Public universities and human capital development in the United States

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Abstract Public colleges and universities play an important role in the formation of human capital through the attraction, training, and often local-regional retention of students. Much of the existing research on the subject examines one stage in this process, one type of institution, and/or one type of regional environment. While such studies can generate important insights, taking too narrow a perspective on one or more of these elements can lead to distortions about the impact of institutions of higher learning on the regions they serve. This paper adds to the literature by (1) widening the temporal frame of analysis to include the student’s journey from hometown to campus and then to additional locations 10 years after graduation, and (2) by deepening the cross-sectional view of a region’s layered institutions to include the many different types of public higher education and the variety of human capital they support. Data from 64 institutions spread across 10 labor market regions under the State University of New York show how institution type corresponds to (1) the geography of populations served, (2) the nature of skills and training supplied, and (3) local/regional retention a decade later. The empirical study also identifies the extent to which factors such as regional variation, degree level, and students’ program of study associate with human capital development (e.g., wages, retention) and therefore contributes to a more nuanced understanding of the broader relationship between institutions of higher learning and local/regional human capital formation.

Keywords Public universities · Human capital · Program of study · Wages · Retention

Introduction

As the global economy has become increasingly knowledge-driven, academic interest in the various roles colleges and universities play in regional economies has expanded in turn (Benneworth & Nieth, 2020; Harrison & Turok, 2017). Yet certain aspects of the university-regional development relationship have attracted more scholarly attention than others. In particular, university-led advancements in computing, materials research, and biotechnology (cf. Lawton-Smith & Bagchi-Sen, 2012), as well as a deeper understanding of how endogenous technological change can lead to positive regional transformation (Romer, 1990), have led to a greater interest in the role of higher education in tech transfers and innovation (Park, 2001). As a result, scholarship has tended...
to place the research university at the center of the higher education-regional development relationship, while small, teaching-centered colleges have attracted comparatively less attention in the local–regional development literature.

Yet for public colleges and universities, maximizing the formation of human capital across several segments of the labor force is as vital a mission as research and development (Goldin & Katz, 1998, 2008). College degrees lead to higher wages for individuals and correspond to even larger gains at the population level (Moretti, 2004a, b), which makes expanding access to higher education an attractive, if not essential, proposition for state governments. Accordingly, most public higher education systems in the U.S. are intentionally designed to ensure spatially, socially, and economically accessible higher education for citizens, which they often accomplish through a multi-tiered institutional structure. This multi-level design, while effective, increases the complexity of the higher education-regional development relationship and may limit the applicability of certain conclusions gleaned from studies based on a single type of institution. For example, how research institutions attract students, educate them, and help to increase the region’s retention of graduates will likely differ from how small bachelor’s or community colleges implement the same process. In addition, much of the existing scholarship on human capital development examines one stage in this process, potentially leading to some distortions in our understanding of the impact of colleges and universities on the region’s human capital over the long term.

To address such limitations in the existing literature, this paper takes a more holistic view of public universities and human capital development in the U.S. Doing so involves (1) widening the temporal frame of analysis to include the student’s journey from hometown to campus to relative location 10 years after graduation, and (2) deepening the cross-sectional view of a region’s layered institutional milieu to include the many different types of public higher education and the variety of human capital they support. To that end, we examine the association of types of higher education institutions with the attraction, formation, and retention of human capital, which we define as the skills, training, and education of individuals. We also analyze the association of institution type, degree level, students’ program of study, and regional location with human capital development, that is, wage and local retention patterns. The result is a more nuanced understanding of the broader relationship between students in institutions of higher learning and local/regional human capital development.

**Research context**

Three streams of literature inform this study. Because the region’s incentive to nurture human capital informs the design of public higher education systems, the first stream involves the relationship between human capital and regional development. There is substantial evidence that human capital is a key causal factor in regional economic growth (Boucher et al., 2003; Lange & Topel, 2006). Leading scholars like Becker (1964), Tinbergen (1974), Goldin and Katz (1998, 2008), and Moretti (2004a, b) stress that skills, education, and training function by enhancing units of labor, making it a multiplicative, rather than additive, input. Part of human capital’s relevance to regional development derives from the fact that this enhancement often occurs at the community level, as the social returns to education and training often exceed the private ones (Moretti, 2004a, b; 2009; 2012; Lange & Topel, 2006). Abel and Gabe (2011) observed such effects in sub-national GDPs; in that study, a 1% increase in college graduates corresponded to a 2% increase in the GDP of a region.

Some places and groups benefit more from an increase in human capital than others. High levels of human capital, measured in terms of both population density and educational attainment rates, are generally associated with higher wages (Moretti, 2004a, b). Yet studies have also shown that lower-skilled workers benefit more from the presence of high-skilled workers in the workplace than other high-skilled workers do (Cornelissen et al., 2017; Jarosch et al., 2019; Moretti, 2004a, b). Moretti (2004a, b) estimated that a 1% increase in the college graduate population can raise the rest of the community’s wages in significant ways: high school drop outs earn 1.9% more, high school graduates’ wages increase by 1.6%, and college graduates benefit from a wage increase of 0.4%. It has been suggested that these wage bumps are a function of productivity increases and peer effects, and overall productivity increases most when
high skill and low skill laborers work alongside one another (Mas & Moretti, 2009). This implies that the largest gains happen in communities with lower educational attainment rates and reaffirms the benefit of access to higher education for geographically and socio-economically marginalized populations—a fundamental goal of U.S. public higher education systems (Goldin & Katz, 2008). It also means attraction and retention rates are particularly crucial in post-industrial communities experiencing population loss or ‘brain drain,’ and in rural communities with lower overall levels of education.

The second stream of literature concerns student migration patterns. At the individual level, potential and developed human capital is a highly mobile resource, and a region’s success in enriching its human capital depends on both structural and behavioral variables that underlie push and pull migration effects. Here, the existing scholarship has tended to look at one part of the college students’ journey, and thus one stage in the human capital development process. For example, the geography of a student’s chosen institution, relative to the student’s place of origin, has been considered at international and sub-national, inter-regional scales (Faggian et al., 2017; Holton & Riley, 2013). Among these studies, several use movement across state or country borders to estimate the effects of various location-specific amenities or policies (Biagi et al., 2011; Cooke & Boyle, 2011; Faggian & Franklin, 2014). Others consider pull factors like institutional prestige. Brennan and Cochrane (2019) suggested those universities that cultivate elite reputations may be more outward-looking in mission and draw students (who at the outset embody potential human capital) from a larger number of places and from further away. Such inward flows of burgeoning talent create new networks that link the region to the global economy, which is partly why Benneworth and Hospers (2007) refer to universities as ‘global–local pipelines.’ Status is just one of several pull factors, however, and may not always be the strongest. Van Mol and Ekanmer (2016) found that Erasmus international students preferred to study in European capitals and second-tier cities than in outlying areas with better-ranking schools. Meanwhile, an increasingly vast literature surrounds the locational choices of college graduates (Chen & Rosenthal, 2008; Clark et al., 2002; Costa & Kahn, 2000; Florida, 2002; Kaemmerer & Foulkes, 2022; Storper & Scott, 2009; Whisler et al., 2008). Their apparent proclivity for large metropolitan cities (Ewers, 2007), cultures of tolerance (Florida, 2002), and amenities to distract and entertain them (Clark et al., 2002) have become a driving force behind economic development policies in communities vying to attract the educated (Ploger & Weck, 2014).

Such constructions, now popular, generally assume students are a geographically temporary group who move to college towns for training and education, and then move elsewhere to find jobs. Yet the ‘temporary’ nature of student populations is not necessarily true. A few studies have shown that many students who move to a new area for college will also stay in that community after they complete their degree (Winters, 2011a, b) (though importantly, these emphasize the 2–5 years following graduation). Such graduates have likely developed an affinity for local amenities and cultural values (Winters, 2011a, b) or privilege the lower cost of living some university communities may provide (Glaeser & Mare, 2001).

A number of studies have also, implicitly or explicitly, explored why college students choose to attend programs close to home, and to remain in the area after graduating. College choice is closely related to household economic characteristics and family norms, as well as university academic performance and state-level policies. Students with limited family resources, from single-parent households, or in states with high-performing and/or low-cost schools are less likely to move great distances to attend college (see Cooke & Boyle, 2011; Mulder & Clark, 2002 for studies of why students choose to move away for school). Those that do not face such worldly constraints but nevertheless choose to remain close to home may reveal preferences for non-tradable, or non-economic environmental or social factors (Immeraj et al., 2018).

The third and final stream of literature relates to the compatibility of regional graduates’ training and education with macroeconomic and regional labor market demand. Much of the work on human capital and regional economic development has been preoccupied with educational attainment rates, conventionally measured as the proportion of adults with a bachelor’s degree or higher (Mellander & Florida, 2012), but far fewer studies have attempted to probe the precise nature of it (Corominas et al., 2010). Though likely due to a lack of relevant data, this nevertheless
presents a significant omission because the market does not treat all education and training equally. Rather, the returns to education are closely related to the technological and social structure of the economy as well as to the adaptive capacity of the regional public–private institutional milieu (Cooke & Morgan, 1998) to provide relevant training.

Given that technology is biased toward skill (Tinbergen, 1974), technological advancement will exacerbate income inequality among groups with different skillsets unless a compatible human capital supply increases in step with demand (Goldin & Katz, 2008). Economic transformations over the last 40 years exemplify such shifts. New technologies, deindustrialization and the expansion of the biomedical and health services sectors (up about 5% as a share of U.S. GDP since 1985) increased demand for skills in STEM fields, while the market power of degrees in education, humanities, and some social sciences has waned (Carnevale et al., 2011). Such structural changes are largely reflected in wage differentials between graduates at various degree levels and across fields.

More regionalized economic processes also affect the value and supply of a given degree (Gialis et al., 2017). A large number of geographically concentrated graduates with high-level skills can themselves create or attract new markets, as, for example, when technology companies choose to locate near large research universities with reputable computer science programs. Alternatively, the “dependency model” suggests the skills of graduates must match the needs of the labor market for specific forms of knowledge and skills (Corominas et al., 2010; Lawton-Smith & Waters, 2019) if the area wants to retain graduates, and for the college to positively affect the local economy. These supply and demand constructions may seem more or less relevant depending on the kinds of institutions—doctoral universities for the former, community colleges for the latter—under consideration. For example, the tech-driven economic growth of Silicon Valley, Route 128 outside of Boston, and Pittsburgh is often attributed to pools of technically skilled graduates from Stanford, MIT, and Carnegie Mellon, respectively. Meanwhile, community colleges are often seen as providing skills that fill gaps left by other institutions. Yet Velluzzi (2010) showed that 2-year community colleges can also enhance the competitiveness of regional clusters, both on the supply side by acting as a ‘labor market intermediary’ and providing specialized training, and on the demand side through brokering and coordinating network relationships and increasing entrepreneurialism.

While the impact of Stanford, MIT, and Carnegie Mellon have undergirded a set of ‘best practices’ for the university-regional alliance, the prestigious and research-driven nature of these institutions make their role in their regions’ success difficult to replicate in places without similar institutional endowments. By contrast, the relationship between smaller colleges and industrial clustering, such as Velluzzi (2010) demonstrated with the case of Walla Walla Community College and Washington state wine country, has greater relevance to a larger number of labor market regions. Community colleges are located in large and small metropolitan communities, as well as rural areas, and comprise approximately 1/4th of institutions of higher education in the U.S. In mid-to-large cities and regions with multiple colleges and universities, teaching colleges and 2-year institutions may play a complementary or supporting role in supplying skilled labor. In rural areas or less populated communities characterized by institutional thinness (Todtling & Tripl, 2005), bachelor and community colleges serve as anchor institutions, and a primary source of educated labor for the local labor market. In this way, institution type intersects in undereveloped ways with the regional development scholarship that has attempted to address the role of higher education in non-central and lagging regions (cf. Benneworth & Nieth, 2020; Huggins & Johnston, 2009; Pugh, 2016).

Data and methods

The empirical analysis uses a multi-tiered public system of higher education: The State University of New York (SUNY) system is a comprehensive public university system in the U.S. (similar to other systems in other states) with 64 total institutions spread (by design) across 10 state labor market regions (as defined by the New York State Department of Labor). These regions include the global megacity of New York City (NYC) and its suburbs, the state capital region, four post-industrial communities experiencing population loss, and two primarily rural areas, all varying significantly in both educational attainment and median wages (see Table 1). In New York state,
93% of citizens live within 15 miles of a SUNY campus, and almost 100% are fewer than 30 miles away from a school (suny.edu) (see Fig. 1). Approximately one-third of New York high school graduates end up attending a SUNY school, and 445,000 (or 37%) of active New York college students are enrolled at a SUNY.

Table 1 Regional wage and educational characteristics

| Region                  | Median Wage | % of adult population with associate’s degree | % of adult population with bachelor’s degree | % of adult population with graduate or professional degree | % of adult population with some kind of college degree |
|-------------------------|-------------|-----------------------------------------------|--------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------|
| Hudson Valley           | 39,118      | 7.9                                           | 19.5                                       | 16.8                                                      | 44.2                                                 |
| Long Island             | 46,555      | 8.4                                           | 22.6                                       | 18.7                                                      | 49.7                                                 |
| New York City           | 41,357      | 5.4                                           | 24.4                                       | 20.1                                                      | 49.9                                                 |
| Capital District        | 34,485      | 11.5                                          | 18.6                                       | 17.2                                                      | 47.3                                                 |
| Central New York        | 31,752      | 12.7                                          | 16.3                                       | 12.4                                                      | 41.4                                                 |
| Finger Lakes            | 31,600      | 12.8                                          | 17.4                                       | 14                                                        | 44.2                                                 |
| Southern Tier           | 30,008      | 12                                            | 15.7                                       | 15.2                                                      | 42.9                                                 |
| Western New York        | 29,926      | 12.7                                          | 14.9                                       | 12.1                                                      | 39.7                                                 |
| Mohawk Valley           | 30,396      | 12.7                                          | 14.1                                       | 11                                                        | 37.8                                                 |
| North Country           | 30,654      | 11.2                                          | 11                                         | 11                                                        | 33.6                                                 |

Median wage and educational attainment data are retrieved at the county level, then averaged by labor market. Data are obtained from the 2019 American Community Survey 5-year estimates. The education rates indicate the highest level of education a proportion of the population has attained. Calculations are undertaken by authors.

According to the Carnegie Classification system, which is a commonly used framework (currently managed by Indiana University’s Center for Postsecondary Research) to identify groups of peer institutions, SUNY has 8 doctoral degree granting institutions, including 4 with very high research activity (class “R1”), 1 with high research activity (“R2”), and 3 special focus 4-year colleges, including two medical schools and one school of optometry. There are 15 master’s institutions, which also offer bachelor’s and associate degrees but are not considered research universities because they generally lack doctoral training. The master’s institutions can be further grouped by student body size: 6 larger programs, 5 medium programs, and 4 smaller programs.
There are 7 bachelor’s institutions; of these, 6 offer both 4-year and 2-year degrees and are characterized as ‘mixed bachelor’s and associate’s,’ while 1 is classified as ‘liberal arts’ and only offers 4-year degrees. There are 29 associate’s institutions or community colleges. These institutions only offer 2-year and certificate programs, and additional subclassifications are made based on disciplinary focus and student body composition (‘transfer,’ ‘career,’ or ‘mixed/technical’). Finally, there are 5 additional colleges: 4 statutory institutions within Cornell University and 1 specialized program in ceramics at Alfred University. Unless otherwise indicated, these 5 institutes are mostly excluded from the present analysis due to a lack of data (in the case of Cornell) and to small cohort sizes (in the case of the New York College of Ceramics at Alfred University).

The data analysis is organized in three stages. In the first stage, we address the questions of how specific institution types attract high school graduates. Using a dataset provided to us by SUNY, which includes de-identified state and countries of origin for SUNY students at doctoral, master’s, and bachelor’s institutions for 2018, we calculate the percent of students that are (1) from New York state, (2) from another U.S. state, and (3) from outside the U.S. These variables are used to understand the extent to which each class of institution is attracting human capital into the state and the region. Because data are not available for community colleges in this dataset, we gather additional student origin information from the Rockefeller Institute’s 2011 SUNY Impact Report, which offers student origin estimates (percent of students from the region, percent of non-regional students from New York, percent of U.S. students from outside New York, and percent of students from outside the U.S.) aggregated by labor market. Although less current and less institutionally precise than the SUNY dataset, when analyzed alongside each region’s institutional composition, these data allow us to confirm community colleges serve local students at higher rates.

In the second stage, we consider how institution type relates to the role of colleges and universities in supplying skilled human capital to the workforce. This analysis is based on several quantitative and qualitative measures, particularly concerning the skills of graduates (proxied by degree level and program of study), their wages, and regional factors (e.g., industrial characteristics). We first construct a general program typology that spans multiple disciplinary fields (Table 2). These programs serve as a proxy for the nature of human capital supplied. Because certain liberal arts and humanities degrees are too broad to relate to a single program of study, we do not include them in this analysis, which we acknowledge may lead to some underestimates of skills supplied. Based on field of study data from the National Center for Education Statistics, liberal arts degrees (including social sciences and history) amount to 8% of total conferred college degrees.

Next, we gather wage data for graduates from the SUNY Office of Institutional Research and Data Analytics’ ‘Gradwage’ Dashboard (www.suny.edu/gradwages). This dataset links the Social Security numbers of SUNY graduates (and their course of study while at SUNY) to wage information from the NY Department of Labor. The dashboard is searchable by several variables; we collect median wages for graduating cohorts (2005–6, 2006–7) by program of study at each institution and at each relevant degree level 10 years after graduating. If schools offer more than one course of study that can be categorized as a certain program (for example, a variety of majors are classified as ‘technical trades’), the median wage of graduates from these programs is averaged to produce the data point. One major limitation is that the data from programs with fewer than 11 graduates over the 2-year cohort time period are suppressed for privacy reasons, which likely leads to some distortion among small programs (for example, this will underestimate the existence and contribution of most of SUNY’s 320 doctoral programs).

Though we recognize that wages do not necessarily correspond to the societal value of many types of skills, education, and training, we use wages as a proxy for the broader regional and/or macroeconomic market value of a given skillset. After calculating the

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1 In 1862, the Morrill Act established public land grant universities throughout the U.S. At that time, New York already had dozens of reputable independent private colleges. So, rather than establishing a single major State University (or even a series of them), the state instead established several publicly funded colleges within the private, ivy-league Cornell University, located in New York’s Southern Tier region (Levine 1988). This unique public–private statutory arrangement continues today.
median wage for the SUNY graduates of the programs outlined in Table 2 a decade after graduation, we construct a table that itemizes which programs and degree types had wages above or below the median. This table is organized by Carnegie classification. We code approximately 435 programs using capital and lower-case letters for above and below the median, respectively. This gives rise to patterns that reveal which types of institutions are producing certain kinds of skills (Table 5).

We also use this data to conduct a series of chi square tests. Here, the categorical variables are grouped by (1) institution type (Carnegie classes), (2) program of study, (3) degree level, and (4) labor market region, and the data correspond to the number of programs whose graduates earn more or less than the SUNY median wage. To avoid errors from low expected values, we use the primary Carnegie classifications (Associate’s, Bachelor’s, Master’s, or Doctoral) and merge doctorates (e.g., Ph.D., Ed.D.) and first professional degrees (e.g., M.D., J.D., O.D.) into a single degree level. The Cramér’s V statistic is used to compare the strength of association between wages and institution type, wages and program of study, wages and degree level, and wages and labor market regions.

In the third and final stage, we use similar approaches to examine how institution type corresponds to long run retention patterns. The percent of SUNY graduates living in New York state 10 years after graduating are gathered from the ‘Gradwage’ Dashboard for each program of study, at each school, and each degree level. We calculate the median retention rate among all the SUNY programs we are studying (see Table 2) and itemize whether retention rates are above or below the median in another table, once again organized by Carnegie classification. This produces patterns for the macroeconomic and regional labor markets, such as whether graduates of certain kinds of institutions and programs are more or less

| Program of study | Fields included |
|------------------|----------------|
| Ag. & Natural resources | Agriculture, Natural resource management |
| Art & architecture | Architecture, Visual and Performing Arts |
| Technical trades | Communication technologies, Construction, Engineering technologies, Mechanic and repair technologies, Precision Production, Science technologies, Transport and Materials Moving |
| Communications and media | Communications and Journalism |
| Law | Legal studies; Professional law and Paralegal |
| Health | All health professions and related clinical and life sciences |
| Hospitality | Personal and culinary services, Parks, recreation, leisure, and fitness |
| Security | Criminal justice/forensics |
| Engineering | Engineering |
| Social services | Public administration and social services |
| Education | Education, Library Science |
| Computers and math | Computer information sciences, Math and statistics |
| Business and finance | Business, marketing, management, and related services, Consumer services |
likely to remain in New York after 10 years (Table 8). We also use this table as a starting point for exploring several examples of how skills correspond to employment in regional industrial clusters, and program-specific situations like job guarantees and state professional licensing requirements. A series of chi square tests and the corresponding Cramér’s V statistic allow us to consider how strongly institution type, program of study, degree level, and regional environment relate to retention patterns. As a final step, we compare retention rates to student origin data, which allows us to observe net inflows or outflows of human capital.

Findings and discussion

Our findings substantiate the need for scholars to sometimes widen the spatial and temporal frame and deepen the institutional scope of analysis when answering questions involving public universities and the attraction, formation, and retention of human capital. In this case, expanding the study parameters helps to reveal how SUNY’s multi-level institutional design is sufficiently flexible to respond to a variety of inter- and intra-regional labor market needs. Key findings include, but are not limited to, (1) the use of specialized curricula to attract non-local students, (2) the idiosyncratic ways in which regional institutional environments shape a college or university’s specific role in the labor market (e.g., anchoring vs. supporting, market-creating vs. market-filling), (3) the weaker applicability of “creative class” theses in more variegated institutional and regional contexts, and (4) the observation that this, and likely other large state systems are facilitating net outflows of human capital.

Attract

At the institution level, there are several generalizable trends along with a few idiosyncratic observations. The proportion of in-state students at master’s and bachelor’s institutions is higher than at doctoral institutions, and the corresponding rates of out of state and international students are therefore lower (Table 3). For example, 94.6% and 95.7% of students at larger master’s and mixed bachelor’s colleges, respectively, are from New York, while only 74.2% of students at R1 research universities are considered in-state. Research universities are able to attract students from dozens of states and countries—16.1% of students at R1 universities are international.

Other studies have described prestige and attractive campus environments as primary pull factors. An intuitive yet underreported insight our analysis

| Carnegie classification | Student origins (%) | Mean retention (%) |
|-------------------------|---------------------|--------------------|
|                         | NY State | Out of state U.S | International |
| **Doctoral**            |          |                  |               |
| Very high research (R1) | 94.6     | 3.4              | 2             | 65.5 |
| High research (R2)      | 94.2     | 2.9              | 2.9           | 65.8 |
| Special focus           | 81.2     | 14.1             | 4.7           | 53.7 |
| **Master’s**            |          |                  |               |
| Large programs          | 95.7     | 3.2              | 1.1           | 69.1 |
| Medium programs         | 84.3     | 13.7             | 2.0           | 54.3 |
| Small programs          | 84.3     | 13.7             | 2.0           | 54.3 |
| **Bachelor’s**          |          |                  |               |
| Mixed (assoc./bach.)    | 84.3     | 13.7             | 2.0           | 54.3 |
| Liberal arts (bach. only)| 84.3   | 13.7             | 2.0           | 54.3 |
| **Community**           |          |                  |               |
| High transfer           | –        | –                | –             | 67.7 |
| Mixed transfer/technical| –        | –                | –             | 74.1 |
| High career             | –        | –                | –             | 69.5 |
reveals is that specialized curricula at 4-year institutions also attracts out of state and international students at higher rates. The School of Environmental Science and Forestry in the Central New York region is the only SUNY school classified as an R2 institution, and its niche programs (which, as the college's name suggests, are heavily concentrated in the natural sciences) serve a large number of out-of-state students (see Table 3; 16% of ESF’s student body is out-of-state). SUNY Purchase, the system’s only bachelor’s college with an ‘arts and science’ focus, manages to pull students across state borders at rates approaching research universities (13.7% of its students are from another state), most likely due to its close proximity to NYC and to its liberal arts curriculum. Meanwhile, at the Fashion Institute of Technology (FIT) in NYC, about 13% of students are international, and another 24% are from out of state. In addition to the college’s location in a global city, these students are likely attracted to the college’s unique and reputable art and design programs.

While niche curricula can be a strong pull factor, specialized institutions do not correspond to higher out-of-state attendance when the institution is motivated to capture talent from within New York. This is a strategy to keep human capital in state after graduating, since New York students may have more non-career-related reasons to stay. The system’s two stand-alone medical schools, as well as its College of Optometry (all classified as ‘Special Focus’ institutions, Table 3), serve mostly in-state students, which likely reflects the appeal of in-state tuition to students and the state’s wish to fulfill demand for physicians. For example, there are dozens of unique pathways into the Upstate and Downstate M.D. programs available for New York undergraduates, both from other SUNY schools and from the state’s many private colleges and universities. These strategies are successful in increasing the number of in-state students (91.8% of students are from New York) and the higher retention rate (57.4% of graduates are living in New York after 10 years) versus other doctoral and professional-degree granting schools (where 54.7% and 52.3% of graduates from R1 and R2 institutions, respectively, remain in New York) implies that in-state attraction efforts do modestly correspond to better retention rates a decade later.

By design, community colleges, which have more localized missions, tend to serve local students at higher rates than 4-year institutions. We can confirm this is true in New York by looking at the SUNY institutional composition of each labor market and the corresponding student origin information (Table 4). SUNY in the Hudson Valley region is dominated by community colleges (6/8 of institutions are 2-year), and it has the highest rate of regional,
in-state students (82%). The Capital District, which is the location of the R1 University at Albany, the larger master’s school Empire State, also has 4 community colleges and one of the higher proportions of in-state students (94%) overall.

Train

In addition to promoting geographic and socioeconomic access to higher education, the social mission of public colleges and universities is largely based on offering strategic and socially relevant degrees (Goldin & Katz, 2008). The way this unfolds in practice throughout a public system depends on the nature of the institution, degree level, and program of study. The pattern in Table 5 shows obvious program gaps at some levels and concentrations of programs in others. Associate’s and bachelor’s colleges offer the majority of programs in law and legal studies, hospitality, and technical trades like mechanic and repair technologies and materials moving. Programs in engineering and education are heavily concentrated among master’s and doctoral universities. Meanwhile, nearly all types of institutions offer programs in health professions, computers and math, and business and finance.

The association between institution type (Carnegie classification), program of study, degree level, and labor market region with wages are all above the critical chi-square values, indicating a statistically significant relationship between each category and the wages of graduates (Table 6, Appendix Tables 9, 10, 11 and 12). However, the strength of association varies. Institution type (Carnegie classification), degree level, and program of study have a stronger association with wages (Cramér’s V of 0.45, 0.48, and 0.41, respectively) than labor market region (Cramér’s V of 0.31). This corresponds to the greater market power of more advanced degrees and degrees from certain institutions. Graduates of doctoral institutions are overwhelmingly likely to have wages above the median (graduates of 67/74, or 90.5% of all programs have wages above $57,630, which is the median wage for all the programs we are studying). Master’s institution graduates are also more likely to make more than the median (graduates from 75/130, or 57% of programs at master’s colleges, make more than $57,630). Graduates of bachelor’s and community colleges tend to make below the median (30/58, or about 52% of programs at bachelor’s institutions, and 126/173, or 73% of programs at associate’s colleges make less than the median). Program of study is also strongly associated with wages, which explains how associate’s degree graduates from most technical trade programs (see the capital As in the Technical Trades column, Table 5) can make more than some bachelor’s and master’s degree graduates from education, communications and media, art and architecture, and/or social services programs (lowercase m and b in related columns, Table 5). This corresponds to strong demand for technically-trained, 2-year graduates in most labor market regions, and the importance of community and bachelor’s colleges in supplying them. As we describe below, in many cases, it also corresponds to targeted career training and better job placement programs.

Yet even among the same class of institutions, the role of colleges and universities in developing human capital can vary by region in sometimes significant ways. Research institutions are nearly always regional anchors, but master’s, bachelor’s, and community colleges can play either supporting or leading roles in human capital development depending on their regional institutional and industrial environment. For example, bachelor’s and associate’s programs in the Finger Lakes region offer curricula that largely complements large regional private research universities, the University of Rochester (U of R) and Rochester Institute of Technology (RIT). U of R and RIT are internationally known for their programs in optics and electrical engineering. These programs anchor export-producing clusters in electronics and imaging ($6 billion in exports in 2012 alone) and industrial machinery and services ($3.7 billion). Consequently, no SUNY school in the region offers a bachelor’s or higher degree in engineering, and small programs in computers and math suggest SUNY does not supply significant human capital to the main R&D channels within the electronics and imaging cluster. Still, 2-year programs in applied vocational technologies (e.g., computerized drafting and design, engineering science) at Monroe and Genesee Community Colleges do fill critical jobs in these sectors. These graduates earn less than the SUNY median ($52,705 and $48,028 at Monroe and Genesee, respectively versus the median value of $57,630), but over 50% more than the regional median income of $30,652, and over 70% of these graduates remain in New York after 10 years.

In the rural north country region, which is characterized by the state’s lowest educational attainment
Table 5  Institution type, programs by level of educational attainment, and median wages

| Institution | Program | Ag./nat. resources | Art & Architect | Tech trades | Comms. & media | Law & legal | Health | Hosp-itality | Engineer-ing | Soc. services | Educ | Comp. & math | Bus. & finance |
|-------------|---------|--------------------|----------------|-------------|---------------|-------------|--------|-------------|---------------|---------------|------|------------|----------------|
| **Doctoral** |         |                    |                |             |               |             |        |             |               |               |      |            |                |
| R1          | B, b    | M, D, M, b, m, b   | B, M, B       | P           | P, P, M, D,   | D, D, D, M, | D, M,  | D, M, M, M, | D, M, M, M, | M, M, M, M, | M, M, M, | M, M, M, M, | M, M, M, M,   |
| R2          | M, b, a | B, M               |                |             |               |             |        |             |               |               |      |            |                |
| Spec        |         |                    |                |             |               |             |        |             |               |               |      |            |                |
| **Master’s**|         |                    |                |             |               |             |        |             |               |               |      |            |                |
| Large       | b       | M, b, m, b, b, b, b| B, B, M, b, m,| B, M, b, b  | M, m, b, b   | M, M, M, m,| M, M, M, | M, B, M, b,| M, B, B, B,| A, M, M, M,| M, M, M, | M, M, M, | B, B, B, B,    |
| Medium      | B, b    | M, b, b, b, b, b, b| B, b, b, b, b,| M, B, M, b, m| b, b         | M, M, m, b,| M, B, B,| M, B, B, B,| M, B, B, B,| M, B, B, B,| M, B, B,| M, B, B, | B, B, B, B,    |
| Small       | M, B, A,| B, A, b            | B, B, A, b    | m, b        | B             | M, b, b   | M, B, B,| B, B, B, B,| M, M, M, B,| M, M, M, B,| M, M, M,| M, M, M, | B, B, B, B,    |
| **Bach**    |         |                    |                |             |               |             |        |             |               |               |      |            |                |
| Mixed       | A, b, a | B, B, a, a, a, a, a| A, A, A, A, A,| B           | A, B, A, a, a,| a           | a, b   | B, B, B, B,| B, B, B, B,| B, B, B, B,| B, B, B,| B, B, B, | a, a, a, a, a, |
| Lib. arts   | M, b    | B                  |                |             |               |             |        |             |               |               |      |            |                |
| **Community**|        |                    |                |             |               |             |        |             |               |               |      |            |                |
| High transfer| a      | a, a, a, a, a, a, a| A, A, A, A, A,| A, a, a, a, a| A, a, a, a, a| a, a, a, a,| a, a, a, | A, A, A, a,| A, A, a, a,| A, A, a, a,| a, a, a,| a, a, a, a, | a, a, a, a, a, |
| Mixed/tech  | a       | A, A, a, a, a, a   | a, a, a, a, a,| A, a, a, a, a| A, a, a, a, a| a, a, a, a| a, a, a| A, A, a, a,| a, a, a, a,| a, a, a, a,| a, a, a,| a, a, a, a, | a, a, a, a, a, |
| Career      | a       | a                  | a, a, a, a, a,| A, a, a, a, a| A, a, a, a, a| a, a, a, a| a, a, a| A, A, a, a,| a, a, a, a,| a, a, a, a,| a, a, a,| a, a, a, a, | a, a, a, a, a, |

Median wage = $57,630. Data elements indicate program availability and corresponding level of degrees (A Associate’s, B Bachelor’s, M Master’s, D Doctorate, P Professional). Uppercase letters indicate the wages of graduates living in New York state 10 years after graduating is above the 50th percentile for all SUNY graduates ($57,630); lowercase letters indicate the graduate wages are at the 50th percentile or below. Source: SUNY Gradwage Dashboard.
rates (only 33.6% of adults have a 2- or 4-year, or post-graduate, degree) and low incomes (see Table 1; the median income in this region is $30,654, versus the U.S. median personal income of $33,706), there are fewer private colleges and no public research universities. Accordingly, the master’s colleges SUNY Plattsburgh and SUNY Potsdam, the mixed bachelor’s college Canton Technical, and Jefferson, Clinton, and North Country community colleges all act as regional anchors, helping to create markets as well as train human capital to sustain them. For example, when the Quebec vehicle manufacturer Nova-Bus was looking for a location for a new U.S. manufacturing plant, Clinton Community College played an influential role in attracting the investment to upstate New York. The college worked closely with the company, as well as with additional suppliers that subsequently clustered in the area, to develop specialized training modules in such areas as blueprint reading and industrial technology through its Institute for Advanced Manufacturing (Rockefeller Institute, 2011). Graduates of technical trades programs at Clinton Community College make slightly less ($57,337) than the median relevant SUNY wage ($57,630), but about 87% more than the regional median wage ($30,654), and 81% of these graduates work in New York a decade on.

Retain

Retention rates exhibit notable associations with institution type (Carnegie classification), degree level, and program of study (Cramér’s V of 0.37, 0.32, and 0.39, respectively; Table 7). Alumni from community and mixed bachelor’s colleges remain in New York state over the long term at higher rates than graduates from master’s and doctoral colleges and universities. Retention rates for 112/173, or 65%, of programs at community colleges, exceed the median SUNY retention rate of the programs we are studying (66.7%), while only 12/74 (16%) of programs at doctoral universities do (Appendix, Table 13). The difference is similarly strong in degree level. About 64% of associate’s degree programs have retention rates above 66.7%, while 0% of programs at the doctoral/professional degree level have retention rates of 66.7% or higher (Appendix, Table 14).

In describing the structural and behavioral drivers that underlie the settlement patterns of college graduates, Florida (2002) and others (e.g., Clark et al., 2002; Ewers, 2007) predict that the technically skilled, as well as “people in design, education, arts, music and entertainment, whose economic function is to create new ideas” (Florida, 2002, p. 8) will seek out cities with educated populations, better access to
technology, and more tolerant cultures. Such dynamic urban economies are characterized by higher costs of living and higher incomes. This theory has at least some explanatory power in the SUNY context, though there are some inconsistencies between wages and retention patterns, as well as retention patterns and program of study that suggest some important limitations to the “creative class” theory. An analysis of the coded programs in Table 8 shows how program of study relates to retention patterns. Art and architecture graduates have one of the highest mobility rates (Table 8, Appendix, Table 7), but one of the lowest median wages, too (Appendix, Table 11). Agriculture and natural resource management graduates have a similar wage-mobility profile, though presumably they are less likely to become part of the urban creative class. Programs that develop human capital for non-tradable services, such as hospitality, health, education, and social services, tend to have higher retention rates across degree level and institution type (see Table 8 to observe the persistence of capital letters in each of these columns, and across the rows corresponding to institution type). Although the Covid-19 crisis has accelerated the adoption of remote learning and telemedicine and may affect the overall tradability of educational and healthcare services, licensing requirements may also be driving some of these trends, and therefore may continue to anchor human capital in regions where demand is high for licensed professionals like nurses and teachers.

Given that the presence of educated labor generates larger positive externalities in regions with lower educational attainment levels (Moretti, 2004a, b), the ability to retain graduates with relevant skills is especially critical in the rural Mohawk and North Country regions, and the post-industrial area of Western New York. In the North Country, graduates of SUNY Plattsburgh’s health professions and related clinical sciences programs are trained to address the specific challenges of delivering healthcare in a rural setting, including how to use remote technologies to engage both patients and specialists at a distance. The region-specific training corresponds to higher retention rates; over 94% of master’s degree graduates from SUNY Plattsburgh programs in areas such as speech language pathology and mental health counseling remained in New York after 10 years. There is also evidence that community college programs with targeted job prospects lead to higher retention rates and higher wages for graduates in these regions. In Mohawk Valley, Fulton-Montgomery Community College’s Electrical Technology program is one such example. Redesigned in response to growing needs at Global Foundries’ semiconductor plant in nearby Saratoga Springs, median wages for graduates of this program after 10 years is $62,405, and 70.6% of program alumni live in New York over the long term.

Among all of the different types of colleges and universities, these kinds of technical and career-oriented 2-year institutions had the highest retention rates (74.1% and 69.5%, respectively; Table 3). Meanwhile, lower average retention rates than the proportion of New York in-state students at doctoral universities (e.g., at R1s, 74.2% of students are from New York, but the school’s overall retention rate is just 54.7%), master’s institutions, and bachelor’s colleges reveal that in general, this state system facilitates a net outflow of human capital. While describing the university as a ‘global–local pipeline,’ Benneworth and Hospers (2007) implied the university was a crucial attractor for talent and technology. In addition to substantiating the need to analyze multiple stages of human capital development, our findings that students from public master’s colleges and research universities do not remain in the area at particularly high rates raise new questions about the economic value of these outflows to regions (e.g., do extra-regional alumni networks feedback into the regional economy through tourism, real estate, or other economic channels?).

Conclusions

Studies that narrowly evaluate the role of colleges and universities on regional human capital formation through one stage of student migration, one class of institutions, and/or one type of region risk distorting the contributions of institutions of higher education to regional development across time and space. To address this issue, we evaluate how the nature of colleges and universities is associated with the attraction, formation, and retention of human capital by examining how institution type corresponds to (1) the geography of populations served, (2) the programs offered and the wages graduates earn, and (3) whether graduates are more or less likely to be living in the broader community over the long term. We simultaneously assess the extent to which degree level,
Table 8  Institution type, programs by level of educational attainment, median retention

| Institution Type | Program Type | Ag./Nat. resources | Art & Architecture | Tech trades | Comms. & Media | Law & Legal | Health | Hospitality | Engineering | Soc. services | Educ | Comp. & Math | Bus. & Finance |
|------------------|--------------|--------------------|--------------------|-------------|----------------|------------|--------|-------------|-------------|--------------|------|-------------|----------------|
| Doctoral         | R1           | b, b               | b, m, m, b, b, m, d| b, b, m, m, d| B, b, b, m, m, p, p, d| b, d, d, d, m, m, m, b, b|M, M, d, B, M, m | b, m, b, h, m, m, m, d, d| b, b, b, h, m, m, m |
|                  | R2           | b, m, a            | m, b               | b, m, m, b, m| p, p, p, b, m | b, b, b, b, m | M, M, b, b, b, b | M, b, b, m, m, m, m, b | b, b, b, b, b, b |
|                  | Spec         | p, p, p, b, m       | b                  |             |                |            |         |             |             |              |      |             |                |
| Master’s         | Large        | b                   | B, b, b, b, b, m, m| M, B, B, b, b| M, b, b, M, b, b,M | M, M, M, M, b, b, b, b | M, M, M, M, b, b, b, b | B, b, b, b, b, m | B, b, b, b, b, m |
|                  | Medium       | B, b               | B, b, b, b, b, b, b| M, B, M, M, B, B, b | b, b | M, M, M, M, b, b, b, b, b | B, b, b, m, b, b, b, b | b, b | B, b, b, b, m |
|                  | Small        | b, b, m, a         | B, a, b            | B, b, b, a, b| b, b | M, b, b            | B, b, b, b, b, b, b, b | B, m, m, m, b, b, b | b, a |
| Bachelor         | Mixed        | A, A, b, a         | B, B, A            | A, A, A, A, B, b, a | A, a | A, A, A, A, A | A, B, B, A, a, A | A, A | B, B, B, A, a |
|                  | Lib. arts    | b, m               | b                  |                | b               |            |         |             |             |              |      |             |                |
| Community        | High transfer| a                  | A, A, a, a, a, a, a| A, A, A, A, A, a| A, A, A, A, a | A, A, A, A, A, a | A, A, A, A, A, a | A, a, a, a | a, a, a, a |
|                  | Mixed/tech   | a                  | A, A, a, a         | A, A, A, A, A, a| A, A, A, a, a | A, A, A, A, a, a, a | A, A, A, A, A, a | A, a, a, a | a, a, a, a |
|                  | Career       | A                  | A                  |                |                |            |         |             |             |              |      |             |                |

Data indicate program availability and corresponding level of degrees (A associate’s, B Bachelor’s, M Master’s, D Doctorate, P Professional). Capital letters indicate that program’s retention (graduates living in New York state 10 years after graduating) is above the 50th percentile for all SUNY graduates; lowercase letters indicate the program’s retention is at the 50th percentile or below. Median = 66.7. Source: SUNY Gradwage Dashboard
student’s program of study, and regional variation are also associated with the market value of specific types of education and graduate retention patterns. In taking both a wider spatiotemporal lens and an institutionally deeper perspective, this paper illustrates the variegated roles colleges and universities play in supplying human capital to regional economies.

Various levels of institutions serve students with different mobility ranges, with large research universities pulling students across greater distances, and small, teaching-centered schools serving local students at higher rates. These groups of schools also supply different kinds of human capital, as associate’s and bachelor’s colleges offer the majority of programs in paralegal training, technical trades, and hospitality, while engineering and education programs are concentrated at master’s colleges and research universities. Although most types of institutions offer degrees in health professions, computers and math, and business and finance, the differences in degree level (and the wages and retention patterns reflected therein) also speak to the importance of providing multiple paths to higher wages, as well as the need to fill jobs at various levels of skill and training. The nature of institution is also strongly associated with graduate retention rates, which imply that students have different mobility ranges. By design, institutions match skills to local labor needs differently, leading to higher retention rates among schools with greater local–regional engagement.

Even among the same types of institutions, there is variation in human capital development. A key reason for this is each region’s idiosyncratic institutional environment. Regions that have multiple SUNY schools, such as the Capital District, or have very few private schools, such as the North Country, play both broader (in the sense that they may need to offer many different kinds of programs) and deeper (in the sense that they often offer more than one type of degree) roles in regional industry. With the exception of community and liberal arts colleges, most public colleges and universities offer several kinds of degrees. Degree level is more strongly associated with graduate wages than institution type, program of study, or labor market region, which illustrates the problem with treating graduates of a single type of school as a monolith, since the market value of the human capital developed within them is not uniform. Similarly, while school type overlaps with programs offered in several areas, the program of study has a slightly stronger relationship to retention rates than institution type. Graduates whose skills are most compatible with non-tradable services, such as education and social services, tend to remain in state, while retention is lower for graduates with skills in highly tradable sectors like computers and math, business, and engineering. The study also reaffirms the role of programs that target specific job outcomes, such as electrical training for semiconductor manufacturing, or nurse and nurse practitioner programs for large medical centers, in the retention process. Such programs are overwhelmingly present at smaller, regionally oriented colleges, which often have more institutional flexibility to address region-specific labor market needs. However, specialized professional (e.g., medical) institutions that admit a large number of in-state students and have modestly higher retention rates than other doctoral-degree granting schools also suggest that all types of public schools can improve graduate retention through greater community engagement (e.g., local student attraction strategies and market-creating and filling activities).

Finally, this study illustrates the need to consider higher education’s role in multiple stages of regional human capital development, since student inflows at one stage correspond to differential patterns of human capital outflows at another. In the literature, student mobility patterns are usually analyzed through the lens of research institutions and are typically concerned with either student attraction or graduate retention. Consistent with this literature, we find institutional prestige and desirable locations do draw students from farther away. Specialized programs and curricula, often corresponding to the nature of the institution itself (e.g., liberal arts colleges) are also important (potential) human capital attractors. Yet colleges and universities that attract students from outside their region also exhibit lower overall retention rates. This is a finding that previous studies, focused on a single stage in the human capital development process, have not explicitly captured. This raises important questions regarding the relative importance of local versus non-local students on the region—while migrant students provide much-needed revenue and short-term local impacts, retention stretches that impact over a long term with regional spillovers that are difficult to measure.

Furthermore, because graduate retention rates are lower than the proportion of students that originate from New York across most institution types (due
to data limitations, we cannot confirm this is true of community colleges), the public state system is generally facilitating outflows of human capital or a broader impact that is difficult to measure. The system trains and then releases human capital into the national and global economy with very limited tracking of this labor. While these net outflows (local-to-global pipelines) do represent regional and state losses in human capital, they also likely represent important social and economic linkages to other parts of the country and the world. The extent to which these linkages feed each region’s development is an important area for future research on universities and scalable networks. As a result, this multi-stage, multi-institution study opens the door to several new research directions and the need for collecting comparable human capital data across systems and regions in the United States, particularly those that consider the relative impact of smaller and student-oriented public institutions on localized human capital development over time vis-à-vis large public research institutions.

Declarations

Conflict of interest  We do not have any COI.

Human or animal rights  We did not involve any human participants and/or animals.

Informed consent  We did not collect primary data.

Appendix

See Tables 9, 10, 11, 12, 13, 14, 15 and 16

Table 9  Data for chi-square analysis: Number of programs above/below median wages by institution type (Carnegie classification)

| Institution type | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|------------------|-------------------------------|----------------------------------|--------|
| Community        | 47                            | 126                              | 173    |
| Bachelor’s       | 28                            | 30                               | 58     |
| Master’s         | 75                            | 55                               | 130    |
| Doctoral         | 67                            | 7                                | 74     |
| **Totals**       | **217**                       | **218**                          | **435**|

Median wages for relevant programs = $57,630. Chi-square = 87.868, df = 3, \( p \)-value = <2.2e−16, Cramer’s V = .45

Table 10  Data for chi-square analysis: Number of programs whose graduates earn above/below median wages by degree level

| Degree level | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|--------------|-------------------------------|----------------------------------|--------|
| Associate’s  | 61                            | 150                              | 211    |
| Bachelor’s   | 84                            | 59                               | 143    |
| Master’s     | 57                            | 9                                | 66     |
| Doctoral     | 15                            | 0                                | 15     |
| **Totals**   | **217**                       | **218**                          | **435**|

Median wages for relevant programs = $57,630. Chi-square = 100.51, df = 3, \( p \)-value = <2.2e−16, Cramer’s V = .482

Table 11  Data for chi-square analysis: Number of programs whose graduates earn above/below median wages by program type

| Program of study | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|------------------|-------------------------------|----------------------------------|--------|
| Ag./natural resources | 4                            | 13                               | 17     |
| Art              | 13                            | 35                               | 48     |
| Technical trades | 24                            | 14                               | 38     |
| Communications/ media | 13                         | 20                               | 33     |
| Law              | 1                             | 13                               | 14     |
| Health           | 45                            | 17                               | 62     |
| Hospitality      | 3                             | 12                               | 15     |
| Engineering      | 12                            | 0                                | 12     |
| Social services  | 8                             | 23                               | 31     |
| Education        | 18                            | 15                               | 33     |
| Computers and math | 38                         | 21                               | 59     |
| Business         | 38                            | 35                               | 73     |
| **Totals**       | **217**                       | **218**                          | **435**|

Median wages for relevant programs = $57,630. For program typology, see Table 2 in the main text. Chi-square = 71.846, df = 11, \( p \)-value = 5.438e−11, Cramer’s V = .406
Table 12 Data for chi-square analysis: Number of programs whose graduates earn above/below median wage by labor market region

| Region           | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|------------------|-------------------------------|----------------------------------|--------|
| Hudson Valley    | 26                            | 25                               | 51     |
| Long Island      | 36                            | 11                               | 47     |
| NYC              | 17                            | 1                                | 18     |
| Capital District | 24                            | 13                               | 37     |
| Central NY       | 23                            | 23                               | 46     |
| Finger Lakes     | 16                            | 32                               | 48     |
| Southern Tier    | 17                            | 20                               | 37     |
| Western NY       | 31                            | 40                               | 71     |
| Mohawk Valley    | 16                            | 29                               | 45     |
| North Country    | 11                            | 24                               | 35     |
| Totals           | 217                           | 218                              | 435    |

Median wage for relevant programs = $57,630. Chi-square = 40.714, df = 9, p-value = 5.637e−06, Cramer’s V = .31

Table 13 Data for chi-square analysis: Number of programs above/below median retention by institution type (Carnegie classification)

| Institution type | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|------------------|-------------------------------|----------------------------------|--------|
| Community        | 112                           | 61                               | 173    |
| Bachelor’s       | 38                            | 20                               | 58     |
| Master’s         | 49                            | 81                               | 130    |
| Doctoral         | 12                            | 62                               | 74     |
| Totals           | 211                           | 224                              | 435    |

Median retention for relevant programs = 66.7% of graduates living in New York after 10 years. 8 programs have a retention rate of 66.7, they are placed in the ‘median or below’ category. Chi-square = 58.102, df = 3, p-value = 1.495e−12, Cramer’s V = .37

Table 14 Data for chi-square analysis: Number of programs above/below median retention by degree level

| Degree level | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|--------------|-------------------------------|----------------------------------|--------|
| Associate’s  | 134                           | 77                               | 211    |
| Bachelor’s   | 48                            | 95                               | 143    |
| Master’s     | 29                            | 37                               | 66     |
| Doctoral     | 0                             | 15                               | 15     |
| Totals       | 211                           | 224                              | 435    |

Median retention for relevant programs = 66.7% of graduates living in New York after 10 years. 8 programs have a retention rate of 66.7, they are placed in the ‘median or below’ category. Chi-square = 45.973, df = 3, p-value = 5.748e−10, Cramer’s V = .32

Table 15 Data for chi-square analysis: Number of programs whose graduates remain in NY 10 years after graduating, by program type

| Program of study                     | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|--------------------------------------|-------------------------------|----------------------------------|--------|
| Ag./natural resources                | 4                             | 13                               | 17     |
| Art                                  | 6                             | 42                               | 48     |
| Technical trades                     | 28                            | 10                               | 38     |
| Communications/ media                | 14                            | 19                               | 33     |
| Law                                  | 6                             | 8                                | 14     |
| Health                               | 41                            | 21                               | 62     |
| Hospitality                          | 11                            | 4                                | 15     |
| Engineering                          | 0                             | 12                               | 12     |
| Social services                      | 19                            | 12                               | 31     |
| Education                            | 20                            | 13                               | 33     |
| Computers and math                   | 31                            | 28                               | 59     |
| Business                             | 31                            | 42                               | 73     |
| Totals                               | 211                           | 224                              | 435    |

Median retention for relevant programs = 66.7% of graduates living in New York after 10 years. 8 programs have a retention rate of 66.7, they are placed in the ‘median or below’ category. Chi-square = 67.6, df = 11, p-value = 3.484e−10, Cramer’s V = .39
Table 16 Data for chi-square analysis: Number of programs whose graduates remain in NY 10 years after graduating, by labor market region

| Region             | Above median (n. of programs) | Median or below (n. of programs) | Totals |
|--------------------|-------------------------------|---------------------------------|--------|
| Hudson Valley      | 27                            | 24                              | 51     |
| Long Island        | 23                            | 24                              | 47     |
| NYC                | 2                             | 16                              | 18     |
| Capital District   | 14                            | 23                              | 37     |
| Central NY         | 18                            | 28                              | 46     |
| Finger Lakes       | 32                            | 16                              | 48     |
| Southern Tier      | 13                            | 24                              | 37     |
| Western NY         | 39                            | 32                              | 71     |
| Mohawk Valley      | 26                            | 19                              | 45     |
| North Country      | 17                            | 18                              | 35     |
| Totals             | 211                           | 224                             | 435    |

Median retention for relevant programs = 66.7%. 8 programs have a retention rate of 66.7, they are placed in the ‘median or below’ category. Chi-square = 24.505, df = 9, p-value = 0.00357, Cramer’s V = .24

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