

A LOCAL LEVEL QUANTITATIVE STUDY OF THE RELATIONSHIP  
BETWEEN FOREIGN-BORN POPULATIONS  
AND CARBON FOOTPRINT

by

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## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
U.S.	United States
GHG	Green House Gas



## **ABSTRACT**

While much environmental social science research has focused on the association between immigrant populations and exposure to toxic pollution, the present study will utilize local carbon footprint data to assess whether foreign-born populations have a positive or negative impact on the environment in the United States. Drawing from the varied tradition of human ecology, two competing hypotheses are derived, one from a Neo-Malthusian perspective and an alternative perspective based on the more recent strand of critical human ecology. To evaluate these competing hypotheses, the carbon footprint data are merged with an array of demographic and economic variables measured at the zip code level across the United States (n=30,552). To approximate a variable representing the immigrant population, the study incorporates a measure of the percentage of the population who is foreign-born. For the analysis, in four separate cross-sectional models, both per-capita and per-household carbon footprints are regressed on the percentage foreign-born, controlling for other demographic and economic factors and for spatial autocorrelation. Results from these spatial regression models consistently indicate that there is a small, inverse association between carbon footprints and percentages of the population that is foreign-born in zip codes across the United States. The conclusion elaborates on the theoretical and practical implications of this finding.

## I. INTRODUCTION

Debate surrounding the environmental implications of immigration is not new. In fact, a particular strand of the public discourse has suggested that foreign-born populations negatively impact the environment (Park and Pellow 2011), either through the act of immigrating or due to their lifestyles once they arrive. However, is there evidence to support these claims? Even though there has been a substantial amount of public debate (Borges-Silva 2018), the environmental impacts of foreign-born populations are not well understood as a topic of academic research. As argued by some anti-immigration organizations, immigrants do, in fact, contribute to environmental degradation (Park and Pellow 2011). Are the lifestyles of foreign-born populations associated with higher environmental impacts? Or, maybe these impacts have been misrepresented by advocacy groups as a strategy to promote their anti-immigration goals? Unfortunately, there are only a few published academic studies that examine issues like this, and they primarily focus on toxic air pollution (Price and Feldmeyer 2012; Bakhtiyarava and Nawrotzki 2016; Liévanos 2015). Toxic pollution is an important factor when it comes to environmental harm, however, it is not the only factor. Resource consumption and carbon footprints have long-lasting potential for environmental degradation as well. This is an opportunity to investigate and empirically analyze the relationship between foreign-born populations and carbon footprints within the United States.

This study examines distribution of foreign-born populations across the U.S. in relation to environmental degradation, rather than evaluating the environmental impact of the migration process. This study answers the research question: Is there a statistical

association between the percentage of a population that is foreign-born and the area's corresponding carbon footprint at a zip code level across the United States? To answer this question, this study will test two competing hypotheses that fall under the broad theoretical umbrella of human ecology. One of these hypotheses is constructed on a neo-Malthusian framework and the other is critical human ecology (York and Mancus 2009). The literature review will elaborate on the underpinnings of the two perspectives and discuss how they contrast in terms of the ecological impacts of immigration and immigrant populations. The section titled Trends of Immigration Research will provide a foundation for the neo-Malthusian hypothesis, and the section called Immigrant Populations and Their Relationship with the Environment will elaborate on the critical human ecology framework. The details in data acquisition methods and hypotheses testing are presented in the Data and Methods. Data for carbon footprints and foreign-born populations for 30,552 zip codes are modeled with a spatial regression that controls for a host of other factors, including spatial autocorrelation. The Results reveal the statistical relationship between foreign-born populations and an area's carbon footprint. The Conclusion discusses the limitations of this research and also the implications of the results.

## II. LITERATURE REVIEW

There is little evidence of research that has examined the relationships between immigrant populations and impacts on U.S. environments. The small amount of literature that exists will be the focus of this discussion. The scholarship addresses two sides of the immigrant-environment relationship. This review also addresses the distinctions between toxic air pollution and resource consumption, and also the importance of carbon footprints as proxies for environmental impacts. The gaps in the literature will be identified, and a theoretical framework that addresses two contrasting perspectives will be presented.

### Trends of Immigration Research

The implications of immigration in many aspects of life have been examined and have fueled contentious debates (Guthman and Brown 2016; Chapman 2006; Borges-Silva 2018; Park and Pellow 2011; Price and Feldmeyer 2012). Between 2000 and 2007, the foreign-born population in the U.S. increased by approximately 25%, adding 38 million to the United States during that period (Pew Hispanic Center 2009). With this influx of immigrants also came debate about the impacts of immigrants on environmental quality (Guthman and Brown 2016; Chapman 2006; Borges-Silva 2018). Something particularly interesting about this dispute was that immigrants often lack the status or means to properly defend themselves in these public debates. Recent immigrants “are among the county’s most socially vulnerable, politically powerless, and economically exploited populations” (Park and Pellow 2002: 4). This lack of political power derives from legislation that prohibited access by some immigrant groups and foreign-born populations to some of our country’s most basic services and restricted the extent of their

legal protections (Park and Pellow 2002).

Much of the fear and resistance that some U.S. citizens have about immigration, can be partially explained by the notion of “right to space”. Simply put, many citizens feel entitled to their own physical space and land, and immigration poses a threat to that sense of entitlement (Stodolska, Peters and Horlets 2017). The often xenophobic and racist discrimination that immigrant populations face can bring on feelings of isolation and insecurity (Stodolska, Peters and Horlets 2017). A clear example of this can be found in Aspen, Colorado, where rich, white environmentalists have proposed and endorsed city ordinances that discriminate against Latino immigrants, and they mask the discrimination by referring to it as “population stabilization” (Park and Pellow 2011). Another example is a situation that occurred in Kettlemen City, California where a company refused to translate environmental impact reports to Spanish even though the reports were pertaining to plans to construct a waste incinerator in the vicinity of a low-income, predominantly Latino immigrant community (Cole and Foster 2000).

There have been arguments that claim that foreign-born populations negatively impact the environment (Muradian 2006; Alola 2019; Borges-Silva 2018). One argument suggests that immigration increases pressure on ecosystems through population growth; people claim that it increases a community’s population size past the point of their environmental carrying capacity (Price and Feldmeyer 2012). Clearly, some Americans are very concerned that immigration is contributing to environmental degradation; whether they truly believe that sentiment or if they find that this environment stance masks their xenophobia and racism. Some concerns stem from the belief that increasing immigrant populations cause disorganization of local communities, which hinders

citizens' abilities to combat the negative impacts of environmental change (Stowell 2007). This perceived connection of immigrants and environmental damage has emerged as a point of contention in the political sphere as well. In fact, the President's Council on Sustainable Development, Population, and Consumption Task Force's report concluded that "reducing immigration levels is a necessary part of population stability and the drive towards sustainability" (1996: 8).

To reiterate, immigration has recently become the major factor in U.S. population growth, contributing to more than one-third of the population increase (Pew Hispanic Center 2009). With population increases of this magnitude, those who maintain a population-pressure position suggest that community infrastructures cannot be developed to support the growth with the limited resources available. They also argue that the amount of residential waste that population increases create could be very damaging to the environment (Price and Feldmeyer 2012). Alola (2019), in a nationwide United States analysis, concluded that migration levels are positively associated with carbon emissions over time.

In some cases, immigrant groups create enclaves within communities and settle proximately and densely within neighborhoods. Some people focus in on these immigrant enclaves and argue that because some immigrants reside in these highly concentrated areas, they are linked to two forms of environmental degradation: urbanization and population density. Proponents of the population-pressure argument have also claimed that immigrant groups tend to have higher fertility rates than most native-born, which also increases population and adds to the strain on communities and their surrounding environments (Price and Feldmeyer 2012).

Those from the population-pressure perspective on immigration also suggest that immigrant populations directly harm the local environment. They argue that immigrant populations can cause environmental degradation by the congestion they create, the pollution they produce, processes of sprawling development, waste production, depletion of natural resources, and water consumption (Muradian 2006). According to this position, even if the immigrants themselves do not produce high levels of pollution, they are still damaging the environment because they are contributing to the destabilization of communities which makes them more vulnerable to environmental harm (Price and Feldmeyer 2012).

In 1999, the Aspen City Council in Aspen, Colorado unanimously passed a resolution asking the Congress and President of the United States to restrict the number of immigrants coming into the country in the name of environmental protection. In fact, one of the main factors cited for the elite's desired crackdown on immigration in Aspen was the alleged negative impacts of immigrants and foreign-born people on their local environment (Park and Pellow 2011).

#### Immigrant Populations and Their Relationship with the Environment

One huge factor that is many times excluded from the discourse surrounding migration is globalization. Globalization is a huge driver of migration, as it involves the rapid extraction and consumption of natural environments, it increases levels of social stratification and income inequalities, and results in higher levels of environmental degradation, which can trigger emigration. Many argue that blaming immigrants for environmental harm is a scapegoat, rather than assigning blame to the unjust globalization practices that destroy ecosystems and impact populations (Chapman 2006).

The small amount of scholarship regarding the relationships between immigrant populations and their environments discounts most claims that immigrants cause significant environmental damage. Immigrant groups face higher and disproportionate levels of exposure to environmental hazards, especially in wealthier regions (Bakhtsiyarava and Nawrotzki 2017). In fact, “the small body of existing literature is generally supportive of the ecological footprint/community resource positions and indicates that immigration has little to no impact on environmental harm” (Price and Feldmeyer 2012:124). Areas with proportionally larger foreign-born populations actually have lower levels of air pollution than average (Squalli 2010). Some studies have concluded that there is no relationship between immigration and environmental degradation (Cramer 1998; Dustmann and Okatenko 2011).

According to Price and Feldmeyer’s (2012) analysis of air pollution, immigration, temperature, and weather trends, they concluded that immigrant populations tend to create far less pollution than native-born Americans. This suggests that though immigration may increase population growth, immigrants themselves tend to not increase rates of environmental degradation (Price and Feldmeyer 2012). Immigration likely causes less environmental damage than within-country migration or natural population growth. In many cases, immigrants lead modest lifestyles, consuming less, generating less waste, and causing less environmental damage (Dietz and Rosa 1997; White 2007). In many other countries people tend to utilize less technology and consume fewer luxury items than the native-born United States citizens (Dietz and Rosa 1997). High technology and luxury items are usually produced and consumed in ways that generate more waste, greater energy consumption, and ecological stress (Dietz and Rosa 1994). This research



showcases how immigrant populations generate less pollution than native-born populations. Therefore, this raises questions as to whether a similar pattern occurs with regard to carbon footprint levels.

Interestingly, there have been multiple examples of groups who have been very critical of immigrants in relation to the environment (President's Council on Sustainable Development 1996; Park and Pellow 2011), that actually took part in some situations that can bring a great deal of damage to the environment. To halt immigration through the southern U.S. border, the Trump administration is currently building a wall. The wall is causing great environmental damage in the borderlands. In many areas along the border, wildlife habitats are being disrupted and destroyed. Some portions of the zone have high natural biodiversity that can be devastated by barriers. The construction of the fence can also destroy local economies on both sides of the border that are based on wildlife tourism (Gaskill 2016). The barriers have already reduced species' ranges in some, such as California red-legged frogs, Arroyo toads, black-spotted newts, jaguarondis, and Pacific pond turtles, by 75% (Gaskill 2016). Each of these species are already endangered or threatened, and limiting their critical habitats and range will increase the likelihood of extinction (Gaskill 2016).

In another example, the Aspen city council, a city with a reputation for being environmentally friendly, commonly approves construction of 10,000-square-foot vacation homes with heated driveways and swimming pools at the same time laying blame for their environmental problems on the mobile homes of Latino immigrant population (Park and Pellow 2011). The reality is that the consequences of global warming and locally changing climates will not impact people of different economic

classes and social strata equally. The consequences will most deeply affect the poorest parts of the world, while the primary contributors of greenhouse gases (GHGs) and environmental damages are the affluent countries and wealthier populations (Park and Pellow 2011).

### Carbon Footprint

Much of the aforementioned research examined the relationship between immigrant populations and levels of toxic air pollution. This literature was presented to elaborate on the apparent relationship between immigrants and environmental quality. This study, however, does not focus on toxic air pollution. Rather, the focus for this study is on another environmental impact, the carbon footprint. Air pollution is in some cases connected to carbon footprints as some atmospheric emissions from various modern activities and processes are GHGs and carbon footprints reflect the increase of carbon released to environmental processes. However, following the tradition of environmental sociology and environmental justice, it is imperative to make distinctions between the toxic pollution and resource consumption (Yearly 2005) There are important differences between toxic air pollution and carbon footprints. Toxic pollution, in general, contaminates air, water, and land, and can affect people's health (Landrigan, Halper, and Silbergeld 1989; Arto, Genty, Rueda-Cantuche, Villanueva, and Andreoni 2012), while carbon footprints are measures of the releases of fossil carbon (and other GHGs) through the processes of manufacturing and using goods and services. Carbon footprint is a way to reflect the impacts of human activities on the global environment, which leads to global warming and changing climates.

Carbon is a large component of GHG emissions. Energy production processes that

generate carbon (carbon dioxide, methane, and other organic gases) and other GHGs are often the primary method to generate a “carbon footprint” (Moser and Kleinhüchelkotten 2018). These emissions are often correlated with high levels of environmental stress (Habans, Clement and Pattinson 2019). Constant and increasing releases of these emissions are strongly tied to global warming, which can promote changes of Earth’s climates, and are often linked to negative environmental impacts (Moser and Kleinhüchelkotten 2018). Individuals and families contribute to carbon footprints through lifestyles and habits like sizes of living space, and consumption of energy, animal products, fuel, and so on. Testing to determine whether there is an association between carbon footprints and immigrants can suggest the extent of impacts they have on the environment.

#### Theoretical Framework

This study tests two hypotheses that are constructed in the framework of human ecology. Human ecology concerns itself with the interactions between people and the environment, how they work as a system, and the implications of the relationships. Human ecology is multifaceted, however, this study examines one issue from the perspectives of two opposing ideologies: the neo-Malthusian framework and the critical human ecology framework (York and Mancus 2009). Though rooted in the human ecological tradition, each of these frameworks have different views of the environment-society relationship. Some views in human ecology focus on how population density, growth, and structure explain environmental impacts (York, Rose, and Dietz 2003). Other views focus on societal factors such as economic systems, social relations, and more that produce environmental damage (York, Rosa, and Dietz 2003). This study will test two

hypotheses based on these perspectives to evaluate the environmental impacts of immigrants.

### *Neo-Malthusian Framework*

According to the neo-Malthusian framework, which is a philosophical resurgence of Malthusian reasoning, immigration impacts the environment negatively. This framework focuses heavily on population size, population pressure, carrying capacity, and the implications of population growth on resources and environmental quality. With this framework, essentially, the more people that are, the scarcer resources will be. While Malthus was very concerned with reproduction in a resident population, neo-Malthusianism also concerns itself with immigration as well. Anything that generates population increase causes tension with the resource base. Malthus argued that food production, which increases arithmetically, cannot increase at the rates of exponentially growing populations (Malthus 1797). His view is the basis for claims that immigrants threaten the abundance of basic resources needed for citizens. Another neo-Malthusian fear is that immigrants put unacceptable levels of pressure on a community's environment, reducing the local carrying capacity, and make it easier to strip resources to the point that they will no longer be able to support the population (Price and Feldmeyer 2012).

Arguments are often made that immigrants create population pressures that in turn create strains on not only the environment, but they are also said to change the inner workings and structures of local communities (Price and Feldmeyer 2012). Immigration is believed to cause a domino effect of degradation. The idea is that when population increases, production and consumption increase to supply the increasing demand. This

process, in turn, generates greater pollution that degrades the environment, which reduces resource productivity, which increases GHGs that ultimately lead to global warming, climate change, and eventually environmental collapse. The neo-Malthusian framework suggests that there is a positive relationship between the proportion of immigrants in a unit area and the carbon footprint of that area.

### *Critical Human Ecology Framework*

Critical human ecology (York and Mancus 2009) suggests that geographical, biological, and demographic factors influence (but do not determine) a community's or a society's way of life (York and Mancus 2009). This approach is "critical" because, though still rooted in human ecology, it incorporates a Marxist structure of analysis of the relationship between people and their environment (York and Mancus 2009). Historical materialism is borrowed from Marxist philosophy to reevaluate human ecology. The critical human ecology framework argues that while population is an important factor, it is not necessarily as important or detrimental in the way that Malthus described. There are other more harrowing factors that can and should be addressed when it comes to environmental degradation.

This framework takes into consideration the different environmental factors that drive migration, which in turn leads to the foreign-born population that we are focusing on for this study. Again, this is not a study looking at the environmental consequences of the act of migration itself, however, it is analyzing the relationship of foreign-born populations that are already in the United States, and their relationship with the environment (specifically carbon footprint). As previously noted, some studies have found that immigrant populations generate smaller environmental impacts than native-

born populations. The critical human ecology framework suggests that there are other factors, such as capital, class, social relationships, etc., that influence and regulate the society-environment relationship, and their roles are much greater than the conditions of being an immigrant. Critical human ecology suggests that there is no association between immigrant populations in a region and the carbon footprint of that region.

### Gaps in Literature

With a few exceptions (e.g., Liévanos 2015), there is little quantitative data presented to support or refute the connections between immigrants and environmental degradation. There is, in fact, so little research on this subject that a large majority of literature has been limited to qualitative examinations. Statistical analyses of empirically measured variables could help to ground the findings. It would also be beneficial to interview immigrants, government officials, and others to fill the gaps that remain in the qualitative analyses.

There is also little information about the relationships between immigrants and their carbon footprints. There has been a study that examined how immigration affects the carbon production of a state (Alola 2019), but it merely focused on the process of immigration, not on the lives of immigrants that have settled. Others have studied the experiences of immigrant populations in terms of environmental hazards and their exposure to risk. These, however, focused on polluted environments. There have been no studies of carbon production from immigrants' consumption of goods and services.

### Hypotheses

There are two different hypotheses being analyzed for the purposes of this study, each of them being backed by a different theoretical framework. These are competing

hypotheses, both of which fall under the research tradition of human ecology. The two competing hypotheses were founded on the principles of neo-Malthusianism and critical human ecology (York and Mancus 2009). The first hypothesis that will be tested in the analysis is supported by the neo-Malthusian framework:

H1: There is a significant, positive association between foreign-born populations and the carbon footprint.

The competing hypothesis is backed by critical human ecology:

H2: There is no significant association, or an inverse association, between foreign-born populations and the carbon footprint.

#### Theoretical Framework for Control Variables

Before discussing the data and methods used to evaluate the primary research question of the thesis, this section reviews the various theoretical perspectives and empirical research to justify the inclusion of several control variables. These perspectives are based on common frameworks in the environmental sociology literature, including human ecology, ecofeminism, ecological modernization, critical environmental justice and political economy. Variables such as these covariates have been studying across these topics in an effort to analyze their varying environmental impact (Lempriere 2016; Pellow 2018; Mies, Shiva, and Salleh 2014; York, Rosa, and Dietz 2003; Wells-Dang, Nyi Soe, Inthakoun, Tola, Socheat, Thanh Van Nguyen, Chabada, and Youttananakorn 2016). Previous literature has showcased how a person's income can heavily influence their impact on the environment (Moser and Kleinhüchelkotten 2018; Dietz and Rosa 1997; White 2007). Research on the gender dimensions of environmental impact suggest that men and women do consume resources in different kinds of ways (Druckman, Buck,

Hayward, and Jackson 2012). Certain researchers have investigated and found that a person's age can contribute to the way in which they consume certain resources (Liddle 2014). Studies have also shown that areas with a higher population density tend to have lower levels of carbon emissions (Liddle 2014). The control variables help to comprise population characteristics, and they are all variables that can have an impact on carbon emissions and carbon footprint levels as well.



### **III. DATA AND METHODS**

Is there a statistical association between immigrant populations and environmental impact? To answer this question, the analysis will examine variation at the level of the zip-code across the United States. This analysis will be done by combining two separate datasets into one and organizing them by corresponding zip codes. The zip code area was chosen for analysis because it was a more collective measurement than studying individuals, households, or census blocks and provides sharper resolution than can state-wide analysis.

#### Independent Variables

The primary independent variable used for this analysis is the percentage of foreign-born (or immigrants) in each zip code zone. Covariates included demographic and economic variables: median household income, the percentage of unemployed, the percentage of males, the percentage of non-Hispanics, the percentage over 65 years old, the percentage under 18 years of age, and population density. All data for these variables were extracted from the American Community Survey's 2017 5-year Estimate of Population. Previous studies demonstrated that these variables are significant predictors of various types of environmental impacts. As covariates, they ensure that the slope estimate for percent foreign born is not spurious, and thereby ensure that there is no variable bias.

The American Community Survey is an ongoing yearly survey that provides the public with information about the people who make up the United States. This survey gives information about demographics, economic information and much more, which can be broken down into a multitude of levels (U.S. Census Bureau 2020). The survey is

conducted and collected throughout the year using mail in questionnaires, interviews over the telephone, and at-home visits conducted by Census Bureau field representatives. The American Community survey also does 5-year intervals which helps to yield more information and estimates for smaller areas. For context, 1-year estimates cover only areas with populations greater than 65,000 people, while 5-year estimates typically cover every area (U.S. Census Bureau 2020 ). The American Community Survey is a survey that is used to project estimates for larger populations. Each person who participates in the survey is part of a sample of a larger population sharing characteristics with the participant. To accomplish this, the American Community Survey bases samples on population estimates provided by a Census Bureau program called “Population Estimates Program” (U.S. Census Bureau 2020).

The American Community Survey does not have a variable for immigrant status; however, they do have a variable for foreign-born people in each zip code, and this was used in the analysis. The 2017 American Community Survey 5-Year Estimates survey was chosen because it was the first year that had available data for the Foreign-Born population at a zip code level at the time this study was conducted. With the Foreign-Born variable, it is important to keep in mind that this variable focuses on solely on people who were born outside of the United States; it does not concern itself with the citizenship status of the participant.

#### Dependent Variables

The carbon footprint data used for this analysis were acquired from Kevin Ummel’s study conducted for the Citizens Climate Change Lobby (2014). This research and analysis contains details on household and per capita carbon-tax burdens, and these

are used as proxies for “carbon footprint” in this study. Ummel’s variables reflect the use of carbon-intensive goods and services and converts that use into a carbon tax, which is often used as a way to reveal a carbon footprint for a person, a process, or a place (Clement, Pattinson, and Habans 2017; McLaughlin, Elamer, Glen, AlHares, and Rasheed Gaber 2019; Boucher 2016).

These data were also zip-code level measures, which corresponds to the American Community Survey 5-Year Estimate. The Ummel research was conducting by analyzing data from the The Bureau of Labor Statistics’ Consumer Expenditure Survey and The Public Use Microdata Sample. The Consumer Expenditure Survey included gasoline, electricity, and natural gas use, among others (52 categories in all). The Public Use Microdata Sample provided demographic and expenditure data. Ummel then used boosted quantile regression trees to analyze the two data sets. Through these tests, Ummel formulated and computed corresponding carbon-tax burdens for zip codes across the United States (Ummel 2014).

**Table 1.** Variables and Sources of Data

<b>Variables</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>	<b>Source</b>
<b>Dependent Variables</b>					
Mean Household Carbon Tax Burden	663.901	93.401	212.09	1182.3	Citizens' Climate Change Lobby
Mean Per Capita Carbon Tax Burden	266.832	39.964	92.5	579.07	Citizens' Climate Change Lobby
<b>Independent/ Control Variables</b>					
Percent Foreign-Born	6.523	8.826	0.016	76.381	American Community Survey 5-Year Estimates
Median Household Income	67002.94	25419	10000	266394	American Community Survey 5-Year Estimates
Percent Unemployment	4.873	1.489	1.409	20.863	American Community Survey 5-Year Estimates
Percent Male	50.229	3.128	25.811	99.743	American Community Survey 5-Year Estimates
Percent Non-Hispanic	90.548	15.372	1.199	99.944	American Community Survey 5-Year Estimates
Percent Over 65 Years Old	17.96	6.013	0.027	83.371	American Community Survey 5-Year Estimates
Percent Under 18 Years Old	21.806	4.678	0.256	71.857	American Community Survey 5-Year Estimates
Population Density	1304.359	5035.42	0.007	159898	American Community Survey 5-Year Estimates and Topologically Integrated Geographic Encoding and Referencing

To examine the relationships between foreign-born populations and carbon footprints, the demographic data and carbon footprint data were joined in ArcGIS into a single dataset and a shapefile was created. To ensure that only valid data were included for zip code areas, any zip code without information for any of the variables was dropped from the analyses in an effort to prevent skewed results. The final dataset included 30,552 zip codes areas of the United States. The dataset was exported to GeoDa and Stata for further analyses. The dependent variables were log transformed in GeoDa to address heteroscedasticity and to ensure that the residuals were normally distributed.

**Table 2.** Summary Statistics and Bivariate Correlations

		0	1	2	3	4	5	6	7	8	9
0	Mean Household Carbon Tax Burden	1.0000									
1	Mean Per Capita Carbon Tax Burden	0.6235	1.0000								
2	Percent Foreign-Born	-0.1190	-0.3152	1.0000							
3	Median Household Income	0.6051	0.4048	0.1921	1.0000						
4	Percent Unemployed	-0.3156	-0.3139	-0.0411	-0.3334	1.0000					
5	Percent Male	-0.0193	0.0079	-0.0564	-0.0706	0.0221	1.0000				
6	Percent Non Hispanic	0.1823	0.4450	-0.6736	0.1096	-0.1158	-0.0465	1.0000			
7	Percent Over 65 Years Old	-0.1719	0.2788	-0.2868	-0.1465	0.0623	-0.1480	0.2806	1.0000		
8	Percent Under 18 Years Old	0.3260	0.3105	0.0985	0.0798	-0.0247	-0.2048	-0.2750	-0.5469	1.0000	
9	Population Density	-0.1862	-0.1377	0.4609	0.0701	-0.0422	-0.1128	-0.2198	-0.1608	-0.0894	1.0000

Multiple regressions were run in order to test the relationships between carbon footprint and foreign-born populations. A spatial lag model and spatial error model were performed to analyze the data. For each of these models, a univariate Moran’s I test was run on the residuals. The dependent variables were the mean household carbon tax burden and the mean per capita carbon tax burden. The independent variables were the percentage of the population that was foreign-born, the median household income, the percentage unemployed, the percentage that were males, the percentage of the population that was non-Hispanic, the percentage older than 65 years, the percentage younger than 18, and population density.

#### IV. RESULTS AND DISCUSSION

This analysis was conducted in order to test each of the competing hypotheses by examining the relationship between foreign-born populations and carbon footprint. In this section, the results and explanations for the outcomes are discussed. To test the hypotheses regarding the relationship between foreign-born populations and carbon footprints spatial lag and spatial error models were used to regress the dependent variables on the independent variables. Moran's I was used to measure for spatial autocorrelation in the residuals.

The percentage of population that was foreign-born was negatively or inversely correlated to both the mean household carbon tax burden and the mean per capita carbon tax burden across all models. As shown in Table 3, the coefficient can be interpreted to mean that with every 1% increase in foreign-born populations, the carbon footprint is approximately .0026% smaller. Within every model the percentage of the population that is foreign born (as well as the rest of the covariates) was statistically significant. The Moran's I (0.095) indicated that the model that best fit the pattern was the spatial error model using household data. Each of the spatial error models showed an inverse relationship between percent of the population that is foreign-born and both mean household carbon tax burden and mean per capita carbon tax burden

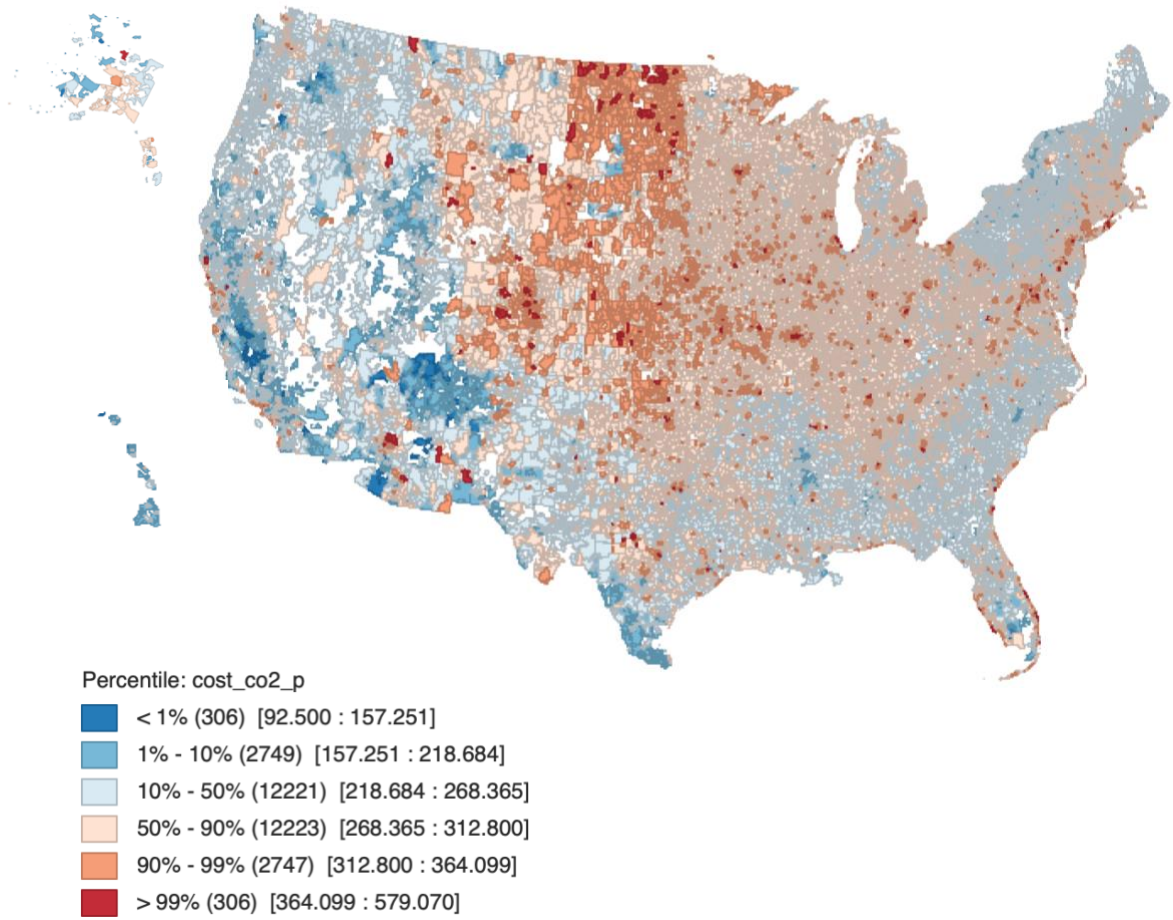
Moran's I was important for this analysis, because it measures spatial autocorrelation, which is a statistic that indicates how geographically intertwined two variables are across the study area; thus, the ideal result of Moran's I is that the residuals are close to zero. Moran's I reveals and confirms the statistical significance of the variables tested within a particular region, and confirms that the results are not affected

by spatial proximity to another area. A low Moran's I shows that a model is controlling for spatial affiliation amongst the variables. The closer that Moran's I is to negative one, the stronger the correlation. Among these models, the lowest Moran's I and the strongest correlation were achieved by the spatial error model using the household data. These results reveal that foreign-born populations and carbon footprints are inversely related among zip codes, confirming the critical human ecology hypothesis.

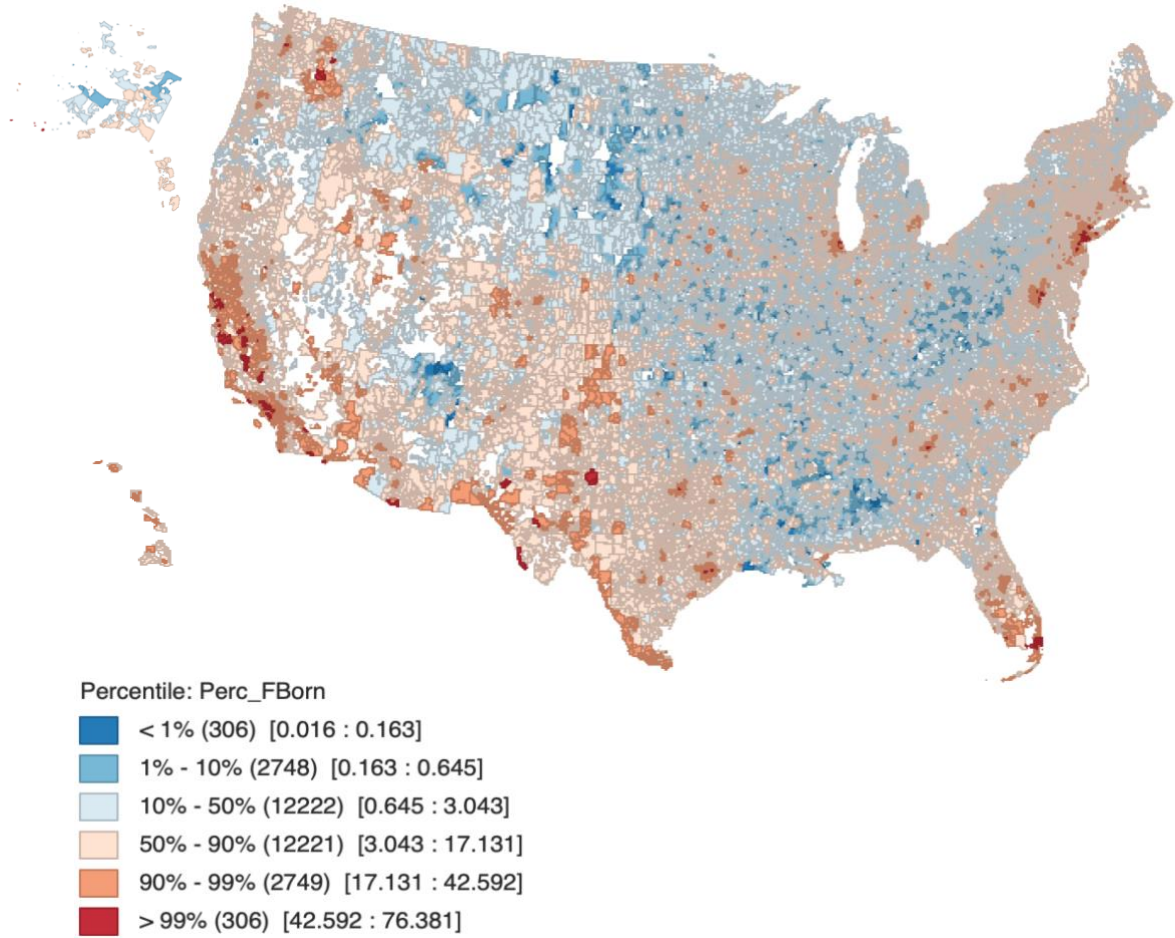
**Table 3.** Regression Models

Independent Variables/ Covariates	Spatial Lag with Household		Spatial Error with Household		Spatial Lag Per Capita		Spatial Error Per Capita	
	b	Std. Error	b	Std. Error	b	Std. Error	b	Std. Error
Percent Foreign Born	-0.0026***	0.0001	-0.0009***	0.0001	-0.0047***	0.0001	-0.0021***	0.0001
Median Household Income	0.0000***	0.0000	0.0000***	0.0000	0.0000***	0.0000	0.0000***	0.0000
Percent Employment	-0.0099***	0.0004	-0.007***	0.0006	-0.0166***	0.0004	-0.0106***	0.0007
Percent Male	0.0037***	0.0002	0.0017***	0.0002	-0.0005***	0.0002	-0.0034***	0.0002
Percent Non Hispanic	0.0005***	0.0000	0.0003***	0.0001	0.0012***	0.0000	0.0015***	0.0000
Percent 65 and over	0.0009***	0.0001	-0.0003***	0.0001	0.0023***	0.0001	0.0015***	0.0001
Percent 18 and under	0.0098***	0.0001	0.0051***	0.0001	-0.0084**	0.0001	-0.0108***	0.0001
Population Density	-0.0000***	0.0000	-0.0000***	0.0000	-0.0000***	0.0000	-0.0000***	0.0000
LAMDA			0.7911	0.004			0.7872	0.0041
Moran's I	0.562		-0.095		0.577		-0.101	
n	30552		30552		30552		30552	





**Figure 1.** Percentage of Carbon Footprint Per Capita Map



**Figure 2.** Percentage of the Population that is Foreign Born Map

The aim of this study was to examine the relationship between foreign-born populations and carbon footprint levels across the United States at a zip-code level, controlling for spatial clustering, demographic, and economic variables. The results indicate that there is an inverse relationship between the foreign-born populations and carbon footprint levels. This suggests that in areas with larger foreign-born populations tend to have a lower carbon footprint. This finding dismisses the neo-Malthusian argument that immigrants are a major reason for environmental degradation. Concerning critical human ecology, these findings support one of the primary points of the framework, being that while population can potentially contribute to environmental degradation, it is not as detrimental as other factors.

#### Covariates

There were also interesting results regarding the relationships between the covariates and the carbon footprint variables. The percentage unemployed and the population density were negatively correlated with mean household carbon tax burden and mean per capita carbon tax burden in every model. Each of these of these findings are supported by previous research (Moser and Kleinhüchelkotten 2018; Liddle 2014). If a person is unemployed, that likely means that they are receiving little to no income, and research shows people with lower levels of income tend to have a smaller environmental impact (Moser and Kleinhüchelkotten 2018). Previous literature also states that areas with a higher population density tend to have lower levels of carbon emissions, which supports the findings of the Population Density variable (Liddle 2013).

The percentages of the population older than 65 and younger than 18, and the percentage male had various results across the models. For example, the percentage under

19 and the percentage male were positively correlated with the mean household carbon tax burden, but then both were negatively correlated in the models predicting mean per capita carbon tax burdens. The percentage over 65 had a positive correlation across every model except for the Spatial Error Model for the Mean Household Carbon Tax Burden Variable. Research in the past has found that many times younger age groups have a positive correlation with emissions from transport, while the opposite is true for older age groups. For factors such as residential electricity consumption, research has found that the results resemble a U-shape, with the youngest and oldest groups having positive correlations, and the middle-aged groups had negative correlations (Liddle 2014). It seems as though the correlation varies heavily when it comes to the type resource consumption in relation to age, therefore that could be a reason why the of this study results vary. With the percent male variable, it has been found that men have a larger environmental impact than women when it comes to leisure, recreation, food and drink consumption. However, it was found that the carbon that is related with household work was higher for women than men (Druckman et al. 2012).

Median household income and the percentage that were non-Hispanic were positively associated with carbon footprints in all four models, and this speaks to the value of the critical human ecology framework. Research has shown that people who were born in other countries in some cases consume fewer commodities that cause higher levels of environmental harm than do native-born citizens (Dietz and Rosa 1997; White 2007). Because of this significant positive correlation between median household income and carbon footprint, one could infer that those with higher incomes consume more and therefore have larger carbon footprints. The finding concerning the percentage of the

population that non-Hispanic speaks to the work that Park and Pellow conducted in Aspen, when they observed that the non-Hispanic community appeared to consume resources at astronomical levels in comparison to other groups within the same area (2011). This exemplifies how in some cases there are more pressing factors rather than population when it comes to environmental degradation.

## V. CONCLUSION

This study examined the relationships between foreign-born populations and environmental degradation, more specifically carbon footprints. The results show, in a zip-code level unit of analysis, that there is a small but inverse association between foreign-born populations and carbon footprints in the United States. Zip codes with larger immigrant populations had lower carbon footprints. This conclusion will offer up ways in which these findings can be applied and its potential implications, and it also displays how this study did face certain limitations. This section also includes a short overall wrap up of the study, and how it applied to the competing frameworks that fell under the tradition of human ecology.

### Implications

Given the novelty of the research question, the findings from this study suggest for more research on the environmental implications of foreign-born populations. As previously stated, little research has been published on this topic. All research that has evaluated the relationships between immigrants and their environments has focused on toxic pollution. This study, by contrast, focused only on immigrant populations and their local carbon footprints. This is a very general study, and it demonstrates that there is space within which we could study specific foreign-born populations, spanning race and nationality, and examine their relationships with their environments. There is also ample room to expand on the theoretical framework in regard to this topic, and adding more variables (like gross domestic product per capita, for example) to the models could help to strengthen the neo-Malthusian versus critical human ecology argument. Additional statistical analysis and quantitative research can possibly add important information to

policy making and the public discourse surrounding this issue. More studies about these issues may yield greater clarity about the relationships between immigrants and the environment, and similar results may motivate policymakers to rethink the environmental arguments against immigration.

### Limitations

There are a few limitations to this study. The first is the mismatch between the years represented by the two datasets. Ummel's study of carbon footprint (i.e. carbon-tax burden) was conducted in 2014. The only data available from the American Community Survey 5-Year that contained information about foreign-born populations at a zip code level was compiled in 2017. Therefore, there are potential continuity issues due to the incongruity of the dates.

While this was an extensive study that analyzed data from 30,552 zip codes, every zip code area in the United States was not included. Some zip codes lacked some data in both Ummel's dataset and the American Community Survey. To avoid skewing the results, zip codes with missing data were excluded from this study.

Lastly, the data that were used were estimates of both carbon use and production and demographic data; not empirical information from every household in the country. The methods allowed for the examination of a very large region, but there are still coverage and sampling errors due to the infeasibility to survey every single household in the United States.

### Close

In conclusion, this study shows that the spatial distributions of immigrant populations and carbon footprints are inversely correlated in the United States. These

results refute a neo-Malthusian claim that immigrants generate high levels of environmental degradation; therefore, this study exhibits is no support for H1. Instead, the results show that there is no positive association between immigrants and carbon footprints. While population can be a factor, it is not the only factor and there are many other characteristics of communities that must be considered to determine what (or who) generates the greatest amount of environmental harm. Understanding that there is a negative or inverse association is important for the development of future policies regarding immigration. This study establishes a base for future work that examines the connections between foreign-born populations and environment quality.



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