



# Falling Short

## Why Isn't the U.S. Producing More College Graduates?

By Urvi Neelakantan and Jessie Romero

For roughly four decades, the gap in earnings between workers with and without a college degree has been large. This persistent earnings gap is unusual from a historical perspective—in previous instances, workers have responded by increasing their level of education, and the resulting increase in the supply of more-educated workers has narrowed the gap over time. Over the past four decades, students have indeed enrolled in college at increasing rates; however, a large proportion of them have failed to earn degrees. Partly as a result of this bottleneck, the earnings gap has endured.

Why isn't the U.S. producing more college graduates? Two key—and related—factors appear to play a role in college enrollment and completion: socioeconomic status and preparedness, broadly defined to include both academic preparation and the knowledge needed to make informed choices about college. For example, a large literature has documented the contribution of early childhood education to later academic (and labor market) success; children from lower-income families are less likely to have access to such education.<sup>1</sup>

Children from lower-income families also are less likely to have the opportunity to attend high-quality elementary and secondary schools that enable them to make informed choices about their path after high school and succeed along that path. A challenge for policymakers, however, is that the evidence on what makes a school high quality is somewhat mixed and difficult to generalize from one school to another. This remains an important area of economic research, of interest not only to education and fiscal policymakers, but also to the Fed.

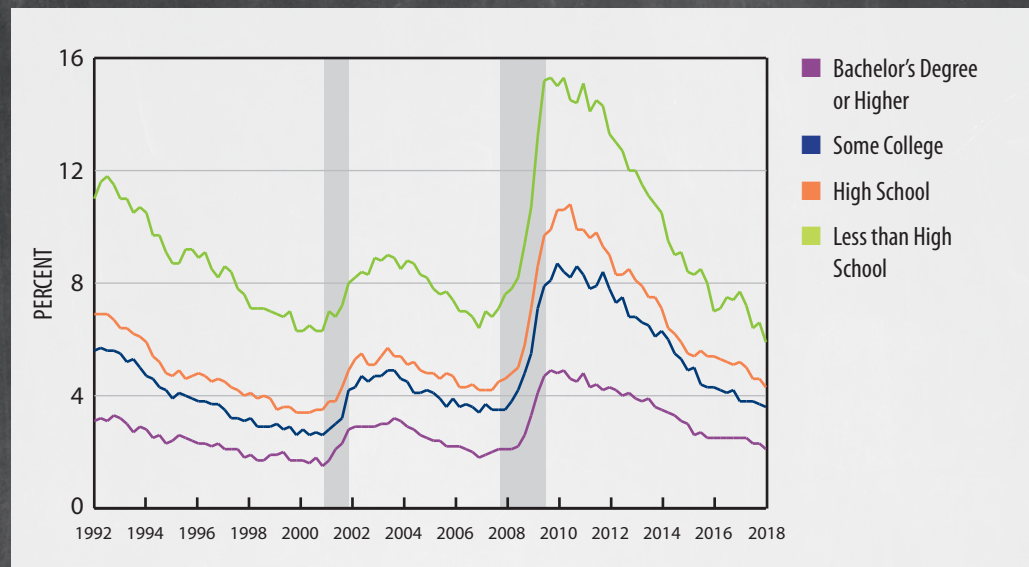
### Why Does the Fed Care about Education?

All policymakers, including those at the Fed, are ultimately concerned about people's standards of living. Improvements in standards of living are driven by economic growth, which in turn depends on productivity. Productivity depends at least in part on human capital—the skills, knowledge, and other intangible qualities that individuals possess. Formal education is a key component of human capital.

Productivity growth is of particular interest to monetary policymakers because of its relationship to the appropriate policy rate. In conventional monetary policy thinking, the central bank's target interest rate should track an underlying interest rate known as the "natural rate of interest." In general, the natural rate and overall economic growth move together: slower growth tends to be associated with a lower natural interest rate, and faster growth with a higher natural rate.<sup>2</sup>



**Figure 1:  
Unemployment  
Rate by Educational  
Attainment**



SOURCE: U.S. Bureau of Labor Statistics Current Population Survey and Haver Analytics  
 NOTES: "Some College" includes people who earned two-year degrees. Data are for workers age twenty-five and older through the fourth quarter of 2017. Shaded areas indicate recessions.

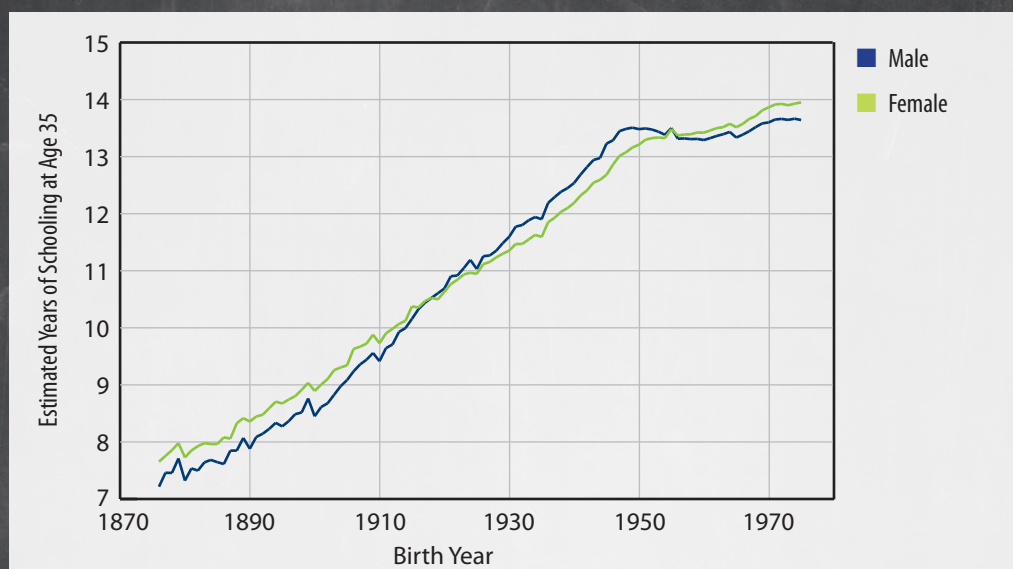
Economists have identified a slowdown in productivity growth in the United States (and other developed countries) beginning in the early 2000s, which could be contributing to slower economic growth.<sup>3</sup> One factor contributing to slower productivity growth might be slower growth in the United States' stock of human capital, which could be dampening the nation's ability to absorb technological and scientific advances. In short, low growth in college attainment may be contributing to a low natural rate of interest. The low average policy rates that would be appropriate in this situation potentially make monetary policymakers' task more difficult by limiting the central bank's ability to respond to recessions.

The Fed also cares about education because its mandate includes a charge to promote "maximum sustainable employment." Aggregate employment (or unemployment) is determined by the rates at which individual workers flow through the labor market, and these flows are influenced by a variety of factors outside the purview of monetary policy.<sup>4</sup> Understanding these factors gives policymakers the necessary context for taking monetary policy actions, including cognizance of those actions' potential limitations. Education is one such factor: during economic downturns and expansions alike, college graduates on average have much lower unemployment rates than workers with less formal education. And during recessions, the unemployment rate for college graduates tends to rise less than the rate for less-educated workers. (Note the large difference in the recession of 2007–09 in Figure 1.) Thus, a well-educated workforce may offer the promise of an economy with a low and stable unemployment rate.

### Supply and Demand for High-Skill Workers

In the first half of the twentieth century, schooling increased steadily for successive cohorts of Americans, according to research by Claudia Goldin and Lawrence Katz of Harvard University. While those born in 1920 had completed less than eleven years of schooling on average by age thirty-five, those born in 1950 completed about thirteen and a half years. However, educational attainment decelerated sharply for those born during the next twenty years, with the result

**Figure 2:  
Years of Schooling  
by Birth Year**



SOURCE: Authors' calculations using 1940–2000 data from the Integrated Public Use Microdata Series: Version 7.0. Minneapolis: University of Minnesota, 2017. The authors follow a procedure similar to Goldin and Katz (2010). NOTE: Estimates are for average years of schooling.

that Americans, particularly men, born in 1970 barely completed more years of school than those born in 1950. (See Figure 2.)<sup>5</sup> Rui Castro of the University of Western Ontario and Daniele Coen-Pirani of the University of Pittsburgh have found similar results. In a 2016 article, they concluded that the college graduation rate for white men actually decreased between the 1948 and 1960 birth cohorts; despite some recovery, the graduation rate for the 1972 cohort was still 3 percentage points lower than the rate for the 1948 cohort.<sup>6</sup>

This slowdown in skill acquisition, combined with growing demand for high-skill workers, contributed to a large increase in the “college premium”—the higher wages and earnings of college graduates relative to workers with only a high school degree.<sup>7</sup> In 1980, workers with a bachelor’s degree or higher earned about 29 percent more than workers with only a high school degree. By 2009, college graduates earned nearly 45 percent more, a gap that has persisted since then. (See Figure 3.)<sup>8</sup>

In previous periods in the United States, an increase in the demand for highly educated workers has been met with a supply response: workers, observing that a skill premium existed, increased their level of education to take advantage of it. Over time, this had the effect of reducing the wage gap. For example, the high school graduate premium plummeted by more than half between 1910 and 1950, a period during which the fraction of seventeen-year-olds who were high school graduates rose from less than 9 percent to nearly 60 percent.<sup>9</sup>

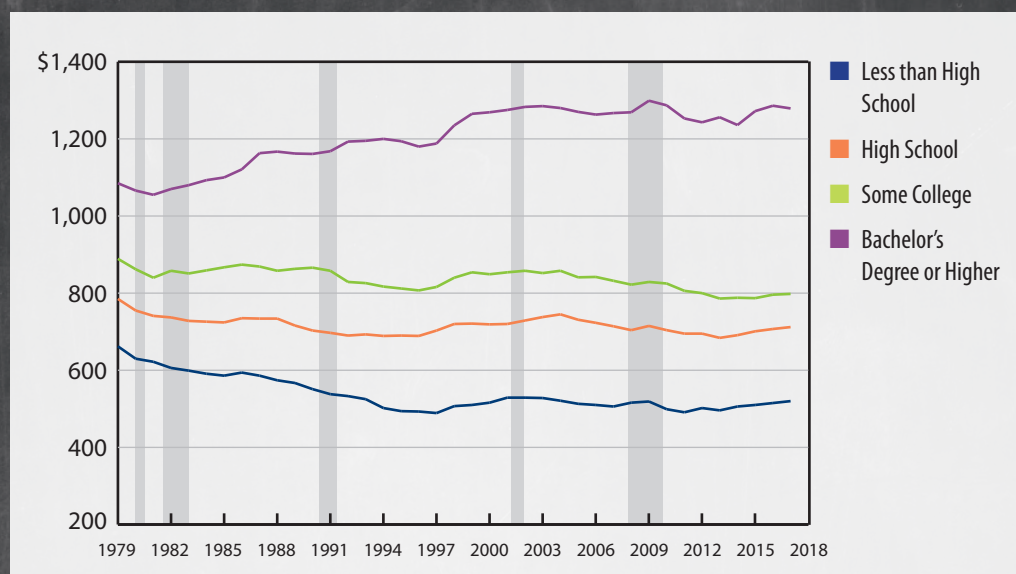
Recent data do point to an increase in educational attainment for cohorts born after the 1970s.<sup>10</sup> Still, the persistence of the college premium suggests that the supply of high-skill workers remains insufficient to meet the economy’s demand. Moreover, to the extent attainment has increased, it has increased unequally.<sup>11</sup>

### **Trends in College Enrollment and Completion**

College enrollment in the United States has grown substantially since the 1970s. Between 1975 and 2015, the share of eighteen- to twenty-four-year olds enrolled in a four-year institution increased from 17.3 percent to 29.9 percent, with the majority of the increase occurring



**Figure 3:  
Median Weekly  
Earnings by Educational  
Attainment**



SOURCES: U.S. Bureau of Labor Statistics (BLS), "Highlights of Women's Earnings in 2016," Table 19, August 2017. Data for 2017 are from BLS, "Usual Weekly Earnings of Wage and Salary Workers," Table 9. NOTE: "Some College" includes people who earned two-year degrees. Earnings are in constant 2017 dollars for full-time, wage and salary workers age twenty-five and older. Shaded areas indicate recessions.

between 1975 and 1995, according to the National Center for Education Statistics (NCES). The share peaked at 30 percent in 2011 and then declined—likely as a result of declining enrollment in for-profit schools—before starting to rise again in 2014.

College enrollment varies significantly by measures of socioeconomic status. In 2010–11, 50.7 percent of graduates from public high schools where less than a quarter of the students were approved for free or reduced-price lunch programs enrolled in a four-year college the following year. In contrast, during the same time period, only 29.1 percent of high school students graduating from a school where more than three-fourths of the students were approved for free or reduced-price lunch enrolled in a four-year college. There is also variation by geography; students from rural areas are slightly less likely to attend college than students from suburban areas, and they are more likely to attend a two-year college. Students who obtain a two-year degree do earn more on average than those with only a high school degree, but the premium is much smaller than for those with a four-year degree. (See Figure 3.)

Currently, a large share of students who enroll in college fail to graduate: among students who started attending a four-year institution in 2009, only 59 percent had earned a bachelor's degree within six years, according to the NCES. That's a modest improvement since the 1996 cohort, the first year for which the NCES has published data, when 55 percent earned a degree within six years. (Completion rates vary greatly by type of institution: 59 percent at public colleges, 66 percent at private nonprofit colleges, and 23 percent at private for-profit colleges.)

Like college enrollment, college completion varies by socioeconomic factors. In 2002, the NCES began surveying a cohort of about 15,000 high school sophomores. Students were assigned a composite score for socioeconomic status (SES) based on their parents' education levels, occupations, and income. Then they were grouped into low, middle, and high SES. By 2012, 77 percent of the high-SES students who were enrolled in a four-year college in 2006 had earned a bachelor's degree or higher. But only 50 percent of the low-SES students who enrolled in college had completed their degrees by 2012. Even among students with similar

prematriculation academic achievement, low-SES students were less likely to complete college than high-SES students.<sup>12</sup>

Recent research by Sarah Turner and Emily Cook of the University of Virginia (UVa) illustrates how these differences play out at the state level. Overall, Virginia is one of the most highly educated states in the nation. But within the state, college attendance ranges from less than 50 percent of high school graduates in some low-income, predominantly rural school districts to more than 80 percent in some high-income, suburban school districts, based on data from the 2013–14 school year.<sup>13</sup> There also are systematic differences in the schools to which students apply and eventually enroll; in general, students from less affluent, more rural districts are less likely to apply to and to enroll in high-resource institutions, such as UVa or the College of William & Mary, than students from more affluent, suburban areas. Universities with more resources, as measured by instructional expenditures per student, tend to have higher graduation rates, and their graduates tend to have higher earnings. In part, these outcomes reflect the characteristics of the students most likely to attend high-resource schools, but they also reflect the benefits of greater resources.

### Is the Problem Paying for College?

Given the correlations between family income, college enrollment, and college completion, not to mention widely publicized tuition increases in recent decades, one approach to reducing disparity has been to increase the availability of need-based financial aid.<sup>14</sup> Thus, at most schools, there is a large difference between sticker price and net price, especially for students from lower-income families. And at some of the most selective (and expensive) schools, the availability of considerable need-based financial aid produces realized net costs for low- and moderate-income families that actually are lower than net costs at less selective schools. The posted price to attend UVa, for example, is nearly \$27,000 per year. But for a student with a family income between \$30,000 and \$39,999, the average net price is about \$11,000 per year. In contrast, the sticker price to attend Old Dominion University, in Norfolk, Virginia, is \$21,523, while the net price for a low-income student is \$15,170.<sup>15</sup>

Many students do not seem to have full information about college costs. In a 2015 survey, Zachary Bleemer of the University of California, Berkeley and Basit Zafar of Arizona State University found that students and their families believed the annual net cost of attending a four-year college was about \$10,000 higher than the actual net cost. Lower-income families and families where the parents had not attended college were more likely to overestimate costs.<sup>16</sup>

While posted prices can make a college seem less attainable than it actually is, paying for any college may remain a burden for many families.<sup>17</sup> Research by John Bailey Jones of the Richmond Fed and Fang Yang of Louisiana State University suggests that if college costs had stopped increasing after 1961, enrollment would have been 3 percent to 6 percent higher in 2010.<sup>18</sup>

*Need-based financial aid makes many high-resource institutions, such as the University of Virginia, more affordable than their sticker prices may indicate.*



UVa PHOTO





*Many students drop out of college after they discover that their grade performances are insufficient to earn degrees.*

In addition, the returns to college are uncertain, both because of the likelihood of noncompletion and because of earnings variation even among those who do graduate. This uncertainty, combined with the costs of college, makes college a risky investment. Some students who choose not to enroll, particularly those from low-wealth households, appear to be making rational decisions because the risks to them are large enough to exceed the expected gains.<sup>19</sup>

Why do some students fail to complete college? Research suggests that the decision to drop out reflects a process of learning about one's own ability; many students seem to lack sufficient knowledge about their academic ability when they enter college, and they drop out based on what they learn about their ability after they enroll.<sup>20</sup>

This process of self-discovery may work differently for students from different socioeconomic backgrounds, according to research by Ali Ozdagli of the Boston Fed and Nicholas Trachter of the Richmond Fed.<sup>21</sup> In a 2015 paper, they developed a model in which students enroll in college and are endowed with a particular wealth level. Students learn about their ability to accumulate skills by taking exams; each time they take an exam, they update their beliefs about their abil-

ities and weigh the expected gains from completing college against the costs of remaining in college. Ozdagli and Trachter demonstrate that students' initial wealth levels affect their belief threshold for dropping out. Wealthier students are less risk-averse and thus more likely to continue investing in the risky asset, that is, to continue attending college. Poorer students are about 27 percent more likely to drop out. They also drop out about one year earlier.<sup>22</sup>

It might also be the case that children from families with fewer resources are less prepared for college in the first place. Virginia Commonwealth University economists Adam Blandin and Christopher Herrington have studied how college attainment varies among students from different family backgrounds and whose parents have different education levels. In general, they found that college completion rates have increased more for students who grew up in a two-parent household where at least one parent had a bachelor's degree or higher. The authors attribute this difference to the fact that these "high-resource" families are able to invest more in preparing their children for college.<sup>23</sup>

### **Preparing Students for College**

This research raises the question: Why are some students better prepared than others? Preparation includes two key components, both of which tend to vary with socioeconomic factors. One component is information, or "knowledge about college." Numerous studies have shown that low-income students don't know as much about the application process and tend to receive less help navigating it. In part, this could be because they know fewer adults who have completed college. It also could be because they attend high schools with fewer resources for college guidance.<sup>24</sup>

The schools children attend also affect the second major component, academic preparation. In the United States, residential neighborhoods are the predominant mechanism of assigning students to schools. The value of a neighborhood's schools in turn affects its housing prices. This gives wealthier parents more options, as they can afford to move to neighborhoods with higher housing prices and better quality schools or opt to send their children to private schools. Recent research by Sean Reardon of Stanford University found that students in the most and least socioeconomically advantaged school districts performed an average of four grade levels apart.<sup>25</sup>

While research suggests school quality improves academic outcomes, defining "quality" is no simple task. Researchers have been attempting to do so since at least the 1960s, when Johns Hopkins University sociologist James Coleman conducted the first comprehensive survey of the U.S. educational system.<sup>26</sup> (Coleman concluded that a school's physical amenities were less of a factor in achievement than a student's peers and socioeconomic background and that disadvantaged students in particular would benefit from greater diversity.)

Because there is significant variation across school districts, schools, and students themselves, it is difficult to generalize the outcomes of any specific intervention to other settings. In addition, it is very difficult to disentangle the various factors that contribute to school quality and student outcomes.

Despite these caveats, two factors consistently emerge from the research as important inputs into school quality: teacher quality and class size.<sup>27</sup> For example, a one standard deviation increase in teacher quality has been shown to raise math achievement by 0.15 to 0.24 standard deviations per year and reading achievement by 0.15 to 0.20 standard deviations per year.<sup>28</sup> But what makes a teacher effective? One determinant is experience—teachers who have been in the classroom at least three years tend to do better than those with less experience.<sup>29</sup> But beyond this fact, the answer remains somewhat elusive. This is an open area of research, and the findings will be important for designing policies that effectively incentivize better teaching.<sup>30</sup>

Switching to a small class can raise a student's test scores by about 0.15 standard deviations, according to studies of Project STAR, a class-size reduction initiative in Tennessee. The gains were the largest for lower-income and minority students. But while reducing class size, particularly for kindergarten through third grade, may have significant effects on students' academic performance, smaller classes are costly. In addition, to the extent class-size reduction requires schools to hire inexperienced or less-effective teachers, the benefits could be muted.

## School Choice

School choice programs, such as private school vouchers, charter schools, and open enrollment, attempt to break the link between families' socioeconomic status and their access to quality schools. Proponents of

*Switching to a small class can raise a student's test scores by about 0.15 standard deviations, according to studies of Project STAR.*





expanding school choice also argue that offering more alternatives to traditional public schools will introduce competition in an otherwise noncompetitive public school sector and make public schools more productive. A potential downside of such programs is that they reduce academic diversity in the classroom, which may be particularly detrimental for lower-achieving students.<sup>31</sup> In addition, low-performing schools (and the students who remain in them) may be left even worse off because school funding is typically tied to school size.

Currently, twelve states and Washington, D.C., offer voucher programs, including Maryland and North Carolina.<sup>32</sup> (Some states also offer education savings plans or scholarship tax credits to help children attend private schools.) Some studies have found positive effects for certain groups of students in certain subjects, but the results are inconsistent. Several recent studies actually found that test scores declined for children using vouchers to attend private schools.<sup>33</sup> This might reflect the fact that private schools with declining enrollment, perhaps because of lesser academic quality, are more likely to participate in voucher programs.

There seems to be more evidence in favor of charter schools, which receive public funding but are independently operated under a charter with the school district. Charter schools have become widespread since the early 2000s. Currently, at least forty-two states and D.C. have passed legislation allowing charter schools, including every state in the Fifth District. From the 2004–05 school year through the 2014–15 school year, the percentage of all public schools that were public charter schools increased from 4 percent to 7 percent, and the number of students enrolled in public charter schools increased from about 900,000 to 2.7 million, according to the NCES.

Numerous studies have shown improvements in standardized test scores for students attending charter schools, with the largest gains accruing to students from disadvantaged backgrounds. Some research also has found that students attending charter schools are more likely to graduate from high school and attend college.<sup>34</sup> Because charter schools vary widely in their instructional approaches, however, any positive results might only be applicable to the particular schools studied.<sup>35</sup>

Another mechanism for increasing school choice is open enrollment, where students have the option to transfer to another school within their district or even to a school outside their district. Most states allow open enrollment in some form, albeit with a number of restrictions based on a school's capacity and which students receive priority.<sup>36</sup>

In the Fifth District, the Charlotte-Mecklenburg school district offered open enrollment for the 2002–03 school year after a court ruling ended a decades-old busing program.<sup>37</sup> One study found that students who used the choice program to attend a school with higher test scores had significant gains in academic achievement.<sup>38</sup> Another study found that girls who attended a higher-quality school were much more likely to graduate from high school and attend college, although for boys on average there was little effect.<sup>39</sup>

A universal difficulty in assessing school-choice programs is controlling for selection effects. For example, the gains in academic achievement observed in Charlotte might have occurred because more academically focused or motivated students (or those with more academically focused parents) chose to take advantage of the opportunity to attend a different school.



*It is possible that better preparation could lead to higher college completion rates without increasing the number of college graduates.*

## **Beyond College**

This essay has focused on college completion rates as a factor restricting the supply of college graduates in the United States, including how students' preparation during K-12 affects their chances of earning a degree. It is possible, however, that improvements in preparation could lead to higher college completion rates without increasing the number of graduates: to the extent "knowledge about college" is part of being prepared, students on the margin of dropping out of college might decide not to enroll in the first place.

In fact, a high school that focuses predominantly on college preparation might not be a good match for everyone. If the only reason to graduate from high school is to enroll in college, then students who do not wish to attend college or who perceive large barriers to doing so might not see much value in graduating. For those students, information about and access to vocational training or apprenticeship programs, for example, could increase the value of finishing high school and improve their labor market outcomes relative to dropping out.<sup>40</sup>

In addition, while most studies of school quality focus on academic gains, these are not the only reasons to try to improve schools. Efforts to improve school quality also may improve students' noncognitive skills and thus affect labor market outcomes through those channels. For example, one study of Project STAR found that class quality (as measured by students' end-of-year test scores) in kindergarten through third grade had significant effects on skills such as effort, initiative, and lack of disruptive behavior in later grades.<sup>41</sup> These skills, in turn, are highly correlated with earnings later in life even after conditioning on test scores. These results suggest that high-quality classrooms may lead to improved labor market outcomes long after their effects on test scores have dissipated. ■

*Urvi Neelakantan is a senior policy economist and Jessie Romero is a senior economics writer in the Research Department at the Federal Reserve Bank of Richmond. The authors are grateful to John Bailey Jones, Karl Rhodes, Nicholas Trachter, and John A. Weinberg for many helpful comments.*

*The views expressed are those of the authors and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.*



## Endnotes

- <sup>1</sup> For an overview, see Duncan and Magnuson (2013).
- <sup>2</sup> For more on the natural rate, see Lubik and Matthes (2015).
- <sup>3</sup> Cette, Fernald, and Mojon (2016).
- <sup>4</sup> Hornstein, Krusell, and Violante (2007).
- <sup>5</sup> Goldin and Katz (2010), p. 20.
- <sup>6</sup> Castro and Coen-Pirani (2016).
- <sup>7</sup> Increasing demand and higher wages for high-skill workers is generally attributed to “skill-biased technical change,” or changes in technology that increase the productivity of workers with the education to use the new technologies. For more, see Goldin and Katz (2010) and Jones and Yang (2016). There is some debate, however, about whether the value of a college degree stems from the knowledge gained during college or from the “signal” sent by obtaining a degree (Caplan 2018). Also, Schwartzman (forthcoming) illustrates how spillovers among skilled workers may contribute to higher wages for those workers.
- <sup>8</sup> Some economists are now asking why the premium has not continued to increase. Some research suggests the demand for high-cognitive workers has actually decreased since 2000, leading college-educated workers to move down the occupational ladder and perform jobs typically held by less-skilled workers (Beaudry, Green, and Sand 2016). Other research finds that technological change has polarized the labor market and led to a decline in middle-skill jobs (Acemoglu and Autor 2011; Autor and Dorn 2013). Valletta (2017) finds evidence of both “de-skilling” and polarization.
- <sup>9</sup> For more on changing wage structures, see Goldin and Katz (2010) and Goldin and Margo (1992).
- <sup>10</sup> Blandin, Herrington, and Steelman (2018).
- <sup>11</sup> Blandin, Herrington, and Steelman (2018).
- <sup>12</sup> National Center for Education Statistics, “Education Longitudinal Study of 2002.”
- <sup>13</sup> Cook, Romero, and Turner (2017).
- <sup>14</sup> It’s also possible that the greater availability of financial aid has enabled colleges to raise tuition more than they otherwise would have.
- <sup>15</sup> Cook, Romero, and Turner (2017).
- <sup>16</sup> Bleemer and Zafar (2018).
- <sup>17</sup> The evidence on whether financial factors restrict college attendance is mixed. See Lochner and Monge-Naranjo (2012).
- <sup>18</sup> Jones and Yang (2016).
- <sup>19</sup> Athreya and Eberly (2016); Hendricks and Leukhina (forthcoming).
- <sup>20</sup> Stinebrickner and Stinebrickner (2008) and (2012).
- <sup>21</sup> Ozdagli and Trachter (2015).
- <sup>22</sup> In related research, Trachter (2015) finds that community colleges are a relatively inexpensive way for students to learn about their ability before potentially transferring to a four-year college.
- <sup>23</sup> Blandin, Herrington, and Steelman (2018).
- <sup>24</sup> Hoxby and Avery (2013).
- <sup>25</sup> Reardon (2016).
- <sup>26</sup> Coleman (1966).
- <sup>27</sup> Rivkin, Hanushek, and Kain (2005); Schanzenbach (2006).
- <sup>28</sup> See Fryer (2013).
- <sup>29</sup> Rivkin, Hanushek, and Kain (2005).
- <sup>30</sup> See Neal (2011) for a discussion of teacher incentives.
- <sup>31</sup> For an overview of the literature on peer effects, see Sacerdote (2011).
- <sup>32</sup> Vermont and Maine also have voucher programs, but these are long-standing policies for students who live in towns without a public school.
- <sup>33</sup> For example, see Figlio and Karbownik (2016).
- <sup>34</sup> See Hoxby and Rockoff (2005); Gronberg and Jansen (2001); Abdulkadiroğlu et al. (2011); and Booker et al. (2011).
- <sup>35</sup> Bifulco and Ladd (2006).
- <sup>36</sup> The No Child Left Behind Act of 2001 mandated that students can transfer out of schools that fail to make “adequate yearly progress” two years in a row. For an overview of open-enrollment policies, visit the Education Commission of the States at [www.ecs.org/open-enrollment-policies](http://www.ecs.org/open-enrollment-policies).
- <sup>37</sup> CMS serves roughly 150,000 students in North Carolina and is the eighteenth-largest school district in the country.
- <sup>38</sup> Hastings and Weinstein (2008).
- <sup>39</sup> Deming et al. (2014).
- <sup>40</sup> Cullen, Levitt, Robertson, and Sadoff (2013).
- <sup>41</sup> Chetty et al. (2011).

## References

- Abdulkadiroğlu, Atila, Joshua D. Angrist, Susan M. Dynarski, Thomas J. Kane, and Parag A. Pathak. May 2011. "Accountability and Flexibility in Public Schools: Evidence from Boston's Charters and Pilots." *Quarterly Journal of Economics* 126 (2): 699–748.
- Acemoglu, Daron, and David H. Autor. March 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics* Volume 4, Part B, edited by David Card and Orley Ashenfelter. Amsterdam: North-Holland, pp. 1043–1171.
- Athreya, Kartik, and Janice Eberly. Revised November 2016. "Risk, the College Premium, and Aggregate Human Capital Investment." Federal Reserve Bank of Richmond Working Paper No. 13-02R.
- Autor, David H., and David Dorn. August 2013. "The Growth of Low-Skill Service Jobs and the Polarization of the U.S. Labor Market." *American Economic Review* 103 (5): 1553–1597.
- Beaudry, Paul, David A. Green, and Benjamin M. Sand. January 2016. "The Great Reversal in the Demand for Skill and Cognitive Tasks." *Journal of Labor Economics* 34 (S1): S199–S247.
- Bifulco, Robert, and Helen F. Ladd. Winter 2006. "The Impacts of Charter Schools on Student Achievement: Evidence from North Carolina." *Education Finance and Policy* 1 (1): 50–90.
- Blandin, Adam, Christopher Herrington, and Aaron Steelman. February 2018. "How Does Family Structure during Childhood Affect College Preparedness and Completion?" Federal Reserve Bank of Richmond *Economic Brief* No. 18-02.
- Bleemer, Zachary, and Basit Zafar. January 2018. "Intended College Attendance: Evidence from an Experiment on College Returns and Costs." *Journal of Public Economics* 157: 184–211.
- Booker, Kevin, Tim R. Sass, Brian Gill, and Ron Zimmer. April 2011. "The Effects of Charter High Schools on Educational Attainment." *Journal of Labor Economics* 29 (2): 377–415.
- Caplan, Bryan. *The Case Against Education: Why the Education System Is a Waste of Time and Money*. Princeton, N.J.: Princeton University Press, 2018.
- Castro, Rui, and Daniele Coen-Pirani. July 2016. "Explaining the Evolution of Educational Attainment in the United States." *American Economic Journal: Macroeconomics* 8 (3): 77–112.
- Cette, Gilbert, John Fernald, and Benoît Mojon. September 2016. "The Pre-Great Recession Slowdown in Productivity." *European Economic Review* 88: 3–20.
- Chetty, Raj., et al. November 2011. "How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project Star." *Quarterly Journal of Economics* 126 (4): 1593–1660.
- Coleman, James S., et al. 1966. "Equality of Educational Opportunity." National Center for Education Statistics, U.S. Office of Education.
- Cook, Emily E., Jessie Romero, and Sarah Turner. December 2017. "Transitioning from High School to College: Differences across Virginia." Federal Reserve Bank of Richmond *Economic Brief* No. 17-12.
- Cullen, Julie Berry, Steven D. Levitt, Erin Robertson, and Sally Sadoff. Spring 2013. "What Can Be Done To Improve Struggling High Schools?" *Journal of Economic Perspectives* 27 (2): 133–152.
- Deming, David J., Justine S. Hastings, Thomas J. Kane, and Douglas O. Staiger. March 2014. "School Choice, School Quality, and Postsecondary Attainment." *American Economic Review* 104 (3): 991–1013.
- Duncan, Greg J., and Katherine Magnuson. Spring 2013. "Investing in Preschool Programs." *Journal of Economic Perspectives* 27 (2): 109–132.
- Figlio, David, and Krzysztof Karbownik. July 2016. "Evaluation of Ohio's EdChoice Scholarship Program: Selection, Competition, and Performance Effects." Thomas B. Fordham Institute.
- Fryer, Roland G. April 2013. "Teacher Incentives and Student Achievement: Evidence from New York City Public Schools." *Journal of Labor Economics* 31 (2): 373–407.
- Goldin, Claudia, and Lawrence F. Katz. 2010. *The Race between Education and Technology*. Cambridge, Mass: Harvard University Press.
- Goldin, Claudia, and Robert A. Margo. February 1992. "The Great Compression: The Wage Structure in the United States at Mid-Century." *Quarterly Journal of Economics* 107 (1): 1–34.
- Gronberg, Timothy J., and Dennis W. Jansen. April 2001. *Navigating Newly Chartered Waters: An Analysis of Texas Charter School Performance*. Austin, Texas: Texas Public Policy Foundation.



## References

- Hastings, Justine S., and Jeffrey M. Weinstein. November 2008. "Information, School Choice, and Academic Achievement: Evidence from Two Experiments." *Quarterly Journal of Economics* 123 (4): 1373-1414.
- Hendricks, Lutz, and Oksana Leukhina. Forthcoming. "The Return to College: Selection and Dropout Risk." *International Economic Review*.
- Hornstein, Andreas, Per Krusell, and Giovanni L. Violante. October 2007. "Technology–Policy Interaction in Frictional Labour-Markets." *Review of Economic Studies* 74 (4): 1089–1124.
- Hoxby, Caroline M., and Christopher Avery. Spring 2013. "The Missing 'One-Offs': The Hidden Supply of High-Achieving, Low-Income Students." *Brookings Papers on Economic Activity*.
- Hoxby, Caroline M., and Jonah E. Rockoff. March 2005. "The Impact of Charter Schools on Student Achievement." Manuscript.
- Jones, John Bailey, and Fang Yang. July 2016. "Skill-Biased Technical Change and the Cost of Higher Education." *Journal of Labor Economics* 34 (3): 621–662.
- Lochner, Lance, and Alexander Monge-Naranjo. September 2012. "Credit Constraints in Education." *Annual Review of Economics* 4: 225–256.
- Lubik, Thomas A., and Christian Matthes. October 2015. "Calculating the Natural Rate of Interest: A Comparison of Two Alternative Approaches." Federal Reserve Bank of Richmond *Economic Brief* No. 15-10.
- National Center for Education Statistics. 2002. "Education Longitudinal Study of 2002."
- Neal, Derek. 2011. "The Design of Performance Pay in Education." In *Handbook of the Economics of Education*, Volume 4, edited by Eric A. Hanushek, Stephen Machin, and Ludger Woessmann. Amsterdam: North-Holland, pp. 495–550.
- Ozdagli, Ali K., and Nicholas Trachter. November 2015. "On the Distribution of College Dropouts: Wealth and Uninsurable Idiosyncratic Risk." Federal Reserve Bank of Richmond Working Paper No. 15-15.
- Reardon, Sean F. April 2016. "School District Socioeconomic Status, Race, and Academic Achievement." Manuscript.
- Rivkin, Steven G., Eric A. Hanushek, and John F. Kain. March 2005. "Teachers, Schools, and Academic Achievement." *Econometrica* 73 (2): 417–458
- Sacerdote, Bruce. 2011. "Peer Effects in Education: How Might They Work, How Big Are They and How Much Do We Know Thus Far?" In *Handbook of the Economics of Education*, Volume 3, edited by Eric A. Hanushek, Stephen Machin, and Ludger Woessmann. Amsterdam: North-Holland, pp. 249–277.
- Schanzenbach, Diane Whitmore. May 2006. "What Have Researchers Learned from Project STAR?" *Brookings Papers on Education Policy* 9: 205–228.
- Schwartzman, Felipe. Forthcoming. "Inequality across and within U.S. Cities at the Turn of the Twenty-First Century." Federal Reserve Bank of Richmond *Economic Quarterly*.
- Stinebrickner, Ralph, and Todd Stinebrickner. December 2008. "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study." *American Economic Review* 98 (5): 2163–2184.
- Stinebrickner, Todd, and Ralph Stinebrickner. October 2012. "Learning about Academic Ability and the College Dropout Decision." *Journal of Labor Economics* 30 (4): 707–748.
- Trachter, Nicholas. March 2015. "Stepping Stone and Option Value in a Model of Postsecondary Education." *Quantitative Economics* 6 (1): 223–256.
- Valletta, Robert G. Revised October 2017. "Recent Flattening in the Higher Education Wage Premium: Polarization, Skill Downgrading, or Both?" Prepared for presentation at the NBER Conference on Research in Income and Wealth, "Education, Skills, and Technical Change: Implications for Future U.S. GDP Growth," Bethesda, Maryland, October 16–17, 2015.