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ABSTRACT

In this paper we use detailed job vacancy data to estimate changes in skill demand in the years since the Great Recession. The share of job vacancies requiring a bachelor's degree increased by more than 60 percent between 2007 and 2019, with faster growth in professional occupations and high-wage cities. Since the labor market was becoming tighter over this period, cyclical "upskilling" is unlikely to explain our findings.

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1 Introduction

The yearly wage premium for U.S. workers with a college degree has grown rapidly in recent decades: from 40 percent in 1980 to nearly 70 percent in 2017 (Autor, Goldin, and Katz 2020). Over the same period, the share of adults with at least a four-year college degree doubled, from 17 to 34 percent (Snyder, de Brey, and Dillow, 2019) (Digest of Education Statistics, 2020). In the "education race" model of Tinbergen (1974), these two facts are explained by rapidly growing relative demand for college-level skills. If the college premium grows despite a rapid increase in the supply of skills, this must mean that the demand for skills is growing even faster.

The education race model provides a parsimonious and powerful explanation of US educational wage differentials over the last two centuries (Katz and Murphy 1992; Goldin and Katz 2008; Autor, Goldin, and Katz 2020). Yet one key limitation of the model is that skill demand is not directly observed, but rather inferred as a residual that fits the facts above. How do we know that the results from the education race model are driven by rising employer skill demand, as opposed to some other unobserved explanation?

We study this question by using detailed job vacancy data to estimate the change in employer skill demands in the years since the Great Recession. Our data come from the labor market analytics firm Burning Glass Technologies (BGT), which has collected data on the near-universe of online job vacancy postings since 2007.

Our main finding is that skill demand has increased substantially in the decade following the Great Recession. The share of online job vacancies requiring a bachelor's degree increased from 23 percent in 2007 to 37 percent in 2019, an increase of more than 60 percent. Most of this increase occurred between 2007 and 2010, consistent with the finding that the Great Recession provided an opportunity for firms to upgrade skill requirements in response to new technologies (Hershbein and Kahn 2018).

We present several pieces of evidence suggesting that the increase in skill demand is structural, rather than cyclical. We replicate the findings of Hershbein and Kahn (2018) and Modestino, Shoag, and Ballance (2019), who show that skill demands increased more in labor markets that were harder hit by the Great Recession. However, when we extend the sample forward and adjust for differences in the composition of online vacancies, we find that this cyclical "upskilling" fades within a few years. In its place, we find long-run structural increases in skill demand across all labor markets. In fact, we show that the increase in skill demand post-2010 is larger in higher-wage cities. We also find much larger increases in the demand for education in professional, high-wage occupations such as management, business, science and engineering.

Previous work using the BGT data has found that it is disproportionately comprised of high-wage professional occupations, mostly because these types of jobs were more likely to be posted online (e.g., Deming and Kahn 2018). As online job advertising has become more common, the BGT sample has become more representative, and the firms and jobs that are added later in the sample period are less likely to require bachelor's degrees and other advanced skills.

We adjust for the changing composition of the sample in two ways. First, we weight all of our results by the employment share of each occupation as well as the size of the labor force in each city in 2006. This ensures that our sample of vacancies is roughly representative of the national job distribution in the pre-sample period. Second, our preferred empirical specification controls for occupation-by-MSA-by-firm fixed effects. This approach accounts for compositional changes over time in the BGT data.

Our results suggest that increasing demand for educated workers is likely a persistent feature of the U.S. economy post-recession. Recent work has documented a slowdown in the growth of the college wage premium since 2005 (Beaudry, Green, and Sand 2016; Valletta 2018; Autor, Goldin, and Katz 2020). Yet this slowdown has occurred during a period of rapid expansion in the supply of skills. We find rapid expansion in the demand for skills, suggesting that education and technology are "racing" together to hold the college wage premium steady.[1]

2 Data and Sample

BGT scrapes job vacancy data from more than 40,000 online job boards and company websites. They apply a text processing algorithm to the raw data that removes duplicate postings and parses the data into a number of fields, including six-digit Standard Occupational Classification (SOC) code, industry, firm name, location, education and work experience requirements, and more than 12,000 unique job skills. Hershbein and Kahn (2018) and Deming and Kahn (2018) compare the coverage of the BGT data to the Job Openings and Labor Force Turnover (JOLTS) survey and find that it provides good coverage overall that is substantially better for professional, high-wage occupations.

Our data from BGT start in 2007, and then are available from January 2010 through October 2019. We restrict the sample to job vacancies with non-missing occupation, firm name, and metropolitan statistical area (MSA) codes. This yields a sample of 120,731,719 unique job vacancies. We apply a simple regularization procedure to the firm name field in the BGT data, eliminating punctuation and common phrases such as “LLC” or “Corp” in order to identify firms across vacancy postings. We supplement the BGT data with occupational employment shares and MSA-level characteristics from the 2005-2006 American Community Survey (ACS), as well as the MSA-level unemployment rate from the Bureau of Labor Statistics (BLS).

Following Hershbein and Kahn (2018), we study cyclical upskilling using an MSA-level shift-share instrument, which they define as the change between 2006 and 2009 in projected annual employment growth based on employment shares in three-digit North

[1] Modestino, Shoag, and Ballance (2016) find evidence that the demand for skills declined more between 2010 and 2014 in labor markets that were hit harder by the Great Recession. They identify this “downskilling” by comparing labor markets within the same year, whereas we estimate the overall time trend across all labor markets. Beaudry, Green, and Sand (2016) document a “Great Reversal” in the demand for cognitive tasks since 2000, although they do not directly measure employer skill demands. Moreover, their data end in 2013, when the recovery was just beginning.

American Industry Classification System (NAICS) codes averaged over 2004-2005 and national employment changes at the 3-digit industry level. We obtain these MSA-level "Bartik" shocks directly from the Hershbein and Kahn (2018) replication file. We also use the change in the MSA-specific unemployment rate over the same period, following Modestino, Shoag, and Ballance (2019). All of our results are weighted by the size of the labor force in each MSA times the national share of employment for each 6-digit (SOC) occupation code in 2005-2006.

3 Results

We begin by estimating the following empirical specification:

$$Y_{i,t,m} = \alpha_0 + \sum_t (\rho_t \times I_t + \alpha_{1,t} shock_m \times I_t) + \beta X_m + \epsilon_{i,t,m} \quad (1)$$

We regress an indicator for whether the job vacancy requires a four-year bachelor's degree on year fixed effects (ρ_t), interacted with the MSA-specific Bartik shock ($\alpha_{1,t}$) described above. We also include MSA-level demographic characteristics as controls.[2] Standard errors are clustered at the MSA level, although we omit confidence intervals from the Figures in all cases because the standard errors are so small.

Figure 1 plots the share of job vacancies requiring a bachelor's degree by year, separately for MSAs that experienced Bartik shocks at the 5th and 95th percentile respectively. Specifically, we compute the implied value by multiplying the shock-by-year ($\alpha_{1,t}$) coefficients times the actual values of the Bartik shock for MSAs at each percentile, and then adding that value to the constant terms for each year.[3]

[2] Following Hershbein and Kahn (2018), we control for share female, share black/Hispanic/Asian, marriage and migration rates, educational attainment and school enrollment, the age structure, labor force participation and mean wages in each MSA in 2005-2006.

[3] The 5th and 95th percentile values of the Bartik shock are 3.135 and 4.406 respectively. The coefficient on the 2010 shock is 0.025, resulting in a gap of (4.406-3.135)*0.025 = 0.032 percentage points between the solid line and the dashed line in Figure 1. The Bartik shock coefficient is near zero in the years after 2011, which explains why the two lines converge.

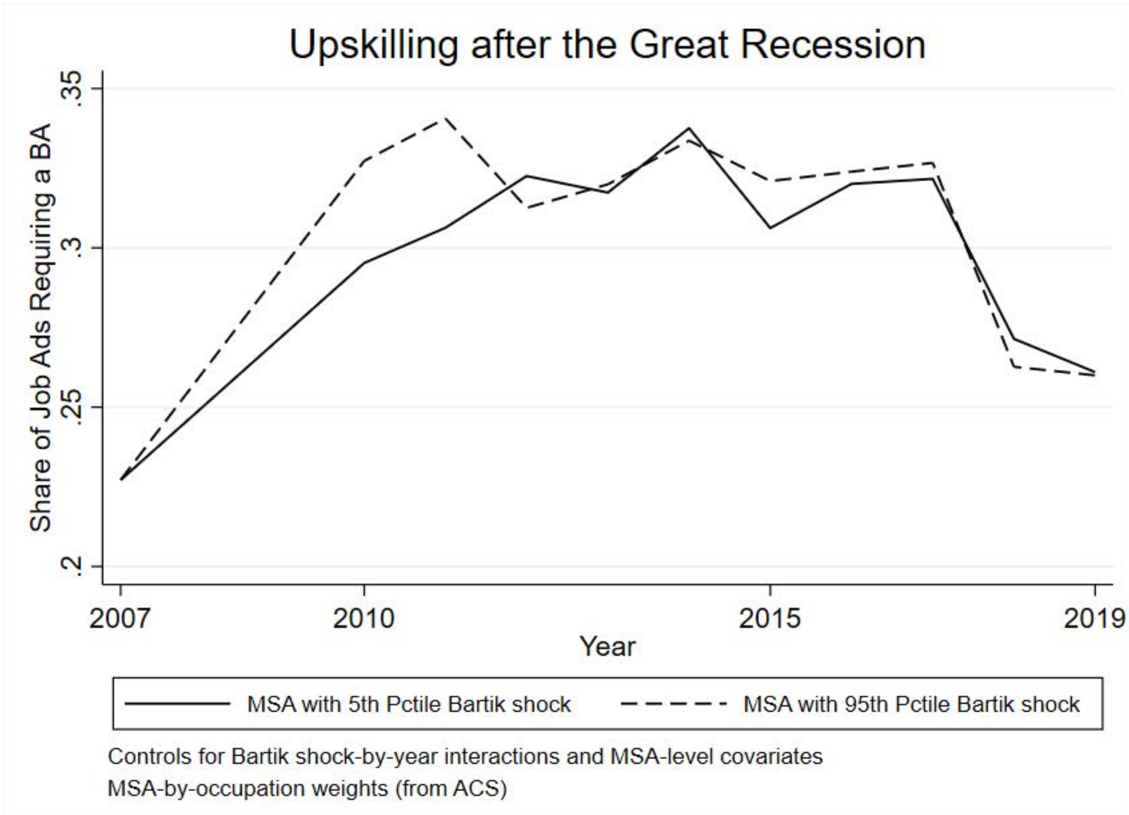

Figure 1

Similar to Hershbein and Kahn (2018), we find a larger increase in skill requirements in labor markets that were hit harder by the Great Recession. This difference persists into 2011, and then disappears thereafter. As Figure 1 shows, the first order fact is that BA requirements increased everywhere between 2007 and 2010, with a magnitude ranging from 7 to 10 percentage points in the MSAs least and most affected. From 2012 to 2017, the share of jobs requiring a bachelor's degree stabilizes around 32 percent, with little or no differences across labor markets. In 2018 and 2019, it falls sharply to around 27 percent.

The specification in equation (1) does not account for changes in the composition of the BGT sample over time. Posting job vacancies online has become much more common over time. As an illustration, there are about 900,000 unique firm-occupation-MSA combinations in 2007, compared to about 6 million in 2019. We account for possible compositional change by estimating:

$$Y_{i,t,o,m,f} = \alpha_0 + \sum_t (\rho_t \times I_t) + \beta X_m + \phi_{o,m,f} + \epsilon_{i,t,o,m,f} \tag{2}$$

This specification is similar to equation (1), except that we remove the shock-by-year interactions and instead include a series of progressively more detailed fixed effects.

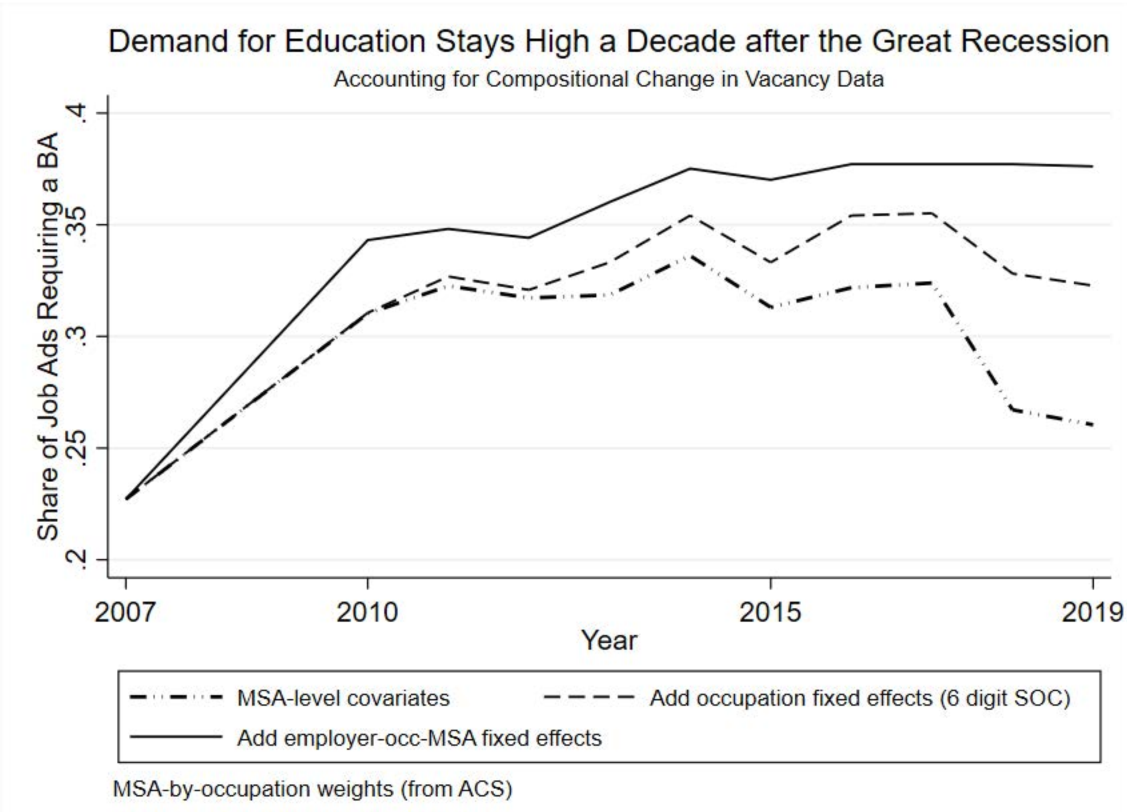

Figure 2

Our first specification follows equation (1) in controlling only for MSA-level demographic characteristics. The second specification adds fixed effects for 6-digit SOC codes. Our preferred specification controls for occupation-by-MSA-by-firm fixed effects ($\phi_{o,m,f}$). The year coefficients from each of these three specifications are plotted in Figure 2. The dash-dotted line presents results that control only for MSA characteristics, and is similar to Figure 1. The dashed line adds controls for six-digit occupation codes, which eliminates the drop in bachelor's degree requirements in 2018 and 2019. The solid line shows results from our preferred specification, which controls for occupation-by-MSA-by-firm fixed effects. Here we see that the share of job vacancies requiring a bachelor's degree increased from 23 percent in 2007 to 34 percent in 2010, and then steadily increased to about 37 percent in 2019. In a balanced panel of firms, jobs and labor markets, the demand for education has remained persistently higher a decade after the Great Recession.

Appendix Figures A1 and A2 present results for high-skilled professional occupations such as management, business, engineering and science.[4] We find very large increases – between 20 and 30 percentage points - in the share of professional jobs that require a bachelor's degree. Across all professional occupation categories, around two thirds of the increase happened between 2007 and 2010, followed by a steady rise thereafter. Finally, Appendix Figure A3 presents results separately for high-wage and low-wage cities.[5] In contrast to the "upskilling" results, we find that the demand for education has increased more in high-wage cities. Not only did these cities experience larger increases in skill demand between 2007 and 2010, but their post-recession growth has been greater as well.

4 Summary

We find large and persistent increases in skill demand following the Great Recession, during a time when labor markets have become much tighter. This suggests that employer skill upgrading is probably here to stay, and that many more job candidates will have to obtain a four-year college degree to compete in the labor market of the 21st century.

[4]Figure A1 presents the year effects from estimates of our preferred specification separately for SOC codes 11 (management) and 13 (business and finance). Figure 2 presents analogous results for SOC codes 15 (computer and mathematical), 17 (engineering and architecture) and 19 (life, physical and social sciences.

[5]We define high-wage cities as the 50 MSAs with the highest weekly earnings in 2006, according to 2005-2006 ACS data. We take this measure directly from the Hershbein and Kahn (2018) replication file.

5 References

1. Autor, David H., Claudia Dale Goldin, and Lawrence F. Katz. 2020. “Extending the Race Between Education and Technology.” Beaudry, Paul, David Green, and Benjamin Sand. 2016. “The Great Reversal in the Demand for Skill and Cognitive Tasks.” Journal of Labor Economics 34 (S1): S199–247.

2. Deming, David, and Lisa B. Kahn. 2018. “Skill Requirements across Firms and Labor Markets: Evidence from Job Postings for Professionals.” Journal of Labor Economics 36 (S1): S337–69.

3. Goldin, Claudia Dale, and Lawrence F. Katz. 2008. The Race between Education and Technology. Cambridge, Mass.: Belknap Press of Harvard University Press.

4. Hershbein, Brad, and Lisa B. Kahn. 2018. “Do Recessions Accelerate Routine-Biased Technological Change? Evidence from Vacancy Postings.” American Economic Review 108 (7): 1737–72.

5. Katz, Lawrence F., and Kevin M. Murphy. 1992. “Changes in Relative Wages, 1963-1987: Supply and Demand Factors.” The Quarterly Journal of Economics 107 (1): 35–78.

6. Modestino, Alicia Sasser, Daniel Shoag, and Joshua Ballance. 2016. “Downskilling: Changes in Employer Skill Requirements Over the Business Cycle.” Labour Economics 41.

7. ———. 2019. “Upskilling: Do Employers Demand Greater Skill When Workers Are Plentiful?” The Review of Economics and Statistics, June, 1–46.

8. Snyder, Thomas D, Cristobal de Brey, and Sally A. Dillow. 2019. “Digest of Education Statistics 2017 (NCES 2018-070).” Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

9. Tinbergen, Jan. 1974. "Substitution of Graduate by Other Labour." Kyklos 27 (2): 217–26.

10. Valletta, Robert G. 2018. "Recent Flattening in the Higher Education Wage Premium: Polarization, Skill Downgrading, or Both?" In Education, Skills, and Technical Change: Implications for Future U.S. GDP Growth, edited by Charles R. Hulten and Valerie A. Ramey, 313–42.

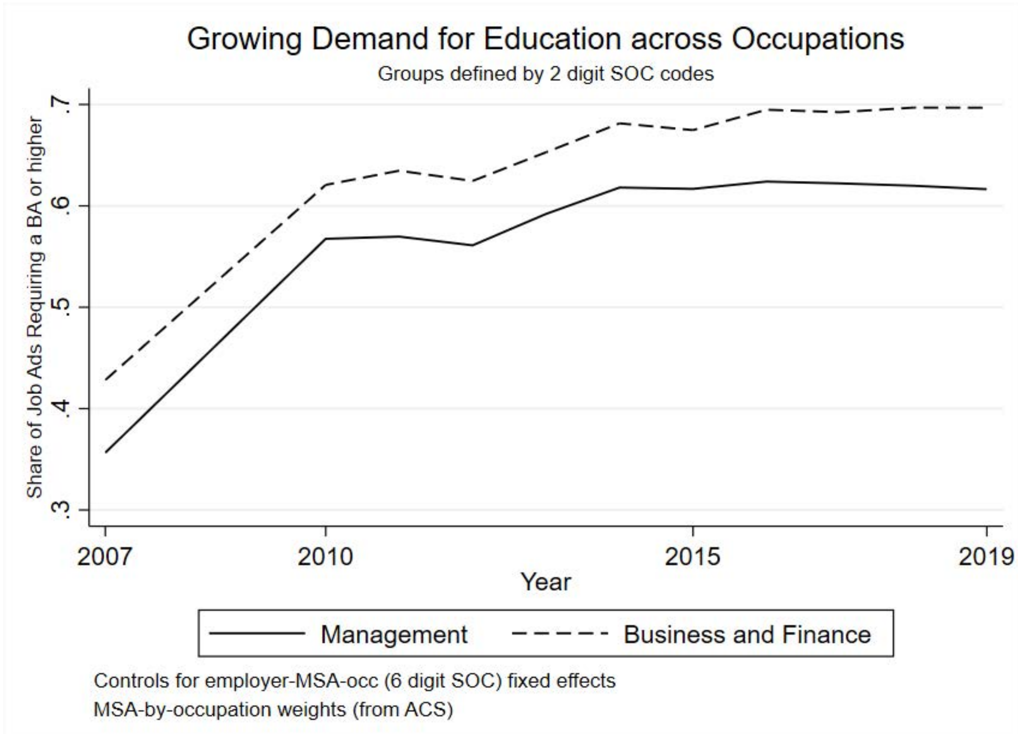

Figure A.1

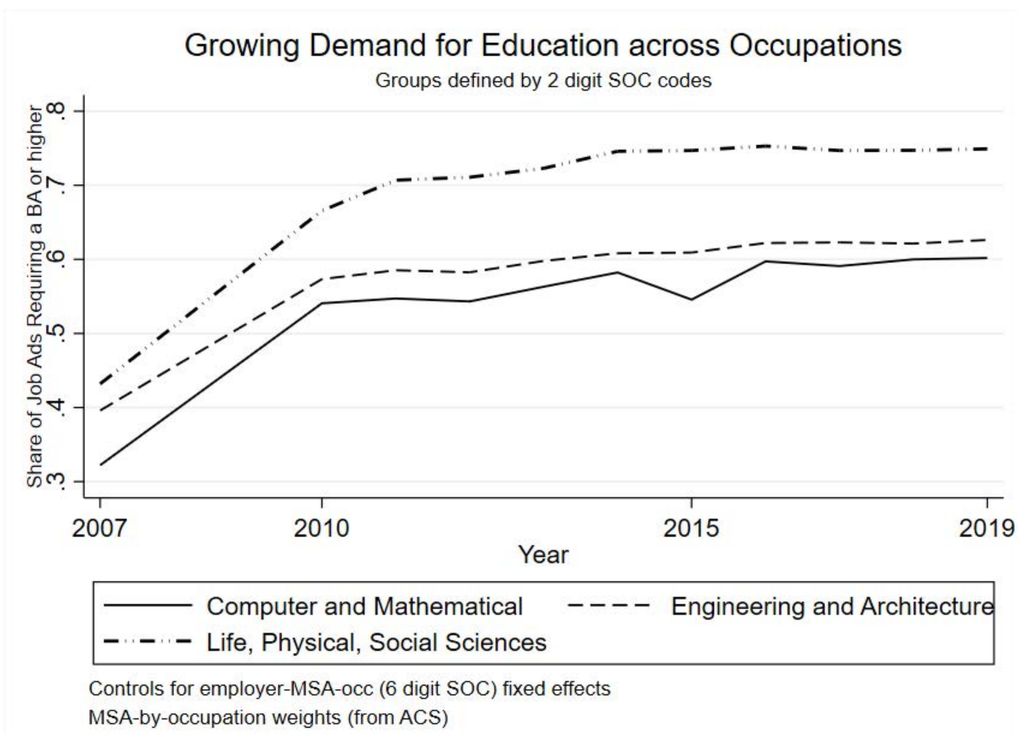

Figure A.2

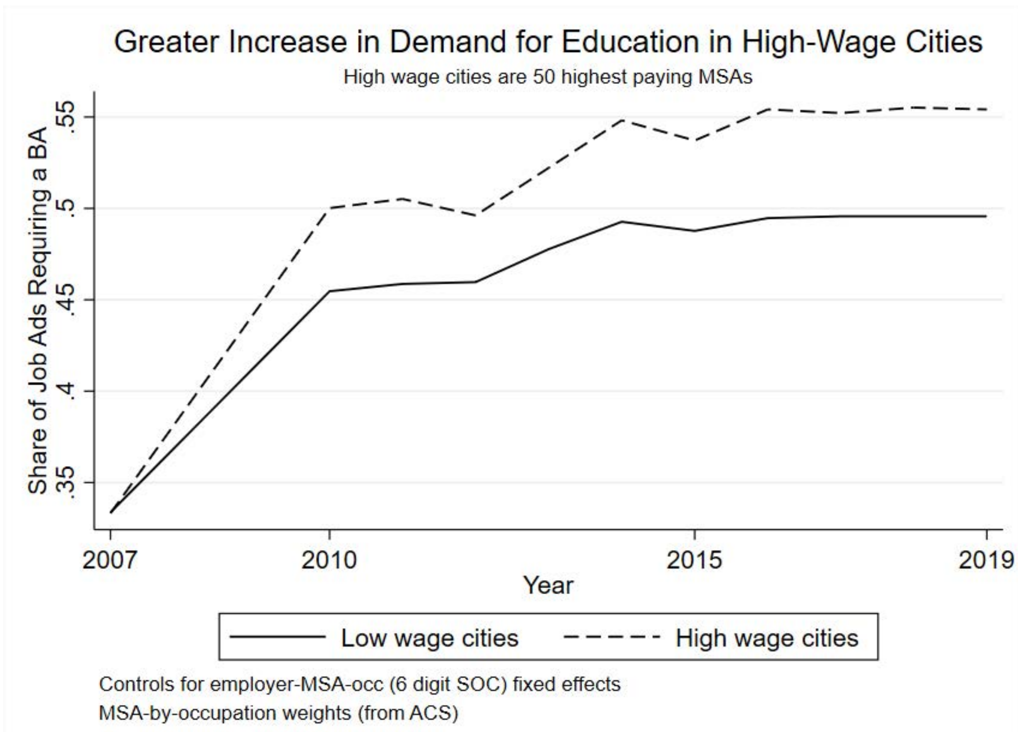
Greater Increase in Demand for Education in High-Wage Cities
High wage cities are 50 highest paying MSAs
Share of Job Ads Requiring a BA
.35
.4
.45
.5
.55
2007
2010
2015
2019
Year
Low wage cities
High wage cities
Controls for employer-MSA-occ (6 digit SOC) fixed effects
MSA-by-occupation weights (from ACS)

Figure A.3