Education, Demand, and Unemployment in Metropolitan America

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"Inadequate demand and inadequate education, relative to available occupations, are both hampering economic recovery in U.S. metropolitan areas."

Findings

An analysis of the gap between the supply and demand for educated workers, and its relationship to unemployment, particularly for the 100 largest metropolitan areas in the United States, finds that:

- **The years of education demanded by the average U.S. job grew slowly but steadily from 2005 to 2009 and slightly outpaced growth in educated labor supply during the recession.** At the height of the recession in 2009, the average U.S. job required 13.54 years of education, up from 13.37 in 2005. The increase reflected layoffs in less-education intensive industries such as construction and manufacturing, amid job gains in industries like health care, education, and professional services that demand more education.
- **Metro areas with larger "education gaps"—shortages of educated workers relative to employer demand—had consistently higher unemployment rates than other metro areas from 2005 to 2011.** Metro areas with larger education gaps experienced unemployment rates an average of 1.4 percentage points above metro areas with smaller such gaps. The difference widened to 1.7 percentage points by May of 2011, suggesting that better educated metro areas had a slightly larger advantage in the wake of the recession than they did before.
- **The types of industries in which a metro area specialized also influenced its unemployment trajectory from 2007 to 2009.** Unemployment rates in metro areas with more jobs in industries resilient to the recession increased an average of 1.4 percentage points less than rates in metro areas with more jobs in economically vulnerable industries.
- **Both industry composition and the education gap help explain the differences in unemployment rate increases across metropolitan areas.** In metro areas with both resilient industries and low education gaps like Washington, D.C., unemployment rates rose by roughly 2 percentage points less than in metro areas with vulnerable industries and high education gaps, like Riverside, CA.
- **Metro areas with larger education gaps exhibit greater differences in unemployment rates between highly educated and less educated workers.** In large metropolitan areas, the difference in unemployment rates between workers with bachelor's degrees and those without high school diplomas ranged from 2.8 percentage points in Poughkeepsie, NY to 14.7 percentage points in Detroit.

Inadequate demand and inadequate education, relative to available occupations, are both hampering economic recovery in U.S. metropolitan areas. With a still weakened private sector, strategic public investment and regional economic diversification can help address the first problem. Yet even when the economy recovers, longer-term "structural unemployment" will linger in some metropolitan areas because of mismatches between the supply of, and demand for, educated workers. Solutions to that problem include boosting educational attainment, enhancing the skills of workers, and increasing demand for less educated workers by providing public goods needed by industries like manufacturing and the "green" economy.

Introduction

In the wake of the Great Recession, the United States economy started growing from the second quarter of 2009 and has grown every quarter since through the second quarter of 2011, just about reaching pre-recession GDP.[1] Yet the July 2011 unemployment rate of 9.1 percent is hardly lower than the unemployment rate of 2009.

Despite stagnation in the labor market, one group of workers is managing to find work fairly readily. The unemployment rate of the college educated was just 4.3 percent in July of 2011, compared to 9.3 percent for workers with a high school diploma only, and 15.0 percent for workers without a diploma.[2]

Likewise, a much higher percentage of less educated workers have dropped out of the labor force all together. Fully 55 percent of workers with less than a high school diploma and almost 40 percent with a diploma are not working and not looking for work, but only 23 percent of workers with bachelor's degrees fall into this category.[3]

Economists have noted for decades that developed countries have experienced an increase in the demand for highly-skilled labor.[4] Lifetime earnings for workers with bachelor's degrees are 84 percent higher than lifetime earnings for workers with a high school diploma only.[5] Unemployment rates for workers with post-secondary education have been consistently lower than rates for less educated workers, and the gap has increased in recent decades.[6] This suggests that the U.S. workforce may lack the education required by employers. If such an education gap has emerged, then one would expect the level of unemployment to be significantly higher in regional economies where the demand for education exceeds the supply.

Other scholars, however, have questioned the extent and importance of observed demand for education.[7] They point to rising wages for low-skilled workers in the 1990s to argue that higher demand for more educated workers has not risen steadily. Moreover, they argue that a general decline in union bargaining power and the inflation-adjusted value of the minimum wage can account for rising income inequality.

A more recent theory advanced by David Autor and colleagues presents a modified version of the skill demand narrative. They document "employment polarization"—low-skilled jobs and high-skilled jobs gaining as a share of total employment relative to mid-level routine jobs, resulting from the interaction of technological change with lowering costs of information processing.[8] This trend produces demand for very-low skilled workers in non-routine occupations like food service and household cleaning, but insufficient demand for high-school graduates or workers with limited college experience in occupations like production, machinery operation, and office support and sales.

With this background in mind, there is a public policy debate today about why unemployment rates remain stubbornly high, even as national economic output has recovered and many metropolitan areas are now producing more than their pre-recession peaks.[9]

Some economists believe that there is significant so-called "structural unemployment" due to an education gap. That is, too few workers have the skills required of the occupations available in their regions. Business owners want to hire but cannot find the talent. David Altig found some initial evidence for this theory, noticing that unemployment was particularly high given the level of job openings.[10] Others subsequently pointed out that this relationship was typical in severe recessions, such as the one that occurred in the early 1980s.[11] Yet there could be high structural unemployment across time periods that is masked by speculative bubbles during booms. A small number of job openings could also itself be a function of inadequate skills. Companies that are managed and staffed by more highly skilled employees might grow more rapidly and thus be in a better position to increase hiring. Finally, macroeconomic analysis does not adequately address or explain vast regional disparities in the unemployment rate.

Other economists argue instead that the unemployment rate remains high because private demand is still inadequate.[12] They point out that hiring seems to be relatively high as a share of job openings, suggesting that employers are generally able to fill their vacancies. They recommend further economic stimulus and other macroeconomic policies to address unemployment.

Some have made efforts to sort out the relative contribution of inadequate demand and education gaps to the current unemployment problem. Economists at the International Monetary Fund (IMF) concluded that structural unemployment has increased by roughly 1.5 percentage points, and that skill mismatches explain roughly one-third of this rise.[13] Alicia Sasser Modestino of the Federal Reserve Bank of Boston finds that trends in wages for highly-skilled and middle-skilled workers, educational attainment within industries and occupations, and vacancy rates for occupations that require a higher percentage of skilled workers, all provide evidence that demand for educated labor is outracing supply.[14]

To sort out these competing claims and the underlying dynamics of unemployment, this report examines education gaps and industry demand in the nation's 100 largest metropolitan areas. Metropolitan areas are a natural unit of analysis given that they offer the best approximation of a regional labor market.[15] Moreover, the wide variation in metropolitan area economic performance, as documented by the Brookings MetroMonitor series, provides a basis for analyzing the factors that explain that variation.[16] After explaining the methodology, the report examines in turn the contribution of education gaps and weak industry demand to levels and recent changes in metropolitan unemployment rates. 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 (available at http://www.brookings.edu/papers/2011/0909_skills_unemployment_rothwell_ berube.aspx) presents this information in more formal and mathematical detail.

Education gap

The education gap is defined in this report as the extent to which demand for educated workers outstrips the supply of those workers in a given regional labor market.[17] It is calculated as:

The years of education required to do the average job in a metropolitan area divided by the years of education attained by the average working-age person in that metropolitan area.

Values of the education gap above one signal an insufficient supply of educated workers in the regional labor market relative to demand. Values below one indicate that the average typical worker has enough formal education to do the average job. A value below one certainly does not mean that all workers have enough education; nor does it mean that there is no structural unemployment in the metropolitan area.[18] Moreover, one limitation of this approach is that it ignores informal skills learned from on-the-job-training, non-academic learning, and trial and error—in a word, experience. These would be much more difficult to measure and compare across metropolitan areas, whereas measures of formal educational attainment are fairly standardized.

To measure education demand, the distribution of education across six education categories (e.g. less than high school, high school, some college, etc) was calculated for every occupation in the United States.[19] 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, were assigned years of education based on the median years of education for people in each educational category.[20] A metropolitan area-level measure of education demand was then generated based on the occupational category of every job in that metro area.

Consider the example of construction trade workers.[21] 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; 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 occupations 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.

Measuring education supply was more straightforward, and employed data from the Census Bureau's American Community Survey on the share of working-age metropolitan residents with each level of educational attainment.[22] The percentages were multiplied by the corresponding years of education to get a measure of years of education attained (or supplied) by the average metropolitan worker.

Finally, the education gap was derived by dividing the years of education demanded by the average job in the metropolitan area by the years of education attained by the average working-age adult.[23]

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. No industries experienced larger job losses during the recession than manufacturing and construction; on the other hand, health care and the public sector fared relatively well from 2007 to 2009. Metropolitan areas with high job concentrations in these industries would thus be expected to perform worse or better than more typical metros.

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.[24] The predicated job growth index estimates:

How changes in national industry demand should impact employment changes in metropolitan area industry demand, given a metro area's initial industry composition.

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.

An advantage of this index is that it is unlikely to be affected by other aspects of the metropolitan area, including its unemployment rate, and it concentrates information for roughly 100 industries in every metropolitan area into one single measure. One disadvantage is that metropolitan trends in industry employment depend on that area's specific companies and enterprises, and some may only be loosely similar to their industry peers in other parts of the country. To take this into consideration, the analysis also estimates how well the predicted job growth index fits actual job growth. The fit between actual and predicted growth is then used to create a new variable that may better capture local dynamics. In general, the insights derived from both methods are roughly the same. The details are discussed in the methods appendix.

Control variables

Other control variables are needed to account for the fact that metros 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 May 2011 and not seasonally adjusted because of data limitations.[25] 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 and trends in predicted industry demand, while holding other factors constant. The main findings here are supported by that background analysis but report less methodologically complex conditional averages. The methods appendix describes the details of the more formal techniques.[26] Data were collected and analyzed for all 366 U.S. metropolitan areas with available data; to simplify the discussion, however, the tables below focus only on the 100 largest metropolitan areas, which have populations of at least 500,000. Those 100 metro areas are home to roughly 65 percent of all Americans.

Findings

A. The years of education demanded by the average U.S. job grew slowly but steadily from 2005 to 2009, and slightly outpaced growth in educated labor supply during the recession.

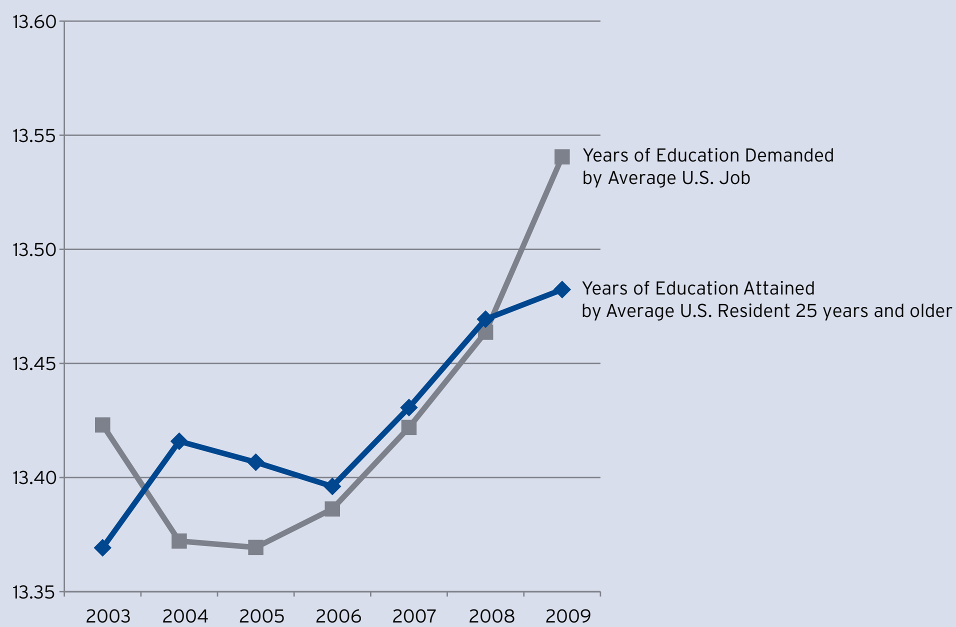
At the height of the recession in 2009, the average U.S. job required 13.54 years of education, up slightly but significantly from 13.37 years in 2005. Meanwhile, the average working-aged adult attained just 13.48 years of education in 2009—and attainment was much lower still, at 12.49 years, for working-aged adults out of the labor force.

Figure 1 plots the national trend in the years of education required by the average U.S. job, as well as the trend in education supplied. An initial dip in demand occurs in the demand for education during the boom in less education-intensive industries like construction, which increased employment by 0.6 million from 2003 to 2005. But from 2006 to 2009, construction shed 1.7 million jobs, corresponding with an increase in education required by the average job. Roughly 12 percent of construction workers age 25 or older have a Bachelor's degree or more education compared to 28 percent of all Americans. Meanwhile, highly educated industries added jobs from 2006 to 2009, including professional, scientific, and technical services (which added 148,000 jobs), educational services (which added 191,000), hospitals (which added 244,000), and ambulatory health care services (which added 505,000).[27] These trends fueled the observed increase in demand for education in U.S. jobs.

Figure 1 also shows the supply side of education, using the working-age population. By that measure, education attainment has also increased but at a slower pace of just 0.8 years since before the recession in 2005. Meanwhile, the demand for education increased by 0.17 years from 2005 to 2009 creating a national education gap of 0.06 years for the first time since 2003.

The same trend can be seen in metropolitan areas. Every one of the 100 largest metropolitan areas saw an increase in demand for education from 2005 to 2009. Boise and Tampa experienced the largest increases—above 0.30 years. Atlanta, Harrisburg, Austin, Honolulu, and Salt Lake saw increases above 0.25.

Figure 1. Years of Education Demanded by Average U.S. Job and Attained by Average Worker and Resident, 2003 to 2009



Source: Brookings analysis of data from IPUMS and U.S. BLS

Table 1. Metropolitan Areas with the Smallest and Largest Increases in the Education Gap from 2005 to 2009

	Change in Education Gap, 2005 to 2009	Education Gap, 2009
10 Metropolitan Areas with Smallest Increases in the Education Gap from 2005 to 2009		
Syracuse, NY	-0.007	0.991
Buffalo-Niagara Falls, NY	-0.003	0.994
Nashville-Davidson—Murfreesboro—Franklin, TN	-0.003	0.991
El Paso, TX	-0.003	1.053
Scranton—Wilkes-Barre, PA	0.000	1.012
Baton Rouge, LA	0.000	1.009
Knoxville, TN	0.001	0.994
Columbia, SC	0.001	0.988
Poughkeepsie-Newburgh-Middletown, NY	0.001	0.988
Albany-Schenectady-Troy, NY	0.001	0.986
10 Metropolitan Areas with Largest Increases in the Education Gap from 2005 to 2009		
Harrisburg-Carlisle, PA	0.017	1.005
Palm Bay-Melbourne-Titusville, FL	0.017	1.001
Little Rock-North Little Rock-Conway, AR	0.018	1.010
Toledo, OH	0.018	1.014
Atlanta-Sandy Springs-Marietta, GA	0.019	0.991
Bakersfield-Delano, CA	0.019	1.061
Austin-Round Rock-San Marcos, TX	0.019	0.984
Jackson, MS	0.021	1.005
Tampa-St. Petersburg-Clearwater, FL	0.021	1.016
Tucson, AZ	0.027	1.001
Average of 100 Largest Metropolitan Areas	**0.009**	**0.999**

Source: Kneebone and Garr (2010)

**Statistically significant at the 90 percent confidence level.*

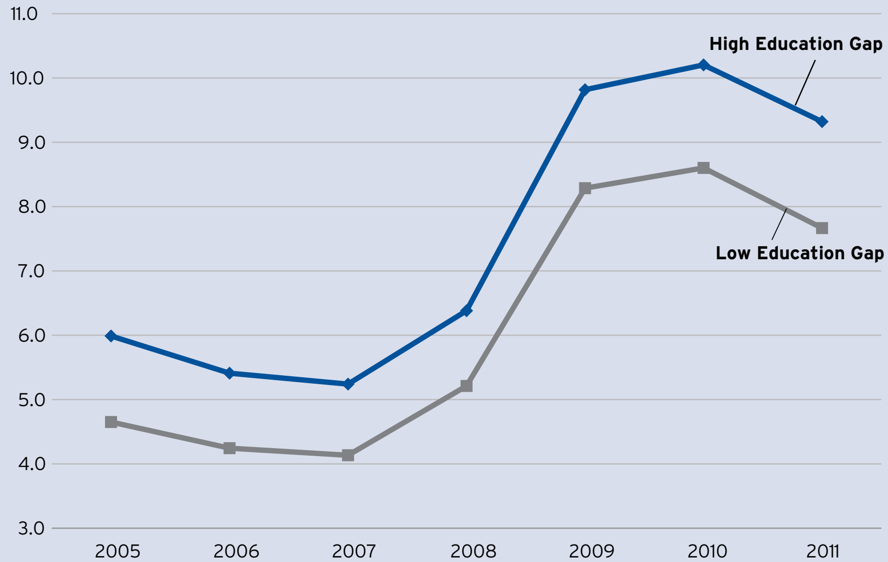
For most metro areas, this increase in demand for education outpaced supply, resulting in a larger education gap. Only four of the 100 largest metro areas—Syracuse, Buffalo, Nashville, and El Paso—reduced their education gaps between 2005 and 2009—all by increasing the supply of educated workers faster than demand. Conversely, metropolitan areas like Tucson and Jackson, MS saw increases in the education gap of 0.2 or more as the supply of skilled workers decreased slightly, even as demand increased. In 55 metropolitan areas, the education gap remained effectively unchanged from 2005 to 2009.

B. Metro areas with larger "education gaps"—shortages of educated workers relative to employer demand—had consistently higher unemployment rates than other metro areas from 2005 to 2011.

The magnitude of the education gap predicts to unemployment at the metropolitan level. On average from 2005 to 3011, metro areas with education gaps above one experienced unemployment rates 1.4 percentage points higher than metro areas with education gaps below one. As Figure 2 shows, the unemployment rate difference reached its lowest point in 2007 at 1.1 percentage points, just before the housing bubble burst.[28] Since then the gap has grown, reaching its peak in May 2011 at 1.7 percentage points. This reflects that recessionary unemployment has been especially severe in metro areas with larger education gaps.

Metropolitan areas with the lowest and highest education gaps illustrate the broader trend. Table 2 reports the average education gap as measured in 2005, 2007, and 2009, the unemployment rate in May 2011 (the most current available as of writing), and the increase in the unemployment rate from the pre-recession minimum to the most current for these metro areas.

Figure 2. Unemployment Rate Trends in Metropolitan Areas with High and Low Education Gap from 2005 to May of 2011



Source: Brookings analysis of BLS, IPUMS

Table 2. Metropolitan areas with the lowest and highest education gaps among the 100 largest

	Education gap (average of 2005, 2007, and 2009)	Unemployment rate, May 2011 (%)	Change in unemployment rate from pre-recession low to May 2011
The 10 metropolitan areas with the lowest average education gaps from 2005 to 2009			
Madison, WI	0.951	5.3	1.9
Washington-Arlington-Alexandria, DC-VA-MD-WV	0.956	5.7	2.7
Provo-Orem, UT	0.956	7.5	5.0
Bridgeport-Stamford-Norwalk, CT	0.957	8.5	4.5
Raleigh-Cary, NC	0.958	7.9	4.3
San Francisco-Oakland-Fremont, CA	0.959	9.3	5.1
Seattle-Tacoma-Bellevue, WA	0.966	8.5	4.4
Boston-Cambridge-Quincy, MA-NH	0.967	6.6	2.5
Minneapolis-St. Paul-Bloomington, MN-WI	0.968	6.3	2.5
San Jose-Sunnyvale-Santa Clara, CA	0.969	9.9	5.3
The 10 metropolitan areas with the highest average education gaps from 2005 to 2009			
Chattanooga, TN-GA	1.017	8.4	4.2
Lakeland-Winter Haven, FL	1.02	10.8	7.2
Youngstown-Warren-Boardman, OH-PA	1.024	9.1	3.1
Riverside-San Bernardino-Ontario, CA	1.026	13.2	8.3
Stockton, CA	1.032	16.2	8.8
Fresno, CA	1.036	16.0	8.0
Modesto, CA	1.042	16.7	8.7
Bakersfield-Delano, CA	1.051	15.0	7.5
El Paso, TX	1.054	10.0	4.1
McAllen-Edinburg-Mission, TX	1.093	11.9	5.3
Average for 100 Largest Metropolitan Areas	**0.994**	**8.8**	**4.4**

Source: Brookings analysis of IPUMS and BLS

Metropolitan Madison, a state capital and home to the main campus of the University of Wisconsin, has had the lowest education gap in recent years, with an index of 0.95. This means that the average occupation in Madison requires five percent fewer years of education than the average working-age resident has attained. This helps explain its extremely low unemployment rate of 5.3 percent, compared to 8.8 percent for the average metropolitan area. Likewise, its unemployment rate has increased by just 1.9 percentage points above its pre-recession low.

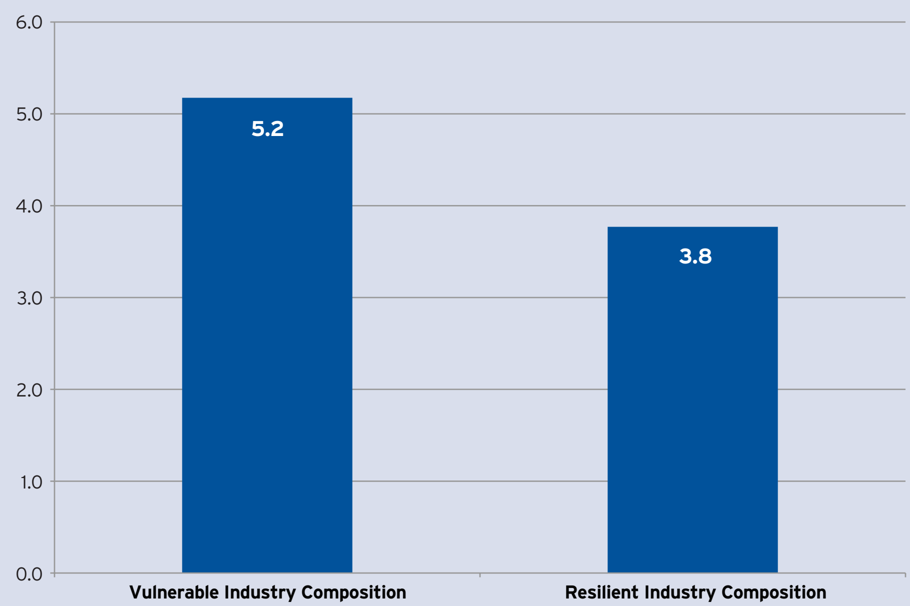
Other metro areas with highly educated residents relative to job demands share Madison's success in achieving low unemployment rates and a small increase in unemployment, including Washington, Raleigh, Boston, and Minneapolis. But others—notably San Francisco and San Jose—have suffered from high levels and changes in unemployment despite their strongly educated populations.

On the other end, nine of the 10 metropolitan areas with the highest gaps in education are currently suffering from higher-than-average unemployment rates, and seven out of the 10 absorbed above-average increases in unemployment rates over the recession. The best examples are the five California metros and Lakeland-Winter Haven, FL, all of which have suffered increases in unemployment rates from three to four percentage points above the metropolitan average.

C. The types of industries in which a metro area specialized also influenced its unemployment trajectory from 2007 to 2009.

The impact of the Great Recession across the nation differed greatly by industry, battering sectors like construction and manufacturing, while leaving others like health care and education relatively untouched. The predicted industry job growth measure described above permits comparison of unemployment rate increases between metropolitan areas that relied disproportionately on industries hit hard nationally, and metro areas specialized in industries that proved more resilient to the recession.[29]

Figure 3. Recessionary Increases in Unemployment Rates in Metropolitan Areas with Vulnerable Industries Compared to Those with Resilient Industries, 2007 to 2009



Source: Brookings Analysis of data from Bureau of Labor Statistics and Moody's Analytics. Metros were classified as having vulnerable industry compositions if predicted job growth was below the metropolitan average and resilient if predicted job growth was above the metropolitan average.

Table 3. Metropolitan areas with the most resilient and most vulnerable industries during the recession among the 100 largest

	Predicted industry job growth, 2007 to 2009 (%)	Change in unemployment rate, 2007 to 2009	Change in unemployment rate from pre-recession low to May 2011	Unemployment rate, May 2011 (%)
Resilient metropolitan areas with 10 best predicted growth rates from 2007 to 2009				
McAllen-Edinburg-Mission, TX	-2.70	3.9	5.3	11.9
Albany-Schenectady-Troy, NY	-2.90	3.0	2.8	6.8
Springfield, MA	-3.20	3.7	3.3	8.4
Honolulu, HI	-3.40	3.3	2.5	4.9
Washington-Arlington-Alexandria, DC-VA-MD-WV	-3.50	3.1	2.7	5.7
Poughkeepsie-Newburgh-Middletown, NY	-3.50	3.7	3.3	7.4
New York-Northern New Jersey-Long Island, NY-NJ-PA	-3.70	4.3	3.9	8.3
Jackson, MS	-3.70	2.5	2.6	7.7
Bakersfield-Delano, CA	-3.70	6.3	7.5	15
Fresno, CA	-3.80	6.5	8.0	16
Vulnerable metropolitan areas with 10 worst predicted growth rates from 2007 to 2009				
Salt Lake City, UT	-5.80	4.3	4.6	7.2
Riverside-San Bernardino-Ontario, CA	-5.90	7.4	8.3	13.2
Charlotte-Gastonia-Rock Hill, NC-SC	-6.10	6.7	5.6	10.4
Las Vegas-Paradise, NV	-6.20	8.1	8.2	12.4
Cape Coral-Fort Myers, FL	-6.30	7.4	7.9	10.8
Phoenix-Mesa-Glendale, AZ	-6.30	5.8	4.7	8
Grand Rapids-Wyoming, MI	-6.40	4.9	2.5	8.3
Greenville-Mauldin-Easley, SC	-6.60	5.2	3.8	8.8
Wichita, KS	-6.70	4.4	3.5	7.6
Greensboro-High Point, NC	-6.90	6.3	5.4	10.2
Average for 100 Metropolitan Areas	**-4.90**	**4.6**	**4.4**	**8.8**

Source: Brookings analysis of BLS, Moody's Analytics

Metro areas with the most resilient industrial compositions were concentrated in industries such as oil and gas extraction, ambulatory health care services, education services, and federal government, all of which added jobs from 2007 to 2009. Metro areas with the most vulnerable industrial profiles specialized in sectors such as wood product manufacturing, textile mills, construction, and transportation equipment manufacturing. Employment in each of these industries shrank by at least 25 percent from 2007 to 2009.

Over that same time period, unemployment rates in metro areas with more jobs in industries resilient to the recession increased an average of 1.4 percentage points less than rates in metro areas with more jobs in economically vulnerable industries (Figure 3). More resilient metropolitan areas, on average, experienced an increase of 3.8 percentage points, compared to 5.2 percentage points in metros that relied on more vulnerable industries. This margin mirrors the advantage conferred by having a low education gap, signifying that employment in vulnerable industries can totally wipe out human capital advantages, and vice versa. One qualification is that predicted industry job growth mattered more than the education gap during the heart of the recession—2007 to 2009—but the two factors were roughly equally important when considering unemployment changes from 2006 through May of 2011.

McAllen, TX had the best-positioned industries of all large metropolitan areas going into the recession, due to its disproportionate share of jobs in health care, local government, and oil and gas extraction (Table 3). (Since 2009, however, McAllen has struggled.)

In addition to health care and government, metropolitan New York has a disproportionate number of jobs in information services and transit that helped it weather the recession. Oil and gas extraction and public sector jobs suggested that Bakersfield's economy would be resilient, but its massive education gap and other disadvantages, such as a weak housing market, may have fueled its rising unemployment rate.

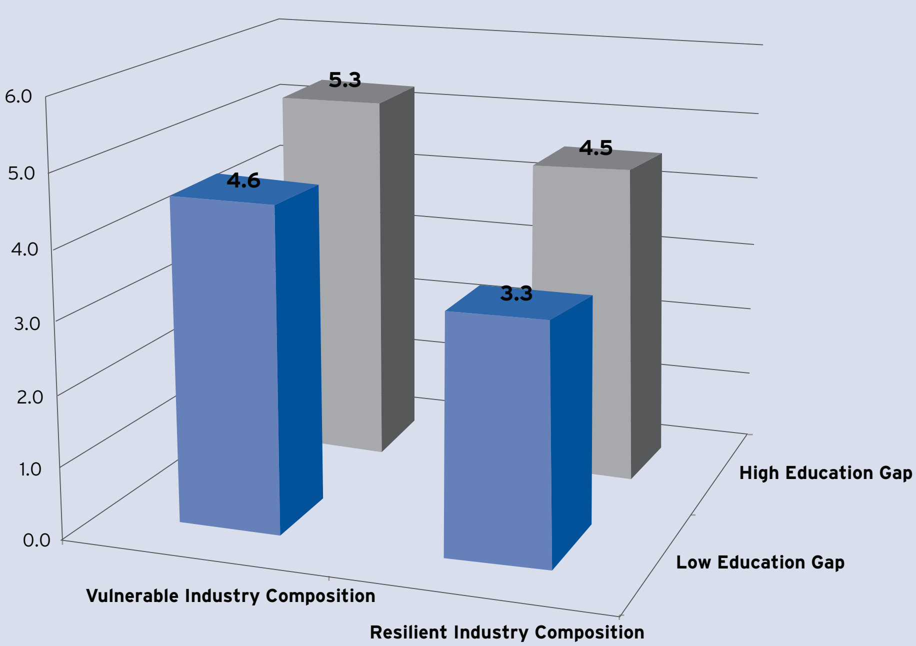
At the other end of the spectrum, Greensboro had what proved to be the most vulnerable industry mix of any of the 100 largest metropolitan areas. Furniture and textile manufacturing were major contributors, as both saw massive U.S. job losses from 2007 to 2009. In Wichita, transportation equipment manufacturing, which accounted for 12.5 percent of its workforce in 2007, made the metropolitan area especially vulnerable. Finally, 27 percent of the Las Vegas workforce was concentrated in two extremely fragile industries in 2007: specialty trade contractors in the construction industry and hotel accommodation. Most of the metropolitan areas at the bottom of Table 2 saw more rapid increases in unemployment rates than the average metro area, and considerably larger increases than in metro areas concentrated in resilient industries.

D. Both industry composition and the education gap help explain the differences in unemployment rate increases across metropolitan areas.

The previous two findings suggest that both education gaps and industry demand factors have influenced metropolitan unemployment trajectories during the Great Recession and its aftermath. This finding examines how these factors converged in individual metro areas, and how they related to metro unemployment trends.

Metro areas that scored above-average on both industry composition (more resilient) and education gap (lower)—saw their unemployment rates rise by roughly two percentage points less than metro

Figure 4. How the combination of education gap and industry composition predicts unemployment rate increases from before the recession to May of 2011 for the 100 Largest Metropolitan areas



Source: Brookings analysis of BLS, IPUMS, and Moody's Analytics. Industry trend refers to predicted industry growth from 2007 to 2009. High or low ranking was based on whether the metro fell above or below the 51st metro ranking

Table 4. Top 10 and bottom 10 metropolitan areas on combined ranking of education gap and industry composition for the 100 largest metropolitan areas

	Combined Rank of Education Gap and Industry Composition	Unemployment Rate, May 2011 (%)	Change in unemployment rate from pre-recession low to May 2011
Metropolitan Areas with Best Rankings on Skill Gap and Industry Composition			
Washington-Arlington-Alexandria, DC-VA-MD-WV	4.0	5.7	2.7
Boston-Cambridge-Quincy, MA-NH	10.5	6.6	2.5
Madison, WI	10.5	5.3	1.9
Albany-Schenectady-Troy, NY	11.5	6.8	2.8
Honolulu, HI	13.0	4.9	2.5
Poughkeepsie-Newburgh-Middletown, NY	15.5	7.4	3.3
San Francisco-Oakland-Fremont, CA	16.0	9.3	5.1
Portland-South Portland-Biddeford, ME	17.0	6.2	2.7
Colorado Springs, CO	19.0	9.3	5.1
Bridgeport-Stamford-Norwalk, CT	20.0	8.5	4.5
Metropolitan Areas with Worst Rankings on Skill Gap and Industry Composition			
Detroit-Warren-Livonia, MI	78.5	11.6	4.4
Los Angeles-Long Beach-Santa Ana, CA	78.5	11.1	6.7
Phoenix-Mesa-Glendale, AZ	79.0	8.0	4.7
Houston-Sugar Land-Baytown, TX	79.5	8.2	3.9
Lakeland-Winter Haven, FL	82.5	10.8	7.2
Dallas-Fort Worth-Arlington, TX	85.0	7.9	3.6
Youngstown-Warren-Boardman, OH-PA	85.5	9.1	3.1
Chattanooga, TN-GA	87.0	8.4	4.2
Greensboro-High Point, NC	88.0	10.2	5.4
Riverside-San Bernardino-Ontario, CA	93.0	13.2	8.3
Average of 100 Largest Metropolitan Areas		**8.8**	**4.4**

Source: Brookings analysis of BLS, Moody's Analytics, and IPUMS

areas scoring below-average on both measures. The former metropolitan areas had unemployment rates in May 2011 3.3 percentage points above their pre-recession minimums. At the same time, those with the worst combination—a high education gap and vulnerable industries—exhibit unemployment rates that are 5.3 percentage points higher. Metro areas in between, with one below-average and one above-average index, experienced moderate unemployment rates increases of 4.6 and 4.5 percentage points respectively for the high education gap and vulnerable industry.

The 10 large metro areas with the strongest combined rankings on education gap and industry resilience have an average unemployment rate of 7.0 percent, compared to 9.9 percent for those with the 10 worst combined rankings. The only two in the top group with above average unemployment rate are Colorado Springs and San Francisco. In this respect, both metros are underperforming relative to where they should be given their human capital and industry base. At the other extreme, Detroit, Los Angeles, Lakeland, Greensboro, and Riverside illustrate the difficulties facing metro areas with high education gaps and vulnerable industry compositions. The two large Texas metro areas with weak combined rankings, Dallas-Fort Worth and Houston, managed to perform reasonably well on unemployment, perhaps because Texas benefited from more conservative mortgage lending practices and thus avoided much of the subprime lending bubble.[30] The appendix table at the end of this report provides the combined rankings for the 100 largest metropolitan areas.

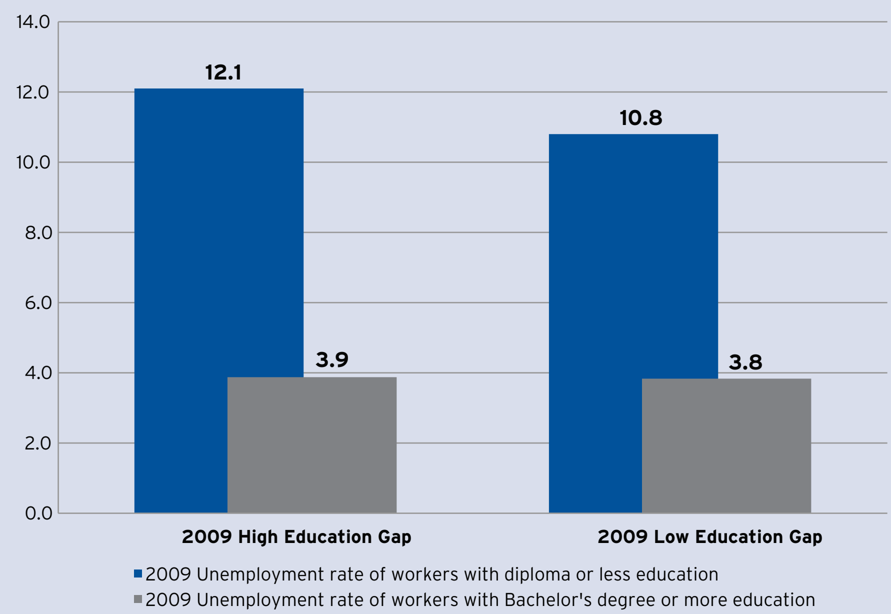
These findings suggest that the education gap and industry composition play roughly equal roles in explaining unemployment rate trends from 2006 until now. As described in the methodological appendix, a more systematic effort was undertaken to assess the relative importance of each after taking into account demographic characteristics and the effects of being in one state as opposed to another. This exercise confirms that the sizes of the two effects are roughly similar during this period. The initial education gap explains roughly 28 percent of the variation in unemployment rates from their minimum to their level in May of 2011. A metropolitan area's industry profile leading into the worst of the recession (the first quarter of 2008 until the first quarter of 2010) explains roughly 16 percent of this increase, while its industry profile during the recovery (the first quarter of 2010 until the first quarter of 2011) explains another 12 percent.

E. Metro areas with larger education gaps exhibit greater differences in unemployment rates between highly educated and less educated workers.

In all of the 100 largest metropolitan areas, unemployment rates for workers with bachelor's degrees are lower than for workers with high school diplomas or less. The magnitude of this difference, however, varies across metro areas. Figure 5 depicts how unemployment rates differ across education groups in metropolitan areas with high education gaps (one or higher) and low education gaps (less than one). It shows that unemployment rates for less educated workers are roughly 1.3 percentage points lower where education gaps are less pronounced. At the same time, the unemployment rates of college-educated workers are almost identical in low and high education-gap metro areas. This finding suggests that the education gap index indicates inadequate demand for less educated workers relative to their supply.

The relationship is evident from a listing of the metro areas with the lowest and highest unemployment rate gaps between educational attainment groups (Table 5). Remarkably, the gap varies from just 2.8 percentage points in Poughkeepsie to 14.7 percentage points in Detroit. In Detroit, workers with bachelor's degrees had only a moderately high unemployment rate of 6.8 in 2009, while 21.5 percent of those with a high school diploma or less were unemployed.

Figure 5. The skill gap and the unemployment rate gap between workers with high and low levels of education



Source: Brookings Analysis of data from IPUMS, the BLS, and the 2009 American Community Survey.

Table 5. The Unemployment Gap in Large Metropolitan Areas between Workers with College Degrees and High School or Less Educations

Metropolitan Area	Gap, percentage points	Unemployment Rate of Workers with Diploma or Less, 2009 (%)	Unemployment Rate of Workers with Bachelor's Degree or Higher, 2009 (%)	Education Gap, 2009
Metropolitan Areas with Highest Gap in Unemployment Rates between Education Groups				
Detroit-Warren-Livonia, MI	14.7	21.5	6.8	1.008
Toledo, OH	14.0	18.1	4.1	1.014
Modesto, CA	13.1	18.4	5.3	1.050
Fresno, CA	12.7	16.1	3.4	1.040
Memphis, TN-MS-AR	12.1	15.4	3.3	1.011
Akron, OH	12.0	15.6	3.6	0.997
Charlotte-Gastonia-Rock Hill, NC-SC	11.8	16.3	4.5	0.990
Bakersfield-Delano, CA	11.2	15.0	3.8	1.061
Stockton, CA	10.5	16.4	5.9	1.040
Dayton, OH	10.5	14.3	3.8	1.010
Metropolitan Areas with Lowest Gap in Unemployment Rates between Education Groups				
San Antonio-New Braunfels, TX	4.9	8.3	3.4	1.021
El Paso, TX	4.6	7.5	2.9	1.053
Los Angeles-Long Beach-Santa Ana, CA	4.5	11.0	6.4	1.015
New York-Northern New Jersey-Long Island, NY-NJ-PA	4.5	10.3	5.7	0.996
Baton Rouge, LA	4.4	6.4	2.0	1.009
Houston-Sugar Land-Baytown, TX	4.4	8.3	3.8	1.016
Rochester, NY	4.4	9.1	4.7	0.990
Portland-South Portland-Biddeford, ME	4.3	7.6	3.3	0.975
Albuquerque, NM	4.0	7.6	3.6	0.994
Poughkeepsie-Newburgh-Middletown, NY	2.8	7.6	4.8	0.988
Average of 100 Largest Metropolitan Areas	**7.8**	**12.1**	**4.3**	**0.999**

Source: Brookings analysis of IPUMS, American Community Survey, and BLS.

The role of other factors in explaining metropolitan unemployment

The results reported above are based on simple correlations, but the basic differences between metropolitan area groupings—such as those with low and those with high education gaps—remain significant after considering multiple factors simultaneously such as industry composition, demographics, and the average effect on unemployment of being located in a given state.

The methodological appendix examines the role of specific state policies as well, considering the effects of taxation, union regulation, and bank regulation on the unemployment rates of metropolitan areas in those states. Introducing these policy control variables did not substantially change the relationship between the education gap index and unemployment. Nonetheless, one state policy was found to matter—banking deregulation. States that opened up their banking sectors to mergers and acquisitions earlier than other states saw housing prices soar during the recent bubble, as lending standards weakened and access to credit flowed. These states and their metropolitan areas—including California, Nevada, and Rhode Island, all early adopters—saw significant increases in unemployment rates, holding other factors constant. Meanwhile, the overall state tax burden, as measured by the Tax Foundation's marginal rate, had no relation to unemployment rate changes; nor did a state's "right-to-work" laws toward union organizing. In other words, there is no evidence that high taxes and unions have caused higher unemployment during the recession. For example, low tax states like Nevada and Florida did not perform any better on average than high tax states like Wisconsin and Maryland. The methodological appendix (available at http://www.brookings.edu/papers/2011/0909_skills_unemployment_rothwell_berube.aspx) discusses these results in further detail.

Discussion

In the debate over "structural" versus "cyclical," or recessionary, unemployment, it is important to distinguish between short-term economic trends that last just a few years and longer term characteristics of the economy.

The education gap is a long-term challenge that was exacerbated by the recession. Even before the recession, metro areas with an education gap index above one had unemployment rates roughly 1.3 percentage points higher than metro areas with an index below one. During the recession, the number of metro areas exhibiting with an education gap above one increased, from 140 in 2007 to 196 in 2009. At the same time, the connection between unemployment and the education gap tightened, with the unemployment rate spread increasing to 1.7 percentage points.

Overall, the education gap explains roughly half of the variation in long-term metropolitan unemployment rates (averaged over five years from 2005 to 2010). But it only explains 28 percent of the increase from 2006 to 2011, and only 20 percent of the increase during the worst of the recession (2007 to 2009).

Metro areas with an education gap have a clear economic imperative to boost educational attainment, especially for their medium- and long-run health. More detailed analysis (shown in the appendix) demonstrates that higher attainment rates for bachelor's and master's degrees are especially important. Increasing attainment can come from attracting highly educated migrants or retaining college graduates, possibly through economic opportunities (such as work or affordable housing) or amenities (such as an efficient commute, pleasant weather, or cultural attractions), or it can come from developing the human capital of the local population, including the next generation of workers.

Developing human capital will mean redirecting young adults towards post-secondary education who might otherwise miss or avoid it. Promoting equal access to high quality education throughout childhood and adolescence is vital to achieving this goal. For older populations, greater access to on-the-job training or adult education at community colleges may be particularly important.

Having a healthy supply of educated workers helps metropolitan labor markets function better, but demand matters too. Even over the long run, metropolitan unemployment rates are significantly lower in metro areas with a higher share of jobs available to workers with high school diplomas and PhDs and professional degrees (see Table 2 in the methodological and technical appendix). The latter finding may reflect the stability of the education, health, and professional services sector, but the link between employment and demand for high school-educated workers probably reflects more favorable matching between less educated workers and prevailing job requirements.

Meanwhile, in the short-term, there is the immediate and difficult problem of how to increase demand for employment. This analysis sheds light on how important aggregate demand was during the worst period of the recession. From the end of 2007 through 2009, most of the increase in metropolitan unemployment can be explained by a sharp drop in aggregate demand. As much as 78 percent of the increase in metropolitan unemployment over this period can be attributed to national industry performance.[31]

As the recession evolved and economic growth resumed in 2009, the relative importance of industry demand and the education gap converged.[32] Much of the remaining variation, approximately 40 percent, can be attributed to a combination of demographic differences (such as age of population, the presence of immigrants) and state characteristics. Metro areas located in states with a longer history of banking deregulation—which led to more mergers and acquisitions, less stringent lending standards during the housing boom, and more foreclosures recently—have also experienced greater increases in unemployment.[33]

The importance of demand, especially during the recession, points to the need for metropolitan areas concentrated in weakly performing industries to diversify into more stable or even growing sectors as soon as possible. Forecasts from Moody's Analytics suggests that some of the fastest growing industries in upcoming years will continue to be healthcare services, social assistance, professional services, and the non-profit sector. Moody's also predicts modest growth in computer and electronics manufacturing and a return to positive growth in construction, especially civil engineering. On the negative side, they forecast job losses in areas like mining, agriculture, chemical, apparel, and fabricated metal manufacturing.[34]

Beyond specific industries, there is good reason to believe that U.S. exports will continue to grow faster than GDP, as large and rapidly growing global economies continue to develop. Metropolitan economies can increase the demand for their labor by undertaking strategies that help local firms meet foreign demand for their manufactured goods and services.[35]

Domestic and global demand will also continue to grow for products and services that benefit the environment. The "green" economy is already more export-oriented than the rest of the economy and those exports are growing rapidly.[36] Moreover, Brookings research finds that employment has been expanding rapidly in a subset of the green economy that is focused on emerging alternative energy production and conservation technologies, otherwise known as "cleantech," and job growth in green manufacturing has outpaced traditional manufacturing.[37] Green industries also provide a disproportionate share of jobs for less educated workers, meaning that their expansion could help lower metropolitan education gaps, while potentially improving their industry orientation.[38] Metropolitan economies can find and develop their specific strengths in these industries through strategic investments in human capital and infrastructure, the adoption of sound workforce development policies that tie demand to training, and sensible regulatory practices that encourage economic development.

Data Appendix. The 100 Largest Metropolitan Areas Sorted by Overall Rank of Education Matching and Predicted Industry Growth the Recession

Metropolitan Area	Overall Rank—Combining Education Gap and Industry Composition	Rank Education Gap, 2009	Rank Predicted Growth from 2007 to 2009	Education Gap, 2009	Predicted Job Growth, 2007 to 2009 (%)	Unemployment Rate, May 2011 (%)	Change in unemployment rate, pre-recession low to May of 2011
Washington-Arlington-Alexandria, DC-VA-MD-WV	1	3	5	0.961	-3.5	5.7	2.7
Madison, WI	2	1	20	0.957	-4.2	5.3	1.9
Boston-Cambridge-Quincy, MA-NH	2	7	14	0.970	-3.9	6.6	2.5
Albany-Schenectady-Troy, NY	4	21	2	0.986	-2.9	6.8	2.8
Honolulu, HI	5	22	4	0.986	-3.4	4.9	2.5
Poughkeepsie-Newburgh-Middletown, NY	6	25	6	0.988	-3.5	7.4	3.3
San Francisco-Oakland-Fremont, CA	7	5	27	0.966	-4.3	9.3	5.1
Portland-South Portland-Biddeford, ME	8	11	23	0.975	-4.2	6.2	2.7
Colorado Springs, CO	9	9	29	0.971	-4.4	9.3	5.1
Bridgeport-Stamford-Norwalk, CT	10	2	38	0.960	-4.6	8.5	4.5
Rochester, NY	11	35	11	0.990	-3.8	7.1	2.5
New Haven-Milford, CT	12	37	12	0.991	-3.8	9.5	4.9
Minneapolis-St. Paul-Bloomington, MN-WI	13	10	40	0.974	-4.6	6.3	2.5
Worcester, MA	14	31	22	0.990	-4.2	7.9	3.1
Baltimore-Towson, MD	14	36	17	0.991	-4.0	7.3	3.5
Omaha-Council Bluffs, NE-IA	16	17	37	0.984	-4.6	4.6	1.3
Syracuse, NY	17	40	15	0.991	-3.9	7.7	3.2
New York-Northern New Jersey-Long Island, NY-NJ-PA	18	49	7	0.996	-3.7	8.3	3.9
Columbia, SC	19	26	32	0.988	-4.5	9.0	4.1
San Diego-Carlsbad-San Marcos, CA	20	23	36	0.987	-4.6	9.6	5.6
Hartford-West Hartford-East Hartford, CT	21	28	33	0.990	-4.5	9.1	4.5
Provo-Orem, UT	22	6	57	0.968	-5.1	7.5	5.0
Austin-Round Rock-San Marcos, TX	23	18	48	0.984	-4.8	6.7	3.0
Raleigh-Cary, NC	23	4	62	0.964	-5.2	7.9	4.3

Data Appendix. The 100 Largest Metropolitan Areas Sorted by Overall Rank of Education Matching and Predicted Industry Growth the Recession (continued)

Metropolitan Area	Overall Rank—Combining Education Gap and Industry Composition	Rank Education Gap, 2009	Rank Predicted Growth from 2007 to 2009	Education Gap, 2009	Predicted Job Growth, 2007 to 2009 (%)	Unemployment Rate, May 2011 (%)	Change in unemployment rate, pre-recession low to May of 2011
Columbus, OH	23	24	42	0.987	-4.6	7.4	2.7
Des Moines-West Des Moines, IA	26	20	47	0.986	-4.8	5.8	2.4
Virginia Beach-Norfolk-Newport News, VA-NC	27	47	21	0.995	-4.2	6.6	3.4
Springfield, MA	27	65	3	1.004	-3.2	8.4	3.3
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	29	53	16	0.998	-3.9	8.4	4.1
Buffalo-Niagara Falls, NY	30	45	26	0.994	-4.3	7.5	2.6
Pittsburgh, PA	31	58	18	1.001	-4.1	6.9	2.6
Jackson, MS	32	70	8	1.005	-3.7	7.7	2.6
Kansas City, MO-KS	33	27	53	0.989	-4.9	8.4	3.4
Denver-Aurora-Broomfield, CO	34	14	69	0.979	-5.3	8.5	4.7
Harrisburg-Carlisle, PA	35	71	13	1.005	-3.9	6.9	3.3
Charleston-North Charleston-Summerville, SC	36	19	67	0.985	-5.3	8.7	4.3
Albuquerque, NM	36	42	44	0.994	-4.7	6.8	3.4
Chicago-Joliet-Naperville, IL-IN-WI	38	29	59	0.990	-5.1	9.5	5.0
Portland-Vancouver-Hillsboro, OR-WA	38	12	76	0.976	-5.4	8.6	3.8
Ogden-Clearfield, UT	38	16	72	0.981	-5.3	7.2	4.4
Providence-New Bedford-Fall River, RI-MA	41	72	19	1.006	-4.2	11.1	5.8
Sacramento—Arden-Arcade—Roseville, CA	41	67	24	1.005	-4.2	11.7	7.0
Milwaukee-Waukesha-West Allis, WI	43	32	60	0.990	-5.1	8.0	3.1
San Jose-Sunnyvale-Santa Clara, CA	44	13	80	0.978	-5.5	9.9	5.3
Oxnard-Thousand Oaks-Ventura, CA	45	38	58	0.991	-5.1	9.5	5.2
St. Louis, MO-IL	45	46	50	0.995	-4.8	8.6	3.5
Seattle-Tacoma-Bellevue, WA	47	8	89	0.971	-5.8	8.5	4.4
Oklahoma City, OK	48	73	25	1.006	-4.2	4.9	1.2
McAllen-Edinburg-Mission, TX	49	100	1	1.098	-2.7	11.9	5.3
North Port-Bradenton-Sarasota, FL	50	15	88	0.981	-5.7	10.3	7.3
Fresno, CA	51	96	10	1.040	-3.8	16.0	8.0
Bakersfield-Delano, CA	52	99	9	1.061	-3.7	15.0	7.5
Tucson, AZ	53	59	51	1.001	-4.9	7.8	4.2
Richmond, VA	53	64	46	1.004	-4.8	6.7	3.6
Cleveland-Elyria-Mentor, OH	53	61	49	1.003	-4.8	7.7	2.2
Cincinnati-Middletown, OH-KY-IN	56	57	55	1.001	-5.0	8.5	3.5
Allentown-Bethlehem-Easton, PA-NJ	57	78	35	1.009	-4.6	8.4	4.1
Nashville-Davidson—Murfreesboro—Franklin, TN	58	39	75	0.991	-5.4	8.5	4.4
Akron, OH	58	50	64	0.997	-5.2	8.2	3.0
Indianapolis-Carmel, IN	60	34	81	0.990	-5.5	7.8	3.7
Atlanta-Sandy Springs-Marietta, GA	60	41	74	0.991	-5.4	9.7	5.1
Scranton—Wilkes-Barre, PA	60	84	31	1.012	-4.5	8.7	3.8
Little Rock-North Little Rock-Conway, AR	60	81	34	1.010	-4.5	7.0	2.5
New Orleans-Metairie-Kenner, LA	64	77	41	1.008	-4.6	8.0	4.5
Jacksonville, FL	64	52	66	0.998	-5.3	9.7	6.5
San Antonio-New Braunfels, TX	66	91	28	1.021	-4.4	7.3	3.2
Knoxville, TN	67	43	77	0.994	-5.4	7.7	3.9

Data Appendix. The 100 Largest Metropolitan Areas Sorted by Overall Rank of Education Matching and Predicted Industry Growth the Recession (continued)

Metropolitan Area	Overall Rank–Combining Education Gap and Industry Composition	Rank Education Gap, 2009	Rank Predicted Growth from 2007 to 2009	Education Gap, 2009	Predicted Job Growth, 2007 to 2009 (%)	Unemployment Rate, May 2011 (%)	Change in unemployment rate, pre-recession low to May of 2011
Miami-Fort Lauderdale-Pompano Beach, FL	68	69	52	1.005	-4.9	11.4	7.8
Cape Coral-Fort Myers, FL	69	30	95	0.990	-6.3	10.8	7.9
Dayton, OH	69	82	43	1.010	-4.7	9.3	3.6
Charlotte-Gastonia-Rock Hill, NC-SC	71	33	93	0.990	-6.1	10.4	5.6
Modesto, CA	72	97	30	1.050	-4.4	16.7	8.7
Birmingham-Hoover, AL	73	68	63	1.005	-5.2	8.8	5.7
Baton Rouge, LA	74	79	54	1.009	-4.9	8.4	4.7
Salt Lake City, UT	75	44	91	0.994	-5.8	7.2	4.6
El Paso, TX	76	98	39	1.053	-4.6	10.0	4.1
Stockton, CA	77	95	45	1.040	-4.7	16.2	8.8
Augusta-Richmond County, GA-SC	78	87	56	1.015	-5.0	8.7	3.2
Orlando-Kissimmee-Sanford, FL	78	56	87	1.000	-5.7	9.9	6.8
Grand Rapids-Wyoming, MI	80	48	97	0.996	-6.4	8.3	2.5
Palm Bay-Melbourne-Titusville, FL	81	60	86	1.001	-5.7	10.8	7.6
Memphis, TN-MS-AR	82	83	65	1.011	-5.2	10.1	4.8
Boise City-Nampa, ID	82	63	85	1.004	-5.6	8.8	6.2
Louisville-Jefferson County, KY-IN	84	66	83	1.004	-5.6	9.5	4.2
Tampa-St. Petersburg-Clearwater, FL	84	88	61	1.016	-5.2	10.5	7.1
Greenville-Mauldin-Easley, SC	84	51	98	0.998	-6.6	8.8	3.8
Las Vegas-Paradise, NV	84	55	94	0.999	-6.2	12.4	8.2
Toledo, OH	88	85	68	1.014	-5.3	9.3	3.3
Tulsa, OK	88	74	79	1.007	-5.5	6.0	2.3
Wichita, KS	88	54	99	0.999	-6.7	7.6	3.5
Detroit-Warren-Livonia, MI	91	75	82	1.008	-5.5	11.6	4.4
Los Angeles-Long Beach-Santa Ana, CA	91	86	71	1.015	-5.3	11.1	6.7
Phoenix-Mesa-Glendale, AZ	93	62	96	1.003	-6.3	8.0	4.7
Houston-Sugar Land-Baytown, TX	94	89	70	1.016	-5.3	8.2	3.9
Lakeland-Winter Haven, FL	95	92	73	1.027	-5.3	10.8	7.2
Dallas-Fort Worth-Arlington, TX	96	80	90	1.010	-5.8	7.9	3.6
Youngstown-Warren-Boardman, OH-PA	97	93	78	1.031	-5.4	9.1	3.1
Chattanooga, TN-GA	98	90	84	1.020	-5.6	8.4	4.2
Greensboro-High Point, NC	99	76	100	1.008	-6.9	10.2	5.4
Riverside-San Bernardino-Ontario, CA	100	94	92	1.033	-5.9	13.2	8.3
Average for 100 Largest Metropolitan Areas				**0.999**	**-4.9%**	**8.8%**	**4.4**

Endnotes

1. U.S. Bureau of Economic Analysis.

2. U.S. Bureau of Labor Statistics, "A-5. Employment status of the civilian noninstitutional population 25 years and over by educational attainment, seasonally adjusted," available at http://www.bls.gov/web/empsit/cpseea05.htm (August 2011).

3. Ibid.

4. Chinhui Juhn, Kevin M. Murphy, and Brooks Pierce, "Wage Inequality and the Rise in Returns to Skill." *Journal of Political Economy* 101 (3) (1993):410-442; Daron Acemoglu "Technical Change, Inequality, and the Labor Market," *Journal of Economic Literature*, 40 (2002): 7-72.

5. Anthony P. Carnevale, Stephen J. Rose, and Ban Cheah, "The College Payoff: Education, Occupations, and Lifetime Earnings," (Washington: Georgetown University Center on Education and the Workforce, 2011).

6. Marco Manacorda and Barbara Petrongolo, "Skill Mismatch and Unemployment in OECD Countries," *Economica* 66 (262) (1999): 181-207.

7. David Card and John E. DiNardo, "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles," *Journal of Labor Economics* 20 (4) (2002): 733–783.

8. David H. Autor, Lawrence F. Katz, and Melissa S. Kearney, "Trends in U.S. Wage Inequality: Revising the Revisionists," *The Review of Economics and Statistics* 90 (2) (2008): 300–323; David H. Autor, "The Polarization of Job Opportunities in the U.S. Labor Market Implications for Employment and Earnings," (Washington: Brookings Institution, 2010).

9. Howard Wial and Richard Shearer, "MetroMonitor: Tracking Economic Recession and Recovery in America's 100 Largest Metropolitan Areas" (Washington: Brookings Institution, 2011).

10. David Altig, "Just how curious is that Beveridge Curve?" *Macroblog*, The Federal Reserve Bank of Atlanta. August 18, 2010. Available at, http://macroblog.typepad.com/macroblog/2010/08/just-how-curious-is-that-beveridge-curve.html.

11. Murat Tasci and John Linder. "Has the Beveridge Curve shifted?" *Economic Trends*, Federal Reserve Bank of Cleveland. August 10, 2010. Available at, http://www.clevelandfed.org/research/trends/2010/0810/02labmar.cfm.

12. Lawrence Mishel, Heidi Shierholz, and Kathryn Edwards, "Reasons for Skepticism about Structural Unemployment: Examining the Demand-Side Evidence," (Washington: Economic Policy Institute, 2009).

13. Nicoletta Batini and others, "United States: Selected Issues Paper" (Washington: International Monetary Fund, 2010). Their approach, however, counts the education gap as higher in states where the share of workers with college degrees exceeds the share of occupations that require a college degree. 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. While this is consistent with structural unemployment, it takes no account of the fact that highly educated workers are more likely to be able to do the work of less educated workers than the converse.

14. 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).

15. Metropolitan statistical Areas are defined by the U.S. Office of Management and Budget for statistical purposes using Census Bureau data to measure the degree of integration between counties in a region.

16. Howard Wial and Richard Shearer, "MetroMonitor: Tracking Economic Recession and Recovery in America's 100 Largest Metropolitan Areas" (Washington: Brookings Institution, 2010).

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. Structural unemployment could be present for some workers even if the typical worker has enough education. Moreover, highly educated workers could be structurally unemployed or under-employed if they cannot find work in their field.

19. Detailed six-digit Standard Occupational Classification (SOC) system categories were pooled into more general

three-digit categories to make them comparable across data sources.

20. 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.

21. 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).

22. The 2005, 2007, and 2009 American Community Surveys were used for this purpose. Working-age here means adults aged 25 or older.

23. This approach credits metropolitan areas possessing a high supply of educated workers with a lower education gap, but some readers may be more interested in the absolute mismatch between supply and demand for education. To calculate this alternative measure, the percentage of metropolitan occupations that demand each education level was subtracted from the supply of workers at the relevant education level. The absolute value of this difference was calculated so that extra supply and extra demand equally contributed to the measure. These values were then added together for each education group. This alternative measure, however, had no predictive power in explaining unemployment, even the unemployment rates of different education groups, so it is not used in the analysis that follows.

24. 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).

25. Since unemployment is partly determined by seasonal trends in education and tourism, the May 2011 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).

26. 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.

27. Source: Brookings analysis of data from Moody's Analytics for employment data and 2009 American Community Survey via IPUMS for education data by industry.

28. This difference is statistically significant with a p-value below 0.000.

29. Metros were classified as having vulnerable industry compositions if their predicted employment growth was below the metropolitan median of -4.7 percent and resilient if above.

30. Anil Kumar, "Why Texas Feels Less Subprime than U.S." *Southwest Economy* 6 (2008).

31. These results were obtained by replicating the analysis shown in column 5 of Appendix Table 3 over the period from 2007 to 2009.

32. These results come from Appendix Table 3.

33. See discussion in the methodological and technical appendix to this report. Giovanni Favara and Jean Imbs, "Credit Supply and the Price of Housing" Discussion Paper 8129 (Center for Economic Policy Research, 2010).

34. Brookings analysis of data from Moody's Analytics for the United States.

35. Emilia Istrate, Jonathan Rothwell, and Bruce Katz, "Export Nation: How U.S. Metros Lead National Export Growth and Boost Competitiveness" (Washington: Brookings Institution, 2010); Bruce Katz and Jonathan Rothwell, "Five myths about U.S. exports," The Washington Post, September 5, 2010.

36. Mark Muro, Jonathan Rothwell, Devashree Saha, with Battelle Technology Partnership Program, "Sizing the Clean Economy: A National and Regional Green Jobs Assessment," (Washington: Brookings Institution, 2011). GTM Research "U.S. Solar Industry Trade Assessment 2011: Trade Flows and Domestic Content for Solar Energy-Related Goods and Services in the United States" (Washington: Solar Energy Industries Association, 2011).

37. Ibid.

38. Ibid.

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