

APPENDIX: METHODOLOGY AND TECHNICAL NOTES

COUNTY ECONOMIES 2020

LOCAL ECONOMIES IN THE GLOBAL MARKET | FEBRUARY 2020

NACo's MISSION

Strengthen America's counties.

NACo's VISION

Healthy, safe and vibrant counties across America.

ABOUT NACo

The National Association of Counties (NACo) strengthens America's counties, serving nearly 40,000 county elected officials and 3.6 million county employees. Founded in 1935, NACo unites county officials to:

- **Advocate county priorities** in federal policymaking
- **Promote exemplary county policies** and practices
- **Nurture leadership skills** and expand knowledge networks
- **Optimize county and taxpayer resources** and cost savings, and
- **Enrich the public's understanding** of county government.

APPENDIX: METHODOLOGY AND TECHNICAL NOTES

NACo’s Global Market Engagement Index

The NACo Global Market Engagement (GME) Index is a measure of how engaged a county is with the global market relative to other counties of a similar economic size. A score of “100” means that the county economy is as engaged globally as one would expect (or predict) a county economy of that GDP and job market size to be. Higher scores represent more global engagement than predicted and lower scores represent less global engagement than predicted. The index is in no way a reflection of economic, social or political wellbeing, since a county’s level of engagement with the global market should be determined by its own unique situation.

The GME Index is calculated by using the following variables for 2003 through 2017: Total Real Exports, Total Real Foreign Direct Investment, Total Export-Supported Jobs, Total FDI-Created Jobs, Real GDP and Total Jobs. Total Real Foreign Direct Investment and Total FDI-Created Jobs are cumulative throughout the aforementioned time-period to capture the long-term effects of greenfield FDI and to make the variables more comparable to Total Real Exports and Total Export-Supported Jobs, which will naturally be compounded each year. One shortcoming of this method is that, naturally, earlier years will have lower scores on the index, and that counties may not be entirely comparable for the first few years. To overcome this shortcoming, we exclude 2003 to 2006 when conducting any time-series analyses of the index and focus primarily on the 2017 values.

To ensure the six variables are comparable across all counties, we converted them all to a natural log scale. We first, however, added one to each observation to effectively replace the missing values for the two FDI variables with zeros, since zeros in the FDI data hold meaning in this model: $\ln(\text{variable} + 1)$.

To estimate the global engagement of an “average county”, we ran a series of simple OLS regressions that estimated Total Real Exports and Total Real FDI based on Real GDP, and that estimated Total Export-Supported Jobs and Total FDI-Created Jobs based on Total Jobs. Below are the results of those four regressions:

Table: OLS Regression Results for GME Index

<i>Dependent Variable:</i>	<i>$\ln(\text{Total Real Exports} + 1)$</i>	<i>$\ln(\text{Total Real FDI} + 1)$</i>	<i>$\ln(\text{Total Export-Supported Jobs} + 1)$</i>	<i>$\ln(\text{Total FDI-Created Jobs} + 1)$</i>
<i>$\ln(\text{Real GDP} + 1)$</i>	0.957*** (0.002)	2.292*** (0.018)	-	-
<i>$\ln(\text{Total Jobs} + 1)$</i>	-	-	0.963*** (0.002)	0.762*** (0.006)
No. of observations	46,019	46,019	46,019	46,019
R-squared	0.885	0.251	0.882	0.274

Note: Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Taking the residuals from the four OLS regressions, we ran a principal components analysis (PCA) with them to determine weights for each variable. Below is the output from the PCA:

Table: Principal Components Analysis Results for GME Index

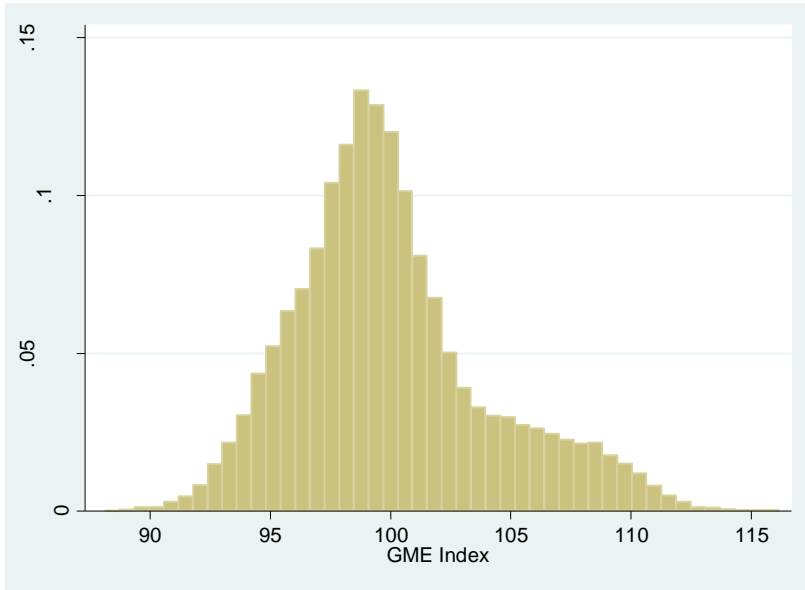
	Component 1	Component 2	Component 3	Component 4
Eigenvalues	2.280	1.603	0.080	0.037
Eigenvectors				
Total Exports (residuals)	0.484	0.516	0.673	-0.214
Total FDI (residuals)	0.510	-0.491	0.222	0.671
Total Export-Supported Jobs (residuals)	0.489	0.509	-0.672	0.223
Total FDI-Created Jobs (residuals)	0.515	-0.483	-0.215	-0.675
No. of observations	46,019			

We multiplied each eigenvector by its corresponding eigenvalue, then took the sum of each variable's weighted eigenvectors, resulting in the following weights:

Variable Name	Weight
Total Exports (residuals)	1.97
Total FDI (residuals)	0.41
Total Export-Supported Jobs (residuals)	1.88
Total FDI-Created Jobs (residuals)	0.35

Finally, we multiplied each variable by its corresponding weight, then added together the weighted variables, plus 100, to calculate the final index. Below are some summary statistics on the final GME index.

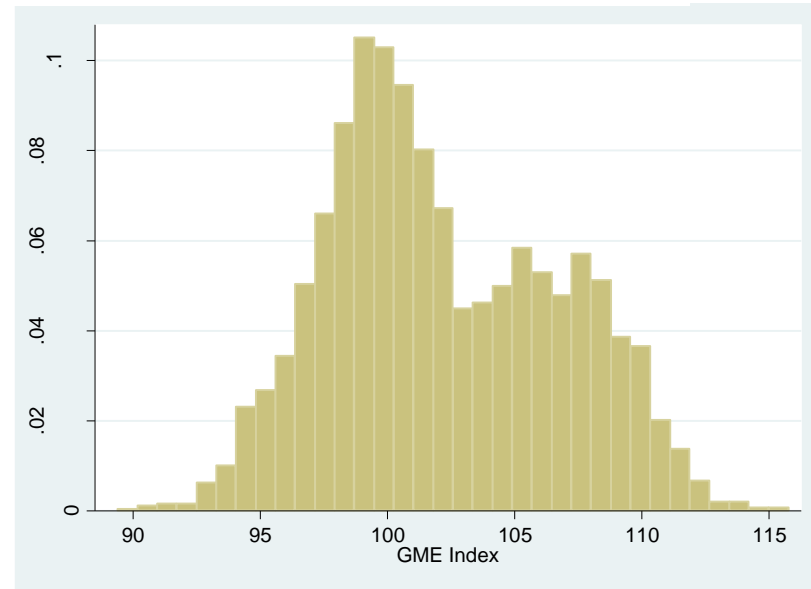
Graph: Histogram of GME Index Distribution, 2003-2017



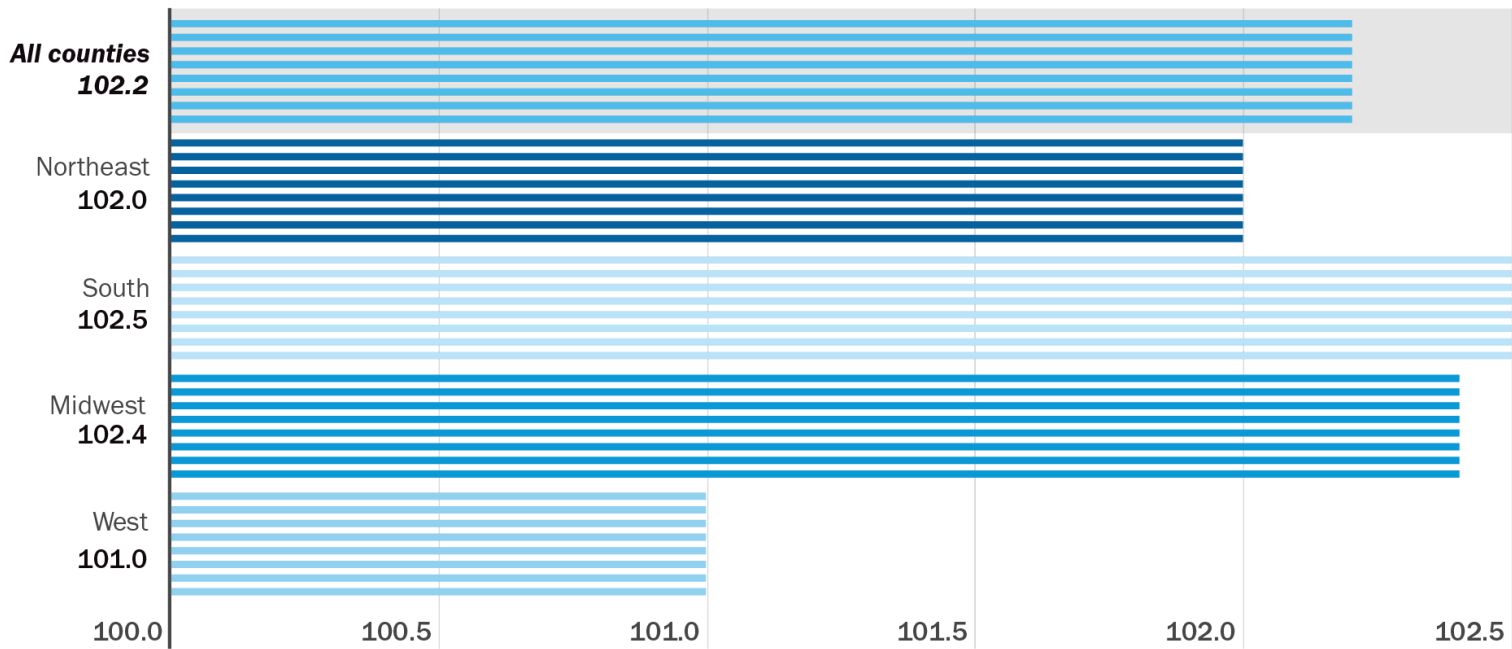
GME Index, 2003-2017	Value
Mean	100
Median	99.40
Minimum	88.13
Maximum	116.13
Standard Deviation	4.114

GME Index, 2017	Value
Mean	102.17
Median	101.33
Minimum	89.39
Maximum	115.75
Standard Deviation	4.54

Graph: Histogram of GME Index Distribution, 2017

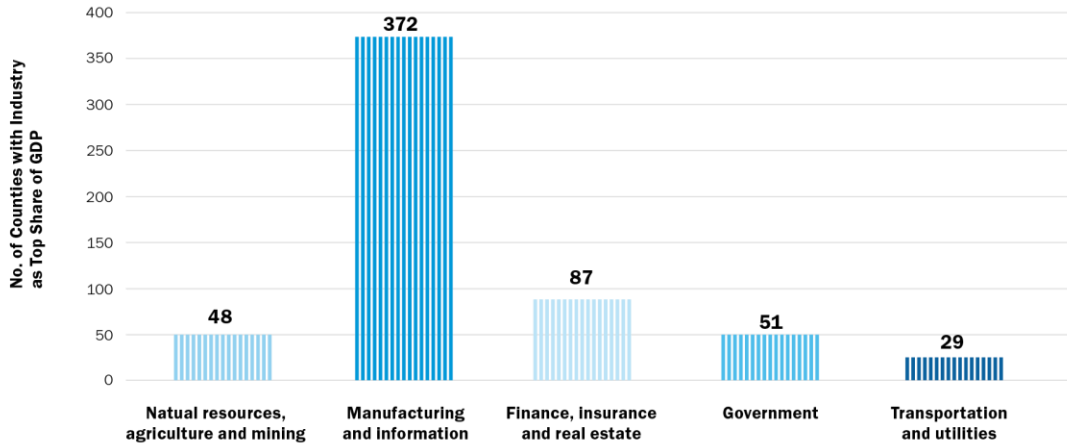


South and Midwest Have the Most Globally Engaged Counties: Average County GME Scores by Region, 2017

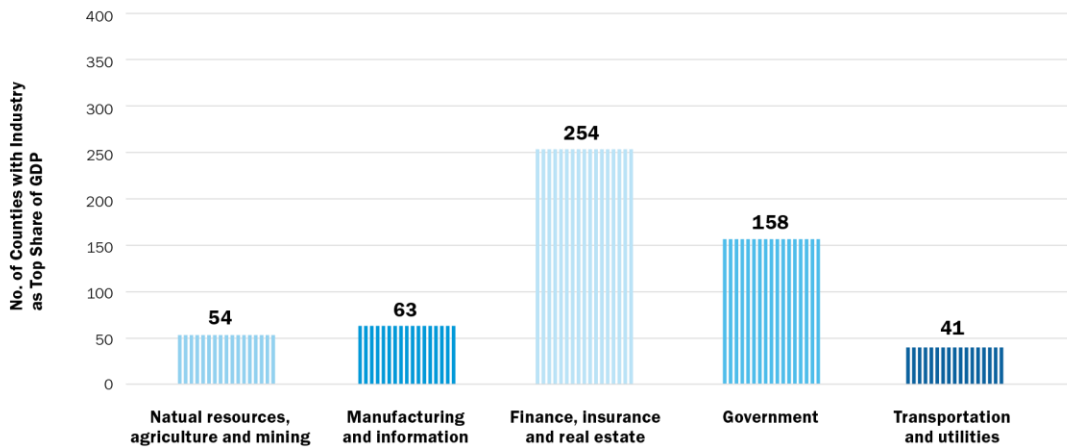


The graph on page 5 of the report (above) shows the average GME Index score for counties in each Census region in 2017. The graphs on page 6 of the report (below) contrast the top quintile (20 percent) of counties with the bottom quintile, by GME Index score. The graphs show the number of counties in each group that have, e.g., manufacturing and information as their top industry, by share of GDP. For example, in the top quintile, in 372 counties (61 percent of the group), manufacturing and information contributes the highest share of GDP to the county’s economy. In contrast, only 63 counties (10 percent of the group) in the bottom quintile have manufacturing and information as their top industry. We use a condensed version of the BEA’s industry breakdown which consolidated industries that had low shares of GDP into larger industry categories, or that dropped them from the visualizations.

Manufacturing Is Top Industry for Most Globally Engaged Counties



Least Globally Engaged Counties Have More Diversified Economies



Sources: NACo Analysis of Brookings Institution Export Monitor (2018), Data; NACo Analysis of fDi Markets, Data

County Export Analysis

County-level export data are from Brookings' Export Monitor 2018. Brookings estimates U.S. exports by production location, and not origin-of-movement, as is the norm with all the other available export databases. The origin-of-movement is not always the place where the good was produced, especially when the exported goods get consolidated along the shipment route. Origin-of-movement export data are sufficient for a freight study, but they provide a distorted view for regional economic analysis.

The analysis of the effect of export reliance on GDP growth and jobs growth, found on pages 7 and 8, estimates the effect of export reliance on GDP and on jobs growth. We use "Export Share of GDP" for export reliance when discussing GDP growth, and "Share of Export-Supported Jobs" when discussing jobs growth.

To estimate the effect of export reliance on economic growth, we use a series of fixed effects regression models. The model is roughly based on a simple economic growth model developed by Heitger (1987).¹ In his model, economic growth for a country is presumed to be dependent on growth of the labor force, capital formation, technological adaptation and human capital. Heitger (1987) also controls for the market size of a country by creating a separate OLS model with "Export Share of GDP" as the dependent variable and "GDP" as the independent variable, then including the residuals from this model.

Mimicking his methodology, in our first model, we use "GDP Growth Rate" as our dependent variable to represent economic growth. Our primary independent variable is "Export Share of GDP". Our other control variables are the following. "Labor Force Growth Rate" represents labor input and growth of labor, naturally. "Real Personal Income, Per Capita (2012\$), Percent Difference Between the County and the National Value" has the twofold purpose of representing technological advancement and human capital, since in the U.S., both high levels of education and technology generally translate into higher per capita incomes. We use the difference between the county and national level to capture the gap in human capital and technology that exists between counties while avoiding the potential problem of endogeneity between personal income and GDP. As a proxy for investment, we use the natural log of "Estimated Value of New Residential Building Permits", since investments in the housing market are closely connected investments in the overall economy and represent one type of investment in a growing economy. Finally, we control for market size by running an OLS regression with the natural log of "Export Share of GDP" as the dependent variable and the natural log of GDP as the independent variable, then including the residuals from this regression as a separate control variable. This variable is important because larger markets are more diversified, so cannot have as high levels of "Export Share of GDP" as smaller, less diversified markets.

Our second model estimates the impact of "Share of Export-Support Jobs" on "Jobs Growth" and diverges from the first model in a few ways. In place of GDP Growth, we use Jobs Growth as our dependent variable. In place of Export Share of GDP, we used the Share of Export-Supported Jobs as our primary dependent variable. In place of Labor Force Growth, we used GDP Growth as a control variable. Finally, instead of controlling for market size using the residuals from a regression of GDP on Export Share of GDP, we controlled for the job market size by using the residuals from an OLS regression of total jobs (natural log) on the share of export-supported jobs (natural log).

See below the results from the OLS regressions to create the variables that control for market size:

¹ Heitger, Bernhard. "Import Protection and Export Performance - Their Impact on Economic Growth." *Weltwirtschaftliches Archiv* 123, no. 2 (1987): 249-61. www.jstor.org/stable/40439424 (February 13, 2020).

Table: OLS Regressions to Control for Market Size

Dependent Variable:	ln(Export Share of GDP)	ln(Share of Export-Supported Jobs)
ln(Real GDP)	-0.051*** (0.002)	-
ln(Total Jobs)	-	-0.042*** (0.002)
No. of observations	33,473	33,473
R-squared	0.022	0.014

Note: Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In both models, we use fixed effects to control for county-level differences. We control for time effects by including dummy variables for each year (except one to avoid perfect multicollinearity). Since our cross section of 3,069 counties is substantially larger than our period of 11 years, including year dummy variables is a better option than including lags of the dependent variable or than differencing any variables. We also chose to use robust standard errors to control for issues of heteroskedasticity.

Alongside running these regressions for all 3,069 counties, we also ran each regression for each Census region and county population size group and compared their coefficients, thus calculating the relative impacts of export reliance on GDP and jobs growth in each region and population group. Regarding population size, NACo categorizes county size based on population: small counties have less than 50,000 residents, large counties have more than 500,000 residents and medium-sized counties have population levels in between the two other groups.

Below are the results from the two models:

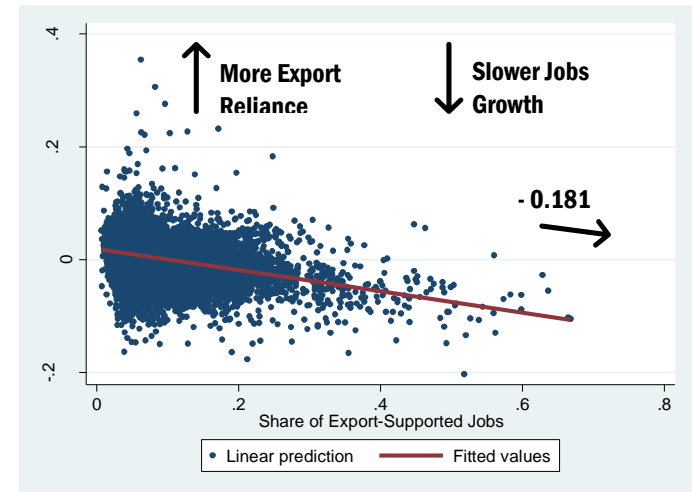
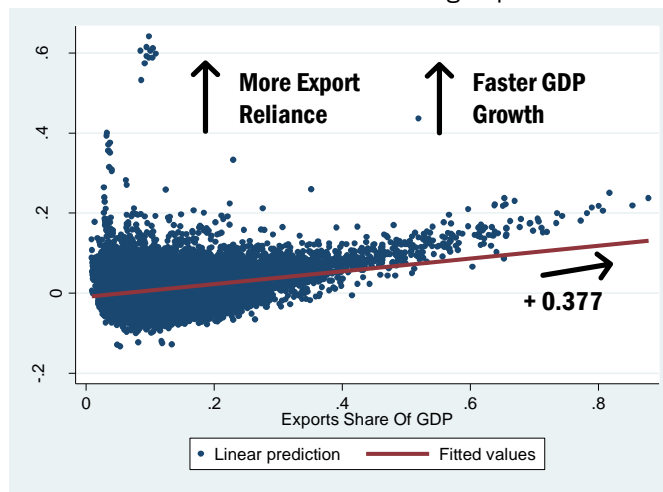


TABLE: RESULTS FROM FIXED EFFECTS REGRESSION OF EXPORT SHARE OF GDP ON GDP GROWTH RATE, 2007-2017

County Group (Sample Size):	All Counties	Small Counties	Medium-sized Counties	Large Counties	Northeast Counties	South Counties	Midwest Counties	West Counties
Dependent Variable: GDP Growth Rate								
Export Share of GDP	0.377*** [0.0548]	0.463*** [0.0607]	0.171** [0.0780]	0.377 [0.427]	0.319** [0.126]	0.284*** [0.0600]	0.585*** [0.112]	0.00243 [0.117]
Labor Force Growth Rate	0.390*** [0.0283]	0.407*** [0.0322]	0.320*** [0.0301]	0.229*** [0.0592]	0.268*** [0.0498]	0.356*** [0.0342]	0.549*** [0.0753]	0.327*** [0.0344]
Real Personal Income Per Capita (2012\$), %Difference Between County and National Level	0.103*** [0.0139]	0.106*** [0.0158]	0.146*** [0.0206]	0.0614*** [0.0206]	0.0461* [0.0235]	0.128*** [0.0228]	0.134*** [0.0166]	0.0417 [0.0267]
Estimated Value of New Residential Building Permits (Natural Log)	-0.000386 [0.000794]	-0.00275*** [0.000898]	0.00400*** [0.00135]	0.00839*** [0.00314]	0.00317 [0.00209]	0.00158 [0.00108]	-0.00365** [0.00142]	0.00027 [0.00169]
Control for Market Size (Residuals)	-0.0318*** [0.00812]	-0.0412*** [0.00943]	-0.0156 [0.0110]	-0.00657 [0.0408]	-0.0132 [0.0184]	-0.0483*** [0.0102]	0.00408 [0.0159]	-0.0286 [0.0186]
Constant	-0.00297 [0.0162]	0.0278 [0.0177]	-0.0586** [0.0282]	-0.198*** [0.0737]	-0.0759* [0.0404]	-0.0238 [0.0224]	0.0205 [0.0267]	0.0367 [0.0356]
No. of Observations	29,544	19,256	8,869	1,419	2,114	12,748	9,633	5,049
R-squared	0.178	0.203	0.201	0.392	0.178	0.166	0.284	0.219
No. of Counties	2,902	1,965	808	129	193	1,276	939	494

Note: Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1

TABLE: RESULTS FROM FIXED EFFECTS REGRESSION OF SHARE OF EXPORT-SUPPORTED JOBS ON JOBS GROWTH RATE, 2007-2017

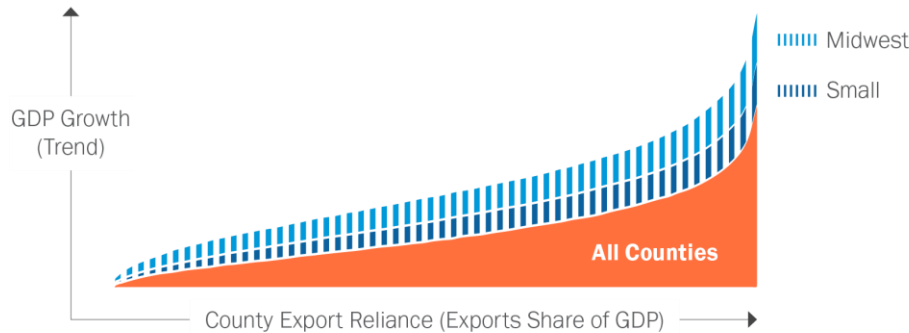
County Group:	All Counties	Small Counties	Medium-sized Counties	Large Counties	Northeast Counties	South Counties	Midwest Counties	West Counties
Dependent Variable: Jobs Growth Rate								
Share of Export-Supported Jobs	-0.181*** [0.0385]	-0.245*** [0.0481]	0.077 [0.0650]	-0.152*** [0.0454]	-0.109 [0.163]	-0.0941 [0.0648]	-0.320*** [0.0677]	-0.121* [0.0728]
GDP Growth Rate	0.342*** [0.0128]	0.351*** [0.0150]	0.333*** [0.0177]	0.266*** [0.0325]	0.335*** [0.0265]	0.368*** [0.0214]	0.334*** [0.0157]	0.331*** [0.0315]
Total Personal Income Per Capita, %Difference Between County and National Level	0.00445 [0.00471]	0.00404 [0.00565]	0.0325*** [0.00900]	-0.00718 [0.00598]	0.0038 [0.0160]	0.00515 [0.00994]	-0.00316 [0.00770]	0.00514 [0.00577]
Total Value of New Residential Building Permits (Natural Log)	0.00185*** [0.000295]	0.00139*** [0.000333]	0.00316*** [0.000569]	0.00668*** [0.00151]	0.00166 [0.00104]	0.000646 [0.000414]	0.00160*** [0.000544]	0.00461*** [0.000734]
Control for Market Size (Residuals)	-0.0041 [0.00344]	-0.00254 [0.00421]	-0.0170*** [0.00608]	0.00562 [0.0111]	-0.00221 [0.0129]	-0.00611 [0.00530]	0.0000939 [0.00640]	-0.00587 [0.00746]
Constant	-0.0115* [0.00616]	0.000695 [0.00712]	-0.0505*** [0.0120]	-0.113*** [0.0300]	-0.0219 [0.0225]	0.00624 [0.0101]	-0.000976 [0.0105]	-0.0609*** [0.0136]
No. of Observations	29,551	19,259	8,873	1,419	2,114	12,755	9,633	5,049
R-squared	0.526	0.5	0.645	0.829	0.603	0.551	0.534	0.501
No. of Counties	2,902	1,965	808	129	193	1,276	939	494

Note: Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1

The graphs on pages 5 and 6 (below) are visual depictions of the overall trends found in this analysis, showing predicted GDP growth and predicted jobs growth based on the coefficients of the export reliance variables (standardized to set the minimum predicted value equal to zero for each graph). We took percentiles 1-99 of Exports Share of GDP, and calculated the trend of predicted GDP growth or jobs growth by multiplying each value by their corresponding coefficient in the above table and adding the coefficient. We then set the minimum value of each graph equal to zero for the sake better visualizing the trend.

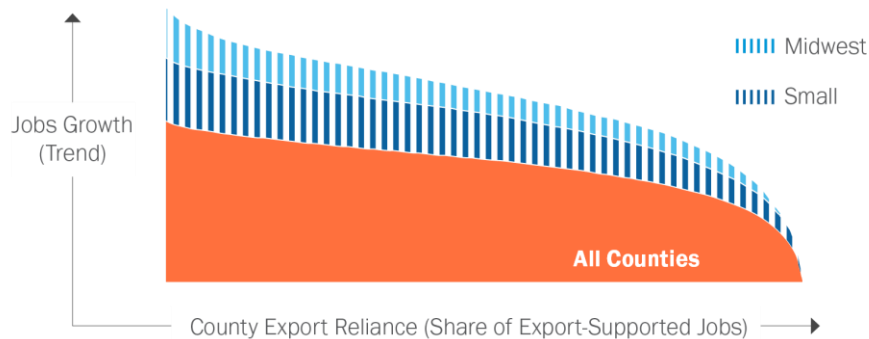
What is Happening? More Export Reliance Connected with Faster GDP Growth, Especially in Small Counties and in Midwest Counties

More Export Reliance =
 Faster GDP Growth in **All Counties**
 Even Faster GDP Growth within **Small Counties** and **Midwest Counties**



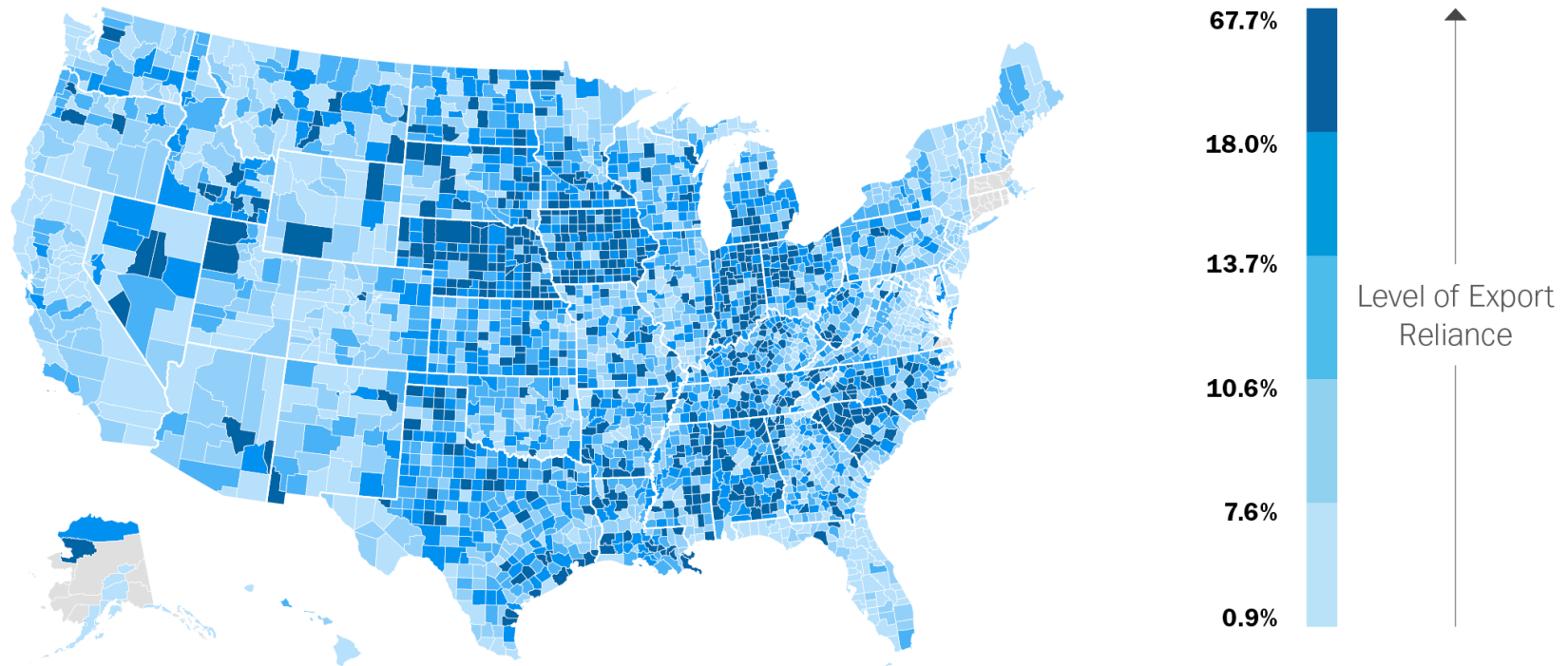
What is Happening? More Export Reliance Connected with Slower Jobs Growth, Especially in Small Counties and in Midwest Counties

More Export Reliance =
 Slow Job Growth in **All Counties**
 Even Slower Job Growth within **Small Counties** and **Midwest Counties**

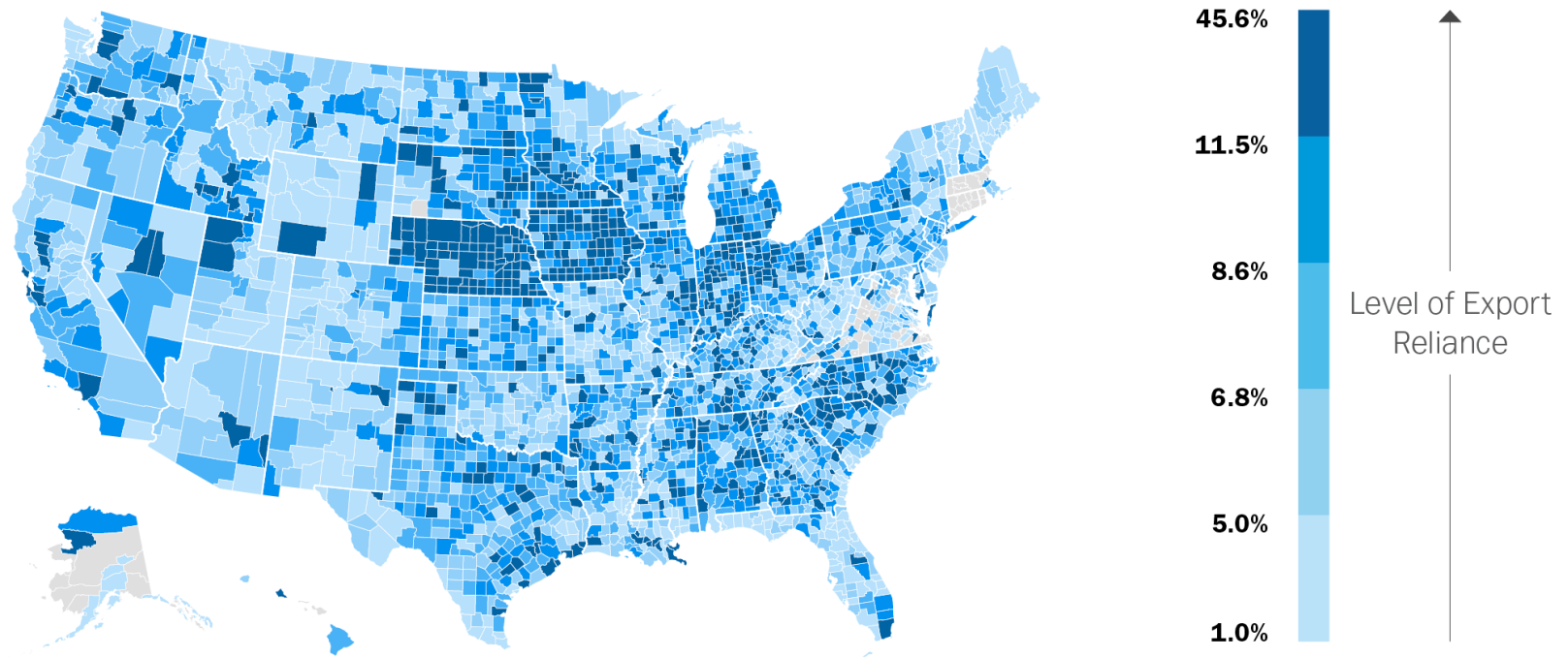


The maps on pages 7 and 8 (below) come from NACo's County Explorer, which can be found at Explorer.NACo.org. Note that the first map shows Export Reliance by Exports Share of **GDP**, while the second map shows Export Reliance by Export-Supported **Jobs**, Share of Total Jobs.

Where is it Happening? Export Reliance by Exports Share of GDP, 2017

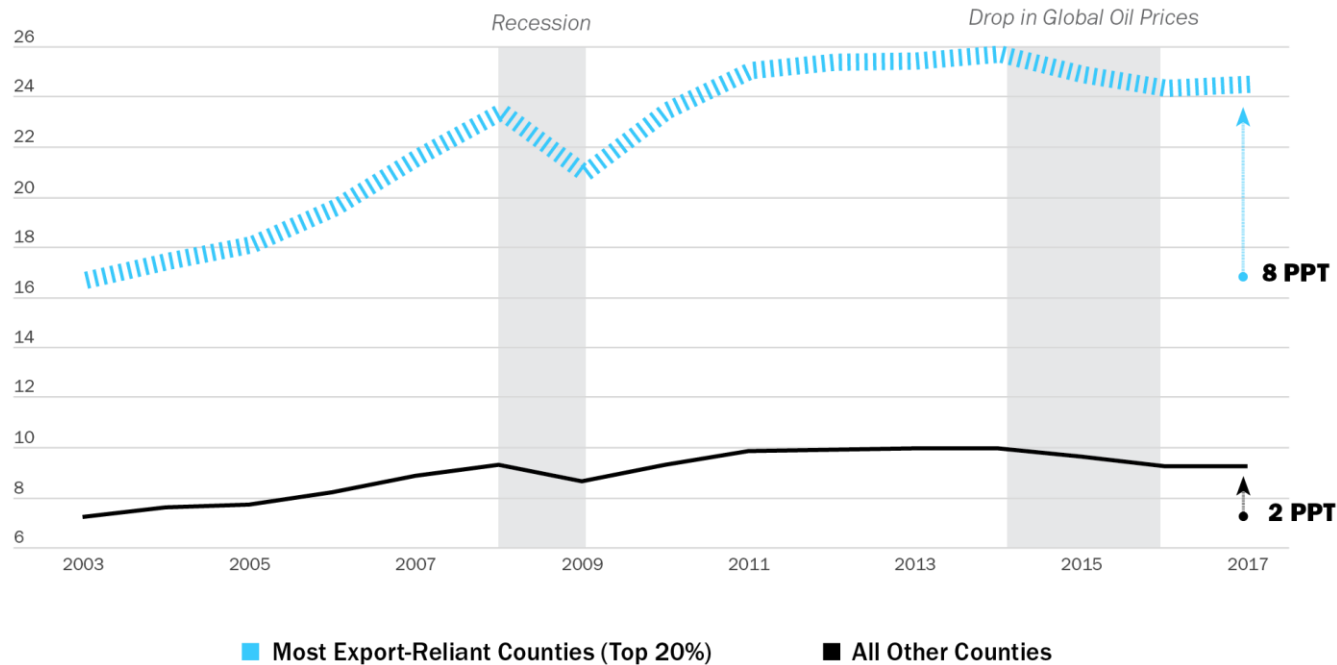


Where is it Happening? Export Reliance by Export-Supported Jobs, Share of Total Jobs, 2017



The graph on page 9 (below) shows the change of International Exports Share of GDP from 2003 to 2017. The top line in blue shows this indicator over time for counties that were in the top quintile (20 percent) of counties by 2017 Exports Share of GDP. The bottom line in black shows this indicator over time for all other counties (*i.e.*, the bottom 80 percent, which excludes the top 20 percent).

International Exports Share of GDP, Most Export-Reliant Counties (Top 20%) vs. All Other Counties, 2003-2017



Sources: NACo Analysis of Brookings Institution Export Monitor 2018, Data; NACo Analysis of Bureau of Labor Statistics - Local Area Unemployment Statistics (LAUS), Data; NACo Analysis of Woods and Poole Economics Inc., Data; NACo Analysis of U.S. Census Bureau - Building Permits Survey, Data.

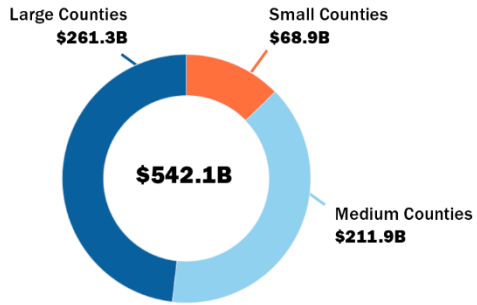
County Foreign Direct Investment (FDI) Analysis

The analysis of foreign direct investment (FDI) going to counties was purchased from fDi Markets and only considers greenfield FDI projects, not mergers and acquisitions (M&A). In a greenfield investment, a company establishes a new facility from the ground up, thereby creating new jobs and bringing new funding into an economy. Joint ventures are only included where they lead to a new physical operation. Data from fDi Markets are collected from publicly available news sources, including: Financial Times newswires and internal information sources; thousands of media sources including all the world's top business sources; over 2,000 industry organizations and investment promotion agencies newswires; and data purchased from market research and publication companies. fDi Markets data also includes estimates for capital investment and job creation derived from algorithms when a company does not release the information.

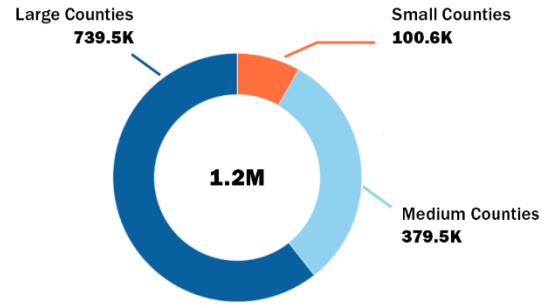
The charts on page 10 (below) show the total FDI capital investment to counties divided by population size and the total number of jobs created by FDI divided by population size. The map (also below) shows the total number of new FDI projects divided by Census-designated region. Regarding population size, NACo categorizes county size based on population: small counties have less than 50,000 residents, large counties have more than 500,000 residents and medium-sized counties have population levels in between the two other groups.

New Foreign Direct Capital Investment and Jobs Created by Population Size, 2003-2017

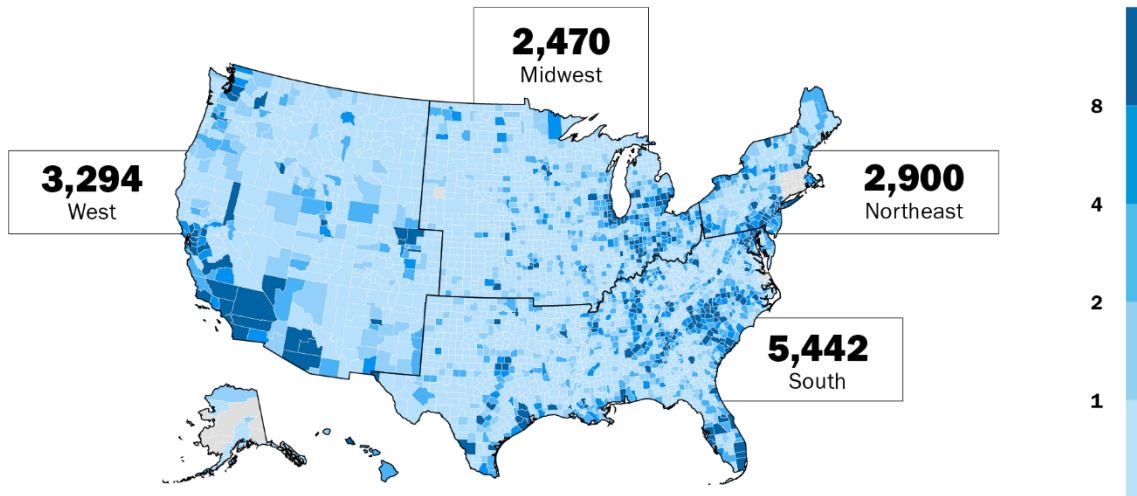
Total FDI Capital Investment



Total FDI-Created Jobs

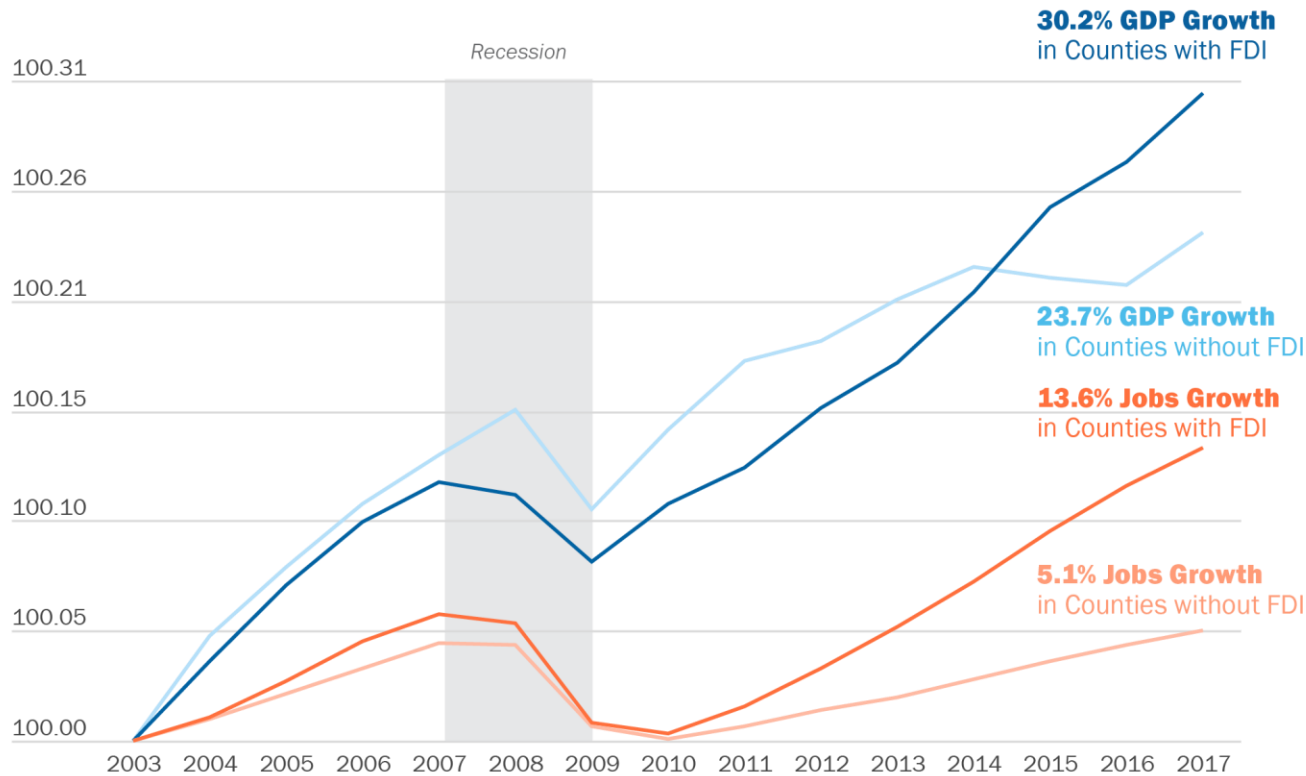


Number of New FDI Projects by Region, 2003-2017



The graph on page 11 (below) divides county economies into two groups: those that did not receive a single FDI project between 2003 and 2017, and those that received at least one FDI project during that time period. The graph shows overall GDP growth and jobs growth for the two groups between 2003 and 2017. The 2003 values are indexed at 100. The authors recognize that no statistically significant conclusions can be drawn from this graph, since dual causality is probable in that FDI naturally creates jobs and increases GDP growth, yet foreign companies are also naturally drawn to already-growing county economies. This graph, therefore, simply illustrates that interplay between economic growth and FDI.

GDP and Jobs Growth of Counties with New FDI Projects vs. Counties without New FDI Projects, 2003-2017



Source: NACo Analysis of fDi Markets, Data; NACo Analysis of Brookings Institution Export Monitor 2018, Data; NACo Analysis of Bureau of Labor Statistics - Local Area Unemployment Statistics (LAUS), Data/

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To view the full report, visit: www.NACo.org/LocalEconomiesInTheGlobalMarket

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