13
Average of weakest metros	**11.0%**	**-40.9%**	**2.2%**	**12.2**	**11.6**
Average of 100 largest metro areas	**5.3%**	**-15.1%**	**2.6%**	**7.9**	**7.9**

Source: Brookings analysis of Conference Board HWOL, BLS, Moody's Economy.com, the Federal Housing Finance Agency and 2010 American Community Survey. Predicted unemployment is based on regression of actual unemployment rates on the variables in the first three columns. The education gap measure displayed here uses 2010, 2011, and 2012 openings data but only 2010 educational attainment data.

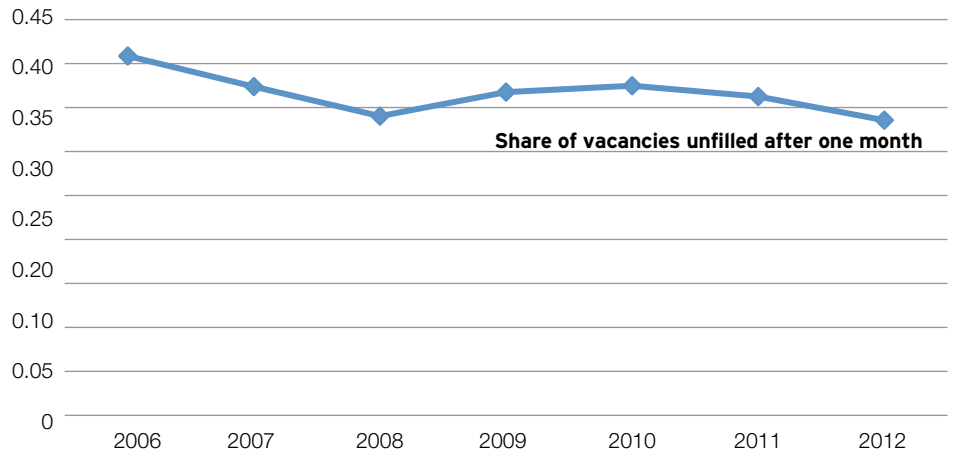
intra-state branching and consolidates, have done better than expected. There are, of course, other factors also left out of this simple model. The metro areas of Rochester and Buffalo are also both heavily regulated by local governments that have kept affordable housing out of wealthy areas and thereby exacerbated racial and economic inequality.[32] These policies weaken the quality of education for lower income workers.

Metro areas with higher education gaps have experienced lower rates of job creation and job openings over the past few years.

As discussed in the introduction, some analysts have speculated that high unemployment rates during this recovery have been prolonged by a skill mismatch. The logic is as follows: If the skills (or education) of unemployed workers does not match what employers need, vacant jobs will remain unfilled even as the economy expands, or employers will invest in technology (e.g. computers or machines) to do the work or offshore it. The unemployment rate will remain high.

For this theory to hold, one would expect that the education gap would explain short-term changes in unemployment as well or better than industry demand and housing prices. As discussed above, this is not the case. Growth in industry demand and housing prices has brought down unemployment.

Figure 8. Share of Vacancies Taking at least One Month to Fill in 100 Largest Metro Areas, 2006-2012



Additionally, one would expect that jobs have become more difficult to fill during the course of the recession, compared to before the recession, and that metropolitan areas that take longer to fill jobs would have higher unemployment rates. Both of these latter predictions are also not supported by the evidence.

To the first point, the number of monthly hires in the United States as a share of job openings announced in the previous month is just as high, on average, in the recovery period (July 2009 to May 2012)—at 1.40—as it was before the recession (February 2002 to December 2007)—at 1.33.[33] Likewise, the correlation between U.S. quarterly job growth and quarterly changes in unemployment is no different in this recovery than in previous recoveries.[34] Moreover, in the 100 largest metropolitan areas, the percentage of jobs that have gone unfilled for one month or longer has not increased during the recession, as Figure 8 clearly shows. In fact, the share of jobs taking at least one month to fill was roughly the same in 1966, 31 percent.[35] Overall, job openings are resulting in the same number of hires and net job creation now as they were before the recession.

To the second prediction, metropolitan areas take longer to fill vacant jobs do not have higher unemployment rates. In fact, more highly educated metro areas tend to have a larger share of jobs, often in science-related fields, that take a month or longer to fill. As Table 7 shows, the metro areas with the highest share of jobs going unfilled include many with relatively low unemployment rates like Dallas, Jackson, Mississippi, Milwaukee, Springfield, Massachusetts, and Washington D.C, whereas those that easily fill jobs include high-unemployment metro areas like Cape Coral, Florida and Las Vegas. The education gap is not correlated with the share of openings that go unfilled.

The evidence offered in the previous findings suggests that skill-mismatch is mostly a long-run problem, with a small cyclical effect. And yet, in explaining that short-term effect, there is another compelling link between education and regional economic success, which is entrepreneurship.[36] In 2007, 48 percent of all business owners with paid employees had obtained a bachelor's degree or higher, compared to just 28 percent of the U.S. population.[37]

With this in mind, an alternative theory for the success of well-educated metro areas is that human capital—measured by either educational attainment rates or the education gap—raises entrepreneurship and business competitiveness, yielding more openings.

Labor economists have noted that the growth rate of college educated Americans has declined, and other scholars have noted a long-term decline in job creation.[38] Indeed, 1980 marks an important turning point in the U.S. labor market from an era of rapid growth in educational attainment and job

Table 7. Metropolitan areas with the highest and lowest share of job openings going unfilled after one month

	Share of openings unfilled after one month, 2012	Change in unfilled rate, 2007-2012	Unemployment rate, May 2012
Metro areas with high unfilled rates			
Bridgeport-Stamford-Norwalk, CT	42%	-3%	7.5
Augusta-Richmond County, GA-SC	40%	-2%	9.0
Milwaukee-Waukesha-West Allis, WI	40%	0%	7.4
San Jose-Sunnyvale-Santa Clara, CA	39%	0%	8.4
Chicago-Joliet-Naperville, IL-IN-WI	38%	0%	8.5
Washington-Arlington-Alexandria, DC-VA-MD-WV	38%	-1%	5.3
Springfield, MA	38%	0%	6.8
Scranton--Wilkes-Barre, PA	38%	1%	8.7
Jackson, MS	38%	-6%	7.1
Dallas-Fort Worth-Arlington, TX	37%	0%	6.8
Average for metro areas with high unfilled rate	**39%**	**-1%**	**7.6**
Metro areas with low unfilled rates			
San Antonio-New Braunfels, TX	29%	-9%	6.6
Charleston-North Charleston-Summerville, SC	28%	-15%	7.9
Akron, OH	28%	-11%	6.6
Tucson, AZ	27%	-6%	7.2
Orlando-Kissimmee-Sanford, FL	27%	-11%	8.3
Raleigh-Cary, NC	27%	-5%	7.7
Las Vegas-Paradise, NV	27%	-4%	11.8
North Port-Bradenton-Sarasota, FL	26%	-15%	8.4
Honolulu, HI	20%	-12%	5.6
Cape Coral-Fort Myers, FL	18%	-26%	8.7
Average for metro areas with low unfilled rate	**26%**	**-11%**	**7.9**

Source: Brookings analysis of Conference Board HWOL data and BLS. 2012 data covers only January and February and was seasonally adjusted by the author.

creation to an era with more modest growth of both educational attainment and job creation. This trend is documented in Figure 9 and cannot be attributed to changes in population growth.

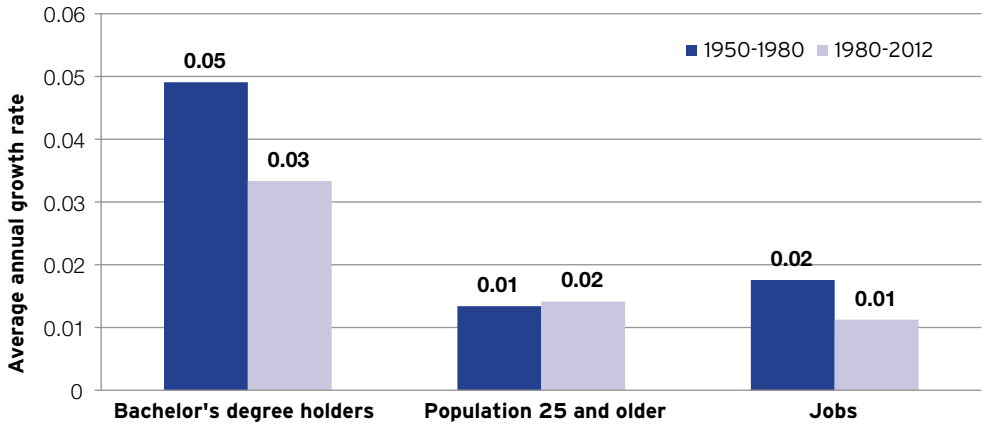
The trend can be seen at the metro scale as well. Large metro areas with above average increases in their bachelor's degree attainment rates had a larger increase in the number of jobs per capita from 1980 to 2010.[39] Metro areas like Boston, Washington DC, Indianapolis, and Seattle experienced a large increase in educational attainment and a large increase in the number of jobs per capita over the thirty year period. Metro areas like Las Vegas, Houston, Wichita, and much of inner California experienced the opposite trend.

Job openings are not created out of nothing. Entrepreneurs are often highly educated, and they consider the quality of their potential labor force before deciding to open a business or expand in a given geographic area. Likewise, a business is more likely to survive during a recession if it has a labor force that matches its skill requirements.

Metro areas with a lower education gap appear more entrepreneurial, as evidenced by their higher rate of job openings. In 2011, monthly job openings as a share of existing employment was 0.4 percentage points higher in metro areas with below average education gaps (2.4), compared to those with above average education gaps (2.0). This translates into roughly 41,000 more openings per year for metro areas with stronger human capital.[40]

Metro areas with a more educated workforce, relative to job openings, score better on measures of job creation. Table 8 lists the large metro areas that score highest and lowest on the education gap measure, using openings. Compared to metro areas that score badly on the education gap, those with low scores exhibit a new job openings rate that is roughly 0.7 percentage points higher and a lower

Figure 9. Long-run Growth in U.S. Higher Education, Population, and Employment in Two Periods, 1950 to 1980 and 1980 to 2010.



Source: Brookings analysis of U.S. Census Current Population Survey, Historical Time Series Tables and BLS Current Population Survey. Education data ends in 2011.

Table 8. Job Openings Rate in 2011 and Job Growth Rate from First Quarter 2008 to First Quarter 2012 in Large Metropolitan Areas with the Smallest and Largest Education Gaps

	New openings per existing job, 2011	Job Growth 2008q1-2012q1
Metro areas with smallest education gap		
Madison, WI	2.6%	-2.1%
Honolulu, HI	2.5%	-3.4%
Raleigh-Cary, NC	2.2%	-2.0%
Provo-Orem, UT	3.1%	0.6%
Rochester, NY	3.8%	-1.3%
Washington-Arlington-Alexandria, DC-VA-MD-WV	1.9%	0.1%
Charleston-North Charleston-Summerville, SC	3.1%	-1.7%
Colorado Springs, CO	1.8%	-1.1%
Minneapolis-St. Paul-Bloomington, MN-WI	2.8%	-0.8%
Poughkeepsie-Newburgh-Middletown, NY	2.7%	-3.1%
Average for low gap metros	**2.6%**	**-1.5%**
Metro areas with largest education gap		
Augusta-Richmond County, GA-SC	1.6%	2.5%
Houston-Sugar Land-Baytown, TX	1.8%	-3.3%
Riverside-San Bernardino-Ontario, CA	1.6%	-8.2%
Stockton, CA	2.4%	-6.6%
Fresno, CA	2.1%	-9.6%
Lakeland-Winter Haven, FL	2.1%	-6.3%
Modesto, CA	2.8%	-8.6%
El Paso, TX	1.6%	2.6%
Bakersfield-Delano, CA	2.1%	-0.6%
McAllen-Edinburg-Mission, TX	1.1%	5.5%
Average for high gap metros	**1.9%**	**-3.3%**
Average for all large metro areas	**2.3%**	**-3.7%**

Brookings analysis of data from the Conference Board HWOL, BLS, and Moody's Economy.com.

rate of decline in total employment (of 1.8 percentage points) since the start of the recession. Even controlling for predicted industry growth, there is a strong negative correlation between actual job growth and the education gap.

These results suggest that the education gap limits the number of job openings. One implication is that metropolitan areas with low levels of education relative to what their industries need, face a cyclical and structural problem: They have too few job openings in the short-term, and over-the long-term, a large number of job seekers are unqualified to fill the jobs that are available.

Discussion

The findings from this analysis emphasize the increasing importance of education for vacant jobs—or at least those advertised online—and shed additional light on the causes of recovery, or lack thereof, in metropolitan areas and the nation. Each metro area's problems are a unique combination of cyclical and long-term strengths and weaknesses.

In the short term, any mismatch between the supply of and demand for education is not a sufficient argument against further stimulus and expansionary policies. While the demand for highly skilled workers continues to outstrip the supply, this does not mean that there are an abundance of job openings that are going unfilled. The share of openings that are going unfilled is 33 percent in the average large metro, which is almost exactly the same ratio as economists found in the 1960s.[41] Openings for higher skilled positions do seem to be harder to fill, but they eventually get filled without apparent harm to regional economies, since metro areas with a high share of jobs going unfilled do not have higher unemployment rates.

Industry trends and house prices still have large and important effects on unemployment rates in metropolitan labor markets. If industry demand and housing can be shored up further, regions will continue to recover, but only up to a point. Potentially, monetary stimulus (increasing the money supply), fiscal stimulus (a combination of increased spending and lower taxes), or other measures to promote demand (e.g. trade agreements) could help, along with actions to stabilize the housing market (e.g., mortgage refinancing).

Under-education and skill mismatch may, however, hurt the economy in the short run by suppressing job creation and entrepreneurship. While the decreasing growth rate of educated workers is a multi-decade problem for the labor market, it can weaken recovery during cyclical downturns by stifling a rebound in job creation. Consequently, policies to boost entrepreneurship could be immediately beneficial.

As to longer-term issues, the recession did not fundamentally change the structure of the economy in terms of the supply and demand for skills or education. Before the recession, inadequate education was a major problem. It continues to be. There are simply fewer jobs per worker for those with little education.

The severity of the long-run education problem varies considerably across metropolitan economies. By providing local services (e.g. administration, restaurants, daycare, health care) and other tasks that do not require formal education, less educated workers complement the activities of highly educated workers, and so the less educated have an easier time finding work in highly educated regional labor markets (which is one reason to keep housing affordable in highly educated metros). Thus, the shortage of highly educated workers in a metro area means that there are not enough openings, too many layoffs, and too many less educated, unemployed workers whose knowledge and skills are not in high demand.

From a regional perspective, one of the most effective ways to enjoy the benefits of high educational attainment rates is to provide education. While college graduates are highly mobile, they also tend to stay in the same state as their university. Indeed, 70 percent of college graduates live in the same state at their college five years after graduation and 61 percent 10 years after.[42] The share is only slightly less for tech entrepreneurs; 45 percent of the founders of large companies created their business in the same state where they attended school.[43] This is one of the reasons why many of the metro areas with the highest college attainment rates also have large research universities, like Austin, Boulder, San Francisco, Boston, and Madison.

Post-secondary education goes beyond research institutions. This report also documents that a relatively high share of job openings available to workers with some college or associate's degrees. The reality is that a bachelor's degree is unnecessary for many jobs, including some that pay decent wages and require intellectually rigorous and creative work.[44] Yet, a high school diploma alone does not prepare workers for the complex mathematical, computer, and science skills needed to succeed on the floor of most modern factories, whereas an associate's degree or some other technical certification can provide the foundations for the life-long mastery of a technical field.[45]

There is a role for technology in improving labor market outcomes. With job openings data available in "real-time," state employment services can improve the usefulness of their websites and placement services. Maine, Florida, and other states have taken positive steps according to a recent analysis.[46]

Along these lines, community colleges and other training organizations have a powerful tool to align investments in courses and resources to the job opportunities posted by employers. With an emphasis on certification, even workers in small metro areas can be assured that they could find work in another part of the country if the relevant companies in their metro close down or move. Community college administrators could utilize job openings information to set the number of classes offered in specific fields, and employers could regularly meet with college leaders to make the curriculum as relevant as possible.[47]

Equity in educational opportunity is also crucial. A primary reason for the education gap is that not enough low income and minority students are pursuing post-secondary educations. While parental education affects the school performance of their children, it is by no means the only factor. Disadvantaged students score higher on standardized tests, graduate at higher rates, and earn higher wages, when they attend schools with better scoring peers or more effective teachers.[48] Yet, a large opportunity gap separates low-income students from the schools attended by affluent students in most metro areas.[49] State or regional-level zoning reforms should be made to let market participants (e.g. developers, home-owners, and non-profit organizations) decide the density of housing rather than local governments.

Education is hugely important to metropolitan labor markets in the long-run because it fuels innovation and because technological-change has complemented highly educated workers, while displacing many less educated workers. Short-term changes in unemployment are largely driven by industry demand and housing markets, but to a lesser degree, education also has an important effect—just not the one many think. The short-term advantage of educated labor markets is not that job vacancies easier to fill, but rather, there are more job openings to be filled as a result of increased entrepreneurial activity.

Appendix

Comparing Openings data across sources: HWOL vs. JOLTS

The fact that the HWOL database is based on advertised online vacancies raises questions as to whether or not certain kinds of jobs are more or less likely to be advertised online. To assess this possibility, HWOL data was compared to another database, the Job Openings and Labor Turnover Survey (or JOLTS), which uses a phone-based survey of employers. Unfortunately, JOLTS is not available at the level of metropolitan areas and is reported only be sector (2-digit NAICS), but not by occupation. To estimate the number of occupational openings, as reported by JOLTS, broad openings in each sector were converted to occupations using information from the Bureau of Labor Statistics' Occupational Employment Statistics Program. This method will tend to bias the estimated characteristics of the openings towards the average existing job.

At the national level, JOLTS and HWOL are highly correlated. From January of 2006 to January 2012, the number of job openings across the two data sets has a correlation coefficient of 63 percent. Despite that high level of correlation, the JOLTS data have a much stronger correlation with the national unemployment rate (as reported by BLS). The correlation between JOLTS openings and the unemployment rate is -93 percent, while it is only -42 percent using the HWOL data. This may reflect similar surveying procedures between JOLTS and the employment survey more so than fundamental differences in accuracy.

Across occupations, there is a high level of correspondence, despite the fact that the JOLTS data allows for only a rough approximation of occupational openings. For January and February of 2012, the number of job openings by minor occupation (3-digit SOC) has a correlation coefficient of 68 percent between JOLTS and HWOL. In both databases, the occupational category with the most job openings is Computer Occupations (151).

Yet, there are important discrepancies. As shown in the appendix, some high-skilled occupations like computers and health practitioners make up a much higher share of jobs in the HWOL data than in the JOLTS data. Likewise, some very low skilled occupations, especially food and beverage services workers (such as waiters and waitresses) seem to be highly under-estimated by HWOL relative to JOLTS.

It is not clear why the databases disagree so sharply on roughly 12 of 94 occupations, but it may be that openings for high-turnover sectors like restaurants are just much more informal. Likewise, computer savvy companies, which are more likely to recruit computer technicians, may use sophisticated online recruitment strategies, which make it hard for Wanted Analytics and the Conference Board to eliminate all duplicate postings. On the other hand, the HWOL data may be more accurate. The JOLTS estimates force the existing sector distribution of occupations on the sector distribution of openings, whereas the latter may very well be two or three times more oriented towards computers. The uncertainty of these estimates should be kept in mind when interpreting the data.

Measuring over-education, under-education, and out-of-degree workers

The education gap measures the inadequacy of supply relative to demand for openings in metropolitan labor markets, but this measure does not report whether or not specific workers are matched and what share of workers in metro areas are appropriately matched to their actual jobs, given their education.

To measure the over and under-education of workers in metropolitan areas, individual data from the 2010 American Community Survey was analyzed via Integrated Public Use Microdata Series (IPUMS).[50] Only workers living in metropolitan areas aged 25 to 64 who reported an occupation were included. Unemployed workers are asked to report whatever their last occupation was, provided they were employed within the last five years.

Appendix Table 1. Occupations with the Largest Discrepancies in Share of All Occupations Across Databases, Comparing HWOL Openings to JOLTS Openings for January and February of 2012

Minor Occupation Title	HWOL Openings, Jan-Feb 2012	JOLTS Openings, Jan-Feb 2012	Share of HWOL	Share of JOLTS
Large potential over-estimation of openings by HWOL compared to JOLTS				
Computer Occupations	859,833	388,006	16%	5%
Health Diagnosing and Treating Practitioners	443,611	303,059	8%	4%
Advertising, Marketing, Promotions, Public Relations, and Sales Managers	168,646	43,303	3%	1%
Other Management Occupations	196,199	111,653	4%	1%
Supervisors of Sales Workers	164,610	70,737	3%	1%
Sales Representatives, Services	178,859	123,054	3%	2%
Operations Specialties Managers	161,686	103,064	3%	1%
Large potential under-estimation of openings by HWOL compared to JOLTS				
Material Recording, Scheduling, Dispatching, and Distributing Workers	59,235	189,850	1%	3%
Material Moving Workers	34,980	166,637	1%	2%
Retail Sales Workers	163,735	361,769	3%	5%
Other Office and Administrative Support Workers	46,874	240,868	1%	3%
Food and Beverage Serving Workers	59,719	361,020	1%	5%

Brookings analysis of data from the BLS, JOLTS, and Conference Board HWOL. All 3-digit (minor) occupations are shown if the difference in the occupational-share of job openings between the two series is greater than 1.5 percentage points. The HWOL data include new openings and those re-announced after being posted the previous month. Data on only "new" openings are available as well but JOLTS does not make that distinction.

To measure job requirements, the average level of educational attainment is calculated for each detailed (six-digit) occupation. Then the most common level of education is ascertained for each detailed occupation, and this is considered the appropriate level of education. Over-educated workers, therefore, are those with a higher level of education than most commonly held by workers with their same occupation (e.g. a bachelor's degree instead of an associate's degree), and the reverse is true for under-educated workers. Weighted averages for metropolitan areas are calculated using individual weights.[51]

To match degree fields to their relevant occupations, 2010 American Community Survey data on degree fields were matched to formal codes developed by the National Center for Education Statistics (NCES) called CIP codes (Classification of Instructional Programs). CIP codes are matched to BLS SOC codes (occupational codes) by the NCES. This analysis counted workers as working out-of-field if their occupation did not match any of the SOC codes suggested by the NCES cross-walk. Because ACS data on occupation are not always available at the most detailed level, three digit codes were used, such that a worker was considered matched if he or she was employed in any occupation with a minor occupational category.[52]

Predicting Metro Area Unemployment

To isolate the effect of the education gap on unemployment from other economic factors—such as housing depreciation and industry concentration—a panel regression was used. The regression equation uses the unemployment rate for a given year for each of the 100 largest metropolitan areas, , as the dependent variable. Equation (1) below shows the full baseline regression with E standing for the education gap, I for exogenous changes in industry demand, and H for housing price changes. Subscripts m and t indicate metropolitan areas and years.

$$1.\ U_{m,t} = \partial + \beta_1 E_{m,t} + \beta_2 I_{m,t} + \beta_3 H_{m,t} + t + m + e$$

The equation includes fixed effects for metropolitan areas and years and is estimated using a balanced panel from 2005 to 2010. Although not shown in this baseline estimation, other demographic controls were also included for population, median age of population (to measure experience), the foreign born share of population, and the share of the population aged 65 and older (to adjust for variation in the number of retirees across metro areas).

Although equation (1) only shows the level of unemployment, a regression was also used to predict annual changes in unemployment. The form was very similar except and predicted industry growth and housing prices changes were not changed. The main difference is that the education gap was lagged one year to mitigate bias from endogeneity and the change in the education gap was included. The equation therefore interprets how annual changes in the education gap affect unemployment changes, conditional on changes in industry demand and housing prices, conditional on the initial education gap. All other control variables were also lagged one year in the fully specified model.

Table A2 reports the results. The three main variables—industry growth, housing price changes, and the education gap—are all highly and consistently significant in the expected directions. The adjusted r-squared outcomes are very high, indicating that the models fit the data very well.

The main concern with these models is that housing price changes and the education gap are potentially endogenous, meaning that they respond to unemployment or changes in unemployment. In the absence of good instrumental variables, the reader is simply cautioned to interpret the results with care. In previous work, the author found that historical education attainment rates could be used as an instrumental variable to explain a variation of the education gap, and the results did not change.[53] This approach, however, would not work in a panel regression that uses multiple observations for the same metropolitan area.

With these caveats in mind, the structural model predicting the level of unemployment is robust to making alternative assumptions about the data and model. In columns 3-4, the results are very similar if the education gap is also lagged. Also, these results can not be attributed to any bias in favor of skilled workers for online vacancies. The results are very similar using two alternative measures of

demand in the numerator of the education gap—one that considers only all existing jobs in the metro area and one that combines both vacancies with all existing jobs. These results are available upon request.

The alternative demand measures were also used to test the robustness of models 1 and 2. In this case, the results did not hold up using all existing jobs or all existing jobs combined with vacancies. This may be due to the fact that increases in unemployment were more likely

Comparing bachelor's degree attainment (supply only) to education gap

One potential concern with this analysis is that it introduces a fairly complicated variable—the education gap—when a more conventional and straightforward variable would work just as well, if not better—the metro area's bachelor's degree attainment rate. As discussed in the text of the report, the raw correlations between unemployment and the education gap are larger than comparable measures, but this could change if other variables are held constant. This hypothesis was tested, by including the bachelor's degree attainment rate directly in the regression analysis along with the education gap. The results suggest that the education gap is a more robust predictor of unemployment. In the more concise models (columns 1 and 3), both variables are significant, suggesting that they measure slightly different phenomena. More importantly, in columns 2 and 4, which have the demographic controls, the bachelor's degree attainment rate is insignificant in the levels regression, while the education gap remains highly significant and only slightly smaller in magnitude than in the Appendix Table 2 regressions that ignore the bachelor's degree attainment rate.

The bachelor's degree attainment rate variable remains significant in both change regressions, but a caveat is needed. The bachelor's attainment rate is lagged two years to allow it to the latest observation from 2010 to affect 2012 data. So, the one year lag reported below is really a three year lag. In other words, the education gap is picking up on the interaction between supply and demand, which remains an important explanatory variable even controlling for previous observations of supply. These results are available upon request.

Reporting the relative effects of the education gap, housing, and industry demand on unemployment rates

The next step was to characterize the results of these regressions and report the effect of the three main variables on unemployment. To do this, columns one and three (the baseline regressions) were used to calculate predicted unemployment rates. The regression model calculates an average effect of the three main variables (education gap, industry demand, and housing prices). For each of the three variables, the coefficient from the regression model was multiplied by metro specific values for the group of metro areas that are above average and those that are below. The difference in these estimated effects were considered the net marginal effect, holding all else constant.

To illustrate, take column three of Appendix Table 2. The coefficient on the education gap for job openings is .68 in the baseline model in column 3. Metro areas were then separated into those that score above and below average on the education gap. For each group, the education gap score was multiplied by the marginal effect of 0.68. The difference between the two group means provides an estimate of the effect on unemployment of being above average compared to below average on the education gap. This was repeated for the housing index and the industry index.

The values were then graphed in the figures reported in the main boy of the text.

Appendix Table 2. Metropolitan Area Panel Regression of Economic Characteristics on Change and Level of Unemployment Rate, 2005-2012

	Annual change in unemployment rate		Unemployment Rate	
	1	2	3	4
Predicted annual industry growth shock	-0.176***	-0.163***	-0.134***	-0.0939**
	(0.0291)	(0.0297)	(0.0352)	(0.0402)
Annual change in Housing Price Index	-0.136***	-0.106**	-0.267***	-0.285***
	(0.0425)	(0.0426)	(0.0430)	(0.0470)
Annual change in education gap	0.121***	0.111***		
	(0.0320)	(0.0316)		
Education Gap, lagged one year	0.0734	0.0670		
	(0.115)	(0.118)		
Share of population aged 65, lagged one year		-25.09		
		(16.18)		
Median age of population, lagged one year		-0.245***		
		(0.0746)		
Share of population foreign born, lagged one year		8.656		
		(6.461)		
Population, lagged one year		-1.07e-07		
		(6.91e-07)		
Education gap			0.680***	0.580***
			(0.128)	(0.142)
Share of population aged 65				-13.64
				(20.63)
Median age of population				0.639***
				(0.0940)
Share of population foreign born				-17.92**
				(8.447)
Population				-3.72e-10
				(9.20e-07)
Constant	3.409***	10.68***	9.172***	-10.78**
	(0.0597)	(3.553)	(0.0789)	(4.627)
Year Fixed Effects	Yes	Yes	Yes	Yes
MSA Fixed Effects	Yes	Yes	Yes	Yes
Observations	600	600	700	600
Adjusted R-squared	0.852	0.859	0.920	0.928

*Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Industry growth, housing prices, and education gap are standardized to have a mean of zero to make effects more comparable.*

Ranking metropolitan areas according to the three variables

To help metropolitan areas residents and analysts assess the underlying strengths of specific areas, a summary ranking was calculated based on the three main variables used in the analysis—industry demand, the education gap, and housing price growth. Because each of these variables has a different effect on unemployment they were not weighted equally. Rather than using arbitrary weights, the weights were calculated based on a regression that considers the marginal effect of each variable, which is to say the effect of a variable, while holding other factors constant.

Appendix Table 3 shows the results of the simply baseline regressions used to assess the relative importance of each variable. The actual values for each metropolitan area were plugged into the equation and multiplied by the respective coefficients to estimate the predicted change and level of unemployment for each metropolitan area. Metro areas were ranked separately for the changes since

Appendix Table 3. Metropolitan Area Unemployment Rate Level and Changes Regressed on Industry Demand, Education Gap, and Housing Price Growth, 2006-2012

	Change in Unemployment Rate from Pre-recession Minimum to May of 2012		Unemployment Rate, May 2012	
	1	2	3	4
Predicted Industry Growth, 2008Q1-2012Q1	-15.09		18.24	
	(14.29)		(17.24)	
Average Education Gap, 2007-2012	14.05***		37.85***	
	(4.037)		(4.869)	
Predicted Industry Growth, 2010Q1-2012Q1		-98.58***		-101.5***
		(27.79)		(34.64)
Average Education Gap, 2010-2012		16.72***		40.12***
		(3.874)		(4.830)
Growth in Housing Prices, 2006-2012Q1	-5.072***	-4.723***	-5.023***	-4.429***
	(0.613)	(0.578)	(0.739)	(0.721)
Constant	-12.69***	-12.31***	-32.22***	-32.44***
	(4.297)	(4.072)	(5.182)	(5.077)
Observations	100	100	100	100
Adjusted R-squared	0.528	0.590	0.605	0.634

*Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

the start of the recession and the current unemployment rate, according to the predicted regression-derived values.

Two different approaches are taken to these regressions. In columns 1 and 3, predicted industry growth is measured since the peak employment (or the start of the recession) in the first quarter of 2008, while in columns 2 and 4 it is measured only during the recovery period, starting in the first quarter of 2010. Likewise, the education gap measure is averaged over the entire recession in columns 1 and 3 and over just the last two years in columns 2 and 4. Using the more recent data fits the variation better, and so those predicted outcomes from columns 2 and 4 are used to rank metropolitan areas. This is not entirely surprising, since predicted industry growth has reversed course for many metro areas, as manufacturing and administrative services have gone from major drags on employment growth to a strong source for new jobs, and the oil and gas sector has gone from being a drag to a boost.

This next section looks at the role of education on job creation from 2006 to 2012. Column one of Appendix Table 4 show that yearly job openings as a share of total employment (i.e. the rate of openings) is strongly correlated with the education gap. This provides evidence that more educated labor markets create more job opportunities at any given point in time. The effect is very strong relative to the industry demand and housing effect, perhaps because the opening rate is more of a long-term measure of entrepreneurial dynamism.

The next column of Appendix Table 4 examines how the education gap affects annual job growth rate. The results show that an increase in the education gap lowers job growth, but in this case, housing price growth and industry demand have larger effects. This is to be expected as annual job growth is much more cyclical in nature than the level of openings at any given time. Even struggling economies that are dependent on cyclical industries like tourism can have a year of fast growth in employment following a very bad year.

Overall, the results from Appendix Table 4 suggest that the education gap plays an important role in the creation of job opportunities in the short-run, but mostly in the long-run. The implication is that the education gap causes higher unemployment, at least in part, through this channel.

Appendix Table 4. Job openings rate and Job Growth regressed on education gap, industry demand, and housing price growth, 2006-2012

	New annual job openings per existing job	Annual Job Growth
	1	2
Predicted annual industry growth shock	0.000659***	0.00351***
	(0.000134)	(0.000501)
Annual change in Housing Price Index	-0.000271*	0.00328***
	(0.000163)	(0.000702)
Education Gap	-0.00552***	
	(0.000487)	
Change in education gap		-0.00143***
		(0.000457)
Constant	0.0149***	0.00991***
	(0.000300)	(0.00103)
Year effects	Yes	Yes
Metro effects	Yes	Yes
Observations	700	600
Adjusted R-squared	0.776	0.806

*Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Variables are standardized to have mean zero and standard deviation of one to facilitate comparison.*

Endnotes

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2. Jesse Rothstein, "The Labor Market Four Years Into the Crisis: Assessing Structural Explanations," Working Paper No. 17966 (Cambridge: National Bureau of Economic Research, 2012).

3. Daron Acemoglu and David Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings," NBER Working Papers 16082 (Cambridge: National Bureau of Economic Research, 2010); Erik Brynjolfsson And Andrew McAffe, Race Against the Machine (Digital Frontier Press, 2011).

4. Brookings analysis of data from Bureau of Labor Statistics Current Population Survey and National Bureau of Economic Analysis recession start and end dates.

5. Nicoletta Batini and others, "United States: Selected Issues Paper" (Washington: International Monetary Fund, 2010). David Peters, "Manufacturing in Missouri: Skills-Mismatch," ESA-0900-2. Research and Planning, Missouri: Department of Economic Development (2000), available at: http://www.missourieconomy.org/industry/manufacturing/mismatch.stm; Alicia Sasser Modestino, "Mismatch in the Labor Market: Measuring the Supply of and Demand for Skilled Labor in New England," (Boston: New England Public Policy Center Federal Reserve Bank of Boston, 2010); Aysegul Sahin, Joseph Song, Giorgio Topa, and Giovanni L. Violante, "Mismatch Unemployment." Working Paper (Federal Reserve Bank of New York, 2012). Narayana Kocherlakota, "Inside the FOMC," Speech in Marquette, Michigan, August 17.

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10. Rothwell and Berube, "Education, Demand, and Unemployment in Metropolitan America."

11. The author thanks George Werking and June Shelp for pointing out that roughly 90 percent of openings are the result of turnover.

12. To assess this possibility, HWOL data was compared to another database, the Job Openings and Labor Turnover Survey (or JOLTS), which uses a phone-based survey of employers. The appendix describes the comparison in detail. The results confirm that HWOL and JOLTS generally move in the same direction and the distribution of openings is similar across occupations (which have to be indirectly estimated from JOLTS). Yet, HWOL shows many more openings in computers and health care occupations than JOLTS, and JOLTS shows more openings for service occupations like restaurants and retail. It is impossible to know which source is more accurate with available data.

13. Detailed six-digit Standard Occupational Classification (SOC) system categories were pooled into more general ("minor") three-digit categories to make them comparable across data sources.

14. Data were accessed using IPUMS; Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2010.

15. For example, the median person with less than a high school diploma received ten years of education (excluding preschool or kindergarten) for each year from 2003 to 2009. In calculating the number of workers with each skill level, people younger than 16 years old were excluded as were those not participating in the labor force.

16. This is the three-digit SOC 472. See U.S. Bureau of Labor Statistics, available at http://www.bls.gov/soc/2010/soc470000.htm (2011).

17. It does not directly measure a mismatch between education attainment and occupations. The author constructed such a measure and found that it had no additional predictive power in explaining unemployment beyond the education gap index and was considerably weaker.

18. The 2005, 2006, 2007, 2008, 2009, and 2010 American Community Surveys were used for this purpose. Working-age here means adults aged 25 or older. Workers over the age of 65 are included because 15 percent are still employed, according to 2010 data, and that share if increases to 23 percent for those with a bachelors degree or higher. Overall, the correlation between the bachelor's degree attainment rate for the population aged 25 to 64 and the population aged 25 and older is 99 percent.

19. Timothy Bartik, "Instrumental Variable Estimates of the Labor Market Spillover Effects of Welfare Reform." Upjohn Institute Working Paper No. 02-78 (Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2002).

20. In previous work, the author estimated how well the predicted job growth index fits actual job growth. The fit between actual and predicted growth was then used to create a new variable that was used to predict unemployment rate changes. In general, the insights derived this method were roughly the same as using the method described above, and so the predicted industry growth measure is relied upon in this analysis. See Jonathan Rothwell and Alan Berube, "Education, Demand, and Unemployment in Metropolitan America," (Washington: Brookings Institution, 2011).

21. The word "effect" in this context should not be interpreted as the effect of a randomly assigned treatment condition, as in a clinical trial. It is estimated based on the average performance of metro areas that score above and below the mean.

22. Since unemployment is partly determined by seasonal trends in education and tourism, the January 2012 observation may not capture these trends adequately as they vary by area. U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, available at http://www.bls.gov/lau/lauseas.htm (August 2011).

23. The general audience reader should keep in mind that the analysis considered a number of potential problems that could arise in analyzing and interpreting the results, such as omitted variables bias, reverse causality, unmeasured

state and metropolitan characteristics, and how errors in the model might be correlated spatially.

24. Enrico Moretti, *The New Geography of Jobs* (New York: Houghton Mifflin, 2012).

25. Brookings analysis of Census Bureau's 2007 Business Owner's Survey.

26. For Poughkeepsie, this may reflect the fact that many workers commute outside the metro area to New York City, where education requirements are higher.

27. Christopher D. Carroll, Misuzu Otsuka, and Jirka Slacalek, "How Large Is the Housing Wealth Effect? A New Approach" Working Paper No. 2006/35 (University of Frankfurt Center for Financial Studies, 2006). Some analysts suggest that falling housing prices also make it more difficult to move, although recent empirical evidence rejects that hypothesis. Aaronson, Daniel, and Jonathan Davis. 2011. How much has house lock affected labor mobility and the unemployment rate? Chicago Fed Letter No. 290, September. Federal Reserve Bank of Chicago; Valletta, Robert G. 2010. House lock and structural unemployment. Manuscript. Federal Reserve Bank of San Francisco.

28. The estimates control for the independent effects of each of the three variables, as well as time trends that affect all metros, and idiosyncratic metro characteristics that did not change from 2006 to 2012, such as geography and history. The external appendix shares the details on how this analysis was conducted.

29. To weigh the three factors empirically rather than arbitrarily, most current metropolitan unemployment rates were regressed on each variable for the 100 largest metro areas. Then, expected unemployment rates were calculated based on the regression coefficients for each variable. The metro areas were ranked according to their expected unemployment rate, which is based entirely on how well they perform on each indicator. This way, each variable was weighted according to its marginal importance in explaining unemployment rates, conditional on the other two variables.

30. In so far as rankings on these measures differ from reality, then they can be explained by other factors not considered in the mode.

31. Giovanni Favara and Jean Imbs, "Credit Supply and the Price of Housing" Discussion Paper 8129 (Center for Economic Policy Research, 2010).

32. Jonathan Rothwell, "Housing Costs, Zoning and Access to High Scoring Schools," (Washington: Brookings Institution, 2012).

33. Brookings analysis of BLS JOLTS data.

34. These conclusions are drawn from the author's analysis of data from the Bureau of Labor Statistics' Current Population Survey, with data as far back as 1948. Three-month growth in jobs is negatively correlated with three-month changes in the unemployment rate, and this relationship is no different after June of 2009, controlling for previous recessions and recoveries (allowing 2 years after the end of the recession to count as recovery). Recession dates were taken from the National Bureau of Economic Research.

35. National Bureau of Economic Research, *The Measurement and Interpretation of Job Vacancies* (New York: Columbia University Press, 1966).

36. Edward Glaeser, Giacomo Ponzetto, and Kristin Tobio, "Cities, Skills, and Regional Change" Harvard Working Paper (2012); Zoltan Acs and Catherine Armington, "New Firm Survival and Human Capital" Max Plank Institute Working Paper (2004).

37. Brookings analysis of Census Bureau's 2007 Business Owner's Survey.

38. Acemoglu and Autor, "Skills, Tasks and Technologies: Implications for Employment and Earnings;" James Stock and Mark Watson, "Disentangling the Channels of the 2007-2009 Recession," Brookings Panel on Economic Activity, March 22–23, 2012.

39. Brookings analysis of data from Moody's Economy.com and Census Bureau for 100 largest metropolitan areas as of 2010. To test this idea, decennial changes in bachelor's degree attainment rates were regressed on decennial changes in employment per capita, controlling for metropolitan fixed effects. Higher increases in education were correlated with more jobs per capita.

40. This correlation between the education gap and job openings rate is significant, even after adjusting for metro demographic characteristics, industry demand, and housing trends. It is also significant using an alternative measure of the education gap that includes all filled and vacant jobs to measure demand.

41. Vladimir Chavrid and Harold Kuptzin, "Employment Service Operating Data as a Measure of Job Vacancies" In National Bureau of Economic Research, ed., *The*

Measurement and Interpretation of Job Vacancies (New York: Columbia University Press, 1966). The 33 percent figure is an un-weighted average of the 100 largest metro areas.

42. Yolanda K. Kodrzycki, "Migration of Recent College Graduates: Evidence from the National Longitudinal Survey of Youth" *New England Economic Review* January/February (2001): 13-34.

43. Vivek Wadhwa, Richard Freeman, and Ben Rissing, "Education and Tech Entrepreneurship" (Kansas City: Ewing Marion Kaufman Foundation, 2008).

44. Anthony Carnevale and others, "Career Clusters: Forecasting Demand for High School Through College Jobs, 2008–2018," (Washington: Georgetown Center on Education and the Workforce, 2011)

45. Ibid.

46. David Altstadt, "Aligning Community Colleges to Their Local Labor Markets" (Jobs for the Future, 2011).

47. To make investments in the quality and timeliness of career education financially profitable, community colleges can leverage the power of the internet and IT software to train workers remotely; Inspired by Brynjolfsson and McAffee, *Race Against the Machine*.

48. Jonathan Rothwell, "Housing Costs, Zoning and Access to High Scoring Schools," (Washington: Brookings Institution, 2012).

49. Ibid.

50. Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated Public Use Microdata Series: Version 5.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2010.

51. Metropolitan area statistics were calculated by using a cross-walk between Public Use Microdata Areas (PUMAs) and metropolitan areas. Since PUMAs are not fully coincident with metropolitan area boundaries, this introduces some minor errors that average to roughly one percent of the population for the average large metropolitan area.

52. 6-digit SOC crosswalk with CIP codes: "National Center for Educational Statistics," available at http://nces.ed.gov/pubs2002/cip2000/ (June 2012).

53. Rothwell and Berube, "Education, Demand, and Unemployment in Metropolitan America."

Acknowledgements

The author is indebted to a number of people for their comments and criticisms that led to improvements in early drafts of the paper, including Alan Berube, Alicia Sasser Modestino, Elizabeth Jacobs, Gary Burtless, George Werking, Michael Mandel, and June Shelp. The author would also like to thank Alec Friedhoff for creating the accompanying web graphics and David Jackson for editing the report.

The Metropolitan Policy Program at Brookings thanks the Ford Foundation for its generous support of the program's research on city and suburban poverty and opportunity, the Annie E. Casey Foundation for its support of the program's research on low-income working families, and the John D. and Catherine T. MacArthur Foundation, the George Gund Foundation, the F.B. Heron Foundation, and the Heinz Endowments for their general support of the program, as well as the members of the Metropolitan Leadership Council.

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