Conceptualizing and Researching the Educational Pipeline

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While there has been much written about dropout from high school and student retention in college as separate phenomena, little conceptual or empirical work examines how the two fit together. Thinking about this matter is timely for at least two reasons. First, the reform movement in standards-based education for K-12 education is beginning to foster significant discussions about the transition between high school and college in many states—a policy agenda usually termed "K-16." States like Maryland, Kentucky, Oregon, and Oklahoma are currently heavily engaged in policy initiatives under this banner, aimed primarily at creating seamless transitions between high school and postsecondary study through better alignment of academic standards, dual enrollment, and advanced placement.

Second, state and national leaders also have a renewed interest in enhancing educational attainment, not just from an educational perspective, but as a key social asset. Partly stimulated by such publications as *Measuring Up* (National Center for Public Policy in Higher Education, 2000, 2002), governors and other policymakers are increasingly viewing high levels of "educational capital" as key to the economic development of their states and the quality of life of their citizens. High levels of attainment are related to higher incomes for individuals and thus to tax revenues and economic activity. Populations with high levels of attainment also make fewer demands on expensive social services like welfare and corrections, while they indirectly save public resources through improved health and better lifestyle choices. Perhaps most important, better educated individuals are able to negotiate increasingly complex decisions about health care, personal finance, and retirement—choices that were once made for them by government or their employers.

Policy Objectives and Alternatives. Viewed from the standpoint of educational capital, a principal policy objective for any polity is to increase the number of individuals with high levels of relevant knowledge and skill among its citizens. Note first that this is a "stock" question, not simply a matter of high levels of production. Polities may experience increases in the number of postsecondary degree winners but still be falling behind with respect to educational capital if their general populations are growing faster because they are experiencing net out-migration of educated citizens, or if growth is occurring disproportionately among particular groups. Note second that "high levels of relevant knowledge and skill" is not necessarily the same as "high levels of educational (postsecondary) attainment." For purposes of this paper, we use educational attainment as a proxy for educational capital, but we return to this issue at the end of the paper to call for better direct measures of population ability levels.

Given this overall policy objective, moreover, there are two quite different avenues to accomplish it. The one that has received the most attention—and the one we address here—is creating an effective "pipeline" for educational attainment through an articulated system of schools and postsecondary institutions within a particular state or polity. Policymakers invest in schools and colleges because they expect that doing so will ultimately increase their stock of educated citizens. But we know that population mobility affects the pipeline at every stage. Potential students may choose to attend college in another state. And after they finish, they may or may not come back. If they complete their baccalaureate studies in the state where they went to high school, enhanced opportunities associated with collegiate attainment mean they have a wider geographic choice of employment. This leads to the second principal policy avenue to enhance educational capital: importing talent directly by creating an economy and quality of life that attracts people with high levels of educational attainment. Colorado, for instance, has high levels of educational capital in terms of the collegiate attainment of its population, but is only a middling performer with respect to the productivity of its educational pipeline (see **Figure 1**). Both public policy and job markets in particular occupations can thus considerably influence the stock of educational capital in a state, independent of the effectiveness of its own educational pipeline (Turner, Bound, Groen, and Kezdi 2001). But most observers agree that the most direct and reliable policy lever available to increase population levels of

educational attainment remains a productive, high-quality educational system.

Stages in the Educational Pipeline. From a conceptual standpoint, a given polity's educational pipeline can be conceived in terms of a series of successive transitions, each of which can be approximated using available statistics:

- Graduation from High School. Although most children in the U.S. attend school through the middle grades, we know that increasing numbers do not complete high school by the time they are nineteen. A first key transition measure is therefore the proportion of ninth graders in high school who promptly attain a high school degree.
- Entry into Postsecondary Education. Unlike secondary school attendance, attending college is an elective decision. Rates of entry into post-secondary education are thus conditioned not only by such matters as postsecondary capacity and student preparation levels, but also by culturally conditioned choices and perceived costs versus benefits. A second key transition measure is thus the proportion of recent high school graduates who enter postsecondary education.
- Persistence in Postsecondary Education. We know that fewer than half of those entering postsecondary education as first-time, full-time students in the U.S. complete a baccalaureate degree at the institution they entered within six years. Research also tells us that, in general, the greatest point of attrition in postsecondary enrollment is the first year of college (Tinto 1987). A third key transition measure is therefore the proportion of entering first-year postsecondary students who enroll for a second year of study.
- Completing Postsecondary Education. Although experiencing some amount of college does result in economic benefit, we know that possession of a baccalaureate credential clearly delineates populations with respect to income (Carnevale and Rose 1998). Thus a fourth key transition measure is the proportion of students enrolled in college who promptly earn a degree.
- Entering the Workforce. Because the principal policy objective in building an educational pipeline is to enhance the stock of educational capital, a final consideration is the ultimate impact of such investments on the workforce. A final key outcome measure is therefore the proportion of individuals with a college credential in the young working-age population (aged 25-44).

Figure 1 presents one way to operationalize these concepts using available national cross-sectional data for states in the U.S. Proceeding from left to right, the table begins with an index of 100 for ninth grade enrollments and presents index scores constructed using these data by state for a) high school students graduating four years later, b) high school graduates entering college, c) college starters returning for their sophomore year, and d) college entrants completing a baccalaureate programs within six years. (Full definitions and data sources for each of these measures are provided at the end of this article.) The table's final column displays the resulting "educational capital" index, calculated in terms of the proportion of each state's young adult population with a baccalaureate degree.

Figure 2 presents most of these data in a somewhat different way, emphasizing the proportion of a given starting group of ninth graders lost at every transition point in the educational pipeline. A number of conclusions are apparent from even a casual inspection of these data. First, differences among the overall yields of the educational pipelines of different states vary widely. The highest overall performers (Massachusetts and Iowa) are almost five times as productive as the lowest performer (Alaska). And this is not just a phenomenon driven by a few extreme cases: the average overall yield of the top quartile is about twice that of the bottom quartile. Second, states with the same overall yield vary greatly in how they get there. Georgia, Oklahoma and Arkansas, for instance, are quite close in overall yield. Yet Georgia loses half its cohort of ninth graders before they graduate from high school, while both Oklahoma and Arkansas graduate well over 70% of their starting ninth graders—within a few percentage points on this statistic of the top performer, Massachusetts. Top performers, of course, tend to do well on all transitions. But it is clear that different states are, for one reason or another, able to exert quite different degrees of policy leverage on each of these key transition points.

Figure 3 juxtaposes each state's ability to produce college graduates—its educational pipeline results—against an educational capital index. The influence of the economy is found at all levels of pipeline success. Note the very different educational capital indices of Massachusetts versus Iowa, or Colorado versus Michigan, or Georgia versus Arkansas. Both states in each of these pairings have essentially the same degree production rates, but substantially different proportions of young adults holding baccalaureate or more advanced degrees. While this analysis does not directly account for migration among college graduates, it suggests that states can yield a relatively high number of graduates who in turn migrate to other states with more vibrant economies (and vice versa).

Figure 4 displays the measures used to generate the educational pipeline results and the original data sources.

Points of Leverage for Policy. While demographic and economic factors will undoubtedly have a lot to do with the leverage that states and polities can exert to improve transition rates at each stage of the pipeline, specific policy areas that can positively influence these rates can be identified conceptually (and, to some extent, have been sustained by research).

- High School Graduation. Policy areas that can positively influence the conversion of large numbers of early high school students into graduates include:
  - ✓ Strategies to improve foundation skills through rigorous course-taking in early grades—together with early childhood intervention programs—targeted at ensuring that typical gaps in achievement between low and high socio-economic status (SES) children that begin to occur in the mid-elementary grades do not develop.
  - ✓ Parental, employer, and community involvement strategies designed to reinforce the message that graduation from high school is important.
  - ✓ Financial equalization policies to ensure that low-income (high dropout) school districts have sufficient resources to mount challenging and diverse curricula and appropriate support services.
- Entry into College. Policy areas that can positively influence college access by high school graduates include:
  - ✓ Affordability strategies such as low levels of public college tuition in relation to the median income of the state's poorest citizens and heavy investment in need-based financial aid that can be utilized by students enrolled in both public and independent institutions.
  - ✓ Structural aspects of a state's higher education system such as the existence of a high capacity open-entry two-year college system with ready geographic access to transfer institutions, or options that can speed the transition from high school to college like dual enrollment or advanced placement.
  - ✓ Rigorous high school course-taking and better alignment between high school exit standards and college entrance or placement requirements.
- Persistence and Graduation from College. Policy areas that are likely to be of importance in promoting the collegiate portion of the educational pipeline include:
  - ✓ First-year programs, learning communities, and academic support programs tailored to the needs of individual learners.
  - ✓ "Intensive" enrollment in foundation coursework in the student's first years of college study (Adelman 1999).
  - ✓ Schedule responsive to the needs of students.
  - ✓ Continuing attention to affordability through low tuition, need-based aid, and especially the avoidance of high debt burden.
  - ✓ Effective transfer arrangements between two-year and four-year institutions that allow students to progress without loss of time or academic credit.

To at least some extent, these are things that polities can influence through policy. But up to now in the U.S., different policy choices have been made in different regions of the pipeline. Positive changes in the performances of most states on *Measuring Up* between 2000 and 2002, for example, were noticeable in the area of Preparation, but were generally negligible in Access and Progress (NCPPHE 2002). While not true of all states, this surely reflects the substantial, deliberate, and sustained policy attention given to K-12 improvement in many states.

Some Cautions About Attainment. In this paper, educational capital has been operationalized in terms of educational attainment. But it is important to emphasize that levels of educational attainment are only *proxies* for the underlying variable of interest: the actual stock of knowledge and abilities possessed by graduates.

Certainly, the assumption of high correlations between credentials and abilities is a reasonable one. Incomes track well with attainment levels, as do job classifications. But doubts about the actual quality of the credentials awarded are both widespread and growing. In K-12, this has been manifest in the increasing incidence of competency-based exit testing for high school graduates. In postsecondary education there is a growing movement to credential graduates in various professional and technical fields. Publications like *Measuring Up 2002*, meanwhile, are calling for the eventual establishment of a collegiate equivalent of the National Assessment of Educational Progress (NAEP), and propose intermediate steps to assess collegiate learning that rely on existing measures.

More immediately, the traditional correspondence between levels of enrollment and levels of learning are beginning to blur. Many high school students now take AP courses or are enrolling directly in college through dual-enrollment programs. Meanwhile, steadily rising numbers of students enter postsecondary education only to take a full load of remedial courses that are high school level at best. Such overlaps between the various stages of the educational pipeline mean that it is no longer safe to assume that students who are *behaviorally* at a particular

stage represent equivalent levels of academic achievement. At the same time, the traditional linear pipeline based on reasonably prompt and successive stages of enrollment at increasingly higher levels is less prevalent than it once was. Aggressive action in adult literacy in some states is increasing the number of GEDs among older populations, rendering them ready for further technical or postsecondary study. And postsecondary study itself is increasingly characterized by longer times to degree and a growing trend toward stop-out and re-entry. Badly needed, therefore, is information about the achievement pipeline—data that would reflect the acquisition of knowledge and skills at or above standard levels for benchmarks like graduation from high school, "grade 14," and graduation from college. In the absence of such information, leveraging the traditional pipeline of credential-based attainment remains the best available option for valuing the educational capital within a state or polity. But it is important for both policymakers and analysts to keep these increasingly salient caveats in mind.

Conclusions. This brief conceptual and empirical treatment of the educational pipeline suggests a number of conclusions:

- If the policy objective is to increase the stock of educational capital in a given polity, looking at the ladder of educational attainment as a single longitudinal phenomenon, composed of key transition points in both secondary and post-secondary education, can pay substantial dividends for policy.
- Examined in "pipeline" terms, the fifty U.S. states exhibit strikingly varied patterns of attainment. Different states perform differently at different stages, and changes in performance historically correspond to both changes in policy and to particular features of each state's approach to educational organization and delivery. This suggests strongly that policy *matters* and that different kinds of policies used in combination will have the greatest impact.
- Stocks of educational capital can be increased in ways other than just increasing throughput in the educational pipeline. Geographic mobility means that polities that are able to create and maintain vital economies will attract college graduates, while the lack of such opportunities may mean that those with a productive pipeline will simply lose their graduates through out-migration.
- Earned credentials are only a proxy for actual levels of advanced knowledge and skill. Direct measures of the latter are increasingly in demand and should be pursued. Growing overlaps between particular stages in the traditional educational pipeline meanwhile complicate the analysis of student progression and underline the need for solid and widespread measures of academic achievement.

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DATA SOURCES

Public High School Graduation Rates: Tom Mortenson, *Postsecondary Opportunity*—9th graders graduating from high school four years later, 2000—number of public high school graduates divided by the number of 9th graders four years earlier. (NCES Common Core Data)

College-Going Rates: Tom Mortenson, *Postsecondary Opportunity* and National Center for Education Statistics, *IPEDS Residency and Migration File*—number of fall first-time freshmen enrolling anywhere in the U.S. divided by the total number of high school graduates, 2000.

First-Year Retention Rates: ACT *Institutional Survey*, 2001—two-year and four-year colleges. Percent of fall full-time, first-time freshmen enrolling the following fall semester.

Graduation Rates: NCES, *IPEDS Graduation Rate Survey*, 2000—percent of full-time associate and baccalaureate students graduating with 150 percent of time. (3 years and 6 years)

Figure 1

State	*Of 100 Ninth Graders, How Many...* Graduate from High School On Time?	Directly Enter College?	Are Still Enrolled Their Sophomore Year?	Graduate Within 150% Time?	Percent of Population 25-44 with Bachelor's Degree or Higher, 2000
Massachusetts	100	75	52	41	28	38.8
Iowa	100	83	54	37	28	25.0
Pennsylvania	100	75	46	36	27	26.7
New Hampshire	100	74	44	34	27	30.1
Rhode Island	100	70	46	37	26	28.5
Connecticut	100	77	48	37	26	34.9
Minnesota	100	84	53	38	25	31.7
New Jersey	100	86	55	40	24	34.1
North Dakota	100	84	58	42	24	26.4
Maine	100	77	42	31	23	23.5
Nebraska	100	84	50	38	22	27.6
Wisconsin	100	78	45	33	22	25.4
South Dakota	100	74	47	31	22	24.8
Kansas	100	74	50	32	22	28.9
Vermont	100	79	36	28	21	29.9
Indiana	100	68	41	30	21	22.1
Virginia	100	74	39	30	20	32.1
Delaware	100	61	36	28	19	27.7
Illinois	100	71	43	29	19	30.1
Missouri	100	73	39	27	18	25.0
New York	100	59	37	28	18	31.0
Colorado	100	71	37	26	18	34.1
Wyoming	100	75	39	NA	18	21.6
Michigan	100	69	40	28	18	24.2
North Carolina	100	59	38	28	18	25.4
Maryland	100	73	40	30	18	33.8
Ohio	100	70	39	28	17	24.2
California	100	69	33	22	17	26.7
Montana	100	78	42	28	17	25.5
Utah	100	84	32	21	16	25.8
Washington	100	71	32	22	16	28.5
West Virginia	100	75	39	27	15	16.6
Oregon	100	67	34	23	15	25.8
Florida	100	55	32	23	14	23.5
Arizona	100	59	30	18	14	23.4
South Carolina	100	51	34	23	14	21.8
Idaho	100	77	34	23	14	22.0
Tennessee	100	55	34	23	14	22.1
Alabama	100	59	34	23	13	21.3
Kentucky	100	66	39	25	13	19.4
Hawaii	100	64	38	22	13	27.3
Mississippi	100	56	36	23	13	17.8
Arkansas	100	74	39	26	12	18.2
Louisiana	100	56	33	22	12	19.8
Oklahoma	100	73	36	23	12	21.3
Georgia	100	52	32	21	12	26.9
New Mexico	100	60	36	22	11	21.2
Texas	100	62	32	19	11	24.0
Nevada	100	69	28	19	11	17.6
Alaska	100	62	28	NA	6	22.2
United States	100	67	38	26	18	26.7

Figure 2

Of 100 9th Graders—Loss at Each Stage of Transition (2000)

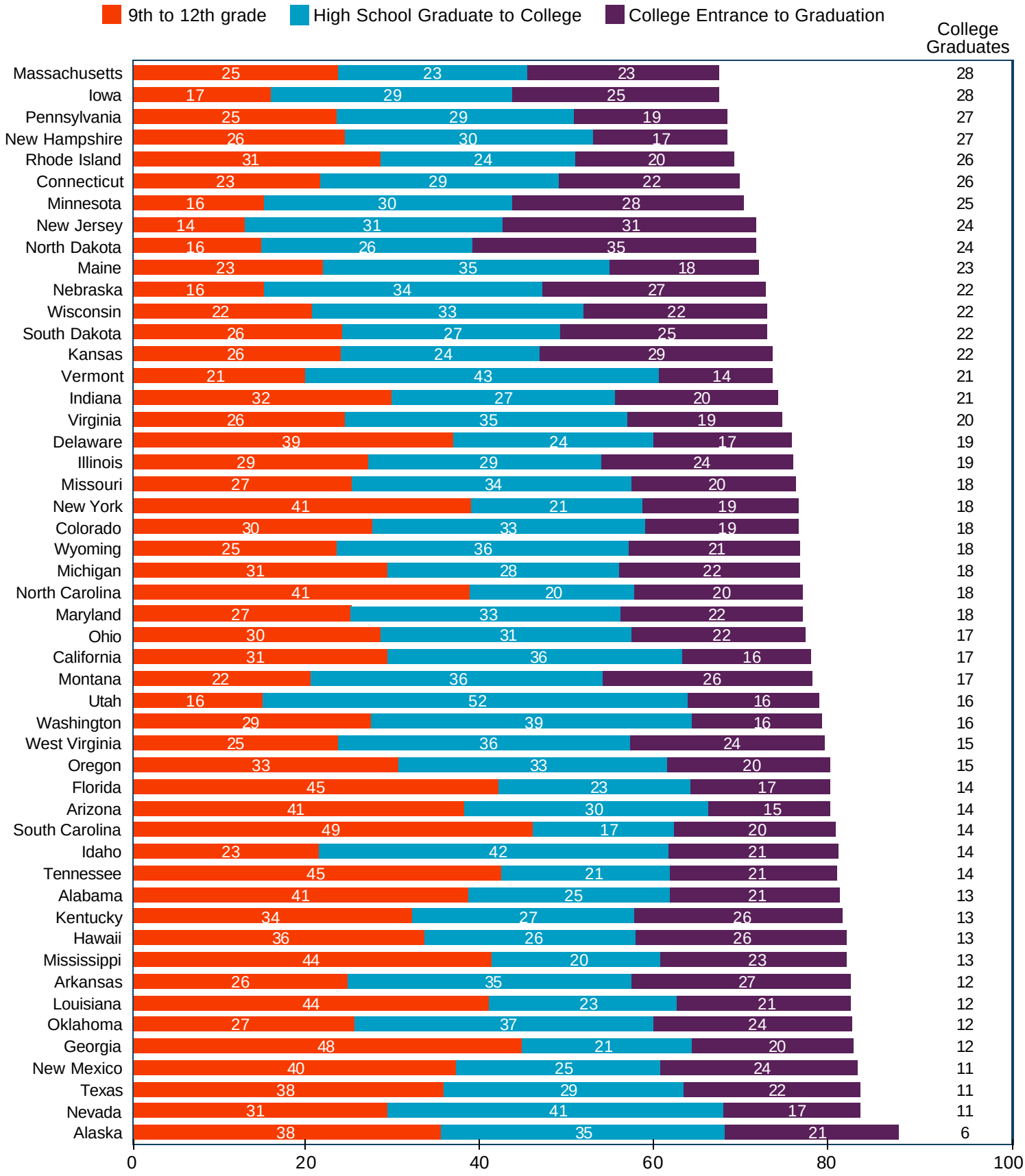
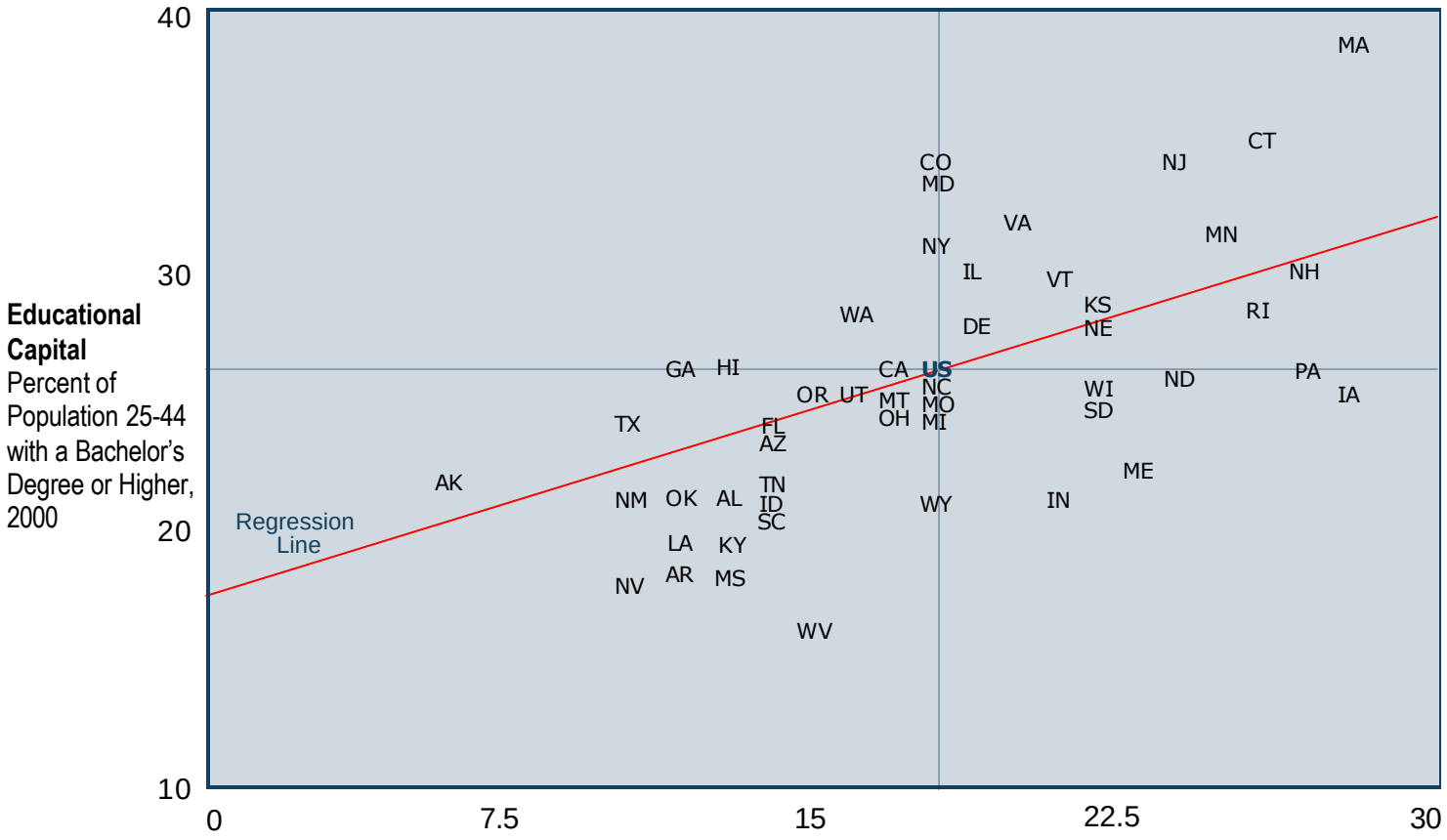


Figure 3

States' Ability to Produce Graduates vs. Ability to Keep and Attract Graduates



Student Pipeline
Of 100 9th Graders, the number: Graduating from High School Within 4 Years, Going Directly to College, Returning Their Second Year, and Completing College Within 150 Percent of Degree Time.

Figure 4

Student Pipeline Sources, 2000

STATE	HS Graduation Rate (%), 9th Graders Graduating 4 Yrs. Later, 2000 (NCES)	College-Going Rate (%), 2000 (NCES)	First-Time Freshmen 1 Yr. from HS — 4 Yr. Colleges (NCES, IPEDS 2000)	First-Time Freshmen 1 Yr. from HS — 2 Yr. Colleges (NCES, IPEDS 2000)	% Four-Year	% Two-Year	% Freshmen at 2 Yr. Colleges Returning Their Sophomore Year (ACT 2001)	% Freshmen at 4 Yr. Colleges Returning Their Sophomore Year (ACT 2001)	Graduation Rate (%), 2 Yr. Colleges — After 3 Yrs. (2000 IPEDS GRS)	Graduation Rate (%), 4 Yr. Colleges — After 6 Yrs. (2000 IPEDS GRS)
AL	58.9	58.0	19,207	8,147	70.2	29.8	48.5	73.7	21.9	46.2
AK	62.3	44.3	1,648	29	98.3	1.7	NA	NA	33.0	22.3
AZ	59.3	50.0	14,453	9,422	60.5	39.5	48.0	71.7	47.6	49.6
AR	73.6	52.9	11,895	3,943	75.1	24.9	55.0	70.3	20.2	34.7
CA	68.7	47.7	85,943	73,424	53.9	46.1	47.6	84.3	43.0	58.7
CO	70.5	52.8	21,126	3,228	86.7	13.3	46.8	74.9	38.4	50.9
CT	77.0	62.2	16,159	3,454	82.4	17.6	47.8	82.8	23.7	59.7
DE	60.7	59.9	4,588	979	82.4	17.6	47.8	82.6	12.9	61.3
FL	55.2	57.5	41,688	32,555	56.2	43.8	62.7	78.8	35.8	53.4
GA	52.3	60.4	29,219	12,004	70.9	29.1	55.0	72.7	26.6	41.1
HI	64.2	59.8	2,630	3,588	42.3	57.7	43.9	72.6	22.9	45.8
ID	76.9	44.8	4,545	2,824	61.7	38.3	NA	67.1	42.5	37.2
IL	71.1	59.8	42,378	24,710	63.2	36.8	51.6	76.1	25.2	56.0
IN	68.2	60.0	38,034	4,683	89.0	11.0	46.1	76.9	26.6	54.2
IA	83.0	64.5	17,407	9,780	64.0	36.0	48.2	81.2	36.7	61.2
KS	74.4	67.5	13,263	8,997	59.6	40.4	50.6	72.8	35.1	48.3
KY	65.8	58.7	17,744	7,709	69.7	30.3	51.4	70.8	21.4	39.3
LA	56.2	59.2	24,714	4,373	85.0	15.0	42.8	69.1	45.3	34.5
ME	76.6	54.3	5,778	980	85.5	14.5	62.9	76.3	49.9	56.7
MD	73.3	54.7	17,774	8,981	66.4	33.6	57.7	82.5	13.3	60.6
MA	74.8	69.0	41,105	9,988	80.5	19.5	57.6	83.6	19.5	63.4
MI	68.7	58.7	39,762	15,708	71.7	28.3	49.3	77.6	18.2	56.1
MN	83.7	63.9	23,300	14,065	62.4	37.6	55.3	79.7	35.3	53.9
MS	56.0	63.4	8,642	10,908	44.2	55.8	57.9	74.2	26.9	45.7
MO	73.0	53.4	24,626	9,135	72.9	27.1	53.9	75.1	40.6	50.0
MT	78.1	54.4	4,902	778	86.3	13.7	NA	66.6	34.4	40.0
NE	83.8	59.3	10,325	3,117	76.8	23.2	52.4	75.6	41.0	46.4
NV	68.8	40.3	4,207	1,372	75.4	24.6	49.3	75.3	31.7	41.3
NH	73.9	59.0	7,727	931	89.2	10.8	66.7	80.2	43.5	64.2
NJ	86.1	63.6	22,109	13,085	62.8	37.2	59.8	81.1	15.3	59.7
NM	60.3	58.9	6,128	4,198	59.3	40.7	52.1	68.6	19.6	39.5
NY	58.6	63.9	84,414	23,739	78.1	21.9	62.6	78.3	28.3	54.9
NC	58.7	65.4	35,833	14,631	71.0	29.0	51.0	80.4	21.4	57.2
ND	84.1	69.4	5,232	2,098	71.4	28.6	NA	72.6	30.7	44.2
OH	69.6	56.1	55,209	14,329	79.4	20.6	55.5	75.2	21.1	50.9
OK	72.8	49.7	14,056	6,310	69.0	31.0	46.8	71.0	22.3	37.6
OR	67.4	51.1	11,126	5,573	66.6	33.4	39.9	78.9	23.1	51.7
PA	74.9	61.5	71,972	19,204	78.9	21.1	60.8	82.2	45.9	62.3
RI	69.5	65.9	10,076	1,747	85.2	14.8	NA	80.9	11.0	65.4
SC	51.0	66.3	16,823	8,626	66.1	33.9	52.5	77.4	17.2	53.0
SD	74.2	64.0	5,192	964	84.3	15.7	NA	65.1	63.8	43.5
TN	54.8	62.2	22,909	10,336	68.9	31.1	54.3	72.8	23.8	46.8
TX	61.9	52.5	64,582	47,832	57.5	42.5	40.8	74.0	15.8	46.4
UT	83.9	38.1	13,429	3,368	79.9	20.1	39.6	72.8	38.8	52.3
VT	78.7	45.3	5,100	21	99.6	0.4	NA	77.3	39.2	60.0
VA	73.9	53.1	32,774	7,556	81.3	18.7	54.8	81.8	21.9	58.7
WA	70.8	44.6	16,033	9,303	63.3	36.7	48.6	83.1	30.0	60.4
WV	74.8	52.4	11,476	1,035	91.7	8.3	51.8	71.8	42.4	38.5
WI	78.0	57.2	28,865	8,513	77.2	22.8	49.6	80.5	34.5	54.5
WY	75.0	52.2	1,274	2,145	37.3	62.7	55.2	76.0	43.6	52.1
US	67.1	56.7	1,135,919	494,425	69.7	30.3	54.1	74.1	30.0	53.0