MIGRATION CENTERS OF VIRGINIA

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To Chandler Jaynes, soon to be Chandler Reyes

ACKNOWLEDGMENTS

I thank my parents for leaving their home for a better opportunity for me and my siblings, your story inspired this case study.

ABSTRACT

As the foreign-born population continues to grow in the United States, analyzing migration factors is crucial for continued growth. Immigration can be integral to the overall economy of an area as it leads to an increase of workers, business owners, taxpayers, and consumers. Virginia, specifically the Northern Virginia metropolitan region, is prime example of this correlation between a high foreign-born population and a bolstering economy. To ensure the large foreign-born population is maintained in Virginia, this study focuses on the significance and causes of migration. Several socioeconomic demographics were examined through regression and suitability analyses to understand the relationship between immigrants and an economy and migration. Based on the knowledge of push and pull migration factors, various demographics were chosen to represent these factors. The regression analysis assessed the relationship between the high foreign-born population and economic demographics, while the location suitability analysis mapped potential sites for immigration based on established migration criteria. The regression analysis proved an overall positive relationship between a large-foreign born population and an area's overall economy, highlighting the importance of migration. The location suitability analysis demonstrated the draw, in conjunction with current immigrant population demographics, to those large urban centers with higher levels of socioeconomic advancement. The final cartographic products will demonstrate the importance of immigration to stimulate an area's economy and produce recommendations for migration centers.

ETHICS STATEMENT

Introduction

Ethics in GIS began to gain traction in the 1990s. Today, cartographic products/geo-visualization allow an individual or group to convey data or the results of an analysis/experiment to a specific audience. To ensure transparency, GIS professionals must follow a code of ethics. Major components of this code include, using trusted data and practices, sensitivity of information, objectiveness (include information that provides support or contrary to analysis/data), citing others work when appropriate, and recognizing limitations (limitations of one's knowledge/skills and the data itself). As information is so widely available, it is important for professionals to take note of only using trusted data sources and citation of work. All forms of information must be vetted and scrutinized by the user to ensure accuracy and reliability. Without properly evaluated data, a professional can produce, intentionally or unintentionally, false or misleading cartographic products, violating GIS ethics.

Case Study

In terms of ethics, in relation to this case study, data quality is at the forefront as it is the main basis for analysis. Only authoritative datasets were collected from government agencies, like the U.S. Bureau of Labor Statistics, U.S. Census Bureau, U.S. Department of Education, U.S. Department of Health and Human Services, U.S. Department of Housing and Urban Development, and U.S. Department of the Treasury. Using these government agencies as data sources provides a sense of confidence, as the data has gone through multiple rounds of quality assurance and control.

As most of these datasets are census related, it is important to summarize the metadata. Summarizing the metadata of these datasets provides clarity of the exact figure being measured or recorded. It also provides the description and defines certain aspects of the data, to include author/owner, year of publication/last update, coordinate/projection systems, spatial resolution, and type of geometry. For example, most of the datasets focus on the foreign-born population in Virginia and the metadata defines what constitutes as a foreign-born person. Data must be properly sourced and documented to ensure the integrity of the analysis.

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LIST OF ABBREVIATIONS

ACS	American Community Survey
AICc	Corrected Akaike Information Criterion
CSV	Comma-separated Values
BLS	Bureau of Labor Statistics
GITTA	Geographic Information Technology Training Alliance
GWR	Geographically Weighted Regression
HRSA	Health Resources and Services Administration
HUD	Housing and Urban Development
ICE	Immigration and Customs Enforcement
LAI	Location Affordability Index
LEHD	Longitudinal Employer – Household Dynamics
MUA	Medically Underserved Areas
MUP	Medically Underserved Populations
NCES	National Center for Education Statistics
NOVA	Northern Virginia
NVRC	Northern Virginia Regional Commission
OLS	Ordinary Least Squares
VGIN	Virginia Geographic Information Network
VIF	Variance inflation factor

INTRODUCTION

Background

In November 2021, the foreign-born population reached 46.2 million in the United States, the highest number ever recorded in American history. 14.2% of the population is comprised of immigrants, a number that has tripled since 1970 (Camarota & Zeigler, 2021). In the 1970s, the origins of immigrants shifted from European countries to non-European countries, specifically in Latin America and Southeast Asia. The effects of this migration shift can still be seen today. One of the largest immigrant migration centers in the nation is Northern Virginia (NOVA), a part of the Washington D.C. metropolitan area (Budiman, 2020).

Virginia has the 9th largest immigrant population in the United States. In 2018, 1.02 million resided in the state, which accounted for 12.2% of its total population. In addition, 939,000 residents were native-born Americans who have at least one immigrant parent, comprising 11% of the population. Close 25% of population have a direct tie to immigration in the state. Origins of these immigrants range from all around the globe, but most are originally from Latin America, 41.8% (America Immigration Council, 2020). This is the remnants of the migration shift from the 1970s.

The Immigrant Effect

The immigrant population in the United States has been on a consistent rise in past decades. Virginia almost mirrors the United States in immigrant population percentage. The immigrant population plays a crucial role in the economy, specifically in NOVA. In 2017, immigrants contributed more than $57 billion to NOVA's economy. Immigrants also accounted for 34% of the region's working-age population. Finally, immigrants made up 59.3% of business owners in personal services, like laundry,

barber, and repair shops, and over 41% of business owners in retail trade (New American Economy, 2020). There are 21,000 Hispanic and Asian owned establishments with paid staff and 75,000 with no staff, or self-employed (Hughes, 2021). As immigration is significant to Virginia's economy, efforts must be made to ensure this upward trend continues by understanding the underlaying factors of migration.

Virginia's foreign-born residents are concentrated in NOVA with 68.1% inhabiting the region (Campos, Kang, Mendenhall and Ricky Yao, 2020). According to the Northern Virginia Regional Commission (NVRC), the region is comprised of Arlington, Fairfax, Loudoun, Prince William, and the independent cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park (NVRC, 2022). As NOVA is not incorporated, some outlying counties could be considered as well, however proximity to Washington D.C. is the major component. Other large concentrations of immigrants are in the Richmond (9.8%) and Virginia Beach (11.5%) metropolitan areas. For remaining regions and counties, immigrants constitute less than 5% of their population.

Even though the immigrant population is concentrated in NOVA, most of the counties in the state have seen large increases of immigrants. Regardless, the disparity is clear that immigrants tend move to more urban and metropolitan areas within Virginia (Sen, 2014). These metropolitan areas are ideal regions for migration due to the socioeconomic advantages of inhabiting a more urban than rural location. As seen in NOVA, this influx of immigrants then funnels back into communities as resources, money, taxes, workforce, and jobs.

Research

There is little to no previous literature studying Virginia migrations patterns and immigrant and economy relationships with a geospatial analytical focus. However, various studies and research have been conducted utilizing similar techniques.

In a study by Adbi Ahmed (2013), at Saint Mary's University of Minnesota, they conducted a geospatial analysis of the immigrant population within the Twin Cities metropolitan counties of Minnesota to locate concentrations of immigrants to help plan and prepare services from both governmental and non-governmental organizations for future waves of migrants. While this study did not focus on migration patterns of immigrants, it focused on the spatial distribution of the foreign-born population within a geographic location. The results of this study concluded that the immigrant population was concentrated in the two major cities in the area, Minneapolis and St. Paul, and bordering counties. Similar techniques, specifically linking census data to counties, were utilized within this study.

Similarly, Giuseppe Borruso and Beniamino Murgante of Universita degli Studi della Bascilicata and University of Triestes (2012), conducted a study that focused on spatial autocorrelation in order to analyze the highest values of a foreigner group considering relationship with the surrounding municipalities. Using spatial autocorrelation techniques allowed to uncover higher values of heterogeneity and relationships between areas. Again, a similar technique, specifically spatial autocorrelation to measure relationships, was utilized within this study.

Goals and Objectives

To further understand the immigrant population in Virginia, the growth of the foreign-born population was examined. Migrations patterns were highlighted for the past

two decades (2000 - 2019) to illustrate movement throughout the state. These patterns revealed the disparity of the immigrant population in major city centers compared to more rural areas. To explain the causes of this disparity, push and pull factors of migration were studied. Using these factors answered why NOVA, and its counties, have become an ideal location for migration. Finally, the relationship between the immigrant population and its effect on a region's economy were explored. By studying and understanding the foreign-born population, state and local governments of Virginia can better service the population while benefitting from them as well.

DATA

Study Area

The focus of this analysis is Virginia. Virginia, being one of the original 13 colonies of the United States, has seen surges of migrants since its founding. Today, it ranks as the 12th largest state by population and the 9th largest by foreign-born population. It is home to some of the most populous and wealthiest counties in the nation, specifically Falls Church and Fairfax cities and Loudon, Arlington, and Fairfax counties (U.S. News, 2020). Virginia's large population and economy, creates a suitable candidate to analyze immigration and the effect on an economy (Figure 1, Table 1). Figure 1 depicts all counties within the state. Virginia is divided into 95 counties, along with 38 independent cities that are considered county-equivalents for census purposes. By combining census data to the appropriate county and census tract, the characteristics of an area can be visually displayed and analyzed. County boundaries were obtained from Virginia Geographic Information Network (VGIN), while the census tract boundaries were obtained from the U. S. Census Bureau (Table 2).

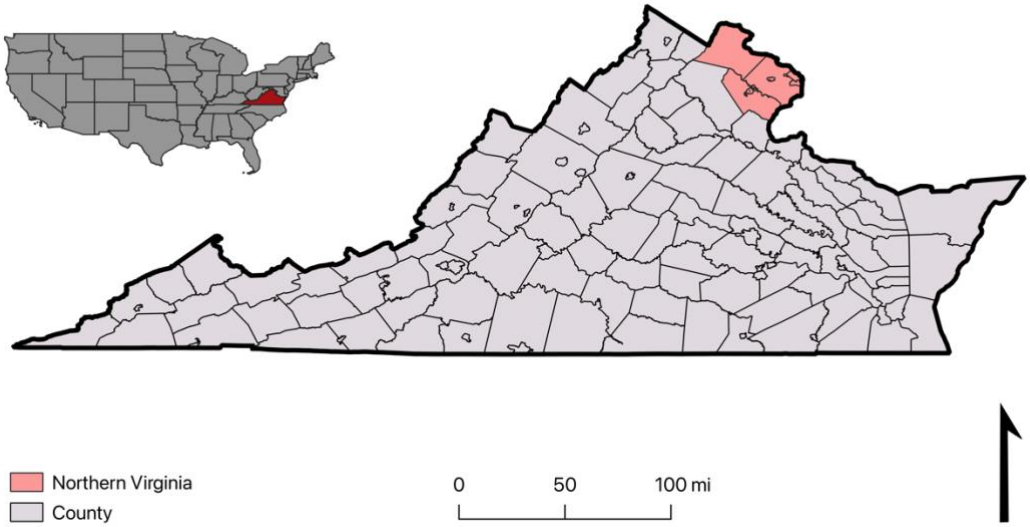

Figure 1. Counties of Virginia

Official Name of Dataset	Virginia Counties
Year of Publication and/or Last Update	December 2021
Author and/or Owner	VGIN
URL or FTP address of Repository	https://vgin.maps.arcgis.com/home/index.html
Description	Virginia County is a feature class representing locality (county and city) boundaries in the Commonwealth of Virginia. This dataset was derived from Census TIGER data supplemented with data made available from the cities and counties themselves.
Coordinate System	WGS 1984
Projection System	WGS 1984 Web Mercator (auxiliary sphere)
Spatial Resolution	N/A
Type of Geometry	Polygon

Table 1. Metadata of Virginia counties

Official Name of Dataset	Virginia Census Tracts
Year of Publication and/or Last Update	May 2017
Author and/or Owner	U.S. Census Bureau, Department of Commerce
URL or FTP address of Repository	https://catalog.data.gov/dataset/tiger-line-shapefile-2017-state-virginia-current-census-tract-state-based
Description	TIGER/Line Shapefiles are extracted from the Census MAF/TIGER database by nation, state, county, and entity. Census MAF/TIGER data for all of the aforementioned geographic entities are then distributed among the shapefiles each containing attributes for line, polygon, or landmark geographic data.
Coordinate System	WGS 1984
Projection System	WGS 1984 Web Mercator (auxiliary sphere)
Spatial Resolution	N/A

Type of Geometry	Polygon

Table 2. Metadata of Virginia census tracts

Demographics

Census data is crucial to document the demographics of a country. The U.S. Census Bureau provides the most in-depth examination of the nation's people. The American Community Survey (ACS), a separate survey from the decennial census, provides extensive data ranging from jobs/occupations, home ownership, veteran status, etc. The decennial census is conducted every ten years, counts every person living the 50 states, District of Columbia, and the five U.S. territories, focuses on a shorter set of questions (such as age, sex, race, Hispanic origin, and owner/renter status), and provides an official count of the population. While the ACS is conducted every month/year, sent to a sample of addresses (about 3.5 million) in the 50 states, District of Columbia, and Puerto Rico, focuses on a larger set of questions (such as education, employment, internet access, and transportation), and provides current information to communities every year (U.S. Census Bureau, 2022).

To measure the growth of the foreign-born population of Virginia, tables in the form of CVS files, were obtained from PolicyMap (https://www.policymap.com). Tables were sourced from the U.S. Census Bureau. PolicyMap curates, normalizes, and makes understandable data from across multiple siloed agencies and supplements that data with data licensed from third party providers (PolicyMap, 2022). All tables of population are estimated or actual population of counties of a range of a five-year span or a singular year (Table 3, Table, 4, Table 5, Table 6). All tables of foreign-born population are estimated or actual population of counties of a range of a five-year span or a singular year (Table 7, Table, 8, Table 9, Table 10). These datasets were joined to the

appropriate county and then used to calculate the percentage of the foreign-born population. A foreign-born person is defined as an individual who was not a U.S. citizen at birth. This includes naturalized U.S. citizens, lawful permanent residents (immigrants), temporary migrants (such as students), humanitarian migrants (such as refugees), and persons illegally present in the United States (U.S. Census Bureau, 2021). The foreign-born population is used as the dependent variable for regression analysis.

Official Name of Dataset	Estimated population by county, as of 2015-2019 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated count of population, between 2015-2019.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 3. Metadata of estimated population by county, as of 2015-2019 in Virginia

Official Name of Dataset	Estimated population by county, as of 2010-2014 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated count of population, between 2010-2014.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 4. Metadata of estimated population by county, as of 2010-2014 in Virginia

Official Name of Dataset	Estimated population by county, as of 2004-2009 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated count of population, between 2004-2009.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 5. Metadata of estimated population by county, as of 2004-2009 in Virginia

Official Name of Dataset	Population by county, as of 2000 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Count of population in 2000.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 6. Metadata of population by county, as of 2000 in Virginia

Official Name of Dataset	Estimated population of all people who were foreign-born by county, as of 2015-2019 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated population who are foreign-born, as reported between 2015-2019. The U.S. Census defines "foreign-born" to refer to anyone who is not a U.S. citizen at birth. This includes naturalized U.S. citizens, lawful permanent residents (immigrants), temporary migrants (such as students), humanitarian migrants (such as refugees), and persons illegally present in the United States.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 7. Metadata of estimated population of all people who were foreign-born by county, as of 2015-2019 in Virginia

Official Name of Dataset	Estimated population of all people who were foreign-born by county, as of 2010-2014 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated population who are foreign-born, as reported between 2010-2014. The U.S. Census defines "foreign-born" to refer to anyone who is not a U.S. citizen at birth. This includes naturalized U.S. citizens, lawful permanent residents (immigrants), temporary migrants (such as students), humanitarian migrants (such as refugees), and persons illegally present in the United States.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 8. Metadata of estimated population of all people who were foreign-born by county, as of 2010-2014 in Virginia

Official Name of Dataset	Estimated population of all people who were foreign-born by county, as of 2005-2009 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated population who are foreign-born, as reported between 2005-2009. The U.S. Census defines "foreign-born" to refer to anyone who is not a U.S. citizen at birth. This includes naturalized U.S. citizens, lawful permanent residents (immigrants), temporary migrants (such as students), humanitarian migrants (such as refugees), and persons illegally present in the United States.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 9. Metadata of estimated population of all people who were foreign-born by county, as of 2005-2009 in Virginia

Official Name of Dataset	Population of all people who were foreign-born by county, as of 2000 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Population that is foreign-born in 2000. The U.S. Census defines "foreign-born" to refer to anyone who is not a U.S. citizen at birth. This includes naturalized U.S. citizens, lawful permanent residents (immigrants), temporary migrants (such as students), humanitarian migrants (such as refugees), and persons illegally present in the United States. Percentage calculations were suppressed in cases where the denominator of the calculation was less than 10 of the unit that is being described (e.g., households, people, householders, etc). Such areas are represented as having "Insufficient Data" in the map. Denominators for percentage calculations were created by summing all of the component data items in a particular dataset.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 10. Metadata of population of all people who were foreign-born by county, as of 2000 in Virginia

PolicyMap not only holds data from the U.S. Census Bureau but other federal agencies as well. The data provided from these agencies serve as variables for the regression analysis and criteria for the location suitability analysis. These tables focus on economics, education, and health. Tables focusing on economic data include estimated median household income (Table 11), average annual wage (Table 12), estimated percent of people unemployed (Table 13), number of people employed (Table 14), estimated percent of people in labor force (Table 15), number of non-federal jobs (Table 16), percent of income spent on housing and transportation (Table 17), total amount of state and local income taxes (Table 18), total amount of business or professional net income (Table 19), and total amount of self-employment tax (Table 20). These datasets will be joined to the appropriate county and then used as explanatory variables or criteria for analysis. Tables focusing on education include graduation rates (Table 21). This dataset will be joined to the appropriate county and then used as criteria for location suitability analysis. Tables focusing on health include Medically Underserved Areas (MUA) (Table 22). MUAs are designated by the Health Resources and Services Administration (HRSA) as having too few primary care providers, high infant mortality, high poverty, and/or a high elderly population. This dataset will be joined to the appropriate county and then used as criteria for location suitability analysis.

Official Name of Dataset	Estimated median income of a family by county, as of 2015-2019 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated median income of a family, between 2015-2019.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A

Type of Geometry	N/A

Table 11. Metadata of estimated median income of a family by county, as of 2015-2019 in Virginia

Official Name of Dataset	Average annual wage across all industries in 2020 by County, as of 2020 in Virginia
Year of Publication and/or Last Update	January 2022
Author and/or Owner	Bureau of Labor Statistics (BLS), Quarterly Census of Employment and Wages
URL or FTP address of Repository	https://www.policymap.com/
Description	Average annual wage across all industries in 2020
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 12. Metadata of average annual wage across all industries in 2020 by county, as of 2020 in Virginia

Official Name of Dataset	Estimated percent of people age 16 years or older who were unemployed by county, as of 2015-2019 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census, ACS
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated percent of civilian people age 16 years or older in the labor force who were unemployed, between 2015-2019. Civilians are defined as those not serving in the armed forces. Percentage calculations are suppressed in cases where the denominator of the calculation was less than 10 of the unit that is being described (e.g., households, people, householders, etc.).
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 13. Metadata of estimated percent of people age 16 years or older who were unemployed by county, as of 2015-2019 in Virginia

Official Name of Dataset	Number of people employed by county, as of 2020 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	BLS, Quarterly Census of Employment and Wages
URL or FTP address of Repository	https://www.policymap.com/
Description	Annual number of people who were employed in 2020. Employed persons include people who did any paid work as employees, worked in their own business or farm, or did unpaid work of 15 or more hours in an establishment owned by a relative.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 14. Metadata of number of people employed by county, as of 2020 in Virginia

Official Name of Dataset	Estimated percent of people age 16 years or older who were in the labor force, as of 2015-2019 in Virginia
Year of Publication and/or Last Update	October 2021
Author and/or Owner	U.S. Census
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated percent of people age 16 years or older who were in the labor force, between 2015-2019. Those in the labor force may be employed or unemployed. Percentage calculations are suppressed in cases where the denominator of the calculation was less than 10 of the unit that is being described (e.g., households, people, householders, etc.).
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 15. Metadata of estimated percent of people age 16 years or older who were in the labor force by county, as of 2015-2019 in Virginia

Official Name of Dataset	Number of non-federal jobs in all industries by county, as of 2017 in Virginia
Year of Publication and/or Last Update	November 2019
Author and/or Owner	Longitudinal Employer-Household Dynamics (LEHD)
URL or FTP address of Repository	https://www.policymap.com/
Description	Count of non-federal jobs in all industries in 2017. Data that includes federal employees is available for only the following years: 2010, 2011, 2012, 2013, 2014, 2015. Available data for other years includes only employees of private firms and state and local governments. Data are not available for all states in all years.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 16. Metadata of number of non-federal jobs in all industries by county, as of 2017 in Virginia

Official Name of Dataset	Percent of income spent on housing and transportation by a median-income family household by census tract, as of 2019 in Virginia
Year of Publication and/or Last Update	May 2019
Author and/or Owner	U.S. Department of Housing and Urban Development (HUD) Location Affordability Portal
URL or FTP address of Repository	https://www.policymap.com/
Description	Percent of income spent on housing and transportation by a median-income family household, as of 2019. According to this data, a "median-income family" household has 4 people,

	the median income for the region, and 2 commuters. Percents greater than 100 occur where the modeled expenses exceed the income of a median-income family household, and likely indicate areas of economic distress. The LAI provides standardized household housing and transportation cost estimates at the neighborhood level. Since housing and transportation costs typically consume about half of the average household budget, these offer a useful tool for evaluating where people decide to live and work, where to locate resources or facilities, and areas of potential economic distress.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 17. Metadata of percent of income spent on housing and transportation by a median-income family household by census tract, as of 2019 in Virginia

Official Name of Dataset	Total amount of state and local income taxes on all income tax returns by county, as of 2018 in Virginia
Year of Publication and/or Last Update	February 2021
Author and/or Owner	Internal Revenue Service (IRS)
URL or FTP address of Repository	https://www.policymap.com/
Description	Total amount of state and local income taxes on all income tax returns in 2018. Total amount of state and local income taxes reported on 1040, 1040A, and 1040EZ forms filed with the IRS for the tax year 2018. Filers can choose to claim either local and state income taxes or sales taxes, but not both.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 18. Metadata of total amount of state and local income taxes on all income tax returns by county, as of 2018 in Virginia

Official Name of Dataset	Total amount of business or professional net income on all income tax returns by county, as of 2018 in Virginia
Year of Publication and/or Last Update	February 2021
Author and/or Owner	IRS
URL or FTP address of Repository	https://www.policymap.com/
Description	Total amount of business or professional net income on all income tax returns in 2018. Total amount of business or professional net income reported on 1040, 1040A, and 1040EZ forms filed with the IRS for the tax year 2018.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A

Type of Geometry	N/A

Table 19. Metadata of total amount of business or professional net income on all income tax returns by county, as of 2018 in Virginia

Official Name of Dataset	Total amount of self-employment tax on all income tax returns by county, as of 2018 in Virginia
Year of Publication and/or Last Update	February 2021
Author and/or Owner	IRS
URL or FTP address of Repository	https://www.policymap.com/
Description	Total amount of self-employment tax on all income tax returns in 2018. Total amount of self-employment tax reported on 1040, 1040A, and 1040EZ forms filed with the IRS for the tax year 2018. This refers to Social Security and Medicare taxes, and does not include other taxes that self-employed individuals are required to file.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 20. Metadata of total amount of self-employment tax on all income tax returns by county, as of 2018 in Virginia

Official Name of Dataset	Graduation Rate by School District, as of 2009-2010 in Virginia
Year of Publication and/or Last Update	May 2019
Author and/or Owner	NCES
URL or FTP address of Repository	https://www.policymap.com/
Description	Estimated percentage of the freshman class that graduated in four years, for the class graduating in the 2009-10 school year. This is calculated by dividing the total number of diploma recipients each year by the average membership of the 8th grade class 4 years prior, the 9th grade class 3 years prior, and the 10th grade class 2 years prior. Ungraded students are prorated into these grades. The data is calculated only for local education agencies that reported both number of graduates and student enrollment. Any school district for which the averaged freshman graduation rate is not available is displayed on the map as having Insufficient Data.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 21. Metadata of graduation Rate by School District, in of 2009-2010 in Virginia

Official Name of Dataset	MUA by census tract, as of 2020 in Virginia
Year of Publication and/or Last Update	January 2022
Author and/or Owner	HRSA
URL or FTP address of Repository	https://www.policymap.com/

Description	MUA, as of 2020. MUAs are designated by the HRSA as having too few primary care providers, high infant mortality, high poverty, and/or a high elderly population. MUP are areas where a specific population group is underserved, including groups with economic, cultural, or linguistic barriers to primary medical care. If a population group does not meet the criteria for an MUP, but exceptional conditions exist which are a barrier to health services, they can be designated with a recommendation from the state's Governor.
Coordinate System	N/A
Projection System	N/A
Spatial Resolution	N/A
Type of Geometry	N/A

Table 22. Metadata of MUA by census tract, as of 2020 in Virginia

METHODS

The primary facet of this research is to document the migration patterns of the foreign-born population and uncover any disparity of distribution. Then to identify the differences between these regions that cause the disparity. Finally, determine the effect the foreign-based population has on a region.

By examining population growth, there was a disparity of the distribution of the foreign-born population throughout the state. Following the methodology (Figure 3) will assist in answering the research questions and confirming the hypothesis. Figure 3 illustrates the steps taken to document migration patterns, locate suitable locations for migration, and analyze the relationship between the foreign-born population and NOVA’s economy.

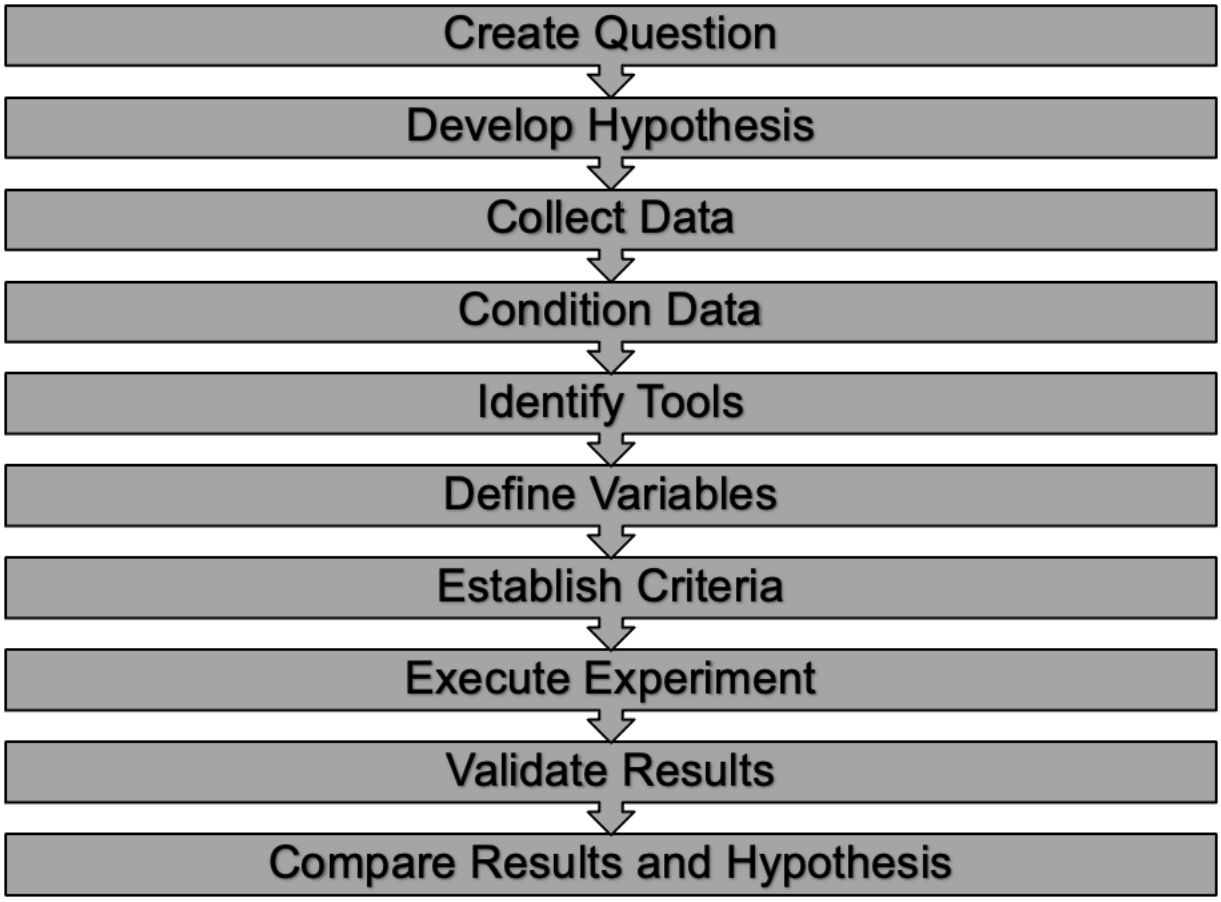

Figure 2. Workflow of methodology

To test these theories, census data that highlights economic and social demographics were collected. Prior to any analysis, the data was conditioned accordingly. The tabular data had to be joined to the county and census tract feature layers. Census demographic CVS tables were converted to Esri tables for better interoperability within ArcPro. The tables were joined to their respective county and census tract by a common field, “FIPS” and “GEOID”. Each row within the tables contained a unique ID, “FIPS” or “GEOID”, which represented an actual county or census tract. Census tract data was then joined to the corresponding county. To visualize the data spatially, each row had to be linked to an administrative boundary

feature layer. From each join, a new feature layer was created representing the respective demographic.

Suitability Location Analysis

Suitability analysis is an approach used to identify locations that best meet established criteria for a site (Briney, 2014). The goal of this analysis being to identify the best areas for migration in Virginia. The criteria for potential sites include low unemployment rates, not a MUA, low percent of income spent on housing and transportation, high graduation rate, high average annual wages, and high median household income. These demographics were chosen to represent the major economic and social pulls for migration, essentially areas with abundant jobs, access to healthcare, affordable housing and transportation, successful school systems, and a strong economy. There are two different methods for suitability analysis, boolean overlay and ranked.

Boolean Overlay Method

The boolean overlay is an intersection of coded data layers using boolean operations (AND, OR, and NOT) resulting in an overlay with areas that are true and areas that are false (GITTA (Geographic Information Technology Training Alliance), 2013). Each demographic feature layer was queried to match the set criteria for the boolean overlay (Table 23). Table 23 lists the criteria for the boolean overlay method for suitability analysis. Layers were then intersected to find the suitable locations.

ID	Condition	Reference Data	GIS features
A	Median household income must above 60,000	County	Selected polygons that met this criterion and save them to a new shapefile
B	Percentage of unemployed must less than 4%	County	Select polygons that meet this criterion and save them to a new shapefile

C	Average annual wage must be above 50,000	County	Selected polygons that met this criterion and save them to a new shapefile
D	Graduation rate must be above 85%	County	Selected polygons that met this criterion and save them to a new shapefile
E	Percentage of income spending on housing and transportation must be below 50%	County	Selected polygons that met this criterion and save them to a new shapefile
F	Must not be a MUA	County	Selected polygons that met this criterion and save them to a new shapefile

Table 23. Criteria for boolean overlay method

Ranked Method

The ranked method is an intersection of standardized and differently weighted layers in a suitability analysis, with the weight that quantifies the relative importance of the suitability criteria considered (GITTA, 2013). Similar criteria were used for the ranked suitability method, with the basis being low unemployment rates, not a MUA, affordability of housing and transportation, high graduation rate, high average annual wages, and high median household income (Table 24). Table 24 lists the criteria for the ranked method for suitability analysis. However, each criteria had defined levels or intervals that prioritized suitable locations. These intervals range from high to low suitability. The higher or lower the percentage or number, the better or worse. A field was added to each feature and then field calculated to introduce the rankings to their respective scheme (Table 25). Table 25 lists for ranking for each criteria. An overall suitability field was added, and field calculated by giving weights to each of the ranks or exports. Demographics regarding economic opportunity were given larger weights as it is primary reason for migration (Table 26). Table 26 lists the weight for each criteria.

ID	Condition	Reference Data	GIS features
A	The higher the median household income, the better	County	Ranked polygons based on the rating

B	The lower the percentage of unemployed, the better	County	Ranked polygons based on the rating
C	The higher the average annual wage, the better	County	Ranked polygons based on the rating
D	The higher graduation rate, the better	County	Ranked polygons based on the rating
E	The lower the percentage of income spent on housing and transportation, the better	County	Ranked polygons based on the rating
F	The higher ranking of MUA, the better	County	Ranked polygons based on the rating

Table 24. Criteria for ranked suitability analysis

ID	Rank	Condition	GIS features
A	1	Above 60,000	High suitability
	2	Within 60,000 – 50,000	Medium suitability
	3	Below 40,000	Low suitability
B	1	Below 4%	High suitability
	2	Within 4% - 7%	Medium suitability
	3	Above 7%	Low suitability
C	1	Above 50,000	High suitability
	2	Within 50,000 – 40,000	Medium suitability
	3	Below 40,000	Low suitability
D	1	Above 85%	High suitability
	2	Within 85% – 75%	Medium suitability
	3	Below 75%	Low suitability
E	1	Below 50%	High suitability

	2	Within 50% - 55%	Medium suitability
	3	Above 55%	Low suitability
F	1	Not an MUA or MUP	High suitability
	2	MUA/MUP – Governor's Exception	Medium suitability
	3	MUA/MUP	Low suitability

Table 25. Criteria for demographic rankings

Criteria	Weight
A	.20
B	.15
C	.25
D	.05
E	.30
F	.05

Table 26. Weights of criteria

Regression Analysis

To find a correlation between the foreign-born population and NOVA's economy, a regression analysis was conducted. Regression analysis assists in modeling, examining, and exploring spatial relationships and explain factors behind observed spatial patterns (Esri, 2022). The first step being an exploratory regression, which evaluates all possible combinations of an input candidate explanatory variables. The dependent variable being foreign-born population and explanatory variables being demographics focused on the economy. The default model criteria within the Esri tool were used to conduct the analysis.

The resulting models of the exploratory regression were then used for a more in-depth analysis by OLS linear regression. OLS analysis generates predictions or to a

model a dependent variable in terms of its relationships to a set of explanatory variables (Esri, 2022). Again, the foreign-born population was used as the dependent variable while the economic demographics were used as the explanatory variables (Table 27). Table 27 lists the dependent and explanatory variables.

Regression Analysis Variables	
Dependent Variables	**Explanatory Variables**
Foreign-born population	Number of people employed
N/A	Number of non-federal jobs in all industries
N/A	Number of people who were in the labor force
N/A	Total amount of business or professional net income on all income tax returns
N/A	Total amount of self-employment tax on all income tax returns
N/A	Total amount of state and local income taxes on all income tax returns

Table 27. Variables for regression analysis

By using spatial analysis techniques, suitability and regression, it provides a quantified measurement of suitable locations for migration and statistically significant relationships between the foreign-born population and an economy. The results of these methods will potentially confirm the hypothesis that in Virginia, immigrants are drawn to large metropolitan areas primarily for economic reasons and that they have a positive effect on the overall economy.

RESULTS/DISCUSSION

Migration centers in Virginia are concentrated in the major metropolitan areas of the state, NOVA, Richmond, and Virginia Beach. With the highest concentration in NOVA, as all counties apart of the region are symbolized as a dark red indicating a foreign-born population greater than 20% (Figure 3). The darker shades of red within figure 3 highlight those areas with a higher concentration of foreign-born people. The foreign-born population has also expanded to the surrounding suburbs of these metropolitan areas as well (Figure 4). Figure 4 illustrates the foreign-born population of

the 2000s. Outside of the three major metropolitan areas, the foreign-born populations of Albemarle County and the city of Charlottesville have grown significantly.

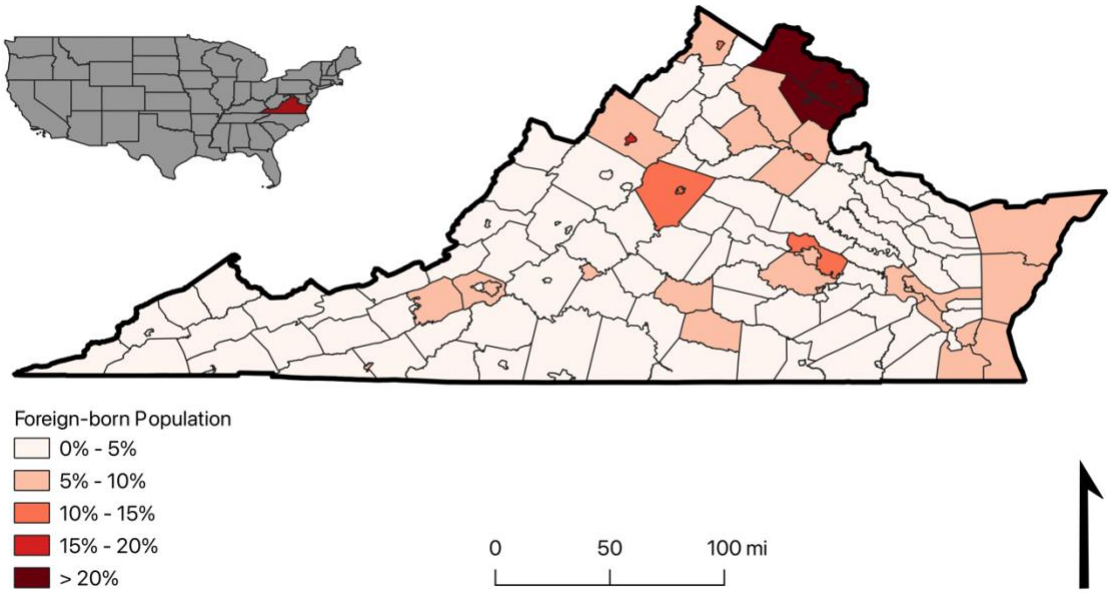

Figure 3. Estimated percent of all people who were foreign-born as of 2015-2019

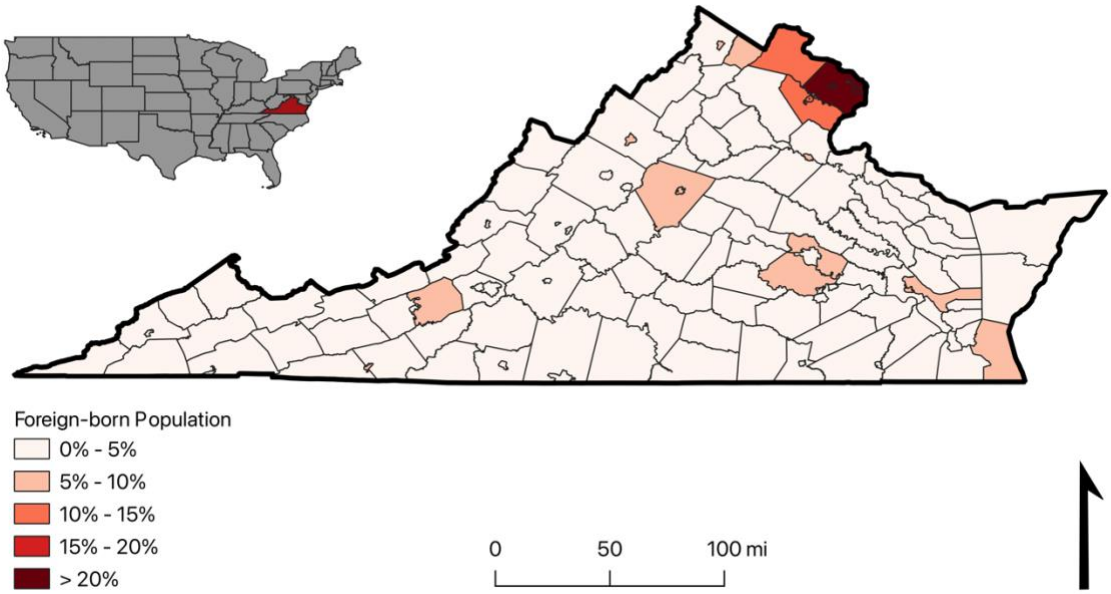

Figure 4. Percent of all people who were foreign-born as of 2000

Even though the foreign-born population is concentrated in these areas, migration has increased all throughout the state in the past two decades. Almost every

county has experienced growth in their foreign-born population. Since 2000, 80% of counties have experienced growth of at least 25% while only 10% have seen a decrease (Figure 5). Counties symbolized as yellow, green, and blue, within Figure 5, illustrates an increase of the foreign-born population greater than 25%.

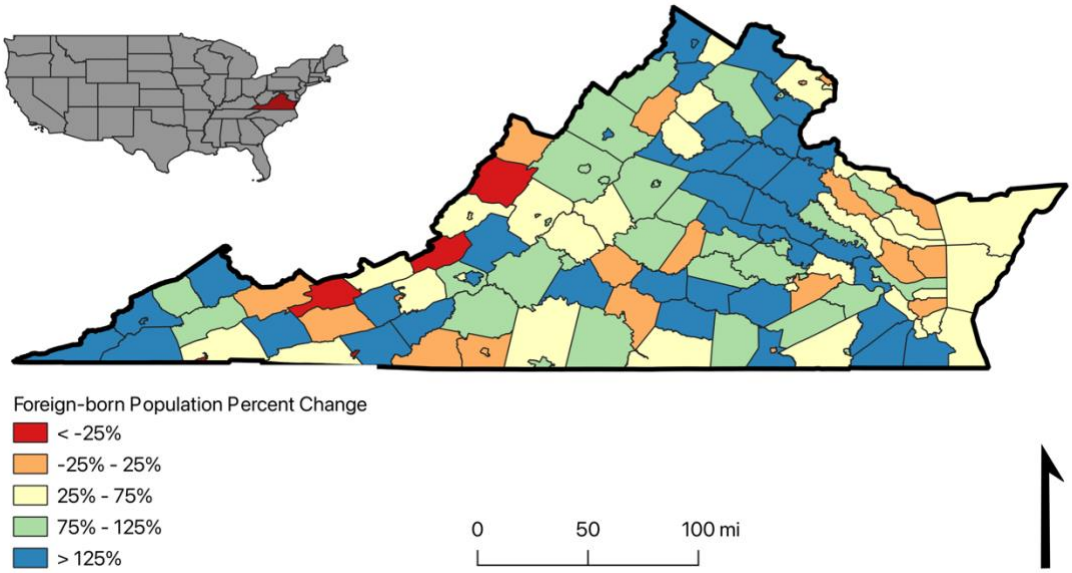

Figure 5. Estimated percent change in the number of people who were foreign born between 2000 and the period of 2015-2019

Suitability Location Analysis

There were six criteria that had to be followed to find the most suitable locations for migration. The boolean method of the suability analysis severely restricted the number of possible areas of relocation due to the number of variables (Figure 6). Figure 6 depicts all counties that fall within the boolean method criteria, symbolized in green. Of the 133 counties only three were suitable locations, less than 2%. The ranked method further expanded suitable locations throughout the state (Figure 7). In Figure 7, counties are symbolized as green, yellow, or red, indicating high, medium, or low

suitability, respectively. According to the ranked method, there are 19 counties (14%) ranked as high, 71 as medium (54%), and 43 (32%) as low suitability.

The two types of suitability analyses, boolean and ranked, reflected the current migration centers of Virginia. The boolean method clearly defined NOVA counties as the most suitable locations. The areas with the largest percentage of foreign-born population, match the most suitable counties and cities of Fairfax, Falls Church, and Loudoun. All of which are a part of the NOVA region.

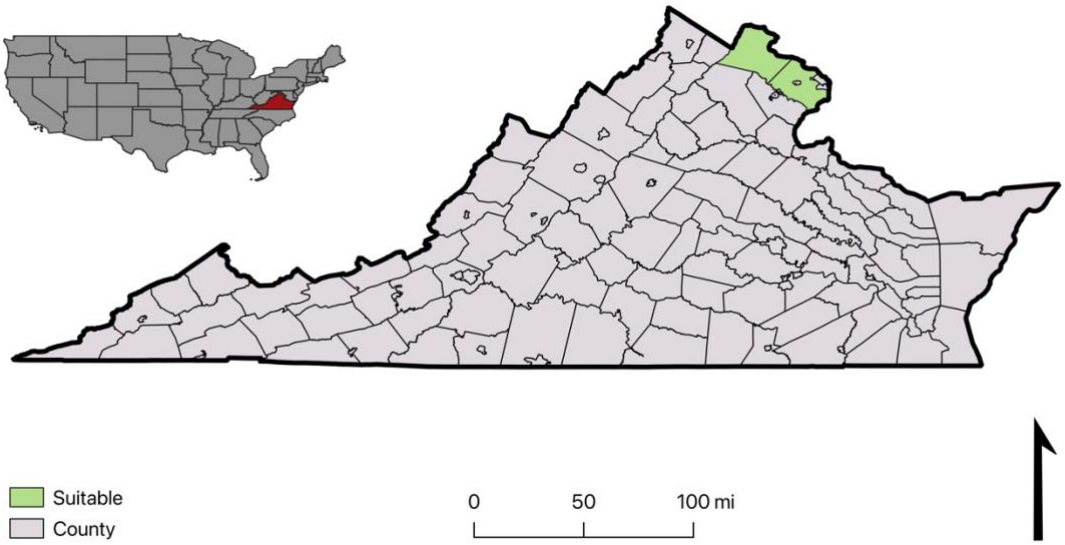

Figure 6. Suitability Location Analysis: Boolean Method

The ranked method offered similar results. The three counties that were suitable, were classified as high in the in the ranked method. All counties of NOVA were classified as high suitability. This method also matched those metropolitan areas with a high foreign-born population, however most of the Virginia Beach and Richmond metropolitan regions were classified as medium. Albemarle County and the city Charlottesville proved to be suitable locations despite not being a large metropolitan

area. Migrants are attracted to those urban centers and avoid the more rural areas of Virginia.

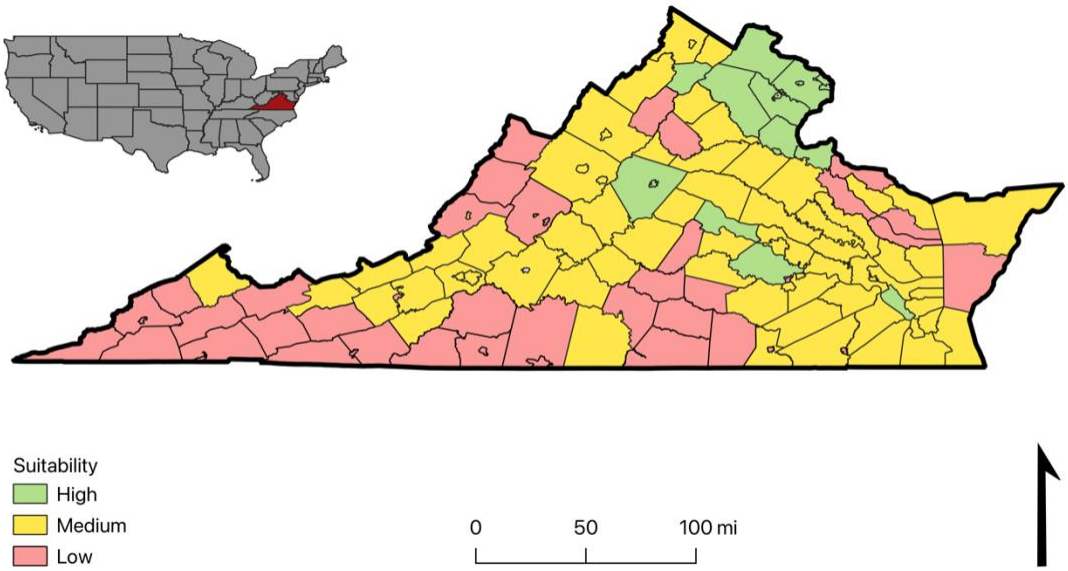

Figure 7. Suitability Location Analysis: Ranked Method

Both methods were successful in locating potential sites for migration. It also provided understanding of the push and pull factors of migration. The similarities of all the potential sites included high levels of economic opportunities (annual wage, median household income, affordability, low unemployment), graduation rates, and accessibility to health care. They also reflected the current demographics of the state, with migrants primarily residing in more urban areas.

Regression Analysis

When conducting the regression analysis, the relationship between the dependent and explanatory variables were examined. The dependent variable being the foreign-born population and explanatory variables being the various demographics focusing on the economy. Using the exploratory regression tool allowed to test for all possible combinations or models of the variables.

1st Iteration

The first iteration of the regression analysis included number of people employed, number of non-federal jobs, number of people in labor force, amount of business or professional net income, amount of self-employment tax, and amount of state and local income taxes. These variables represent the effect the foreign-born population has on NOVA, large labor force, jobs created, business owners, entrepreneurs, and taxes paid. The results of the analysis provided six passing models (Figure 8). Figure 8 provides a summary of all possible combinations or models for the six explanatory variables. However, all variables used were considered redundant due to a high variance inflation factor (VIF) (Figure 9). Figure 9 provides a statistical summary of all criteria for the 6 explanatory variables. All variables had a positive relationship except for self-employment tax.

```
*********************************************************************************
Choose 1 of 6 Summary
    Highest Adjusted R-Squared Results
AdjR2   AICc   JB K(BP)  VIF   SA   Model
 0.98 207.34 0.58  0.11 1.00 0.74  +LABOR***
 0.98 207.57 0.58  0.14 1.00 0.70  +EMPLOYED***
 0.97 211.86 0.48  0.99 1.00 0.61  +JOBS***
                        Passing Models
AdjR2    AICc       JB       K(BP)    VIF      SA         Model
0.982123 207.336283 0.576426 0.106324 1.000000 0.740024  +LABOR***
0.981644 207.574316 0.584089 0.142613 1.000000 0.698940  +EMPLOYED***
0.970460 211.856361 0.482557 0.988068 1.000000 0.614976  +JOBS***
0.965244 213.319757 0.799804 0.822107 1.000000 0.711850  +TAX***
0.963629 213.728573 0.261321 0.934936 1.000000 0.594368  +BUSINESS***
0.955004 215.643894 0.797400 0.968551 1.000000 0.664119  +SELF***
*********************************************************************************
```

Figure 8. Exploratory Regression Model Summary: Six Variables

```
********** Exploratory Regression Global Summary (FOREIGN) **********

             Percentage of Search Criteria Passed
Search Criterion                   Cutoff Trials # Passed % Passed
Min Adjusted R-Squared             > 0.50     39       39   100.00
Max Coefficient p-value            < 0.05     39        6    15.38
Max VIF Value                      < 7.50     39        6    15.38
Min Jarque-Bera p-value            > 0.10     39       35    89.74
Min Spatial Autocorrelation p-value > 0.10     17       14    82.35

--------------------------------------------------------------------------------

     Summary of Variable Significance
Variable % Significant % Negative % Positive
EMPLOYED         92.31       0.00     100.00
LABOR            92.31       0.00     100.00
JOBS             10.53       0.00     100.00
BUSINESS          6.25      25.00      75.00
TAX               6.25      50.00      50.00
SELF              5.56      66.67      33.33

--------------------------------------------------------------------------------

                                  Summary of Multicollinearity*
Variable    VIF Violations Covariates
EMPLOYED  32.96         12 JOBS (37.50), SELF (37.50), BUSINESS (31.25), TAX (31.25)
LABOR     31.93         12 JOBS (37.50), SELF (37.50), BUSINESS (31.25), TAX (31.25)
JOBS     742.14         18 SELF (56.25), BUSINESS (43.75), TAX (43.75), EMPLOYED (37.50), LABOR
(37.50)
BUSINESS 930.39         15 JOBS (43.75), SELF (37.50), EMPLOYED (31.25), LABOR (31.25), TAX (25.00)
TAX      193.59         15 JOBS (43.75), SELF (37.50), EMPLOYED (31.25), LABOR (31.25), BUSINESS
(25.00)
SELF     544.01         17 JOBS (56.25), EMPLOYED (37.50), LABOR (37.50), BUSINESS (37.50), TAX
(37.50)

--------------------------------------------------------------------------------

                     Summary of Residual Normality (JB)
      JB    AdjR2       AICc    K(BP)        VIF       SA   Model
0.979476 0.969422 217.979746 0.366901 598.178442 0.578499  +JOBS  -BUSINESS
0.914177 0.970504 228.014638 0.751878 851.755012 0.945541  +JOBS  -BUSINESS  +TAX
0.799804 0.965244 213.319757 0.822107   1.000000 0.711850  +TAX***

--------------------------------------------------------------------------------

                   Summary of Residual Spatial Autocorrelation (SA)
      SA    AdjR2       AICc       JB    K(BP)        VIF   Model
0.962370 0.988776 241.310757 0.751787 0.287896 528.172789  +EMPLOYED**  +JOBS*  -TAX  -SELF
0.947231 0.989319 240.864107 0.763588 0.291096 531.907173  +LABOR**  +JOBS*  -TAX  -SELF
0.945541 0.970504 228.014638 0.914177 0.751878 851.755012  +JOBS  -BUSINESS  +TAX

--------------------------------------------------------------------------------
```

Figure 9. Exploratory Regression Global Summary: Six Variables

Final Iteration

As there was abundant redundance within the models, variables were removed one by one according to the VIF. In the final iteration, only two variables, number of people employed and number of people in labor force, were used. This iteration

removed all redundancy and provided two passing model (Figure 10). Figure 10 provides a summary of all possible combinations or models for the two explanatory variables. These two were not only 100% significant but also 100% positive (Figure 11). Figure 11 provides a statistical summary of all criteria for the two explanatory variables.

```
*************************************************************************************
Choose 1 of 2 Summary
    Highest Adjusted R-Squared Results
AdjR2   AICc   JB K(BP)  VIF   SA   Model
 0.98 207.34 0.58  0.11 1.00 0.74  +LABOR***
 0.98 207.57 0.58  0.14 1.00 0.70  +EMPLOYED***
                        Passing Models
AdjR2    AICc       JB       K(BP)    VIF      SA         Model
0.982123 207.336283 0.576426 0.106324 1.000000 0.740024  +LABOR***
0.981644 207.574316 0.584089 0.142613 1.000000 0.698940  +EMPLOYED***
*************************************************************************************
```

Figure 10. Exploratory Regression Model Summary: Two Variables

```
********** Exploratory Regression Global Summary (FOREIGN) **********

             Percentage of Search Criteria Passed
Search Criterion                    Cutoff Trials # Passed % Passed
Min Adjusted R-Squared              > 0.50      2        2   100.00
Max Coefficient p-value             < 0.05      2        2   100.00
Max VIF Value                       < 7.50      2        2   100.00
Min Jarque-Bera p-value             > 0.10      2        2   100.00
Min Spatial Autocorrelation p-value > 0.10      2        2   100.00

------------------------------------------------------------------------

     Summary of Variable Significance
Variable % Significant % Negative % Positive
EMPLOYED        100.00       0.00     100.00
LABOR           100.00       0.00     100.00

------------------------------------------------------------------------

 Summary of Multicollinearity*
Variable  VIF Violations Covariates
EMPLOYED 0.00          0 --------
LABOR    0.00          0 --------

------------------------------------------------------------------------

               Summary of Residual Normality (JB)
      JB    AdjR2       AICc    K(BP)      VIF       SA   Model
0.584089 0.981644 207.574316 0.142613 1.000000 0.698940  +EMPLOYED***
0.576426 0.982123 207.336283 0.106324 1.000000 0.740024  +LABOR***

------------------------------------------------------------------------

        Summary of Residual Spatial Autocorrelation (SA)
      SA    AdjR2       AICc       JB    K(BP)      VIF   Model
0.740024 0.982123 207.336283 0.576426 0.106324 1.000000  +LABOR***
0.698940 0.981644 207.574316 0.584089 0.142613 1.000000  +EMPLOYED***

------------------------------------------------------------------------
```

Figure 11. Exploratory Regression Global Summary: Two Variables

OLS Analysis

As the final iteration provided two passing model, those explanatory variables were used as the basis for the OLS analysis. Again, all variables showed a positive relationship. Both models explained over 98% of the variation in the dependent variable (Figure 12, Figure 13). Figures 12 and 13 are the statistical reports generated from the

OLS analysis used to assess the reliability of a model. Both models are significant and effective as Joint F-Statistic is statistically significant while the Koenker (BP) statistic is not. As the Jarque-Bera statistic is not statistically significant, both models are not biased (Figure 12, Figure 13). After performing spatial autocorrelation analysis (Global Moran's I), model residuals were not spatially autocorrelated, indicating models were not misspecified (Figure 14, Figure 15). Figures 14 and 15 are the results of the spatial autocorrelation analysis (Global Moran's I) indicating whether values stored in features are random, clustered, or dispersed.

Number of Observations:	9	Akaike's Information Criterion (AICc) [d]:	206.294252
Multiple R-Squared [d]:	0.986068	Adjusted R-Squared [d]:	0.984078
Joint F-Statistic [e]:	495.435246	Prob(>F), (1,7) degrees of freedom:	0.000003*
Joint Wald Statistic [e]:	513.707669	Prob(>chi-squared), (1) degrees of freedom:	0.000000*
Koenker (BP) Statistic [f]:	2.258060	Prob(>chi-squared), (1) degrees of freedom:	0.132921
Jarque-Bera Statistic [g]:	1.105309	Prob(>chi-squared), (2) degrees of freedom:	0.575420

Figure 12. OLS Diagnostics: Number of people in the labor force

Number of Observations:	9	Akaike's Information Criterion (AICc) [d]:	207.574316
Multiple R-Squared [d]:	0.983938	Adjusted R-Squared [d]:	0.981644
Joint F-Statistic [e]:	428.823531	Prob(>F), (1,7) degrees of freedom:	0.000004*
Joint Wald Statistic [e]:	444.207450	Prob(>chi-squared), (1) degrees of freedom:	0.000000*
Koenker (BP) Statistic [f]:	2.149541	Prob(>chi-squared), (1) degrees of freedom:	0.142613
Jarque-Bera Statistic [g]:	1.075403	Prob(>chi-squared), (2) degrees of freedom:	0.584089

Figure 13. Number of people employed

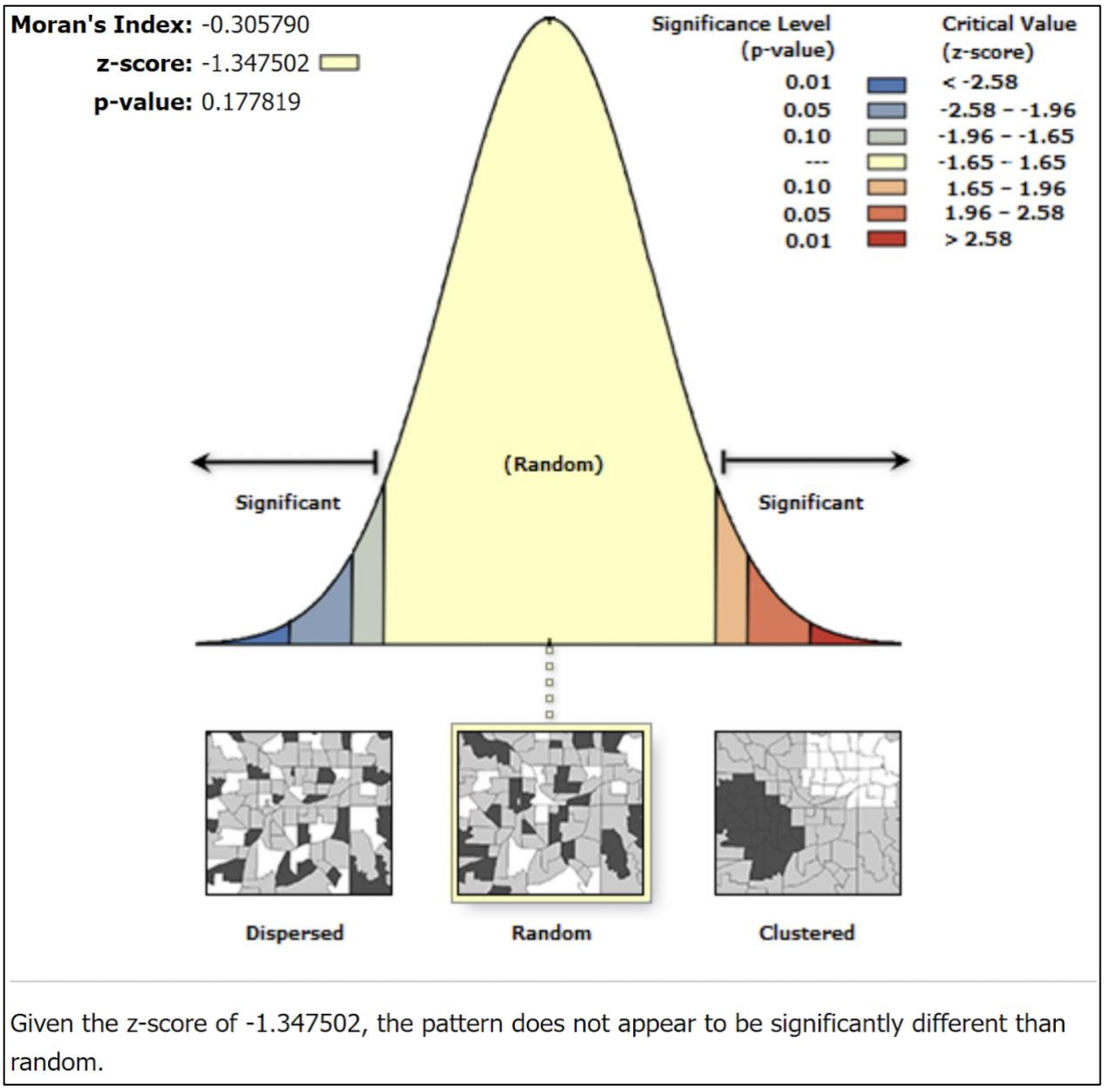

Figure 14. Spatial Autocorrelation (Global Moran's I): Number of people in the labor force

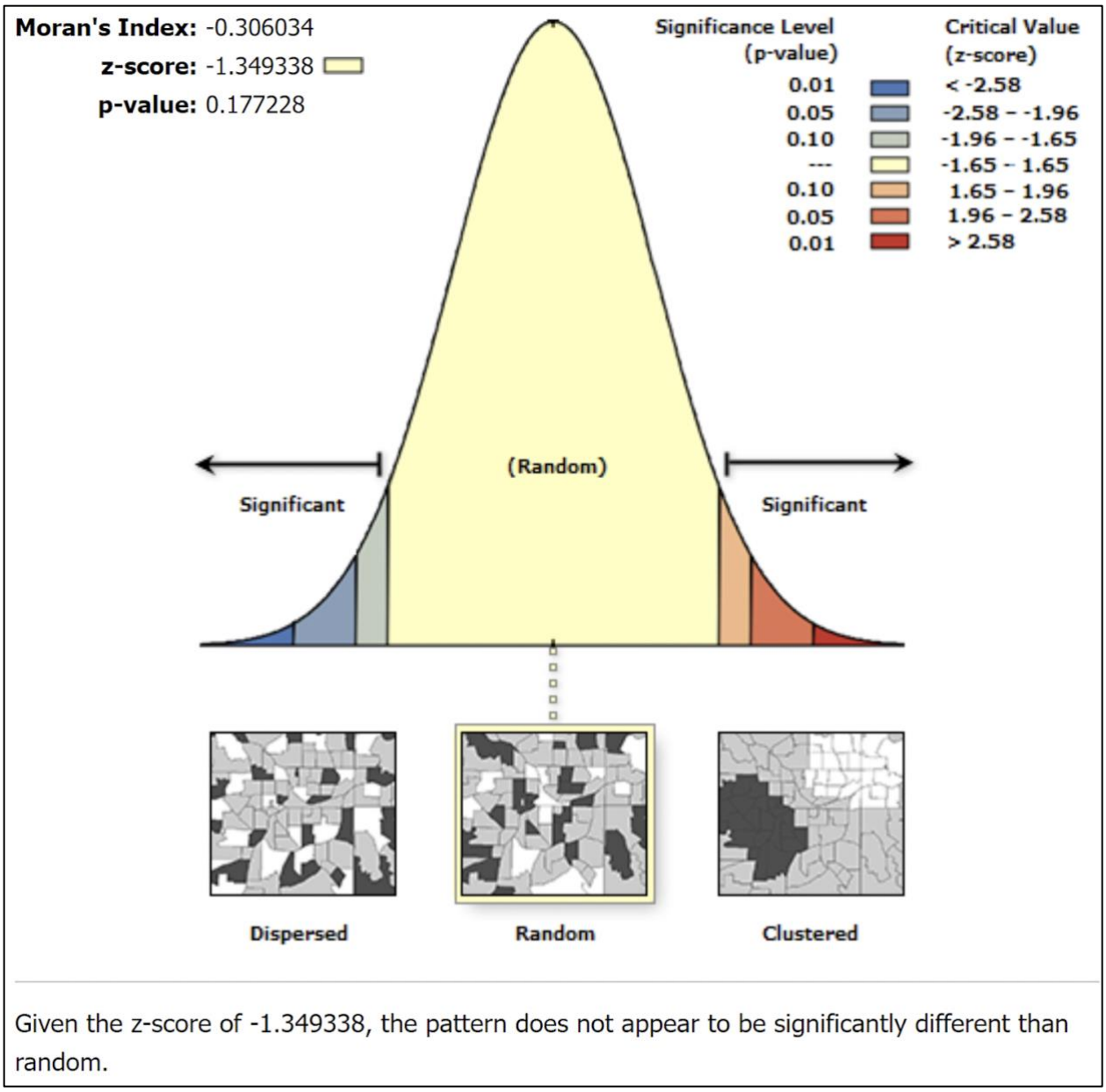

Figure 15. Spatial Autocorrelation (Global Moran's I): Number of people employed

In the original exploratory regression analysis, all variables produced an individual passing model. Regardless, there was a high level of redundancy, meaning some variables explained the same aspect of the dependent variable. Variables were removed and only the number of people in the labor force and number of people employed remained. Even though a singular variable was used for each model, they both explained 98% of the variation in the dependent variable. A missing explanatory

variable could be beneficial in including, but as the Jarque-Bera statistic is not significant it is most likely that a key variable was not missing. All variables would be considered effective predictors. Considering the Corrected Akaike Information Criterion (AICc), the number of people in the labor force is the better model (Figure 12). Regardless of successfulness of the models, more explanatory variables should be explored to fully explain the relationship between variables and avoid redundancy.

Solutions

While economy opportunity is the primary driver for migration, other factors can contribute as well. In Virginia, metropolitan areas not only provide economic opportunity but also are more accommodating to the immigrant population. While there are no sanctuary cities in the state, several counties have taken steps to become more inclusive. Sanctuary cities are typically defined as a city (or a county) that limits its cooperation with federal immigration enforcement agents in order to protect low-priority immigrants from deportation, while still turning over those who have committed serious crimes (America's Voice, 2019). In Fairfax, a policy has been put into place that ends voluntary information sharing between the county and federal immigration enforcement (Olivo, 2021). Similarly, the city of Alexandria, does not question or report the status of citizenship of those that seek protection of its laws or the use of its services (Alexandria, 2022). In Albemarle, the county does not honor Immigration and Customs Enforcement (ICE) detainers without a court order or warrant (Berg, 2018). All these cities and counties have larger foreign-born populations and are considered the most suitable for migration. While not all immigrants in Virginia are illegal, adopting similar policies would create a more hospitable environment and lead to the benefits of a large foreign-born population.

CONCLUSION

By 2065, immigrants are projected to comprise 17.7% of the total U.S. population. They are also projected to account for 88% of the nation's population growth (Pew Research Center, 2015). Virginia has one of largest states in the nation, in terms of population. This can largely be attributed to the fast-growing foreign-born population. Immigrants are primarily concentrated in the metropolitan regions of the state. As a clear disparity of the immigrant distribution was prevalent in Virginia, a location suitability analysis was conducted to examine the causes of this disparity and establish push and pull migration factors.

The NOVA metropolitan region contains the largest number of foreign-born people in the state, as well as one of the largest economies. The foreign-born population can be attributed to its strong economy. Regression analysis was conducted to assess the relationship between the foreign-born population and various economic demographics to understand the effect immigrants can potentially have on an area.

Through the location suitability analysis, NOVA remains, and will continue to remain, a primary location for migration. For the past decade, the counties of NOVA have increased their foreign population to levels that is not seen elsewhere in the state. This is attributed to the leading socioeconomic advancement of the counties. This advancement is highlighted by low unemployment, access to health care, affordability of housing and transportation, successful school systems, and overall strong economy, according to census records. However, the other metropolitan areas like Richmond and Virginia Beach are more than suitable locations for migration. These push and pull factors drive migration to urban centers.

Through regression analysis, the large immigrant population proved to have a positive impact on NOVA. All explanatory variables were had a positive relationship to the foreign-born population, except self-employment tax. In the initial exploratory regression, all variables included in a passing model. However, through removal of redundant variables only two passing models remained. While the only passing models contained one variable, they still exhibited a statistically significant and positive relationship. In NOVA, the foreign-born population provides a large workforce, creates new jobs, and provides revenue to counties through taxes.

Both geospatial analytical techniques depended heavily on the use of variables and criteria. The variables and criteria were based on the census data of Virginia. It is important to note the exact statistic or object being measured. For example, an estimate was used to measure foreign-born population rather than a complete number. As well as the varying dates of publication. The most recent available data was used, when possible, to conduct analysis. Data used ranged from 2000 to 2020. Data collected or recorded in 2019 and 2020 could potentially be skewed because of the COVID-19 Pandemic. Furthermore, different variables could be for used for future research, specifically in the regression analysis as the only passing models contained one variable. The suitability analysis could also have different results, depending on the weights given to the criteria. Many aspects of this research could be adjusted and achieve varying results.

In Virginia, immigrants are drawn to large metropolitan areas due to more socioeconomic opportunities. In return, immigrants bring in a large workforce, create new jobs, and pay it forward to the counties through taxes and other means. Counties in

NOVA have benefited from their immigrant population and continue to grow. This analysis can be used to demonstrate the importance of immigration to state and local governments. By accommodating immigrants to settle, the overall community is improved. As the foreign-born population continues to grow, it is essential to understand the motivation and the communal effects of migration.

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