FutureWork Disruption Index
for North Carolina

How do North Carolina counties compare
on vulnerability to the disruptions
of technological unemployment and demographic change?

Released February 1, 2016, by the Institute for Emerging Issues

This report is organized in three sections:
SUMMARY and KEY FINDINGS; GENERAL DISCUSSION; and METHODOLOGY.

SUMMARY and KEY FINDINGS

North Carolina confronts an enormous future jobs challenge as two big trends converge: (1) a technological revolution will eliminate or seriously reshape more than a million current jobs, and (2) our demography is shifting rapidly as we age, grow more diverse, and our workforce welcomes more women.

According to a recent analysis at North Carolina State University, jobs in some 39 major current employment categories in the state are at least 70% likely to be eliminated within one generation as a result of automation. More than one million North Carolinians currently work in these jobs. (Note: Other analysis implies that an additional one million current North Carolina jobs may be lost during the same time frame to tech-enabled off-shoring; because detailed analysis is not yet available, however, we have not included this further disruptive factor in our modeling.) North Carolina's demographic transition presents additional disruptive effects: the state must replace a large cohort of boomer retirees while ensuring the successful integration of a generation of new workers that includes more women and will become majority-minority.

To draw attention to these important challenges, the Institute for Emerging Issues' new Future**Work** Disruption Index for North Carolina offers a comparative metric that helps define relative exposure to the disruptive impacts of technological and demographic changes for North Carolina's counties and regional Prosperity Zones.

We are releasing the Index now in anticipation of next week's 2016 Emerging Issues Forum, Future**Work** (Feb. 8-9, 2016, Raleigh). The Forum will explore new education approaches, workforce development strategies, and policy innovations required to make North Carolina a leader in the global battle for good jobs for tomorrow's diverse workforce. Register now: emergingissues.org/Future**Work**.

***Key findings and takeaways from the* FutureWork Disruption Index for North**

John T.A.V. Cecil, *Chair* | Anita Brown-Graham, *Director*

Carolina*:*

- Lower-wage jobs are particularly at risk, but automation is reaching up the ladder to threaten many job categories. More than one million North Carolinians are currently employed in these most vulnerable roles. Top five vulnerable roles by total current employment: Food Prep and Servers including Fast Food; Retail Salespersons; Cashiers; Waiters; and General Office Clerks. (**Table 1** includes the top 20, and a full list of threatened job categories is provided in our [Disruption Index Data Resource](#).)

- On average, NC counties face the potential loss of more than 25% of their current jobs and nearly 20% of current wages as a result of automation and related technologies. Counties facing the highest percentage of job losses due to automation are Watauga (41%), Carteret (40%), Dare (40%), Johnston (40%), Buncombe (39%) and Catawba (39%) (**Map 1**).

- Counties vary widely in vulnerability to disruption. Generally, the state's most vulnerable counties feature significant exposure to wage losses, below average higher education attainment rates, and above average levels of racial diversity. The least vulnerable counties are more heterogenous, having in common substantially less wage vulnerability. Given the large number of small population counties among the least vulnerable, we caution that low levels of wage exposure may simply reflect less diversified economies, which brings vulnerabilities in other ways (**Map 2**). Top five counties most vulnerable to disruption: Northampton, Vance, Halifax, Robeson, and Nash. The counties least vulnerable to disruption include a mix of urban, including Orange and Durham, and rural, including Camden, Hyde, and Madison (but see discussion below regarding the impact on our Index values of limited jobs data in smaller counties).

- Regionally, the least vulnerable areas of the state, which include the Charlotte and Triangle metro areas, feature relatively less wage exposure, more people of working age, and higher levels of educational attainment (**Map 3**).

Vulnerability to disruption is not destiny. How we respond influences outcomes. We view this Index as a conversation starter, designed to raise awareness and focus attention on key questions to guide responsive strategies:

1. Whose jobs will be created, changed, or lost in the new automated economy?

2. How will companies and workers need to adapt? What skills will workers need? What kinds of workplace arrangements will maximize industry productivity?

3. What roles should employers, education and training systems, and individuals play in responding to rapidly changing labor markets? What critical factors will provide incentives to companies, individually and collectively, to invest in a community's workforce? Which modernizing changes in our education and workforce delivery systems will most maximize the impact of private sector investments? How should individuals, especially the young, take ownership of their careers?

4. What roles do we expect entrepreneurship and the sharing economy to play in the new automated economy? How can we build the infrastructure needed to support future job creation in those small and micro-enterprise businesses?

5. How will we maximize new information platforms to more efficiently connect workers to work opportunities and employers to the talent they need?

6. How will we use the increasing diversity of our workforce as a competitive advantage for North Carolina?

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GENERAL DISCUSSION

In developing the Future**Work** Disruption Index for North Carolina, we were inspired, in part, by MIT's Erik Brynjolfsson and Andrew McAfee's *Race Against the Machine* (2013), which argues that the rapid pace of technological change threatens to leave much of the workforce behind. In their view, future employment prospects are grim for large numbers of workers whose skills are not aligned with those required by the new economy. The confluence of technological advancements and human capital deficits, say Brynjolfsson and McAfee, poses a significant threat to our economy and society.

Whose Jobs are Most at Risk?

We know that job losses can cripple communities. Even if these losses are counter-balanced by substantial new job creation – and informed observers hold sharply divergent views on that prospect, with pessimists fearing that we're entering a new era of "permanent unemployment" in which technology will replace workers across huge swaths of the economy – the disruptive impacts of this transition remain enormous.

To better understand whose jobs are most at risk in North Carolina, we drew on the work of NC State University economist Mike Walden. He identified 39 occupations judged most vulnerable to technology-driven unemployment and in which more than 10,000 North Carolinians are currently employed (**Table 1**). Lower-wage jobs are particularly at risk, but automation is reaching up the ladder to threaten many job categories. More than one million North Carolinians are currently employed in these most vulnerable roles.

TABLE I: TOP 20 (of 39) MOST VULNERABLE JOB CATEGORIES BY TOTAL CURRENT EMPLOYMENT (click for the Disruption Index Data Resource, which lists all 39 categories incorporated in the Index)

Rank	Job Category	Estimated Current Total Employment	Average Annual Wage
1	Combined Food Prep and Serving Workers, Incl Fast Food	141,040	$17,950
2	Retail Salespersons	140,620	$25,050
3	Cashiers	109,350	$19,170
4	Waiters and Waitresses	78,210	$19,520
5	Office Clerks, General	76,820	$27,410
6	Laborers and Freight, Stock, and Material Movers, Hand	76,760	$25,680
7	Secretaries and Administrative Assistants (Except Legal, Medical)	59,040	$33,410
8	Heavy and Tractor-Trailer Truck Drivers	49,990	$38,620
9	Bookkeeping, Accounting, and Auditing Clerks	43,490	$35,790
10	Sales Representatives, Wholesale and Manufacturing (Except Technical and Scientific Products)	43,390	$65,150
11	Team Assemblers	42,700	$28,050
12	Cooks, Restaurant	36,200	$21,210
13	Accountants and Auditors	30,170	$71,200
14	Landscaping and Groundskeeping Workers	28,900	$24,280
15	Receptionists and Information Clerks	28,200	$26,590
16	Security Guards	26,720	$25,380
17	Exec Secretaries and Exec Admin Assistants	22,940	$48,750
18	Sales Representatives, Services, All Other	21,330	$60,820
19	Shipping, Receiving, and Traffic Clerks	20,160	$30,640
20	Industrial Truck and Tractor Operators	19,810	$30,310

Map 1 shows where these jobs are located across the state, calculated as the

percentage of total current jobs by county. Potential job losses are severe, averaging almost 27% of current employment, with individual counties ranging from 5% (Caswell County) to 41% (Watauga County). Other counties facing the most losses are Carteret (40%), Dare (40%), Johnston (40%), Buncombe (39%) and Catawba (39%).

We also calculated the potential wage losses should these jobs disappear (Map 1; roll over individual counties to reveal their data). On average, counties are facing the loss of nearly one-fifth of total wages, with losses greater than 25% projected in more than 20 counties. Most at risk are Northampton (30%), McDowell (29%), Johnston (28%), Dare (28%), Watauga (28%) and Vance (27%).

MAP I: ANTICIPATED JOBS LOST TO TECHNOLOGICAL UNEMPLOYMENT (BY COUNTY) [click for interactive online map]
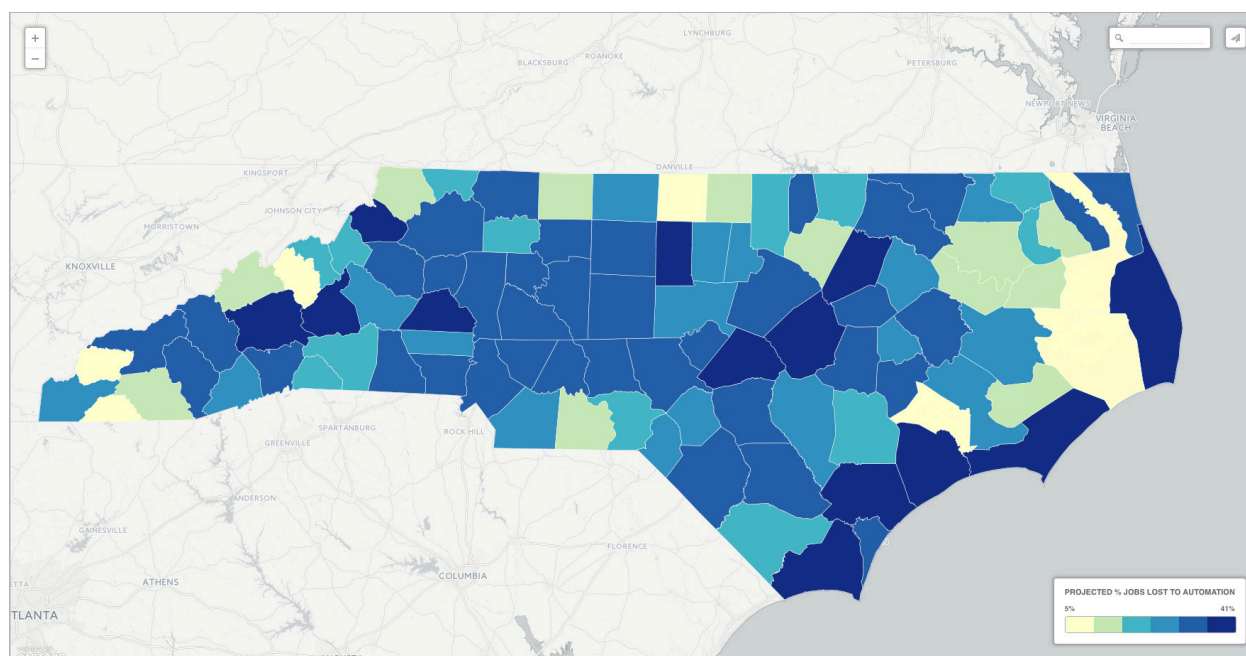
Which Counties Are Likely to Experience the Greatest Disruption? Which Are Not?

Economic and demographic factors combine to play a role in determining a community's vulnerability to the disruptive impacts of technological unemployment and demographic change. Communities with more acute human capital deficits and more demanding demographic profiles are likely to experience greater difficulty coping with inevitable disruptions. We chose four indicators that capture a community's exposure to technology-driven unemployment and its ability to marshall resources to respond. Note: We expect this Index to spark conversation and encourage a hard look at risks

and opportunities ahead; we do not assert that our Index incorporates every factor potentially relevant to future job market and demographic disruption.

- Anticipated wage losses: Wage losses capture both exposure to technology changes but also, indirectly, tax revenue losses hindering a community's ability to respond.

- Higher education attainment levels: More jobs increasingly require higher levels of knowledge and skills. Communities with greater education levels possess a critical advantage compared to those with lower levels.

- The dependency ratio: The ratio of non-working age to working age populations in a locality; high dependency ratios suggest fewer tax-contributing citizens compared to those, younger and older, who require supports of various types.

- Racial diversity: Higher levels of racial diversity are seen as a challenge in the sense that non-White North Carolinians traditionally have had lower rates of educational attainment.[1]

Localities with high scores are expected to have a harder time adjusting to these disruptions resulting from technological job loss and demographic shifts compared to other parts of the state. Please see the Methodology section for additional details on the Index.

Counties vary widely in vulnerability (**Map 2**). Generally, the state's most vulnerable counties feature significant exposure to wage losses, below average higher education attainment rates and above average levels of racial diversity. The least vulnerable counties are more heterogenous, having in common substantially less wage vulnerability. Given the large number of small population counties among the least vulnerable, we caution that low levels of wage exposure may simply reflect less diversified economies, which brings vulnerabilities in other ways.

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[1] As educational attainment levels for all groups change, and as communities across the state attract new non-White (and Hispanic) populations from other areas of the world, it will be important to reexamine this assumption. Already in a few communities, concentrations of highly educated immigrants contribute to the advantage that education confers more generally, even as the diversity measure we use in the Index fails to capture properly their impact. Additionally, Hispanics are currently included as "White" in our data. As their numbers increase, it will be important to understand if initial attainment challenges continue.

MAP 2: FUTUREWORK DISRUPTION INDEX BY N.C. COUNTY [click for interactive online map]
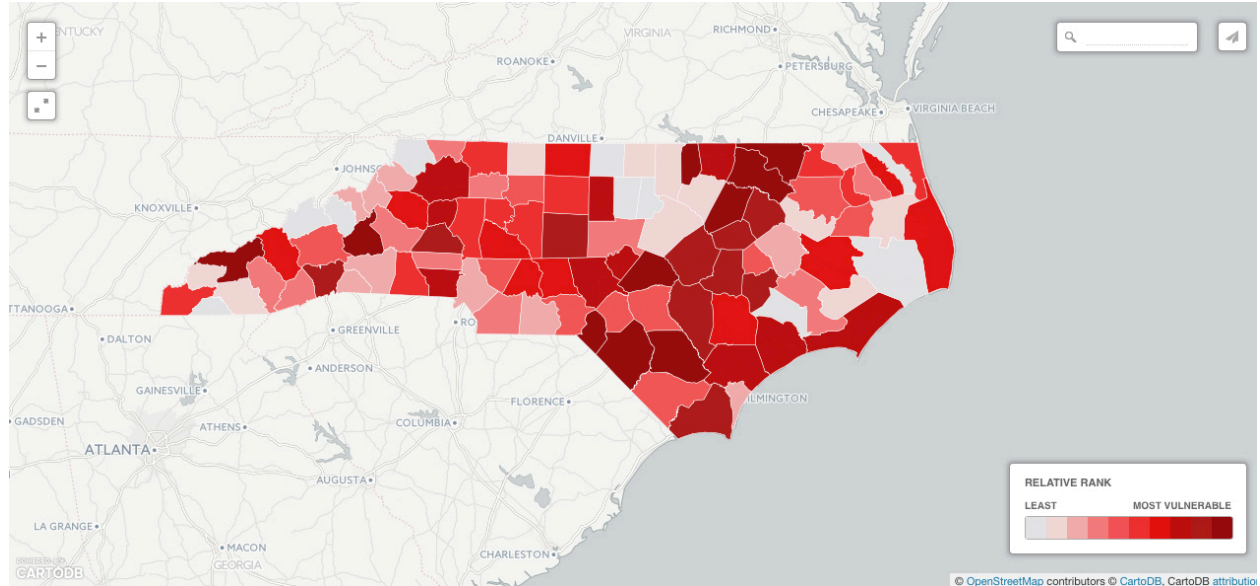
Variations in vulnerabilities are also seen at the regional level (**Map 3**). The least vulnerable areas of the state, which include the Charlotte and Triangle metro areas, feature relatively less wage exposure, more people of working age, and higher levels of educational attainment.

MAP 3: FUTUREWORK DISRUPTION INDEX BY N.C. PROSPERITY ZONE [click for interactive online map]
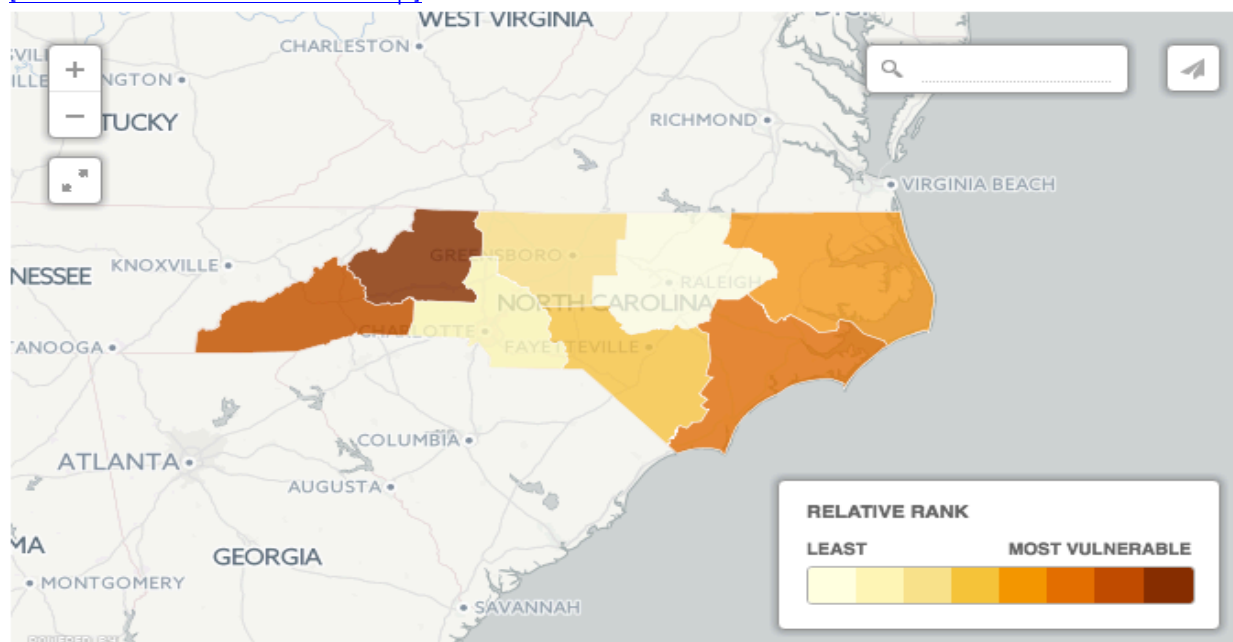
Other Important Considerations (and Cautions):

- The Index considers only those 39 job categories believed likely to be at 70% or greater risk of replacement by technology. Job losses are sure to occur in other occupations, as well.

- Even if many at-risk jobs are ultimately not lost to automation, nonetheless experts agree that the skill mix needed for these occupations will surely change in important ways. Thus, even if technological unemployment is more muted, substantial disruption will happen in existing labor markets.

- Special care should be taken in interpreting Future**Work** Disruption Index results for counties with fewer than 20,000 people. In such counties, employment data is often suppressed to protect legitimate confidentiality concerns of a small number of large employers.

- Our Dependency Ratio data will skew in locales with institutional populations, such as prisons. Additionally, locales with clusters of high-wealth retirees may have similar dependency ratios to counties with retirees of more typical economic status, yet be better positioned to withstand disruption.

- Our data do not account for locales where large numbers of residents commute to adjacent counties for work (Jones County, in particular, is one such example).

- As noted in the Summary, our Index does not consider other analysis that implies that an additional one million current North Carolina jobs may be lost to tech-enabled off-shoring. Detailed analysis of those loss estimates is not yet available.

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METHODOLOGY

The *FutureWork Disruption Index for North Carolina* is comprised of four variables:

a) Wages expected to be lost to technological unemployment: The Index incorporates an estimate of wages expected to be lost to technological unemployment in a given locality. Our analysis builds on the work of North Carolina State University economist Mike Walden, who reviewed the state's current job mix and estimated the relative likelihood that a given job category will be eliminated by automation by 2040. Our estimate of prospective wage loss is conservative: we include only those job categories deemed 70% or more likely to be eliminated by automation and that currently employ at least 10,000 North Carolinians. We do not include the comparable job and wage loss impacts anticipated from technology-enabled offshoring. When calculating estimates of expected wage losses, we use 2015 average wage data by job category drawn from the ACCESS NC Occupation Employment data source.

b) Current average educational attainment: We use a county or zone's most recently reported percentage of population holding an Associate's Degree or higher degree; because higher education levels reduce vulnerability, we weight this factor inversely. Data source: 2009-2013 American Community Survey Five-Year Estimates.

c) Current dependency ratios: We use a county or zone's current dependency ratio, which is obtained by dividing the total number of inhabitants aged 0-14 years and 65+ by the number of inhabitants aged 15-64 years (of working age, in other words). Data source: NC Office of State Budget and Management, North Carolina County Estimates, 2014.

d) Current non-White population percentage: For our population diversity measure, we use a county or zone's current non-White population percentage. Higher levels of racial diversity are seen as a challenge in the sense that non-White North Carolinians traditionally have had lower rates of educational attainment. Data source: NC Office of State Budget and Management, North Carolina County Estimates, 2014.

Weighting the Index:

To compute the Index, we used standardized measures of the following factors for each county or zone, weighted as indicated:
a) [One-half (50%) of composite weight] Wages expected to be lost to technological unemployment.

b) [One-sixth (16.7%)] Current average educational attainment
c) [One-sixth (16.7%)] Current dependency ratio
d) [One-sixth (16.7%)] Current non-White population percentage

Composite total: 100%

We standardized each measure in the composite by transforming data with z-scores; for county data, for example, we do the following:

$$z = \frac{County\ value - Average\ of\ counties}{Standard\ Dev\ \ ation\ of\ counties}$$

Finally, a locality's Future**Work** Disruption Index score is computed via the following formula, with higher scores reflecting greater relative vulnerability:

$$Composite = (Z_{LostWage} \times 50\%) + (Z_{Education} \times 16.7\%) + (Z_{Dependency} \times 16.7\%) + (Z_{Non-white} \times 16.7\%)$$

Our decision to weight wage loss at 50% in our composite Disruption Index score relies on prior research and analysis that chronicles the nature of technological unemployment in the United States. Research by the St. Louis Federal Reserve found that, as we emerged from the recession, roughly 50% of the increase in unemployment was structural – that is, was due to the mismatch between skills possessed by workers and skills demanded by employers. Moreover, during the Great Depression of the 1930s, the nation experienced roughly the same percentage of structural unemployment. Therefore, our 50% weighting choice here reflects that historical and contemporary unemployment composition.

Having weighted the effects of technological unemployment at 50% with attention to the issue of structural unemployment, we use the three demographic variables to round out the remaining 50% of the composite in equal measure of 16.7% (one-sixth) each. Here we are attempting to balance structural with cyclical considerations. Cyclical unemployment historically affects all localities via a range of factors including recession, inflation, disability claims, business cycle fluctuation, consumer and individual demand, and labor market selection (age, race, gender); in our model we assume that such cyclical variables exert equal effects across all localities. The three demographic factors we use are, by contrast, specific to each locality.

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