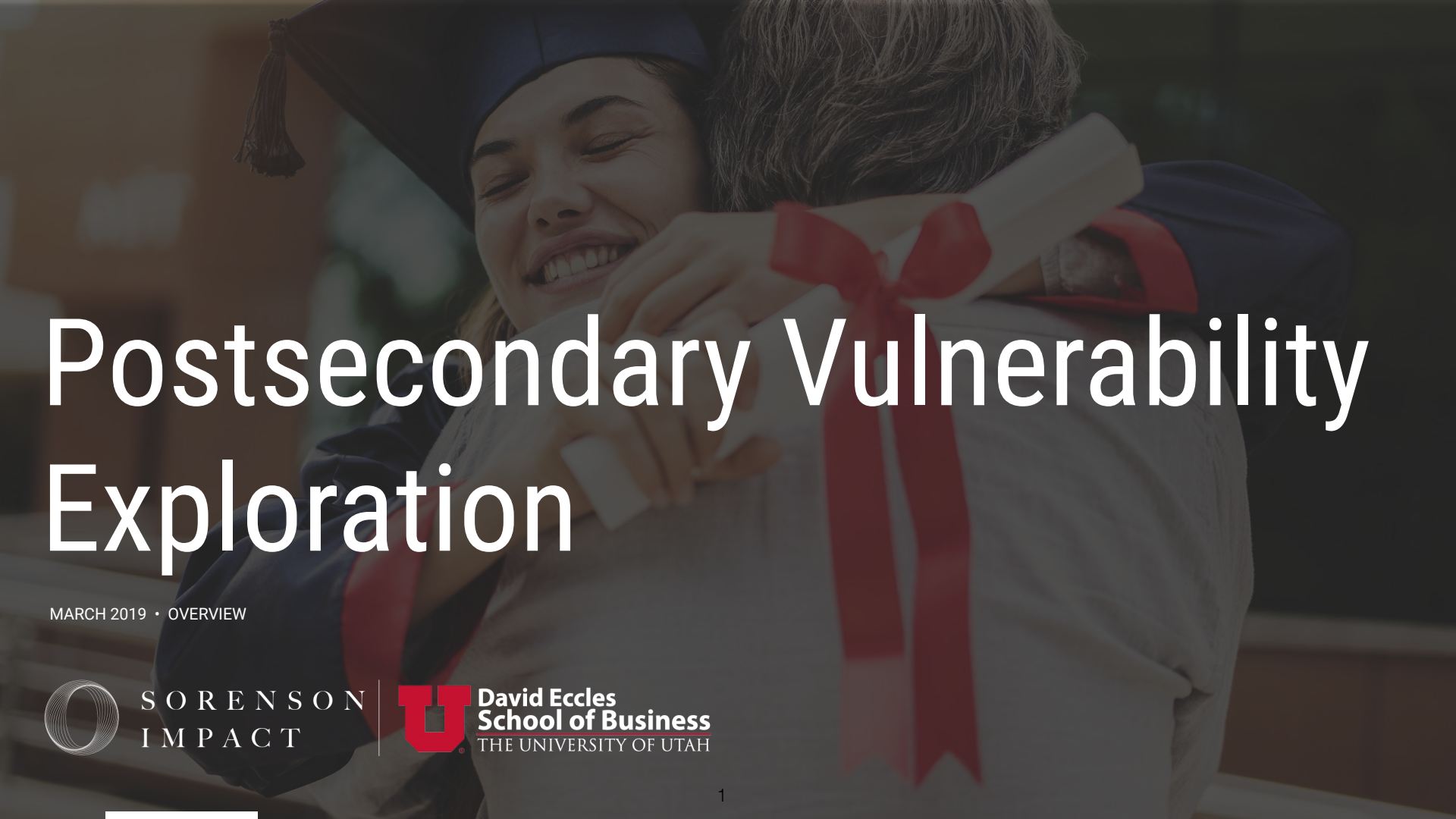


Postsecondary Vulnerability Exploration

MARCH 2019 • OVERVIEW

SORENSON IMPACT

David Eccles School of Business
THE UNIVERSITY OF UTAH

EXECUTIVE SUMMARY

Why is this a draft??

Everything in this document is based on modeling and data that we conducted to address questions that are difficult, if not impossible, to answer: what is the future of higher education in the United States? Who and what will be affected by projected demand changes? When and where? We begin with Nathan Grawe's demographic and demand projections, but quickly move to more speculative modeling and scenario simulation. In particular, data about individual institutions have not been verified and confirmed accurate. We make no guarantees as to the usefulness or accuracy of data about individual institutions.

The thrust of this work is not to projet future scenarios for individual HEIs, but rather to model how complex systems at the state level may change in the face of demand shortages. This is highly speculative, as it involves creating stochastic scenarios of how institutions may react to change, which itself is not certain. As George Box famously quipped, "all models are wrong, but some are useful." We hope this is useful in terms of imagining high-level macro trends that *may* come about in different scenarios. Ultimately, we anticipate and hope that wise policies and actions at all levels of the post-secondary system will obviate some of the potential problems and scenarios we describe below.

Project Overview

Towards a definition of viability

American higher education is projected to experience rapid demographic shifts that will have cascading effects on the enrollment and economics of a large portion of institutions. We were asked by the Bill and Melinda Gates Foundation to help explore and quantify these trends, particularly as they impact low-income, first-generation, and students of color. Our aim for this project was to use existing data and expert advice to make a rational definition of institutional viability, segmenting institutions based on how exposed they are to demographic changes, as well as how sensitive and adaptable they are in the face of difficulty. Ultimately, we were asked to quantify the potential impact of these trends on student equity, which would inform the Foundation's ongoing work to ameliorate postsecondary education.

We have completed working data-based definitions of exposure, sensitivity, adaptive capacity, and impact. We have also created a scenario simulation that takes inputs from these models and creates outputs that can be quantified in terms of their impact over time. To prepare for these steps, we have collaborated with experts to better understand the financial structure of higher-ed institutions; collected, cleaned, and merged dozens of datasets; and written thousands of lines of code to make our work replicable. We have tested the various models to ensure they are logically consistent, and expanded the simulation to incorporate three "what if" scenarios.

Process

Starting with a robust problem definition, we sought data that would allow us both to forecast trends in higher education, and begin to quantify the who, what, where, and why of their impacts. Drawing inspiration from the literature on climate change, we worked closely with the Foundation to categorize our data using three fundamental concepts:

+ Exposure—how likely an area / institution is to be affected by demand changes
+ Sensitivity—how robust each institution is to these changes
+ Adaptive Capacity—how much the institution can improve

We used these data as inputs in a simulation, which allowed us to estimate the future impacts on disadvantaged students.

Student Success Will be Compromised

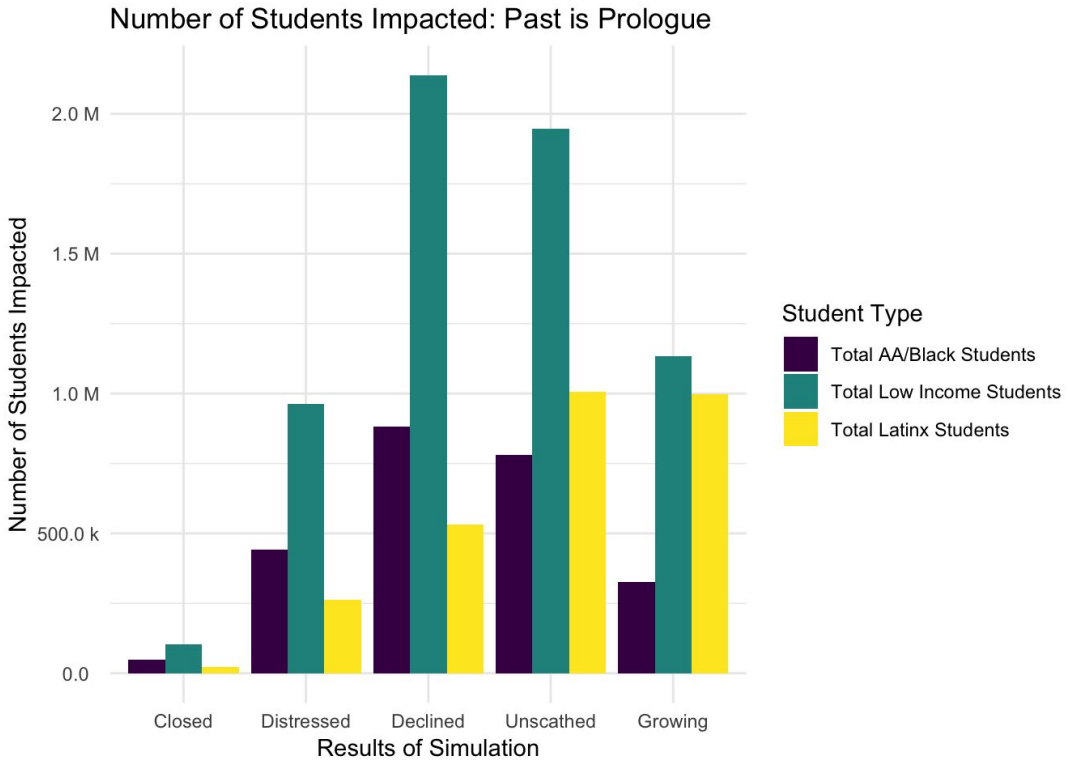
Rather than only thinking about whether an institution will close, we see institutional success and failure as a continuum. The continuum draws out when an institution is declining so much that they end up compromising on student outcomes. We think that compromise occurs when institutions lose 20% of their students over a ten year period. We focus on five institutional Risk Categories. Our Distressed category does not indicate when the lights go off, but rather when we think student success becomes compromised.

CLOSED	An institution closes
DISTRESSED	An institution is forecasted to lose more than 20% of its students
DECLINED	An institution is forecasted to lose between 3% and 20% of its students
UNSCATHED	An institution is forecasted to lose less than 3% of students and not grow by more than 3% of students
GROWING	An institution is forecasted to grow by more than 3% of its students

Notes on our Five Institutional Risk Categories

+ Measuring Growth and/or Decline over a ten year period
+ If a student is in a distressed or declining institution, how is their education impacted?
+ It is not very likely that a school closes, but it is much more likely that a school becomes distressed or declines between 2016 and 2029.

WHO? AA/Black and Low Income



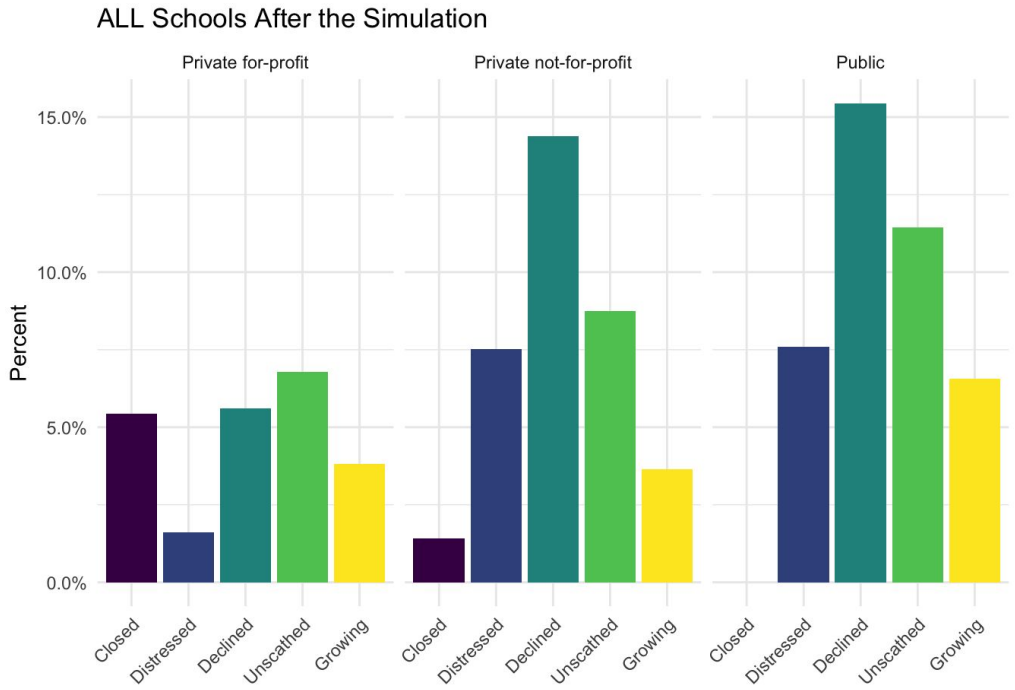
Disproportionate Impact

African American and black students, as well as low income students, will likely be disproportionately affected by changes in demand for higher education. This is partly a function of geography and partly the sensitivity and quality of institutions serving these two demographics. The Higher Education Demand Index (HEDI) projects black and African Americans to drop from 10% of first time students to 9%, exacerbating an already strained situation.

By contrast, the Latinx student population is growing. This suggests that as a group, they will fare better than other demographics; but those in the south, east, and midwest will still be affected by distressed institutions.

If anything, our simulation results are conservative. If HEDI is correct, the drop in black students could be even larger.

WHAT? Institutions in Decline



It's Not Just Closures

Private for-profit institutions have historically closed at higher rates. They also have more precarious finances, with an average sensitivity index of .9(!). But this is offset by size and scale:

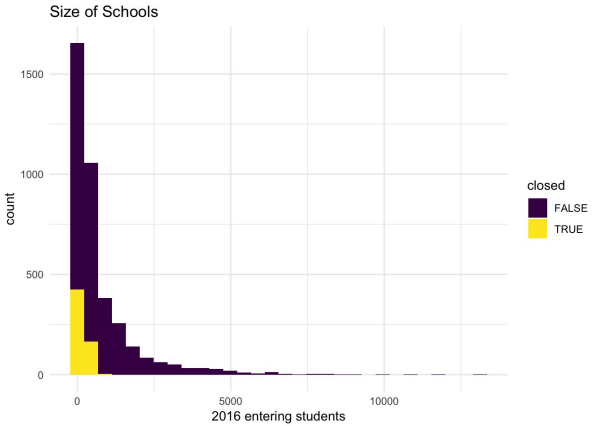
+ The median entering class (first time students) of closed institutions is 58. The mean is about 100.

+ Although closures occur to between 5% and 15% of institutions in our simulation, the percent of students affected is much smaller.

This suggests that the story is less about closures, and more about decline and distress (loss of more than 20%). Publics are not immune to demand changes. The 7% or so of publics that end up as distressed will impact a much larger number of students than closures.

WHAT? % of Colleges is a Bad Metric

Will Half Of All Colleges Really Close In The Next Decade?



It's Not Just Closures (cont.)

Our modeling suggests that 50% is too high. More importantly, however, our modeling suggests that **"percent of colleges" is the wrong metric.**

Attendance at higher education institutions is almost Pareto distributed: the top 20% of institutions account for nearly 70% of the entering first time students. These institutions are much less likely to close. The focus should, therefore, be on the students affected.

WHAT? Finances Don't Tell the Whole Story

We realized early on that the metrics included in the Composite Financial Index (CFI) could only be a part of our Financial Index, and not all of it. The CFI is not comparable across sectors and misses a few key metrics of financial health. As a result, we created our own Financial Index that is 33% of our Sensitivity Index.

Composite Financial Index (CFI)

Net Operating Revenues Ratio *Operating Results*	10%
Primary Reserve Ratio *Resource Sufficiency and Flexibility*	35%
Return on Net Assets Ratio *Asset Performance*	20%
Viability Ratio *Debt Management*	35%

CFI Does Not Include

+ Liquidity and Cash-on-Hand
+ Credit Agency Ratings
+ Expenditures by Functional Category
+ Private For-Profit Universities

WHAT? New Financial Index

SORENSON FINANCIAL INDEX (SFI)

I) Expenses Exceed Revenues	**35%**	**III) Tuition**	**20%**
Core Expense Ratio (trend line) *Expenses to Revenues Less Hospital Revenue*	30%	Tuition Dependency	60%
Return on Net Assets *Asset Performance*	20%	Tuition Discount *% of the sticker price*	40%
Net Operating Revenue Ratio *Operating Results*	50%		
II) Cost Structure (Balance Sheet Metrics)	**25%**	**IV) Strategic Debt**	**20%**
Current Ratio *Liquidity*	20%	Viability Ratio (trend line) *Debt Management*	
Equity Ratio *Leverage*	40%		
Primary Reserve Ratio *Resource Sufficiency and Flexibility*	40%		

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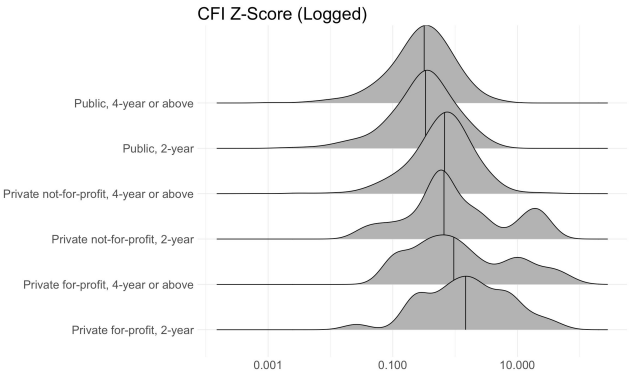
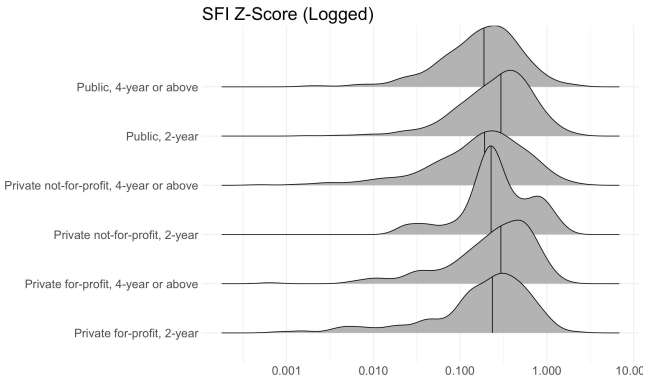
Sorenson Financial Index

+ 4 Components
    + Expenses Exceed Revenues
    + Cost Structure
    + Tuition
    + Strategic Debt
+ Adds metrics of liquidity, leverage, tuition dependency and discount, and expenses to revenues excluding hospital revenues.
+ 33% of Sensitivity Index

WHAT? Comparing CFI to SFI

We wanted to see how the SFI ratio did against the CFI. In order to create a meaningful comparison, we took the z-score of each metric and then logged the CFI and the SFI.





CFI vs SFI

+ In the CFI, Private for-profit institutions' results are unreliable, as the Private for-profits do not segment their balance sheet in IPEDS. The SFI corrects for this by including the equity ratio.

+ Adding a liquidity metric lowers Public and Private not-for profits' overall score, indicating they may have less liquidity (cash on hand).

WHAT? A Tale of Two Sensitivities

Syracuse University and Florida National University have similar scores on the Sorenson Financial Index, but very different scores on the Sorenson Sensitivity Index. The Sensitivity Index takes into account student numbers, sector, and acceptance rate. This creates a more complete picture of how sensitive an institution is to market shocks.

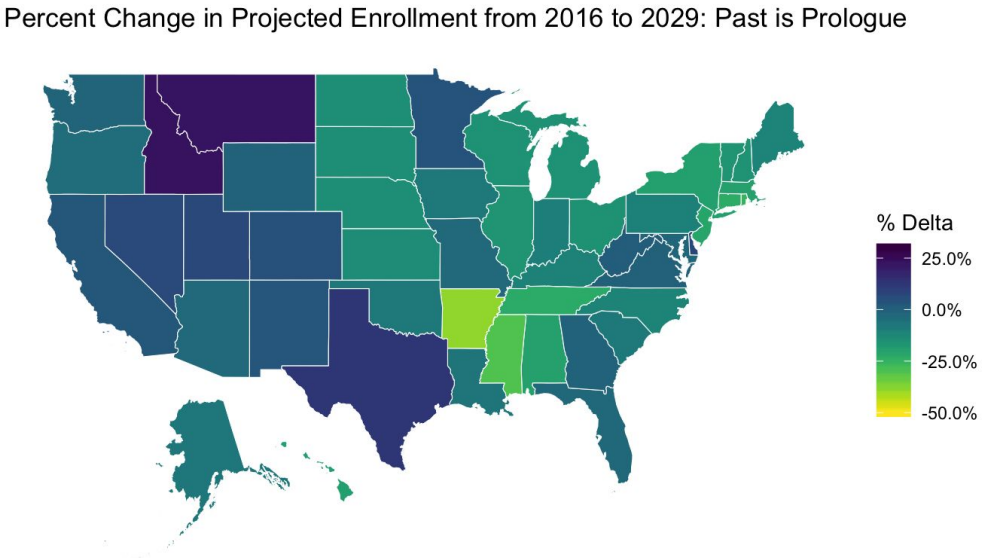
Syracuse	
First Time Students 2016	3,712
Rank	65
Acceptance Rate	52%
Sensitivity Index	**.03**
Sorenson Financial Index	**-0.05**
CFI	0.94
Sector: Private not-for-profit, 4-year or above	

Florida National	
First Time Students 2016	407
Rank	NA
Acceptance Rate	100%
Sensitivity Index	**.86**
Sorenson Financial Index	**-0.07**
CFI	NA
Sector: Private for-profit, 4-year or above	

Our Index

+ Two institutions can have the same Sorenson Financial Index scores but significantly different Sensitivity Index scores.
+ The Sensitivity Index takes into account the dynamic nature of the higher education system. It's not just about finances, but an interplay of size, acceptance rate, who an institution can go to for a financial bailout, and finally, their overall financial health.

WHERE? The South, East, & Midwest



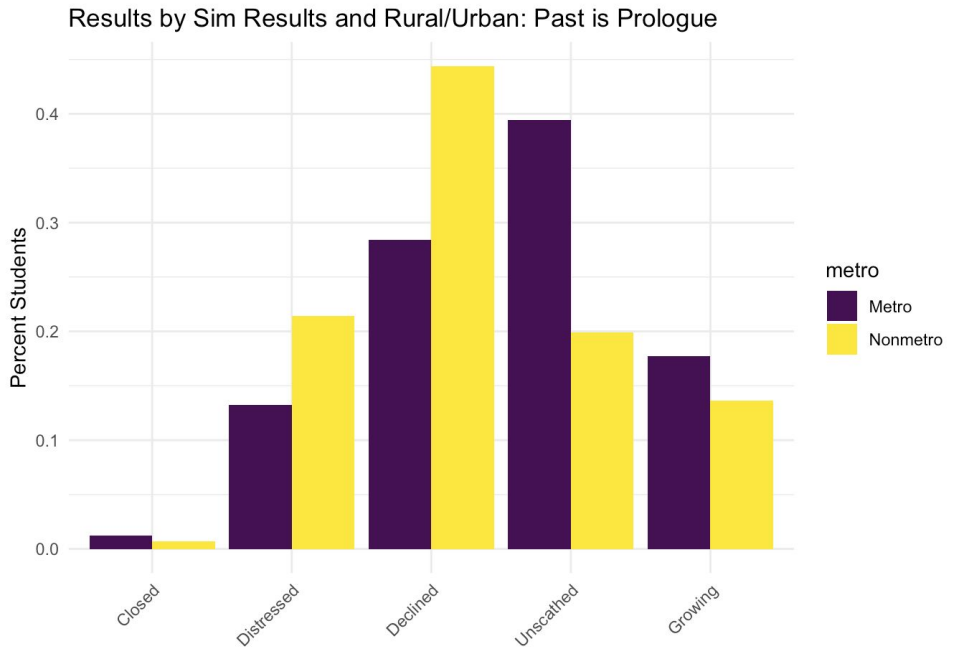
Geography

In Nathan Grawe's book *Demographics and the Demand for Higher Education,* he outlines an alarming trend—the demand for higher education will drop precipitously in the areas that have the largest number of institutions. In absolute terms, New York will be home to the largest drop in student numbers, and Texas will be home to the largest gains. In percentage terms, however, there are several states with destructive declines in our simulation:

+ Arkansas : -38%
+ Mississippi: -30%
+ Rhode Island: -25%
+ Connecticut: -22%

Massachusetts, a bastion of higher education, is projected to lose 20% of first-time students.

WHERE? Non-metro Geographies



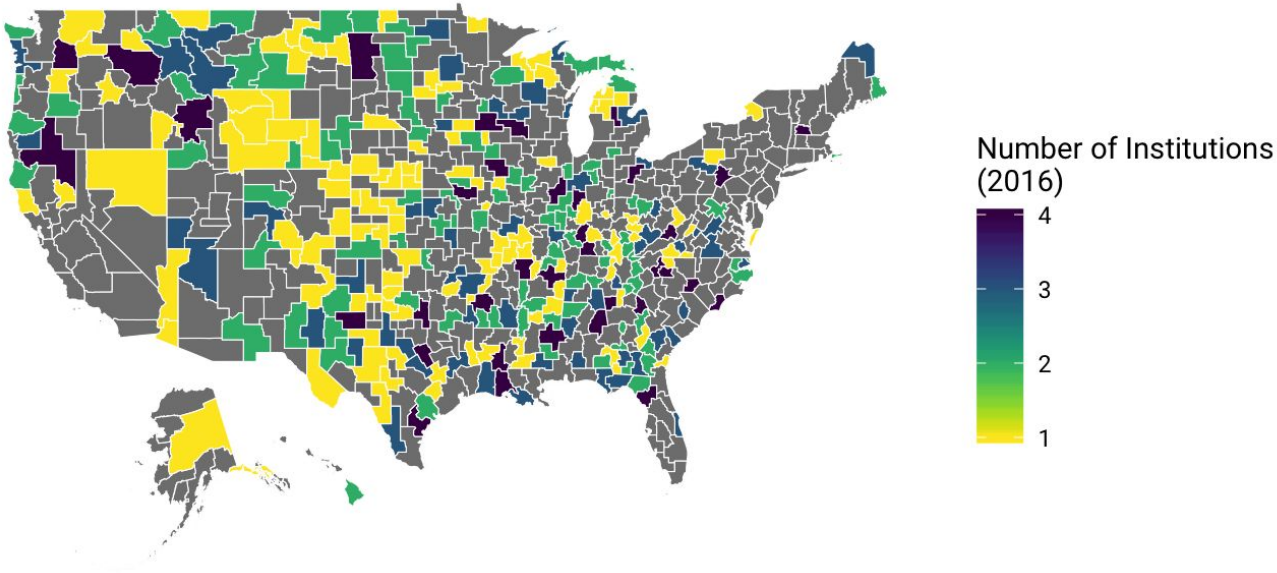
Metro vs Non Metro

The US Department of Agriculture has a Rural-Urban Continuum Code that classifies metro counties by the population size of their metro area, and non metro counties by the degree of urbanization and adjacency to a metro area or areas.

The percent of students at universities in non metro areas whose universities are forecasted to become Distressed or Declined is much higher than for those students who are at universities in metro areas.

WHERE? Education Deserts

Zones at Risk of Becoming Deserts Before Simulation



Students Living in Education Deserts

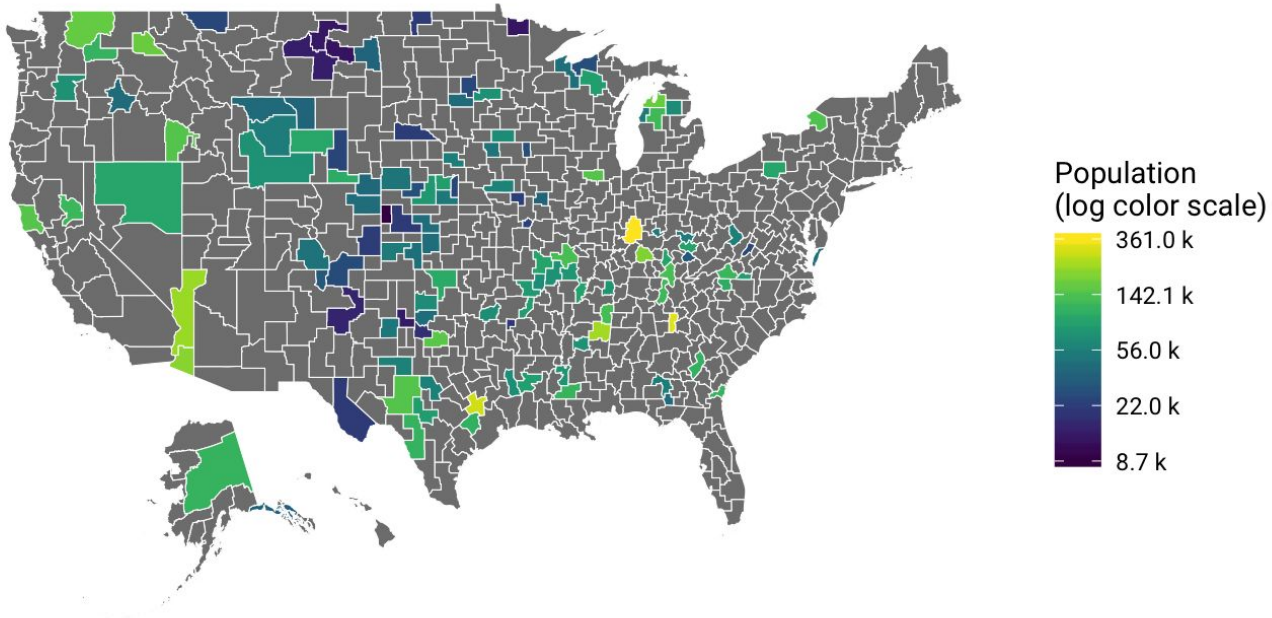
An education desert is defined as having 0 institutions within the boundaries of a commuting zone. There are currently an estimated 3 million students living in commuting zones that are at risk of becoming an education desert.

The table below shows the number of students living in commuting zones with just one to four schools.

Number of Schools	Number of Students
1	494,010
2	743,741
3	980,553
4	876,923
Total Students	3,095,226

WHERE? Education Deserts

Total Population (All Ages) in Desert-Prone Zones with One Institution



Total Population Living in Desert-Prone Zones

A desert-prone commuting zone is an area with very few institutions that could easily become an education desert. There are currently 9.6 million people living in zones with only one institution.

The table below shows the population (all ages) living in commuting zones with just one to four schools.

Number of Schools	Population
1	9,635,338
2 or less	21,667,252
3 or less	35,199,489
4 or less	45,139,252

WHY? Demography and Financial Pressures

Demographic Change

+ Declining enrollments/incoming pipeline (falling birth rates)
+ Changing face of students
+ Increasing number of minorities
+ Shifting patterns in geographic areas
+ Reduced student mobility

Decreasing Revenues and Increasing Costs

+ Decreasing state investment
+ Falling tuition revenues and tuition discounting
+ Smaller institutions taking on debt
+ Increasing student loan debt

Innovations and Disruptions

+ Online delivery model and competency-based learning
+ Changing job market/required skills
+ Ed Tech investments
+ Entities offering alternatives to traditional higher ed institutions

Institutional Supply

+ Increased competition
+ Education deserts
+ Financial disparity, particularly among private nonprofit institutions
+ Closures, mergers, acquisitions
+ Growth in "national scale" institutions

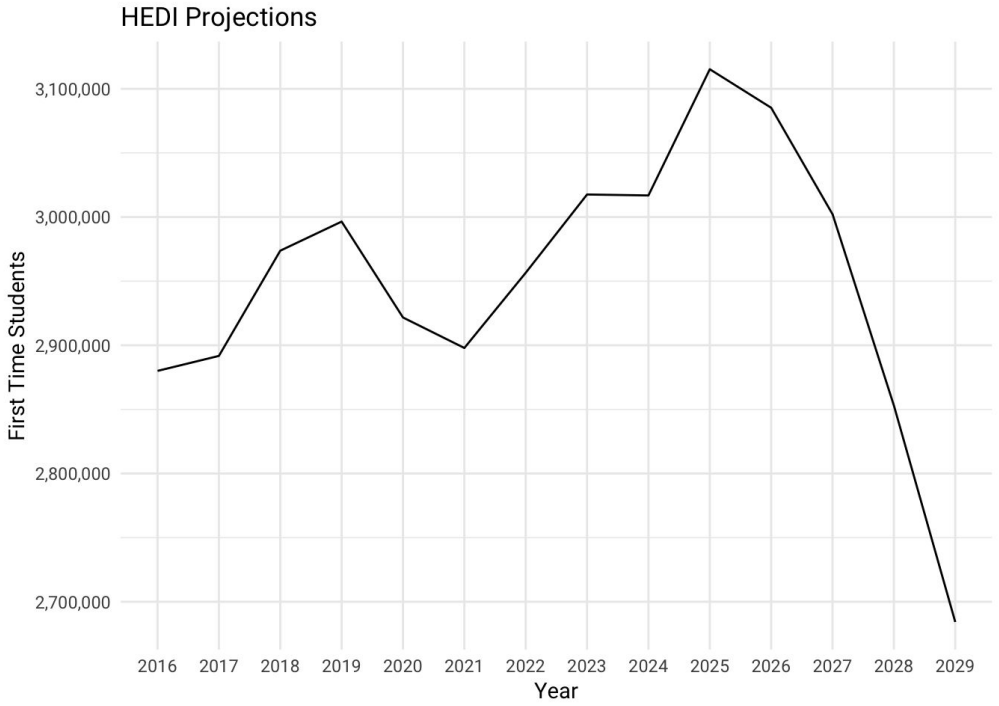
Access and Equity

+ "College knowledge"
+ Attainment gaps
+ Affordability and debt burden disproportionately affects some student groups
+ Education and digital deserts

Infrastructure

- Deferred maintenance on buildings during the recession
- Lazy rivers
- Regulatory changes

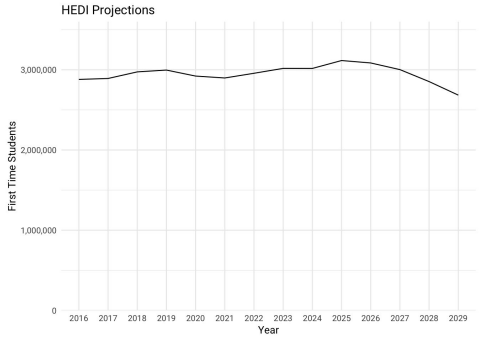
WHEN? 2025 On



*NOTE: y-axis not set to 0

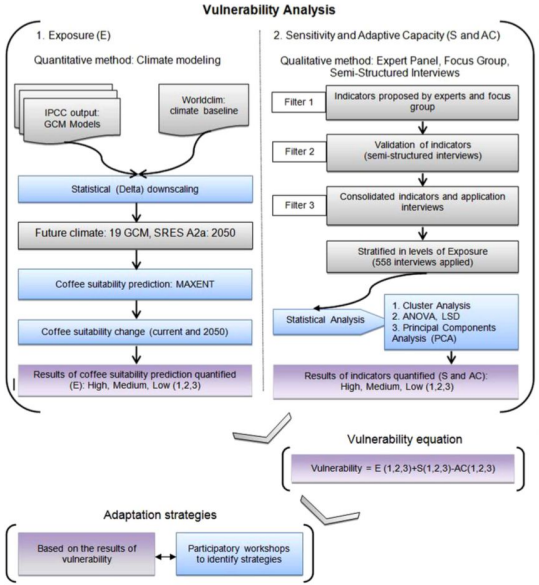
Student Decline

Although this projection varies by state, in general the US is set to experience some relative gains in student enrollment between today and 2026. This increase may exacerbate what comes next by creating a false sense of security. In overall percentage terms, the declines are not huge, as can be seen below. But given their geographic specificity, the years between 2026 and 2029 will be felt as a shock.



Model Inspiration

Coffee farmers' vulnerability to climate change



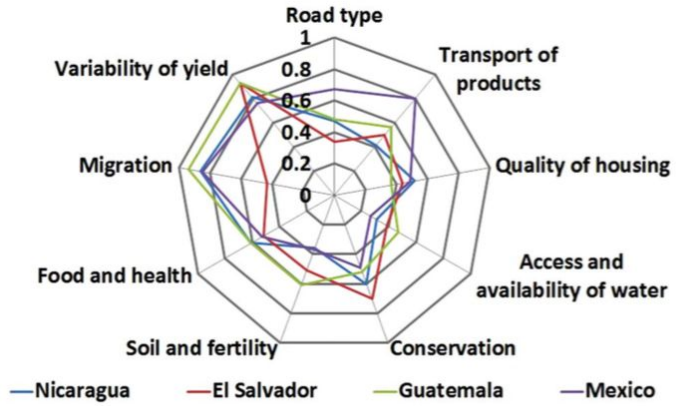


Figure 3. Sensitivity indicators in the livelihoods of small coffee producers to climate change in four countries of Mesoamerica (a high value equals high sensitivity).

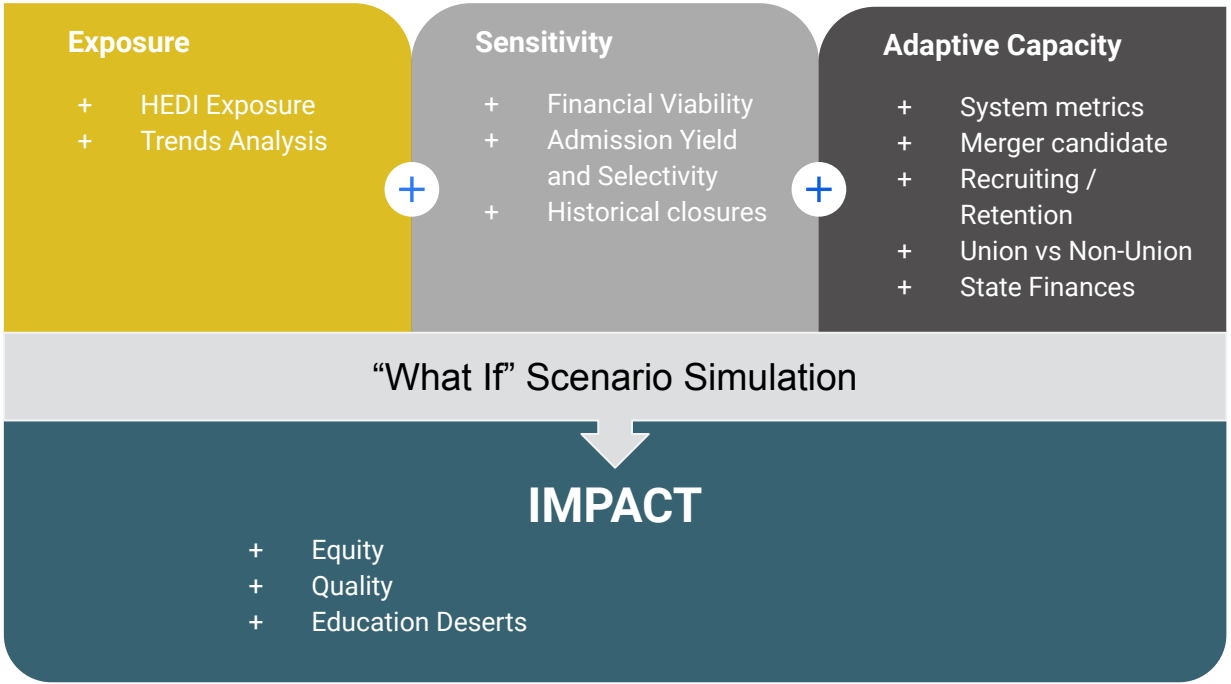
The Study

"An Integrated Framework for Assessing Vulnerability to Climate Change and Developing Adaptation Strategies for Coffee Growing Families in Mesoamerica."

M Baca, P Läderach, J Haggar, G Schroth, O Ovalle
PLoS One 9 (2), e88463.

"Following the Intergovernmental Panel on Climate Change (IPCC) concepts, vulnerability was defined as the combination of exposure, sensitivity and adaptive capacity."

THE POSTSECONDARY VULNERABILITY MODEL



Simulation

Simulation runs State by State until the 2016 entering class equals the 2029 entering class as predicted by HEDI

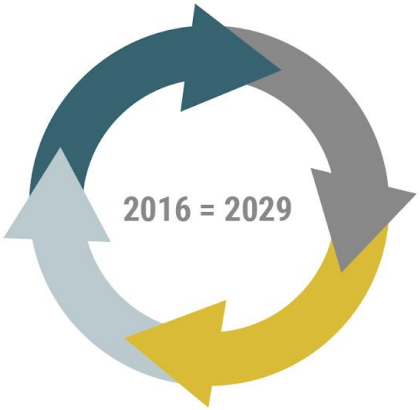
Each state & sector's entering class is predicted to either grow or decline based on HEDI. What the stimulation does to the state depends on if they are predicted to grow or decline.

GROW
2016 < 2029

Each iteration of the simulation is when the simulation selects an institution & decides to **grow** or close the institution.

Selection of the institution is determined **Randomly.**

- If the school is above a high sensitivity threshold, it is closed.
- Otherwise, it is grown by 3%



DECLINE
2016 < 2029

Each iteration of the simulation is when the simulation selects an institution & decides to **decline** or close the institution.

Selection of the institution is determined using the **Sensitivity Index. (high senstivity schools)**

- If the school is above a high sensitivity threshold, it is closed.
- If dice roll = 0, the school declines by 3%
- School can be closed based on probability of closure using a logit model that takes into account sector & size.

Simulation

Simulation runs State by State until the 2016 entering class equals the 2029 entering class as predicted by HEDI

Each state & sector's entering class is predicted to either grow or decline based on HEDI. What the stimulation does to the state depends on if they are predicted to grow or decline.

EXPLANATION

A simple model would shrink or grow all institutions based entirely on HEDI. Our hypothesis is that HEDI provides good state & sector level projectoins, but it's effects will be felt heterogeneously with more sensitive instituions bearing more of the burden of damand changes.

Simulation

DECLINE
2016 < 2029

Each iteration of the simulation is when the simulation selects an institution & decides to **decline** or close the institution.

Selection of the institution is determined using the **Sensitivity Index. (high senstivity schools)**

EXPLANATION

The Sensitivity Index was designed to encapsulate many of the factors (financial, historical, & demographic) that would make an institution more or less susceptible to demand changes. Our hypothesis is that more sensitive schools will shrink and close more frequently.

Simulation

GROW
2016 < 2029

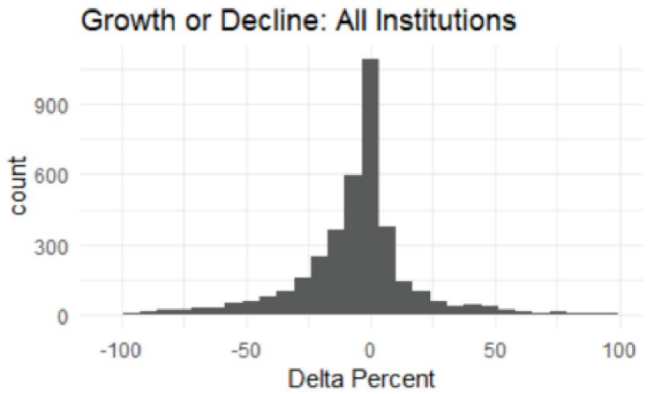
Each iteration of the simulation is when the simulation selects an institution & decides to **grow** or close the institution.

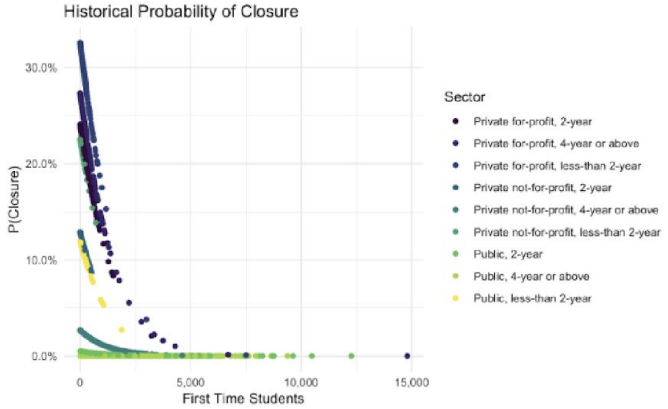
Selection of the institution is determined **Randomly.**

For places with growing demand, we did not have a strong hypothesis about what factors would drive growth at an instututional level.

EXPLANATION

Simulation





EXPLANATION

The closing iteration, decline rate, growth rate & other hyperparameters were set to create a distribution of change that is similar to historical trends. The logit model also ensures that the simulation is grounded in closure trends from the last decade.

If dice roll = 0, the school declines by 3%

School can be closed based on probability of closure using a logit model that takes into account sector & size.

Two Simulation Models

Simulation allows us to explore a variety of possibilities. We have developed two simulations that could be possible reflections of the future:

1. WHAT'S PAST IS PROLOGUE

This Model takes the past and projects it into the future while still reacting to the projected demographic shifts of HEDI.

2. IN MY MIND'S EYE

This Model deviates from *What is Past is Prologue* because we think it may be a faulty assumption to believe that past conditions will persist into the future. There is abundant evidence that Private not-for profit and Public institutions have already been stressed to capacity and have exhausted their adaptive capacity. We also think Grawe's HEDI prediction is conservative. HEDI only takes into account demographic changes. It does not predict declining enrollment as a result of online education, "new" collar jobs, or a declining appetite for student loans. As a result, *In My Mind's Eye* assumes the following:

A. More Private Non Profits and Publics will close in the future, increasing the probability of closure for both 2-year and 4-year institutions.

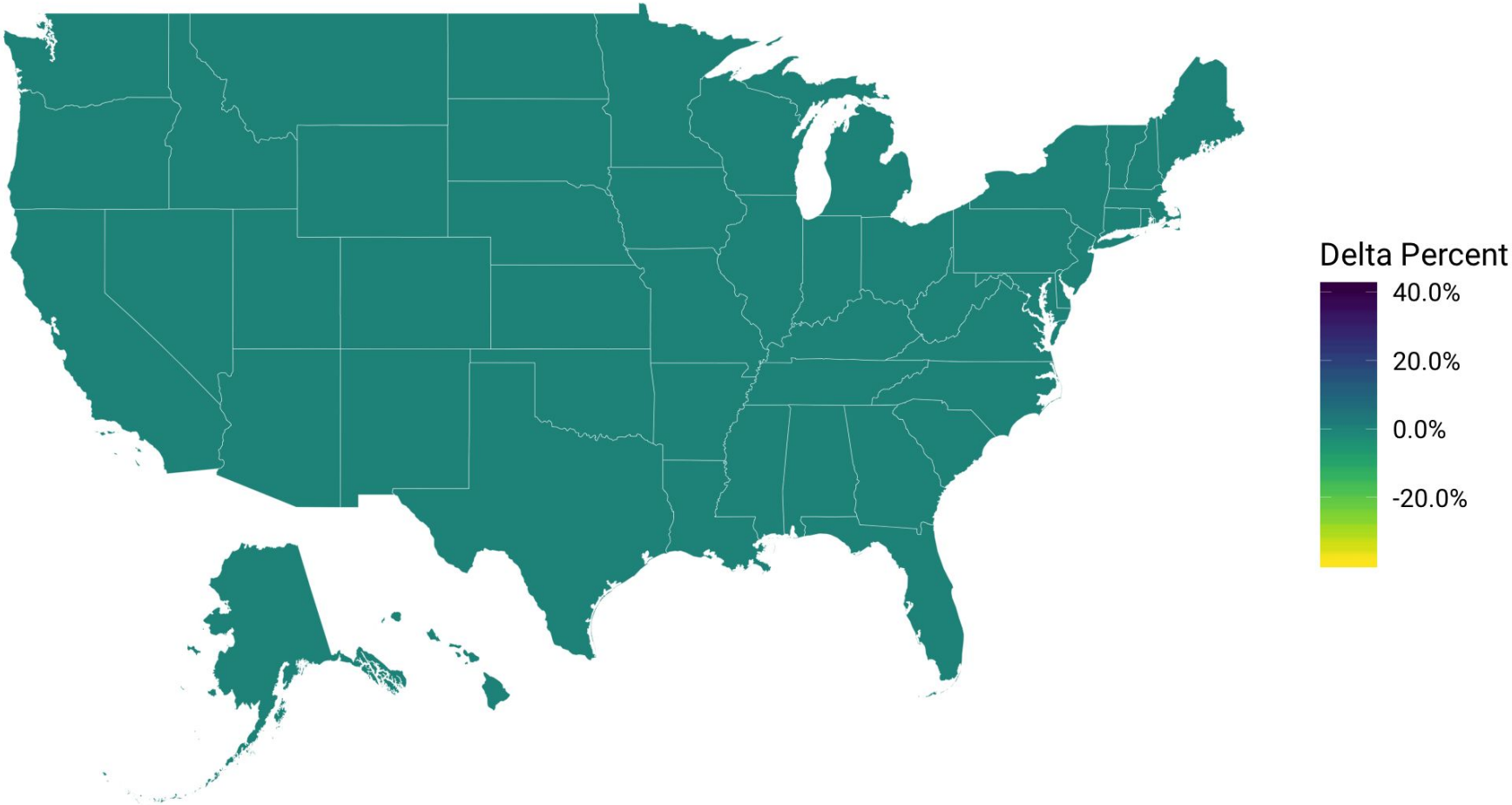
B. The system will lose an additional 10% of students beyond what HEDI predicts.

Several Sources of Uncertainty

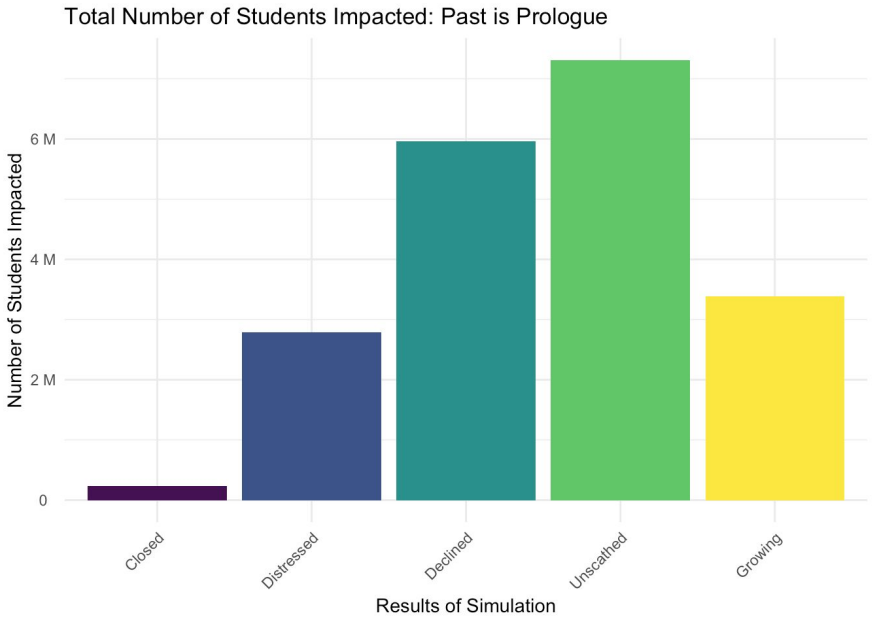
The simulation is meant to test different values in place of uncertain parameters to try and answer questions like these:

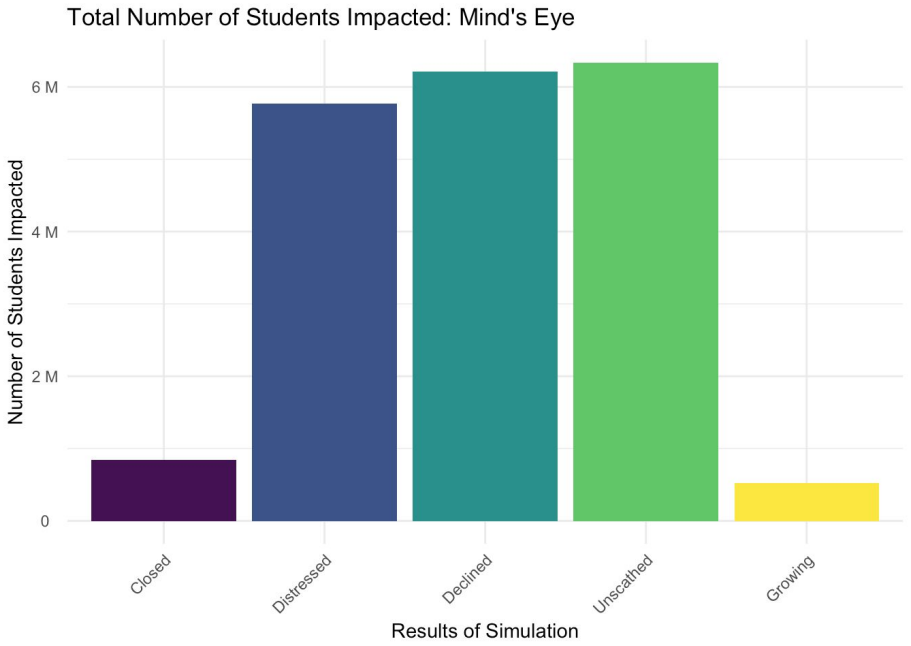
+ How many students will there be? (HEDI)
+ Which institutions will be affected by demand changes?
+ What portion of decline is attributable to closures?
+ What size and type of institutions will close?
+ **What type of students will be affected by institutional distress / closures?**

HEDI Projections as Percent Change from 2016: 2016



Past is Prologue has fewer students in Closed, Distressed, and Declined, and more in Growing than *In My Mind's Eye*





Commuting Zones

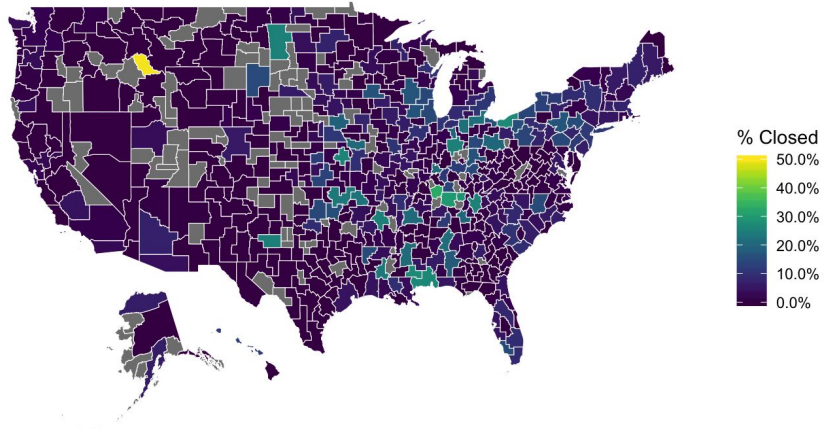
About Commuting Zones

The ERS Commuting Zones (CZs) were first developed in the 1980s as ways to better delineate local economies. County boundaries are not always adequate confines for a local economy and often reflect political boundaries rather than an area's local economy. CZs are geographic units of analysis intended to more closely reflect the local economy where people live and work.

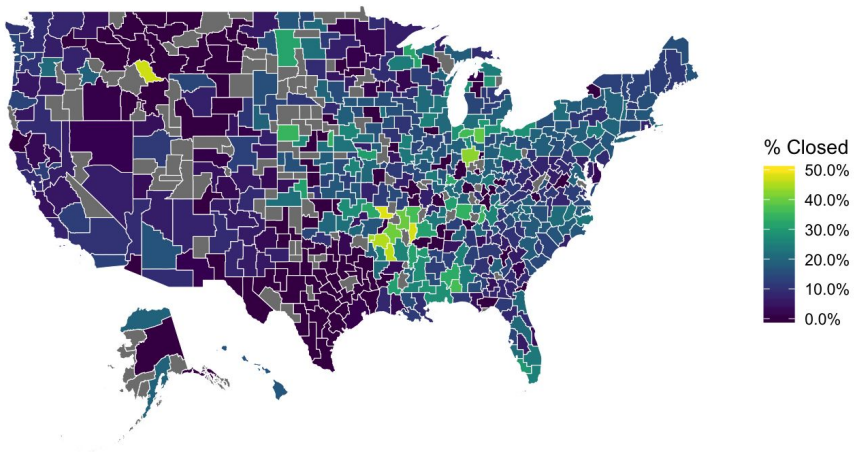
We show both State and Commuting Zone geographies. States are easy to visualize at a glance, while Commuting Zones give a better picture of potential created deserts.

In My Mind's Eye closes more schools than *Past is Prologue*

Percent Closed: Past is Prologue

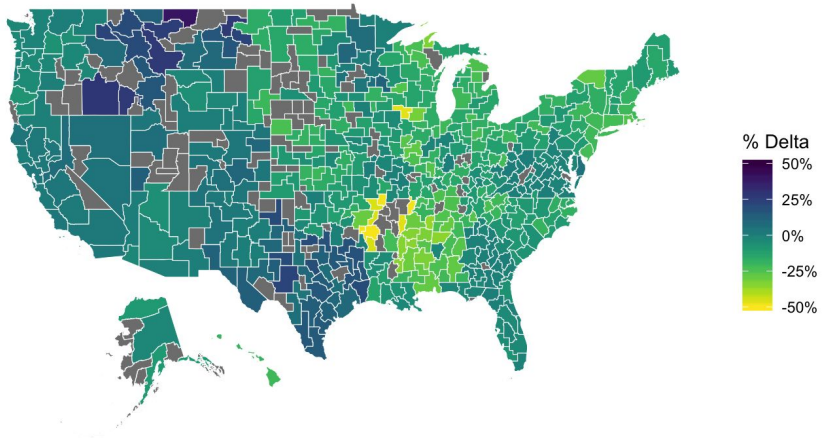


Percent Closed: Mind's Eye

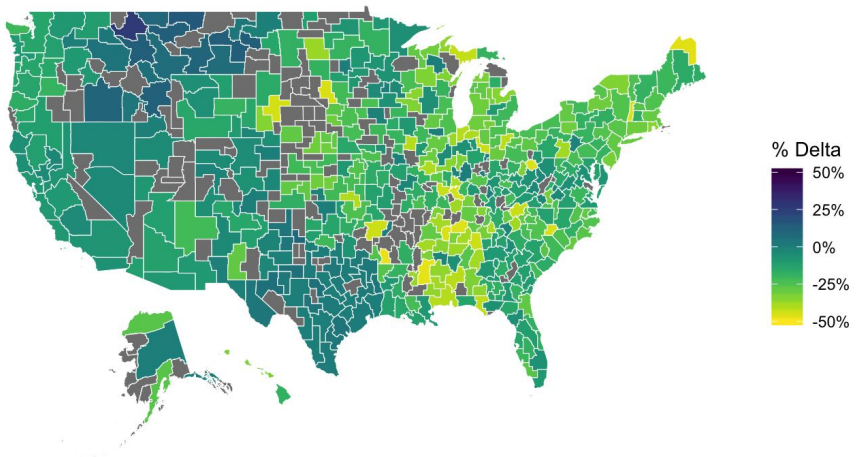


In My Mind's Eye loses more students than *Past is Prologue*

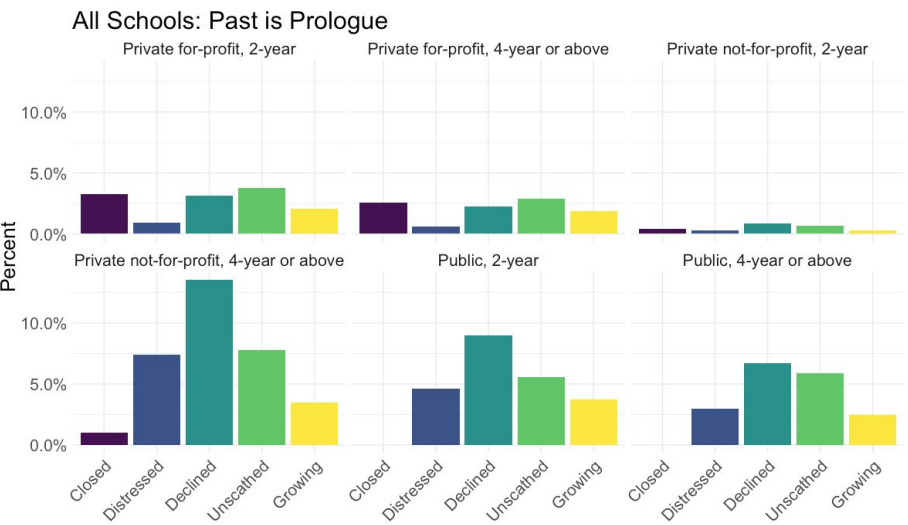
Percent Change in Projected Enrollment from 2016 to 2029: Past is Prologue

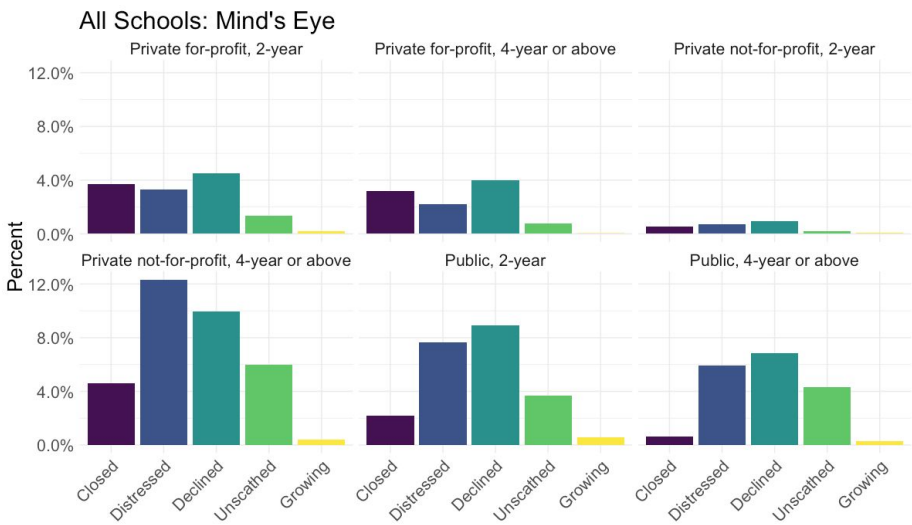


Percent Change in Projected Enrollment from 2016 to 2029: Mind's Eye



In My Mind's Eye closes more private not-for-profit and public schools than *Past is Prologue*





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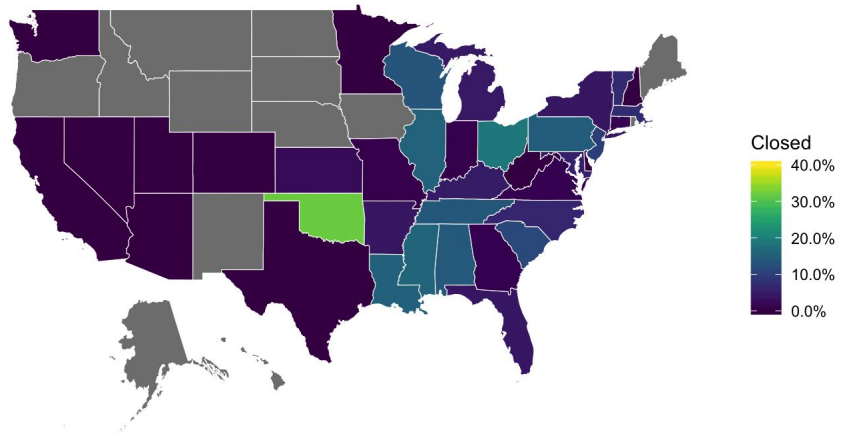
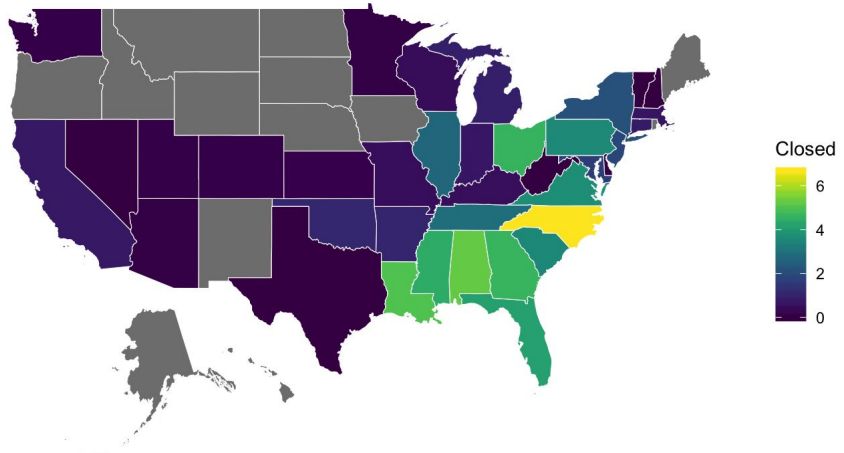
In My Mind's Eye closes more high and moderate quality high Black/African American serving schools than *What's Past is Prologue*

Percent of High/Moderate Quality, High Black Serving Schools Closed: Past is Prologue

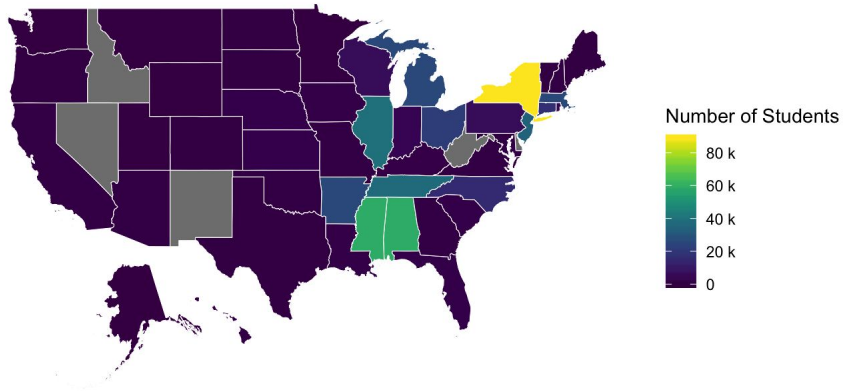


High/Moderate Quality, High Black Serving Schools Closed: Mind's Eye

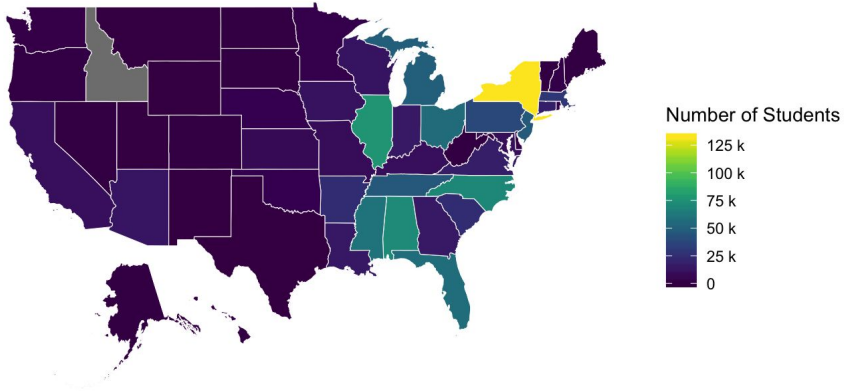


In My Mind's Eye Has More Black/African American Students in Closed and Distressed Institutions than *What's Past is Prologue*

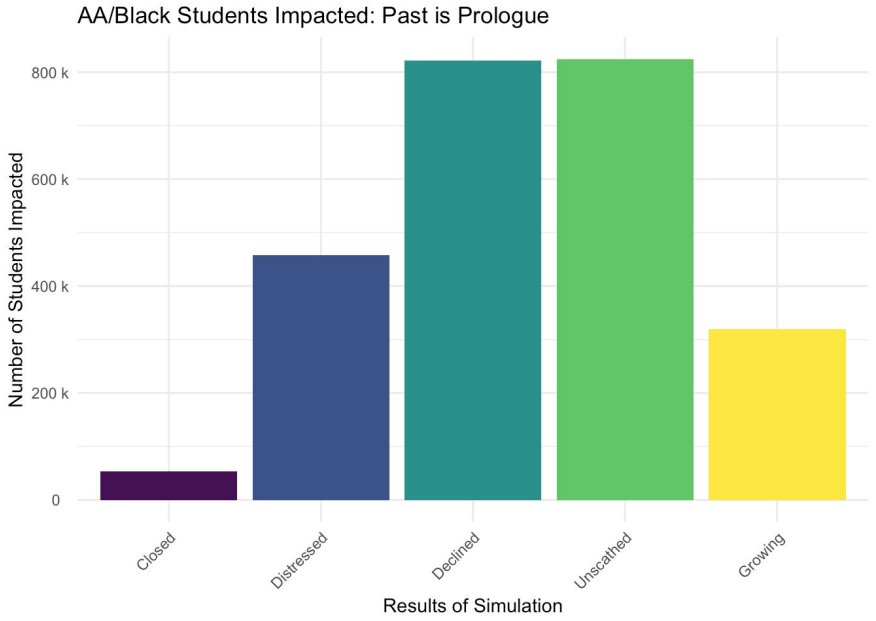
AA/Black Students in Closed or Distressed Institutions: Past is Prologue

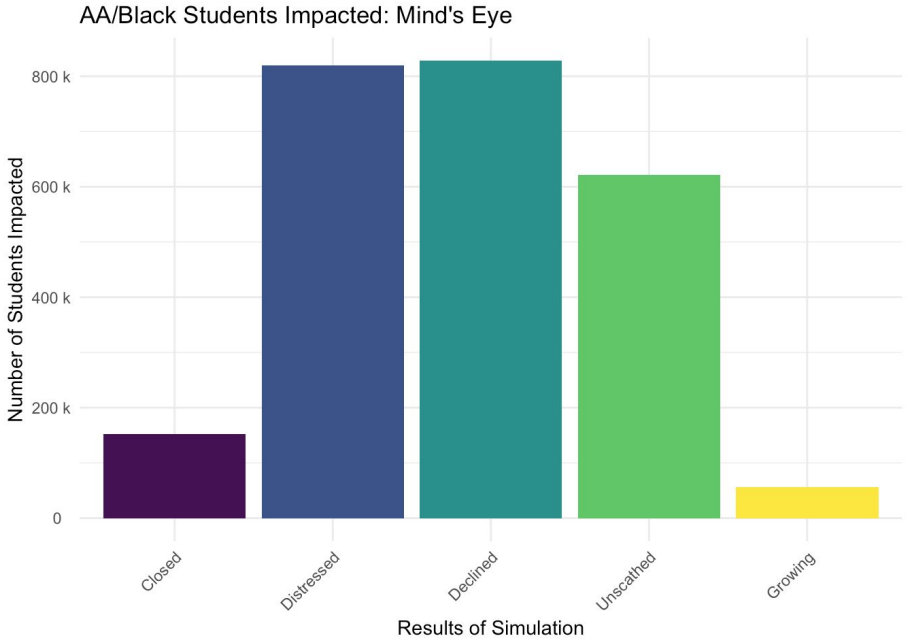


AA/Black Students in Closed or Distressed Institutions: Mind's Eye

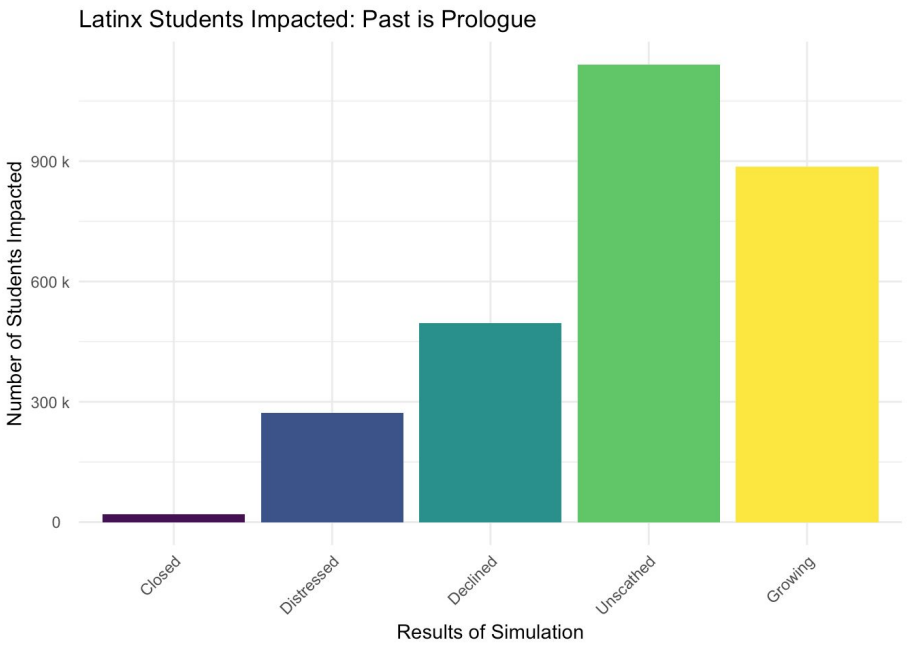


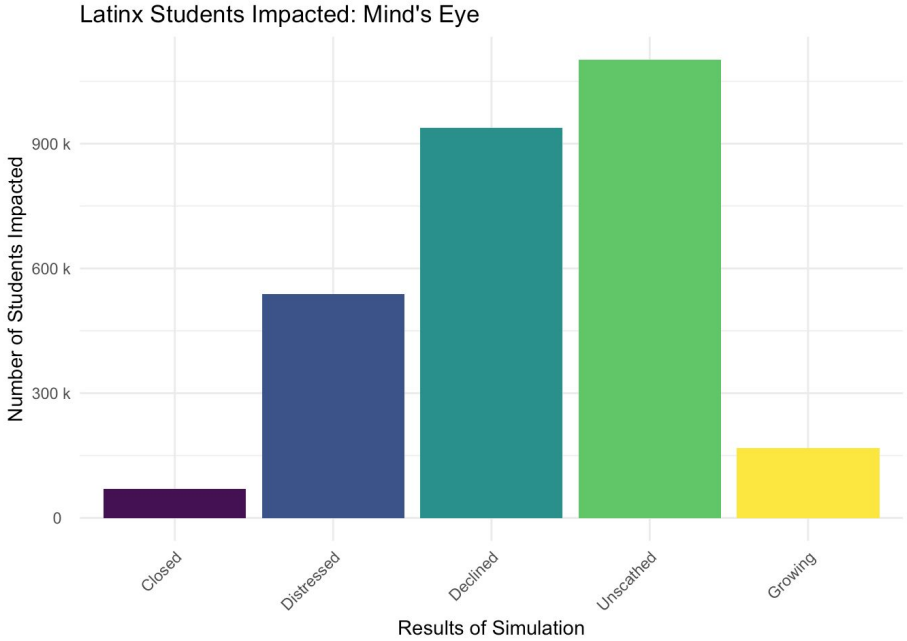
In My Mind's Eye has more Black/African American students in Closed, Distressed, and Declined than *What's Past is Prologue*



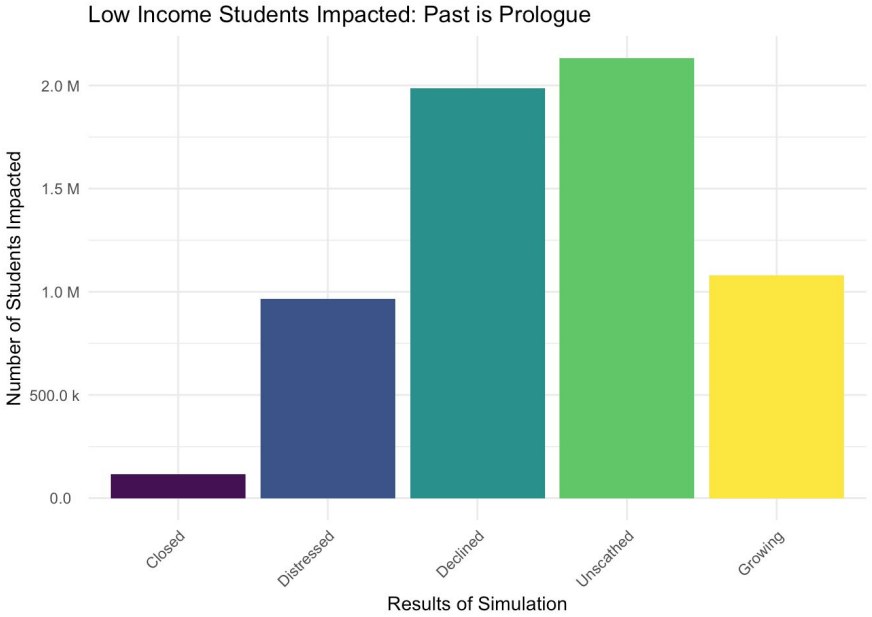


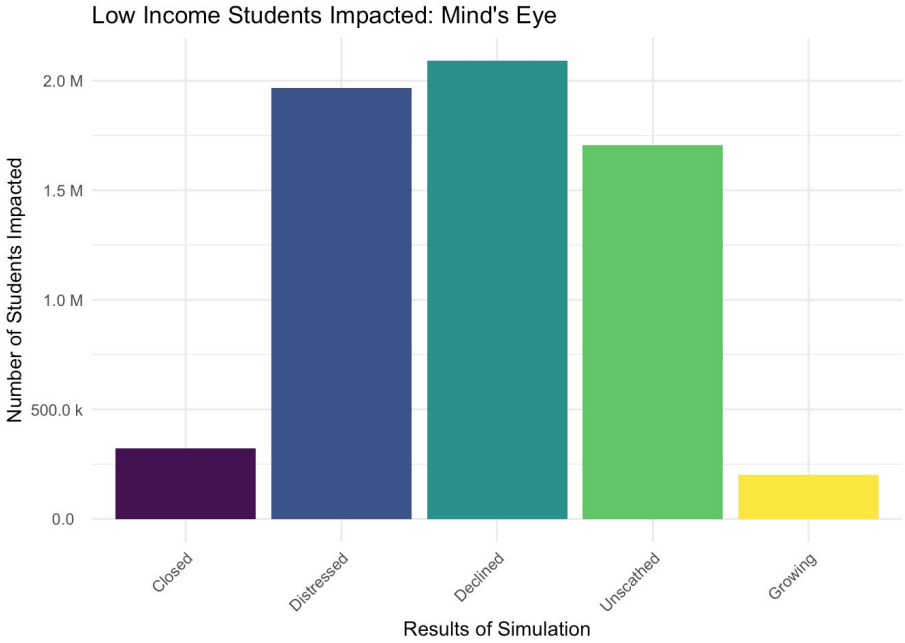
In My Mind's Eye has more Latinx Students in Closed, Distressed, and Declined than *Past is Prologue*



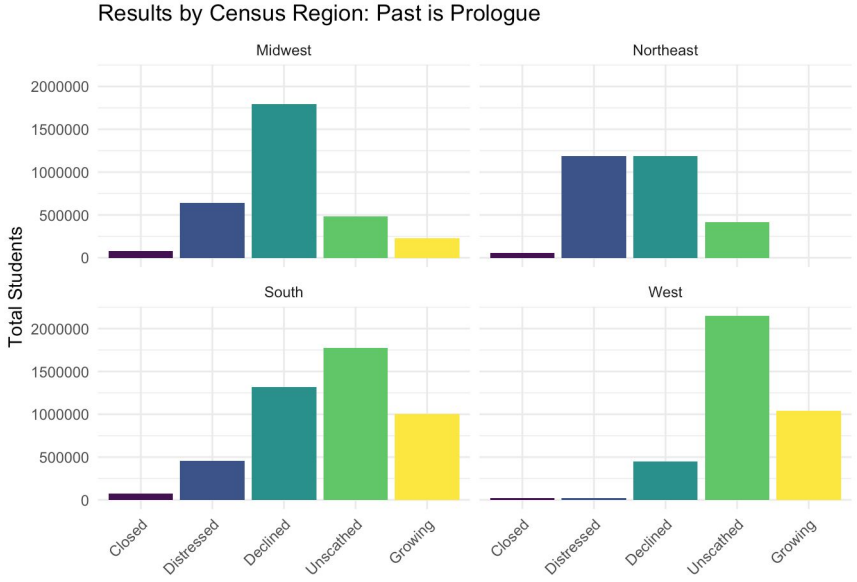


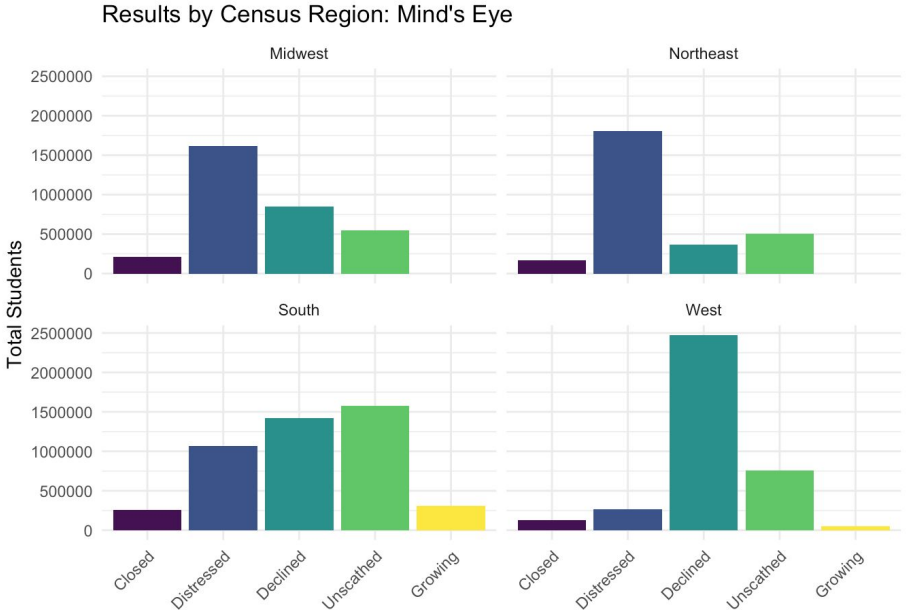
In My Mind's Eye has more low income students in Closed, Distressed, and Declined than *Past is Prologue*





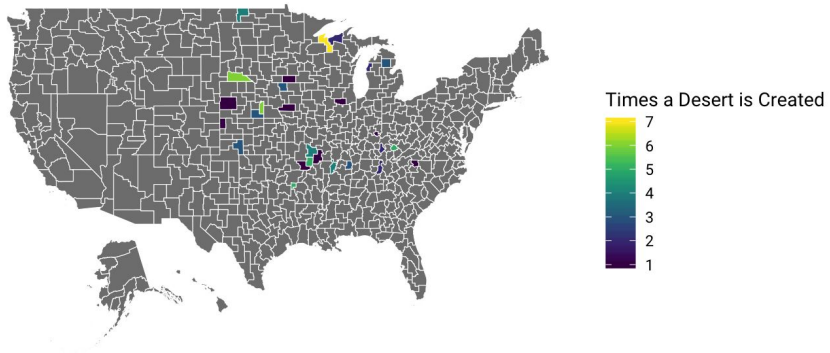
More Students in the Northeast and Midwest are in Distressed and Closed schools in both simulations



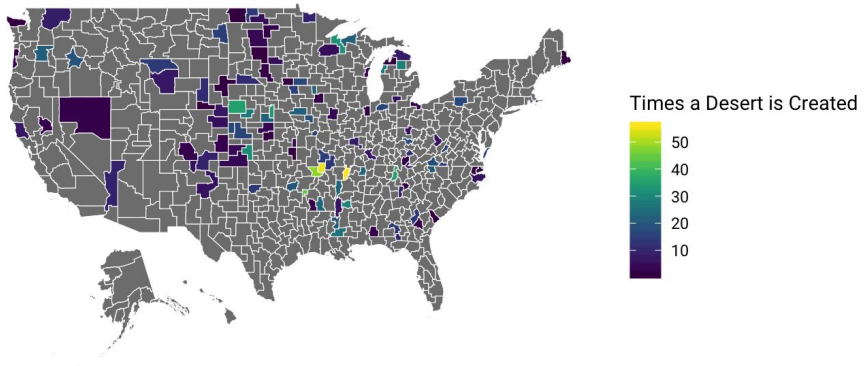


In My Mind's Eye creates many more education deserts than *Past is Prologue*

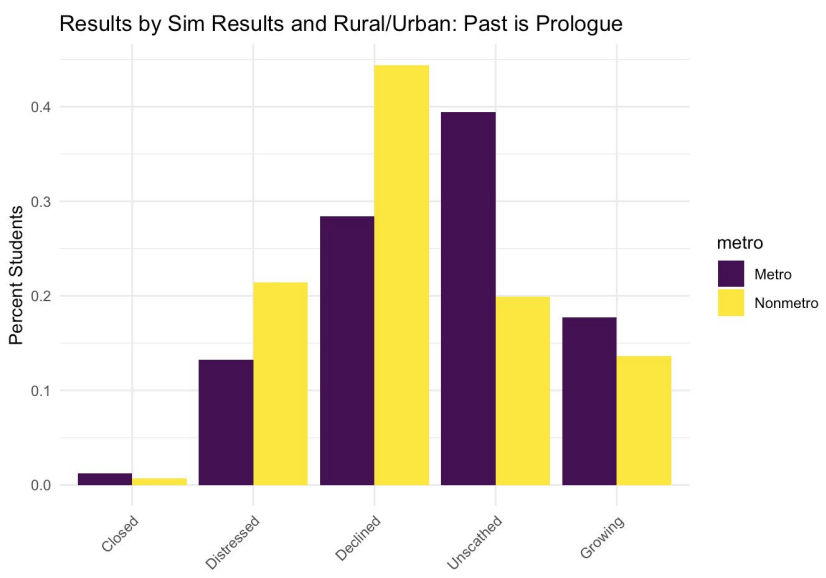
Number of Times a Zone Becomes a Desert Over 100 Simulations: Past is Prologue

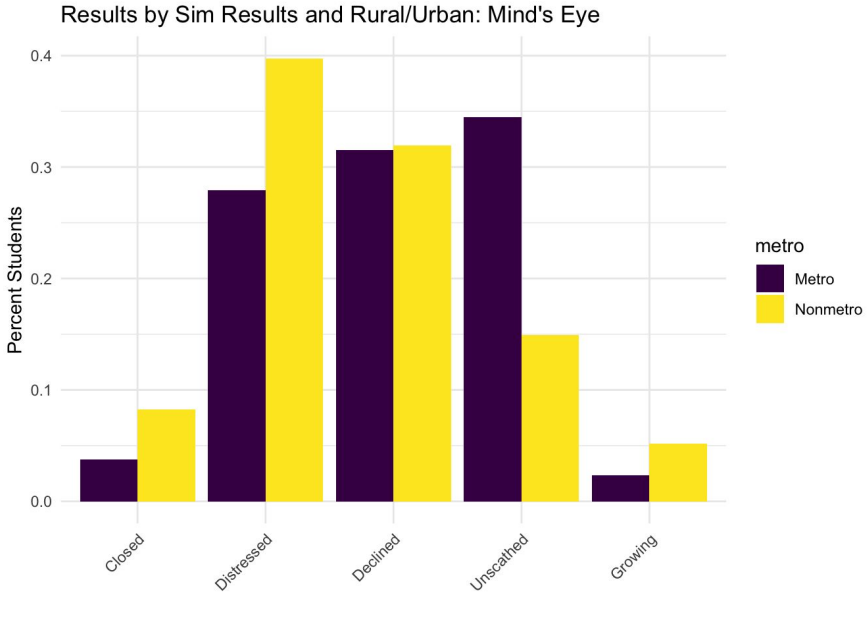


Number of Times a Zone Becomes a Desert Over 100 Simulations: Mind's Eye

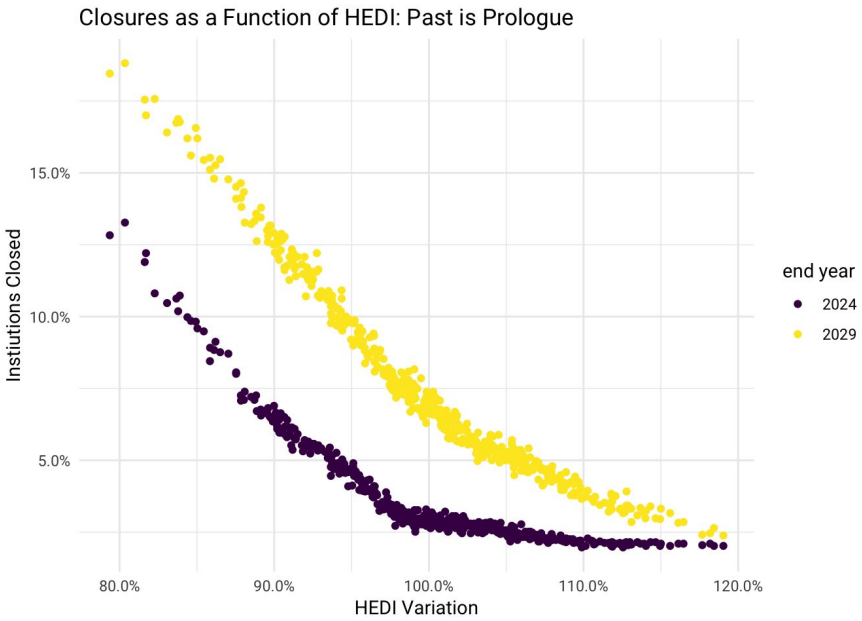


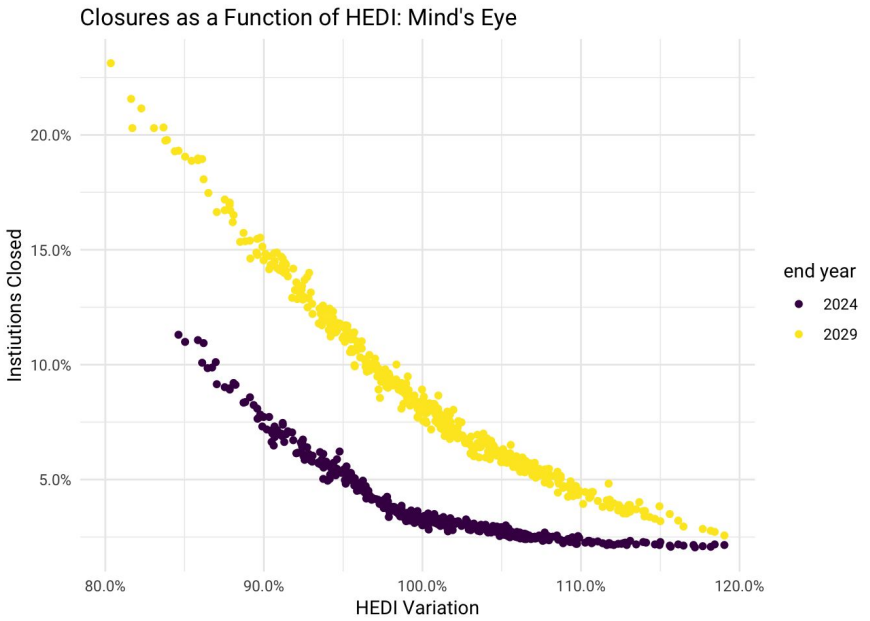
The percent of students living in non-metro areas enrolled in Closed or Distressed schools is higher than students living in metro areas in both simulations



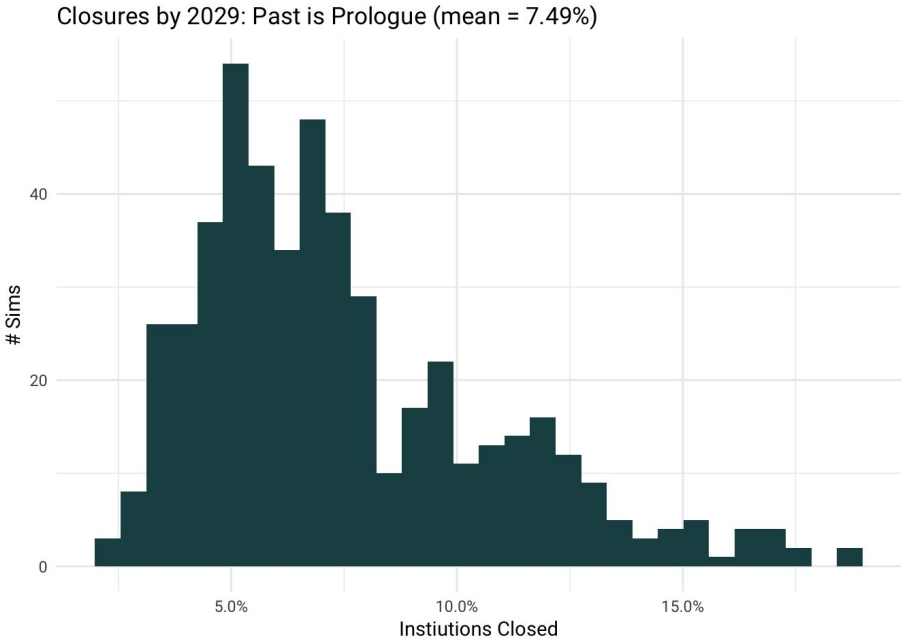


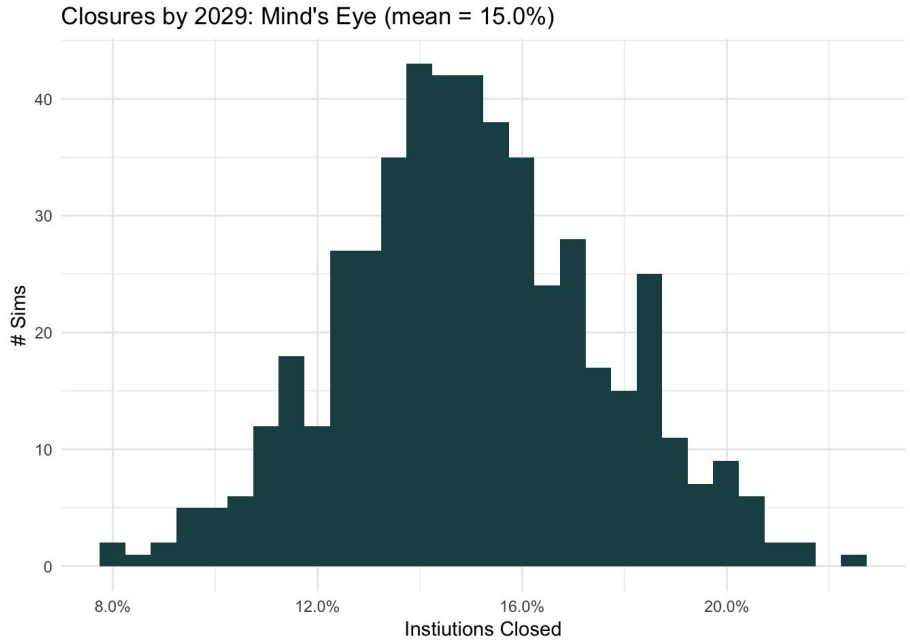
HEDI is the largest factor in Closures and Decline



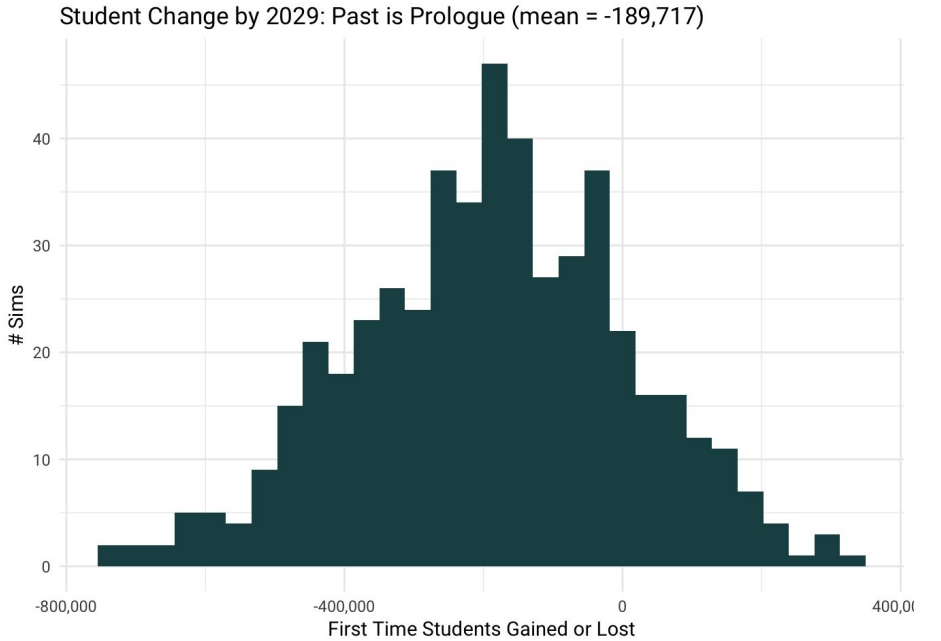


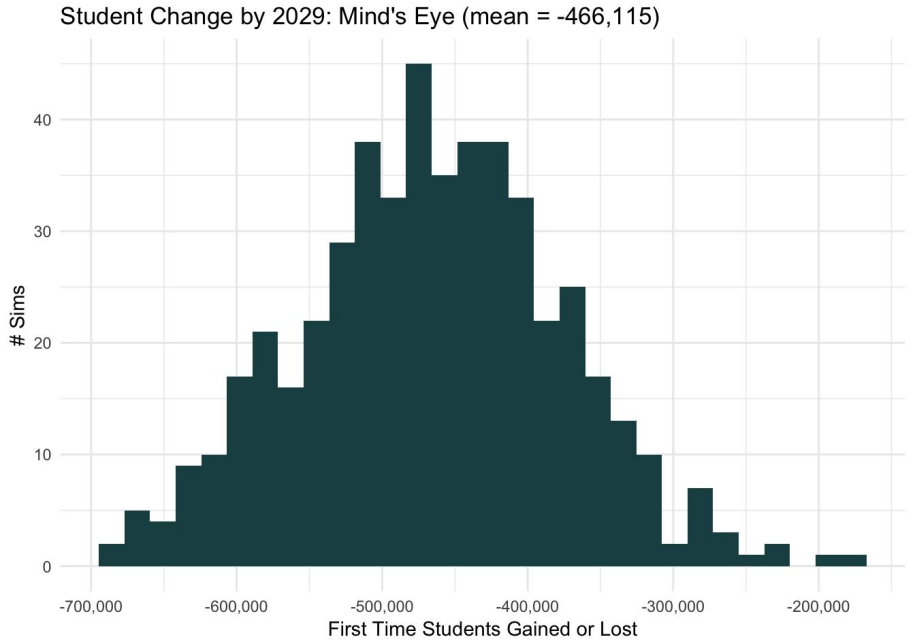
Closures range from 2 to 25%, but center between 5 and 15%



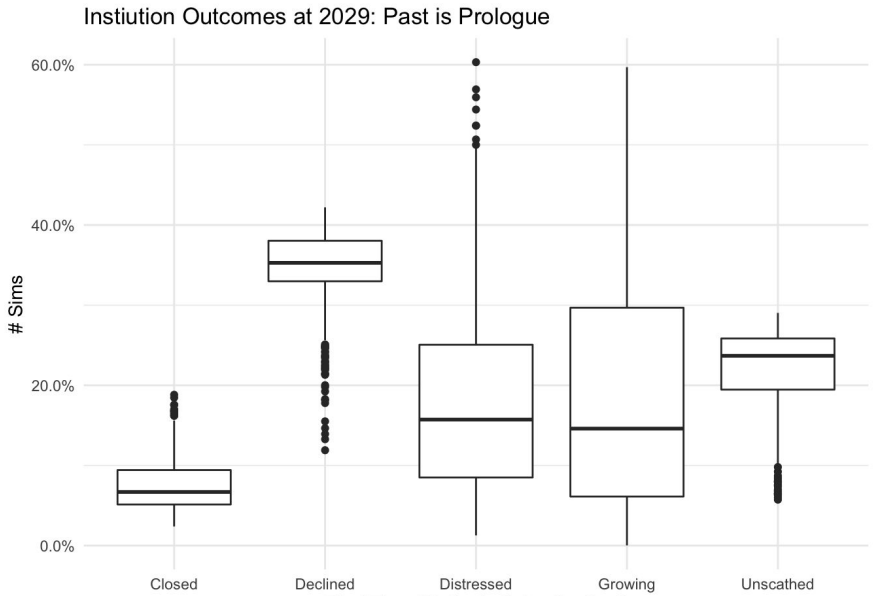


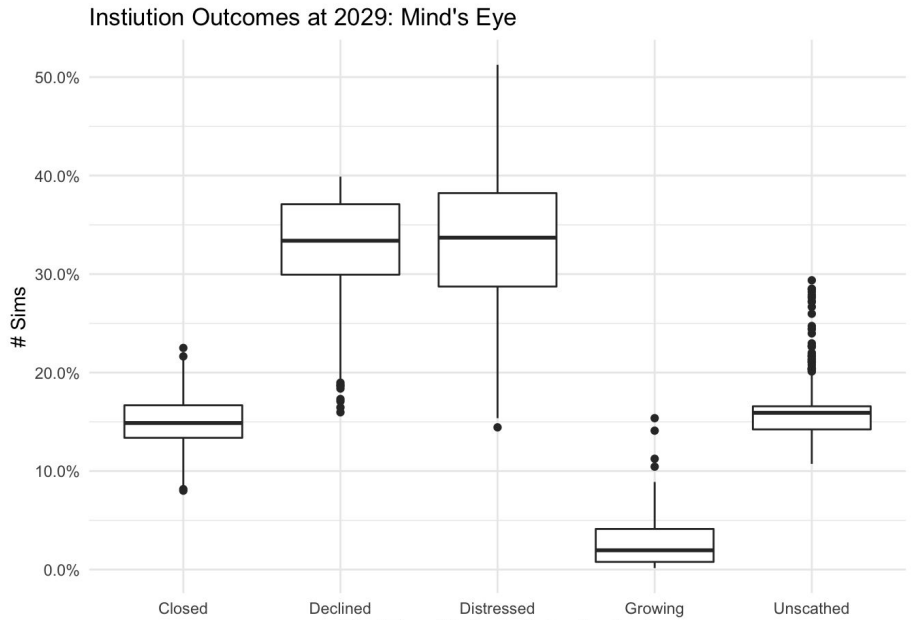
In My Mind's Eye produces more simulations with large declines





There Is a Range of Outcomes for the Institutional Risk Category in Both Simulations





Key Findings

+ Percent of schools closing is the wrong metric. We should instead be focused on the ***number of students impacted.***
+ Taking into account the ***number of students impacted***, both simulations suggest that African American, black, and low-income students will be affected disproportionately by demographic changes in post secondary education.
+ Latinx student population growth combined with an increase in HSI's suggests that Latinx students would not be as affected by closures. However, the institutions that remain following the simulations are largely low quality.
+ Students in non-metro areas will be impacted more than students in metro areas.
+ The Northwest, Midwest, and South will lose the most students.
+ The story is not about closures, but about decline and distress (loss of more than 20%).
+ Public schools are not immune to demand changes. The 7% or so of publics that become distressed will impact a much larger number of students than closures.

Equity Matters

+ Public institutions that experience such changes will affect larger populations of minority and low income students than institutions projected to close.
+ A negative return on investment for minority and low income students continues to be a pervasive issue—this is particularly true for online and for-profit institutions which continue to see increases in enrollment of African American, Hispanic, and low-income students.

Future Opportunities

+ There are opportunities to adjust and refine the simulation and add impact metrics.
+ The simulation could focus on a specific region, and we could add a layer of prediction to closures/distress/decline using machine learning.
+ The simulation could include an early warning system or model that tells us when an institution is showing signs of becoming distressed or in decline (using machine learning).
+ We could focus on a small set of schools to refine how we think of the Sensitivity Index.
+ We could build out tools that would allow others to view the Sensitivity Index and Impact Indices.
+ The real question is—what is the most effective way to intervene?

Focus on Equity

+ Target resources to declining and distressed public institutions projected to affect larger populations of minority and low income students.
+ Address increasing disparities in post-secondary attendance.
+ Invest in peripheral services/supports (for example:. counselors/advisors/centers) to identify and assist low-income, first-generation, and minority students in navigating post-secondary settings as well as efforts to increase persistence and completion.