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Municipal Participation in Environmental Agreements

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Abstract

More than 1,000 mayors signed the United States Conference of Mayors' Climate Protection Agreement (USMCPA) between 2005 and 2009, committing their cities to the reduction of greenhouse gas emissions. This study identifies factors associated with participation of U.S. cities in the USMCPA. Previous qualitative and quantitative investigations have suggested that the existence of co-benefits, elements of climate change stress, and partisan orientation influence municipal participation in environmental agreements. This study uses an empirical model to assess the relative significance of demographic and regional factors, economic structure, environmental conditions, energy use, and political factors in predicting municipal participation in the USMCPA. The results indicate that population density and educational attainment positively predict participation while the unemployment rate negatively predicts participation. These results suggest that development policies can influence the likelihood of city participation in environmental agreements.

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INTRODUCTION

Climate Change Mitigation Efforts
The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC 1992). Concerned about the adverse effects of changes in the Earth's climate, 194 parties signed the UNFCCC, which entered into force in 1994 (UNFCCC 2010a). The UNFCCC created a framework for intergovernmental efforts to address climate change. Within this framework, the Kyoto Protocol, adopted in 1997, committed industrialized countries to reduce greenhouse gas (GHG) emissions (UNFCCC 2010b). By 2013, 190 nations were party to the Kyoto Protocol. Although the United States signed the treaty, it was never ratified by the U.S. Senate (UNFCCC, 2010c). With the end of the Kyoto Protocol's first commitment period in 2012, negotiations are underway to craft a new international framework to continue GHG reduction efforts through binding targets (UNFCCC, 2010b).

At the national level, the United States has not enacted comprehensive legislation aimed at addressing climate change. However municipal governments have taken action to address the issue. More than 200 local governments from forty-three countries established the International Council for Local Environmental Initiatives (ICLEI) in 1990 to coordinate local government responses to global environmental problems (ICLEI 2008). One of the programs sponsored by ICLEI was the Cities for Climate Protection (CCP). Started in 1993, the CCP encouraged local governments to commit to reducing GHG emissions (Betsill and Bulkeley 2004). Under this program, each city set its own reduction target and the ICLEI assisted participants in pursuing their target. As of 2009, the CCP had more than 650 members around the world, including more than 160 members in the United States (Betsill and Rabe 2009).

U.S. Mayors' Climate Protection Agreement
On February 16, 2005 the Kyoto Protocol became law for the 141 countries that had ratified the treaty. The United States was not among this group. In response, Seattle Mayor Greg Nickels launched the United States Conference of Mayors' Climate Protection Agreement (USMCPA) to further the aims of the Kyoto Protocol by leveraging the leadership and action of an equivalent number of U.S. cities (USCM 2008). By signing the agreement, participating cities committed to three objectives: 1) Meet or exceed the Kyoto Protocol targets in their city; 2) Urge state and federal governments to enact policies to meet or exceed a seven percent reduction in GHG emissions from 1990 levels by 2012; and 3) Push the U.S. Congress to pass bipartisan legislation establishing a national emissions trading scheme (USCM 2005a).

In June of 2005, at the 73rd U.S. Conference of Mayors'[viii] Annual Meeting, the Conference adopted a resolution endorsing the USMCPA, calling on cities around the nation to join the agreement, and urging the federal government to enact policies designed to meet the reduction goals set forth in the Kyoto Protocol (USCM 2005b). By that meeting, 141 mayors had signed the USMCPA. Following the initial announcement, mayors continued to join the agreement. By May of 2007, 500 cities were represented

(USCM 2008). At the U.S. Conference of Mayors' Leadership Meeting in October of 2009, Mayor Nickels announced that 1,000 mayors had signed the agreement (USCM 2009). As of March 19, 2011, the list of participating cities stood at 1,049 (USCM 2011). The USMCPA differs from the CCP both in its exclusive focus on the United States and in its broad membership among U.S. cities. In the absence of federal climate change policy, the USMCPA, representing over 88 million U.S. citizens, stands as one of the most comprehensive efforts to address climate change in the United States.

Significance of Municipal Action

Climate change is both a global and local issue. While a changing climate has global implications, mitigation (i.e., reducing GHG emissions) requires action at the local level. Emissions reductions require changes in land use, transportation patterns, and energy generation and use. Though changes in these sectors can be motivated by national policies and international agreements, these sectors are often governed by local, state, and regional policies. Yet it is unclear what drives municipal governments to address climate change when each individual city is unlikely to have a significant impact on global GHG emissions. Identifying factors that influence local political actors to address climate change can inform our understanding of why cities choose to take leadership on issues of national and international significance.

Literature Review

A significant literature exists exploring the factors that influence participation in environmental agreements. This literature includes studies of international participation in environmental agreements, and both qualitative and empirical analysis of municipal participation in environmental agreements.

Explanations of International Participation

There is extensive empirical work exploring the participation of nation-states in international environmental agreements. Timmons Roberts et al. (2004) test multiple theories of international relations in the context of exploring ratification of environmental treaties. The authors construct an index of environmental treaty ratification that includes 192 nations and twenty-two major international environmental agreements negotiated between 1946 and 1999. The authors use ordinary least squares regression and path analysis to predict treaty ratification. They find that three factors significantly predict participation: the narrowness of a nation's economic base, the level of voice and accountability of citizens, and the number of nongovernmental organizations (NGOs) operating in the country. Parks and Timmons Roberts (2006) use the previously developed model to explore the ratification of the Kyoto Protocol. They find that in this case, the most important predictors of participation are the voice and accountability of citizens, the number of NGOs, and the amount of environmental foreign assistance received. Zahran et al. (2007) include measures of resource use in their model of Kyoto Protocol ratification and find that energy inputs into a nation's economy, CO_2 emissions per capita, and a record of previous international cooperation on environmental problems are significant predictors of participation. These studies suggest that some factors are significant predictors of international participation and may have analogues in trying to explain municipal participation in environmental agreements, particularly the participation of U.S. cities in the USMCPA.

Qualitative Explanations of Municipal Action

Past studies of municipal involvement in environmental agreements, specifically the CCP and USMCPA, have relied on qualitative methods to identify factors that determine participation. Betsill (2001) examines the CCP at a relatively early stage. Her work attempts to explain why cities choose to join when a number of barriers, such as a lack of national policy and the perceived limited efficacy of local efforts, discourage participation. She suggests that political leadership, the existence of co-benefits (e.g., improved local air quality or economic savings), and the framing of climate change as a local issue all contribute to municipal participation. Kousky and Scheider (2003), also examining the CCP, argue that the free rider problem should discourage cities from participating. They interview officials from twenty-three U.S. cities participating in the CCP and find that participation is largely a rational policy decision made by political leaders on the strength of perceived potential cost savings or other co-benefits rather than the result of public pressure. Betsill returns to the issue with coauthor Bulkeley (2004) and finds that the CCP's offer of financial and political resources as well as legitimacy for municipal leaders may influence participation.

Engel (2006) examines the USMCPA along with other state and local climate change initiatives and seeks to explain participation in the light of little, in her mind, economic or environmental benefit. She concludes that the presence of co-benefits, political opportunism, and a genuine concern for the environment drove participation among early signers. Betsill and Rabe (2009) confirm earlier findings and show that co-benefits, the opportunity for cities to exercise leadership, pressure from their peers in local governance, and a moral imperative to respond to a perceived environmental problem motivate participation in the USMCPA. They also suggest that local policy entrepreneurs have a role in pushing the issue onto city agendas.

While all of these studies are essential in providing detailed analysis of many of the factors involved in the decision by cities to participate in these programs, each lacks a quantitative approach that would enable comparison between cities that participate and those that do not. These qualitative studies also cannot account for economic and demographic factors that may create the conditions for political action or inaction. Finally, these studies do not allow for comparison of the relative impact of a variety of factors on participation.

Empirical Models of Municipal Participation

Zahran et al. (2008) take the CCP program as their subject and focus on 307 Metropolitan Statistical Areas (MSAs) in the United States. Of this number, sixty-seven had at least one jurisdiction committed to the CCP as of 2005. Zahran et al., seeking to predict participation in the program, divide the potential predictive factors into three categories. The first, climate change risk, measures a city's exposure to the downside risks of climate change as measured by its proximity to a coast, the sensitivity of its ecosystem, and its susceptibility to extreme weather. The second, climate change stress, is a combination of factors that impact climate in potentially negative ways, including transportation modes, energy use, and population density. The final category, civic capacity, takes into account the income and educational attainment of the population as well as variables for environmental commitment on the part of citizens. The authors utilize ordinary least squares regression with unstandardized coefficients and find that climate change risk is an insignificant factor in predicting participation. However, climate change stress is significant and negatively impacts the likelihood of participation. In addition, civic capacity is a significant positive predictor of participation.

Wang (2010) explores a similar question but in the context of the participation of California cities in the USMCPA. He uses data from seventy-two California cities that had signed the USMCPA by the end of 2005. The author uses a survival model to estimate the conditional probability of participation at each point in time. Independent variables include population size, local demographics, the structure of the local government, political factors, environmental conditions, and peer behavior. Wang (2010) finds that population size, income, the percentage of citizens registered as Democrats, a charter style city government, and per capita traffic injuries all have a significant positive effect on the likelihood of signing the USMCPA.

In the light of these findings, work remains in applying these empirical methods to understanding national municipal participation in the USMCPA. There has not been a national empirical study of participation in the USMCPA that examines factors that influence participation of cities in the agreement. This study uses a sample of 280 cities nationwide to assess the significance of demographic, regional, economic, environmental, energy use, and political factors in determining participation of cities in the USMCPA.

METHODOLOGY AND DATA

Methodology

I regress participation in the USMCPA on city characteristics to determine their relative importance in predicting municipal involvement in environmental agreements. Since the dependent variable, city participation, is a dichotomous variable, I estimate a logistic model. Following Zahran et al. (2008), I divide city characteristics into categories. For this study, the categories of interest are Demographic and Regional Factors, Economic Structure, Environmental Conditions, Energy Use, and Political Factors.

The demographic and regional factors considered are population density, educational attainment of the population, median age of the population, and location of the city. My hypothesis is that, given the findings of Wang (2010) and Zahran et al. (2008), population density and education will be positively associated with participation. Median age is included as a demographic control. Regional indicators are constructed to control for regional effects.

The economic factors considered are the unemployment rate, the share of employment contributed by the manufacturing industry, and per capita income. Zahran et al. (2008) found that high dependence on industrial employment was negatively associated with participation of cities in the CCP. Wang (2010) found that income was positively associated with participation in the USMCPA. This study tests those findings and considers the effect of the unemployment rate as well. My expectation is that increased unemployment will make cities less likely to participate due to the perceived trade-off between environmental protection and economic development.

The environmental factors considered are local air quality and cooling degree days, a measure of heat stress. Zahran et al.'s (2008) analysis found that climate change risk, including environmental conditions, was not a significant factor in explaining participation. However, Betsill and Rabe's (2009) work found that some cities considered co-benefits, like decreases in local air pollution, to be motivating factors for participation in environmental agreements. In order to test that effect, a measure of local air quality is included in the model. Cooling degree days are included as a measure of climate change risk in that cities that experience warmer temperatures may be more sensitive to concerns about future warming.

The energy use factors considered are the use of public transportation, residential energy costs, and carbon emissions. Zahran et al. (2008) found that the percentage of commuters traveling alone was, along with other factors, a significant negative predictor of participation in the CCP. This study tests that result by considering the use of public transportation by commuters. In addition, a measure of home energy costs is included to assess the expectation that cities with high energy costs will be less likely to participate. Finally, Zahran et al.'s (2007) study of nations participating in the Kyoto Protocol found that CO_2 emissions were a significant predictor of participation. This study analyzes the effect of CO_2 emissions at the city level.

Political factors, the final category, is measured as the partisan orientation of each city. Wang (2010) found that the percentage of citizens affiliated with the Democratic Party was a significant predictor of participation among California cities in the USMCPA. This study explores that result on a national level.

Although the relationships between these factors are complex, this study adopts a reduced form approach in which only the direct effect of each factor on participation is examined. Therefore, the following logistic regression model is estimated:

Likelihood of Participation = β_0 + β_1(Population Density) + β_2(Education) + β_3(Median Age) + β_4-β_6(Regional Indicators) + β_7(Unemployment) + β_8(Manufacturing) + β_9(Air Quality) + β_{10}(Cooling Days) + β_{11}(Energy Costs) + β_{12}(Public Transit) + β_{13}(Carbon Emissions) + β_{14}(Partisanship) + e

Data and Variables

Cities in this study adopted the USMCPA between 2005 and 2010. Given the availability of data and the relative consistency of many of the variables over time, the independent variables are based on 2000 data. In general, the demographic, economic, environmental, energy use, and political characteristics of cities in the years preceding the USMCPA created the conditions for the decision by political leaders of whether to join. In addition, using 2000 data ensures that a city's decision to participate in the USMCPA does not affect the independent variables. As data on the year a city joined the agreement were not available, more sophisticated hazard models were not estimated.

The dependent variable is a dichotomous measure of participation of cities in the USMCPA. Data on participation in the USMCPA was obtained from the U.S. Conference of Mayors' Climate Protection Center website.[ix] This website includes a list of 1,049 mayors who had signed the agreement as of March 19, 2011. The cities represented by these mayors are compared with the principal cities of MSAs defined by the U.S. Census Bureau.[x] Of the 280 MSAs on which data were available from the 2000 Census, 162 were participants in the USMCPA as of 2010.

The independent variables capture city characteristics. Measures of median age, population density, unemployment rate, manufacturing employment share, per capita income, public transportation use, and educational attainment are based on data from the 2000 U.S. Census, organized by MSA. Estimates of carbon emissions from the one hundred largest U.S. MSAs, as defined by the Brookings Institution based on total employment, were obtained from the Georgia Tech Ivan Allen College School of Public Policy Working Paper #39, *The Residential Energy and Carbon Footprints of the 100 Largest U.S. Metropolitan Areas,* by Marilyn Brown and Elise Logan published in May 2008. Table A-10 provides per capita annual energy use and carbon emissions (measured in metric tons per person) from residential electricity and fuel consumption, excluding transportation, in the year 2000. Of the one hundred MSAs included in Brown and Logan's paper, ninety are part of the sample examined in this study.

Data on local air quality in 2000 were obtained from the EPA's Air Data Air Quality Index Summary Report. The Air Quality Index (AQI) is available at the MSA level and serves as an indicator of overall local air quality as a function of criteria air pollutant levels. The AQI runs from zero to five hundred, with higher values indicating greater levels of air pollution. The median AQI score indicates that half of the daily AQI values during the year were less than or equal to the median value and half equaled or exceeded it. The median AQI score is available for 257 MSAs in the full sample.

Cooling degree days data were obtained from the National Oceanic and Atmospheric Administration's National Climatic Data Center to assess local environmental conditions in 2000. Cooling degree days are a measure of how much (in degrees), and for how long (in days), outside air temperature is higher than sixty-five degrees Fahrenheit. Cooling degree days also provide an indication of the demand for energy to cool buildings. This study uses the cumulative total of cooling degree days in selected cities in the year 2000. This year was chosen for consistency with the other independent variables. These cities are matched to the corresponding cities in the sample. Of the 280 cities in the full sample, 190 have cooling degree days data.

Data on home energy costs were obtained from the Council for Community and Economic Research. Their ACCRA Cost of Living Index includes a measure of the average monthly cost for natural gas, fuel oil, electricity, and any other forms of energy used in the home. It is based on prices collected from around the nation. These data are available for 209 of the MSAs in the sample. In order to standardize this measure, a new variable was created. First, to construct this new variable, average monthly energy costs were multiplied by twelve to create a measure of yearly average energy costs. Second, yearly average energy costs were divided by per capita income to create a ratio of energy costs to income.

Data on partisan orientation in cities came from a survey of U.S. mayoral election results conducted by Fernando Ferreira and Joseph Gyourko of The Wharton School. The authors sent a survey to all U.S. cities with more than 25,000 people as of the year 2000. The survey requested information on the timing of mayoral elections, candidates' names, party affiliation, vote totals, and other relevant information. The resulting data set includes information on 4,543 elections held in 413 cities between 1950 and 2005. Cities represented in the data set were associated with the appropriate MSA in the full sample, producing a set of 150 cities. In order to create an index of the partisan leaning of these cities, the outcome of each election between 1990 and 2000 was assigned a score of 0.0, 0.5, or 1.0. A score of 0.0 was assigned to a victory by a Republican candidate. A score of 0.5 was assigned to a victory by a non-partisan or independent candidate. A score 1.0 was assigned to a victory by a Democratic or Green Party candidate. The resulting scores were averaged to create a continuous variable representing the partisan leaning of the city. This variable ranges from a minimum of 0.0, indicating perfect conservative leaning, to a maximum of 1.0, indicating perfect liberal leaning.

Descriptive Statistics

A preliminary analysis examines summary statistics for the variables of interest. The first level of analysis divides the total sample of 280 cities into the 162 that participated in the USMCPA and the 118 that did not. Table 1 presents the mean and standard deviation for each variable and allows for a comparison between participating and non-participating cities.

TABLE 1: DESCRIPTIVE STATISTICS

Variable	Participants	Non-Participants	Full Sample
USMCPA	162	118	280
Demographic and Regional Factors			
Population Density	367.03 (321.81)	190.07 (141.24)	292.46 (275.30)
Education	25.58 (6.92)	19.31 (5.26)	22.94 (6.99)
Median Age	34.81 (3.52)	35.26 (3.97)	35.00 (3.72)
Economic Structure			
Unemployment Rate	3.608 (1.002)	3.930 (1.297)	3.744 (1.145)
Manufacturing Share	13.34 (5.93)	14.87 (7.65)	13.98 (6.74)
Per Capita Income	20,579.02 (3,471.65)	18,159.64 (2,515.44)	19,663.57 (3,355.86)
Environmental Conditions			
Median Air Quality Index (N=257)	41.59 (12.21)	38.30 (14.09)	40.25 (13.09)
Cumulative Cooling Degree Days (N=190)	1,438.26 (1,169.23)	1,795.42 (1,141.52)	1,558.59 (1,169.25)
Energy Use			
Energy Cost / Per Capita Income (N=209)	0.0634 (0.0162)	0.0672 (0.0154)	0.0650 (0.0159)
Public Transportation Use	2.181 (2.641)	0.858 (0.775)	1.624 (2.169)
Carbon Emissions Per Capita (N=90)	1.0364 (0.3168)	1.1117 (0.3872)	1.0447 (0.3238)
Political Factors			
Partisan Orientation (N=150)	0.5909 (0.3678)	0.5083 (0.3595)	0.5584 (0.3656)

Mean (Standard Deviation)

The mean values of a number of variables of interest are significantly different between participants and non-participants. Participant cities, on average, have higher population density (p=0.0000[xi]), more education (p=0.0000), and higher per capita incomes (p=0.0000). They also make more use of public transportation (p=0.0000), have lower rates of unemployment (p=0.0256), have lower home energy costs (p=0.0264), and have fewer cooling degree days (p=0.0486). The differences between participants and non-participants in the mean values of the other variables are not statistically significant.

The second level of analysis divides the total sample into census regions. Table 2 details the geographic distribution of the sample by census region. Cities in the South make up 44.6 percent of the full sample. Examining the distribution of participating cities reveals that the South region makes up a smaller percentage (36.4 percent) of participant subset than of the total sample. Each of the other three regions' individual share of the participant subset is higher than its share of the total sample. With respect to the non-participant subset, the south region has higher share in this subset (55.9 percent) than in the total sample. Each of the other regions' individual share of the non-participant subset is smaller than its share of the total sample. This initial analysis suggests that southern cities were less likely to join the USMCPA.

TABLE 2: REGIONAL DISTRIBUTION OF FULL SAMPLE

Region	Participants		Non-Participants		Total	
	Observations	Percent	Observations	Percent	Observations	Percent
Midwest	44	27.2	26	22.0	70	25.0
Northeast	26	16.1	9	7.6	35	12.5
South	59	36.4	66	55.9	125	44.6
West	33	20.4	17	14.4	50	17.9
Total	162	100.00	118	100.00	280	100.00

Figures may not sum due to rounding

Since the cities in the South represent the largest share of the sample and seem less likely to participate than cities in other regions, further investigation into how southern cities differ from those in other parts of the country is warranted. Table 4 divides the full sample into cities in the South and those in the other three regions. For each variable of interest, Table 3 provides the mean for cities in the South and the mean for cities in the other regions. On a number of variables, the mean values for southern cities are significantly different from those for cities in other regions. Cities in the South, on average, are less educated (p=0.0004[xii]), have lower per capita incomes (p=0.0000), and use public transportation less often (p=0.0009). In addition, southern cities have a lower percentage of their jobs in the manufacturing sector (p=0.0321), have higher median AQI scores (p=0.0386), have more cooling degree days (p=0.0000), and have higher home energy costs (p=0.0034). The differences in the means on the other variables are not statistically significant, though southern cities' higher carbon emissions per capita mean value comes close to conventional significance levels (p=0.0769).

TABLE 3: SOUTH SUB-SAMPLE

Variable	South	Other Regions
Observations	125	155
Demographic and Regional Factors		
Population Density	287.52 (251.50)	296.44 (293.84)
Education	21.33 (6.17)	24.24 (7.36)
Median Age	34.98 (4.31)	35.01 (3.17)
Economic Structure		
Unemployment Rate	3.841 (1.245)	3.665 (1.055)
Manufacturing Share	13.04 (6.06)	14.74 (7.16)
Per Capita Income	1,8715.54 (3,735.27)	2,0428.12 (2,801.92)
Environmental Conditions		
Median Air Quality Index	42.11 (10.12)	38.83 (14.83)

Variable	South	Other Regions
Cumulative Cooling Degree Days	2,442.54 (931.08)	915.68 (866.98)
Energy Use		
Energy Cost / Per Capita Income	0.0671 (0.0161)	0.0630 (0.0156)
Public Transportation Use	1.175 (1.282)	1.985 (2.628)
Carbon Emissions Per Capita	1.1106 (0.2619)	0.9988 (0.3559)
Political Factors		
Partisan Orientation	0.5743 (0.0374)	0.5476 (0.3617)

Mean (Standard Deviation)

Limitations of Data

The limited availability of data presents a number of concerns. Using data from 2000 establishes the baseline conditions out of which decisions to participate in the USMCPA arose. However, as decisions to join took place between 2005 and 2010, this approach raises the concern that these conditions may have changed significantly by the time any particular city chose to participate. In addition, the U.S. Conference of Mayors did not release the date each city joined the USMCPA. Having data on when each city joined would have made it possible to separate early joiners from late, which may have yielded valuable insight. If the year each city joined was available and time series data were collected, a hazard model could be estimated, addressing some of these concerns.

A second concern stems from the fact that some data, such as USMCPA status, partisanship, and cooling degree days were available only at the city level while other data, such as demographic and economic factors, were available at the MSA level. Therefore, cities are matched to the appropriate MSA by treating the principal city associated with an MSA as a representative city. For example, the city of Davenport, Iowa, is associated with the Davenport Moline Rock Island IA IL MSA. The concern in adopting this approach is that decisions to join were taken at the city level, while the MSA level data provides information about conditions in a wider geographic area that may include multiple municipal jurisdictions. However, as economic and environmental conditions are likely to be broadly similar within the boundaries of any particular MSA, these conditions may have had some influence on decisions at the municipal level.

The third concern involves the construction of the partisanship variable. First, the USCM did not release the partisan affiliation of the participating mayors. Second, it was not possible to identify non-participating mayors and their partisan affiliation. Therefore, historical data on the outcome of municipal elections from 1990 to 2000 is used to create an index representing the partisan leaning of a given city, ranging from 0.0 for perfectly conservative to 1.0 for perfectly liberal. However, constructing this variable reveals two weaknesses. First, the number of elections in that interval varied across cities. Therefore, the index is a more reliable indication of the partisan orientation of some cities than of others. Second, many municipal elections are non-partisan. In constructing this variable, non-partisan or independent candidates, are assigned a score of 0.5. One limitation of this technique is that a non-partisan candidate may have a distinctly liberal or conservative ideology that is not captured by the constructed index.

A final limitation is that full data were not available for all the independent variables of interest. In order to preserve all 280 observations in every primary model, observations for which data were missing are imputed with either the mean or the state mean of that variable. For Median Air Quality Index, Energy Cost / Per Capita Income, and Partisan Orientation, missing observations are imputed with the mean value of those variables for all other observations in the sample. For Cumulative Cooling Degree Days and Carbon Emissions Per Capita, in which geography has a strong influence, missing observations are imputed with the mean value of other observations in the same state. If no other observation in that state had a value, these observations were imputed with the mean of all the observations in the sample. Table 4 provides a comparison of the imputed and unimputed mean and standard deviation for each variable in question. Comparisons of the means of the imputed and unimputed variables using two tailed t-tests find that the means in each case are not statistically significantly different. In order to test the robustness of my results given this technique, alternate models are run without the imputed variables (See Table 6).

TABLE 4: IMPUTED VARIABLES

Variable	Imputed Value	Unimputed Value
	40.245	40.245
Median Air Quality Index^	(12.535)	(13.086)
	N=280	N=257
	1,523.73	1,558.57
Cumulative Cooling Degree Days#	(1,109.31)	(1,169.25)
	N=280	N=190
	1.0484	1.0447
Carbon Emissions Per Capita#	(0.2870)	(0.3238)
	N=280	N=90
	0.0670	0.0650
Energy Cost / Per Capita Income ^	(0.0198)	(0.0159)
	N=280	N=209
	0.5584	0.5584
Partisan Orientation^	(0.2672)	(0.3656)
	N=280	N=150

Mean (Standard Deviation)
^Missing values imputed with mean; #Missing values imputed with state mean.

FINDINGS

In order to determine factors that influence participation in the USMCPA, a series of models are run using a logistic regression. Model 1 consists of demographic and regional factors. Model 2 adds economic variables. Model 3 incorporates environmental variables. Model 4 adds variables designed to capture energy use. Model 5 assesses the significance of political partisanship. Full results are reported in Table 5. In addition to the primary specifications, alternative specifications assess the robustness of the results. Table 6 presents results of the alternative specifications.[xiii]

TABLE 5: PRIMARY SPECIFICATIONS

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Demographic / Regional Factors					
Population Density	0.0040*** (0.0010)	0.0046*** (0.0011)	0.0043*** (0.0011)	0.0034** (0.0012)	0.0034** (0.0012)
Education	0.1582*** (0.0284)	0.1296*** (0.0349)	0.1320*** (0.0362)	0.1266** (0.0390)	0.1278** (0.0392)
Median Age	0.0270 (0.0431)	-0.0215 (0.0521)	-0.0165 (0.0525)	-0.0137 (0.050)	-0.0099 (0.0523)
Midwest	-0.5699 (0.4709)	-0.9493 (0.5928)	-0.8568 (0.6024)	-0.3190 (0.7168)	-0.2580 (0.7243)
Northeast	-0.1738 (0.6247)	-0.4462 (0.6806)	-0.2424 (0.6977)	-0.0977 (0.7894)	-0.0702 (0.7928)
South	-0.9787* (0.4372)	-1.2889** (0.4925)	-1.3648* (0.5725)	-0.8353 (0.6467)	-0.8340 (0.6467)
Economic Structure					
Unemployment Rate		-0.3121‡ (0.1883)	-0.3109‡ (0.1884)	-0.5633* (0.2393)	-0.5581* (0.2403)
Manufacturing Share		-0.0075 (0.0272)	-0.0095 (0.0303)	0.0027 (0.0307)	0.0018 (0.0308)
Environmental Conditions					
Median Air Quality Index^			0.0188 (0.0127)	0.0200 (0.0132)	0.0202 (0.0131)
Cumulative Cooling Degree Days#			0.00006 (0.0002)	0.000007 (0.0002)	0.00002 (0.0002)
Energy Use					
Energy Cost / Per Capita Income^				12.339 (12.75)	12.311 (12.79)
Public Transportation Use				0.4286‡ (0.2448)	0.4139‡ (0.2462)
Carbon Emissions Per Capita#				-1.239‡ (0.757)	-1.287‡ (0.762)
Political Factors					
Partisan Orientation^					0.3485 (0.6099)
Sample	280	280	280	280	280
McFadden's Pseudo R-Squared	0.2561	0.2632	0.2697	0.2897	0.2905
LR Chi-Squared	97.65	100.34	102.83	110.43	110.76

*Standard Errors in parentheses; ***p<0.001, **p<0.01, *p<0.05, and ‡p<0.10.*
^Missing values imputed with mean; #Missing values imputed with state mean.

Results

Model 1 includes variables for a city's population density, level of education, median age, and regional indicator variables for the Midwest, Northeast, and South. Population density (p=0.000) is positively associated with participation. This result is consistent with Zahran et al.'s (2008) finding that population density was positively associated with participation of cities in the CCP. Model 1 also finds the percentage of the population with a Bachelor's degree or higher (p=0.000) to be positively associated with participation in the USMCPA.[xiv] This result is consistent with Wang's (2010) finding that increased education was associated with participation by California cities in the USMCPA. Being located in the South, relative to the baseline category of the West, is negatively associated with participation (p=0.025). See below for further discussion of the influence of the South as a predictor.

Model 2 adds two economic variables to the demographic and regional variables assessed in the first model. The economic variables of interest are a city's unemployment rate and the share of employment in the manufacturing sector. Population density (p=0.000) and educational attainment (p=0.000) remain significant positive predictors of participation, while being located in the South (p=0.009) remains a negative predictor. At the 90% confidence level, the unemployment rate negatively predicts participation (p=0.097). The likelihood of participation was expected to decrease as a city's unemployment rate increases since citizens and their representatives may be less willing to accept a perceived tradeoff between economic growth and environmental protection. Similarly, the likelihood of participation was expected to decrease as a city's share of employment from manufacturing increases. Cities with large manufacturing sectors may expect that greater economic sacrifice will be required to reduce CO_2 emissions. However, Model 2 finds that the percentage of manufacturing employment in a city as a share of total employment is not a significant predictor.

The third model incorporates environmental factors into the analysis while retaining the variables from models 1 and 2. Population density (p=0.000) and education (p=0.000) remain positive predictors, while being located in the South (p=0.017) and unemployment, again at the 90% confidence level, (p=0.099) remain negative predictors of participation. The additional variables are the median air quality index and cumulative cooling degree days. The first of these variables, median air quality index, is included as an indicator of the general level of air pollution in each city. A high level of local air pollution may inspire the citizenry to support action that reduces CO_2 emissions while promising local air quality co-benefits, as found in Engel's (2006) qualitative work. Alternatively, poor local air quality may indicate transportation and production patterns that would require significant reform to reduce CO_2 emissions, potentially discouraging participation. Comparing the median air quality index to city level carbon emissions (data were available to make this comparison for ninety cities) yields a correlation of -0.1127. Therefore, a high median air quality index score may indicate poor local air quality, but is not an ideal proxy for city level CO_2 emissions. Cooling degree days are a measure of the number of days and the margin by which the temperature is higher than sixty-five degrees Fahrenheit. Citizens in cities with higher cooling degree day values may be more likely to be concerned about warming temperatures due to climate change. However, neither variable is found to be a significant predictor of participation. This confirms Zahran et al.'s (2008) finding that climate change risk was an insignificant factor in participation of cities in the CCP.

Model 4 adds three variables that aim to capture energy costs and energy use patterns at the city level. The first variable is the ratio of total average home energy cost to per capita income. This variable is designed to provide a standardized measure of energy costs between cities. The second variable is the percentage of commuters using public transportation. This variable measures the availability and use of low carbon means of transportation. The third is carbon emissions per capita. While the coefficient on energy costs is insignificant, both carbon emissions and public transportation use are significant predictors of participation. At the 90% confidence level, as carbon emissions increase, a city's likelihood of participation decreases (p=0.10), though only at the lowest level of statistical significance. While this finding is intuitive, the low level of significance suggests that it should be treated with caution. At the 90% confidence level, public transportation use (p=0.080) has the expected effect. That is, cities with higher levels of public transit use are more likely to join. It may be that citizens in these cities perceive that participation would cause less disruption to their transit habits than those in cities with lower public transportation use. This result and analysis conforms to Zahran et al.'s (2008) finding. Model 4 also finds population density (p=0.006) and education (p=0.001) to be positive predictors of participation, while unemployment (p=0.019) remains a negative predictor. The South, as a predictor, lost significance with the addition of the energy use variables, suggesting that carbon emissions and public transportation use explain some of the influence that the South was exerting on participation in the previous models.

Model 5 assesses the effect of partisanship on participation. The partisanship variable is an index designed to capture the partisan leaning of cities in the sample. My expectation was that cities with a liberal leaning, as measured by the election of Democratic or Green Party candidates, would be more likely to participate. In addition, Wang (2010) found that among California cities there was a positive relationship between liberal political affiliation and participation. However, Model 5 finds that partisanship is not a significant predictor of participation. This conclusion should be considered with some caution. First, this variable is an imperfect proxy for the true partisan leaning of cities. Many cities have non-partisan elections, making it difficult, based on the available data, to determine the political ideology of winning candidates. Second, regional variation in political ideology may obscure national party positions. A Democrat in one city may take positions more closely aligned with a Republican in another city and vice versa. Of the other variables, population density (p=0.006), educational attainment (p=0.001), and public transportation use (p=0.093) remain positive predictors of participation. Unemployment (p=0.020) and carbon emissions, at the 90% confidence level (p=0.091), remain negative predictors.

As each set of independent variables was added to the models, the McFadden's Pseudo R-Squared value and LR Chi-Squared value increase. In the case of the McFadden's Pseudo R-Squared value, the higher values indicate a greater likelihood and better fit than the previous model. Likelihood ratio tests comparing the fit of the primary specifications find the differences between Models 1, 2, and 3 to be insignificant. Model 4 represents a significant improvement in fit over the preceding models (p=0.05). The differences between Models 4 and 5 are insignificant.

In order to examine the influence of the South as a predictor, Model 6 is estimated using only cities in the South. Using the 125 cities in the sample that were located in the South, Model 6 finds education (p=0.000), manufacturing, at the 90% confidence level (p=0.066), and energy costs (p=0.046) to be positive predictors of participation in southern cities. Unemployment is a negative predictor (p=0.009). Notably, population density and public transportation use are insignificant factors in this model. These results suggest that population density and public transportation use differentiate southern cities from those in other regions but are less influential among cities within the region. Education and unemployment have the same influence in the South as in the full sample. Manufacturing share and energy costs are significant and positive predictors in this model while not significant in the full sample. The positive effect of the energy cost variable may suggest that cities with high energy costs are motivated by the perceived co-benefits of energy savings due to efficiency measures. The positive effect of the manufacturing variable may indicate that cities with a strong manufacturing base also have strong local economies, allowing the citizenry and their leadership to devote attention and resources to addressing environmental issues. It is possible that in some cities a decline in manufacturing would undermine the local economy to the point that investments in environmental issues are unlikely. This study does not address this possibility.

MSA-level carbon emissions were available for ninety cities in the sample. Model 8 uses a restricted sample to test the influence of carbon emissions on participation. This model excludes the regional indicators in order to maintain an adequate sample size. The result is that MSA-level carbon emissions, at the 90% confidence level (p=0.055), are negatively associated with participation in the USMCPA. This finding confirms the results of models 4 and 5, which find a negative association between carbon emissions and participation in the full sample. In addition, at the 90% confidence level the median air quality index (p=0.083) negatively predicts participation, while public transportation use (p=0.098) positively predicts participation. This latter result is consistent with the primary specifications. The negative significance of the median air quality index, while not found in the primary models, does not fit the theory that cities with poor local air quality may participate in hopes of realizing local air quality co-benefits.

Finally limited data are available for a number of variables. Therefore, for the median air quality index, energy costs, and partisan orientation, observations with missing data are assigned the mean value of that variable. For cumulative cooling degree days and carbon emissions, observations with missing data are assigned the state mean for that variable. Model 7, including only variables for which full data are available, finds population density (positive, p=0.003), education (positive, p=0.002), being in the South (negative, p=0.050), unemployment (negative, p=0.056), and public transportation use (positive, p=0.047) to be significant predictors. These effects are consistent with those found in the primary models. Model 9, run without imputation for variables with missing data, uses a restricted sample of eighty-eight cities and finds only population density (p=0.097), education (p=0.042), and public transportation use (p=0.10) to be positive and significant factors. The effect of these variables is consistent with the findings of the primary models. A number of these variables, however, were only significant at the 90% confidence level.

TABLE 6: ALTERNATIVE SPECIFICATIONS

Variable	Model 6	Model 7	Model 8	Model 9
Demographic / Regional Factors	*South only*	*w/o Missing*	*Carbon*	*w/o Impute*
Population Density	0.0022 (0.0019)	0.0035** (0.0011)	0.0023 (0.0040)	0.0047‡ (0.0028)
Education	0.2965*** (0.0765)	0.1119** (0.0355)	-0.0589 (0.2121)	0.2454* (0.1209)
Median Age	-0.0420 (0.0724)	-0.0206 (0.0516)	0.1628 (0.4199)	0.0416 (0.1826)
Midwest		-0.7721 (0.6047)		-0.4234 (1.410)
Northeast		-0.4278 (0.6962)		-2.358 (4.425)
South		-1.0117* (0.5164)		-0.2527 (1.3514)
Economic Structure				
Unemployment Rate	-1.1659** (0.4485)	-0.3659‡ (0.1916)	-2.0693 (1.6056)	0.0877 (0.7365)
Manufacturing Share	0.0975‡ (0.0530)	0.0014 (0.0230)	-0.0006 (0.1434)	0.0683 (0.0695)
Environmental Conditions				
Median Air Quality Index^	0.0057 (0.0279)		-0.0915‡ (0.0527)	-0.0183 (0.0259)
Cumulative Cooling Degree Days#	0.0004 (0.0004)		-0.0010 (0.0008)	0.0004 (0.0005)
Energy Use				
Energy Cost / Per Capita Income^	46.05* (23.07)		60.81 (60.29)	18.21 (31.86)
Public Transportation Use	0.4567 (0.4126)	0.0483* (0.2427)	1.3548‡ (0.8199)	0.9915‡ (0.6110)
Carbon Emissions Per Capita#	-1.550 (1.404)		-5.79‡ (3.02)	
Political Factors				
Partisan Orientation^	0.0942 (0.9372)		0.9603 (1.5674)	-0.0400 (0.9124)
Sample	125	280	90	88
McFadden's Pseudo R-Squared	0.3407	0.2753	0.4846	0.4086
LR Chi-Squared	58.91	104.96	30.42	44.98

*Standard Errors in parentheses; ***p<0.001, **p<0.01, *p<0.05, and ‡p<0.10.*
^Missing values imputed with mean; #Missing values imputed with state mean.

Discussion

The primary models (1-5) show relatively consistent results: population density, educational attainment, and public transportation use are positive predictors of municipal participation in the USMCPA. Partisanship is not a significant predictor, while being located in the South, unemployment, and carbon emissions are negative predictors.

Feiock, Francis, and Kassekert (2010) found that population density was positively associated with community sustainability efforts. Similarly, the results of this study find that population density is a significant predictor of participation across the models. This is consistent with the understanding that denser development reduces energy use from transportation (Glaeser and Kahn, 2008; Golob and Brownstone 2005).

While a causal link is difficult to draw, these results suggest that development policies that encourage density can not only reduce emissions, but also make it more likely that citizens will support municipal participation in environmental agreements. It may be the case that these citizens see action to address climate change as requiring less potential disruption to their transportation and residential energy use patterns than those in less dense cities. This hypothesis is supported by my finding that public transportation use is a positive predictor of participation. Again, residents of cities in which public transportation is both an available and well-utilized form of transit may perceive policies to reduce emissions as less disruptive to their lifestyles.

Semenza et al. (2008) found that increased education was a significant predictor of behavior change related to climate change. This paper's results are consistent with their findings. College education is a significant predictor of participation across the models, suggesting that increased levels of education are associated, at the city level, with action to address climate change. The implications of this finding for future policies to address climate change are ambiguous.

With regard to the influence of partisan affiliation, Zia and Todd (2010) report that ideology is a significant predictor of concern about climate change. Specifically, they find that concern for climate change decreases as citizens' ideology becomes more conservative. Wang (2010) also found that the percentage of Democrats in a city's population was positively associated with participation in the USMCPA among California cities. This result informed my expectation that liberal partisan orientation would positively predict participation. However, the lack of significance of partisanship in my models should be considered with caution. This variable, as described above, is an imperfect proxy for the mayor's party or the partisan leaning of a city. Were higher quality data available, a more defensible claim as to the effect of partisanship on participation might be possible.

The negative predictors—being located in the South, unemployment, and carbon emissions—conform to my expectations. The influence of the unemployment rate on participation suggests that economic development concerns play a significant role in decisions whether to and how to address environmental issues. The mechanism here may be that citizens' concern about unemployment crowds out willingness to address climate change. Gallup polling (Gallup 2011) found that, beginning in 2007 and continuing through 2010, a majority of respondents thought economic growth should take priority over environmental protection. While historically respondents prioritized environmental protection, the margin consistently narrowed during recessions. This suggests, as do this study's findings, that willingness to address environmental issues is closely linked to economic wellbeing.

CONCLUSIONS

The aim of this study is to determine the factors that influence participation of cities in the USMCPA. Identifying the significance of population density, education, unemployment, carbon emissions, and public transportation use suggests a number of implications.

First, population density, carbon emissions, and public transportation use are the residue of city planning and development policies. My findings suggest that dense cities with accessible and well-utilized public transportation not only have lower carbon emissions but also are more likely to participate in environmental agreements like the USMCPA. These findings support the hypothesis that city residents and their representatives are more likely to accept these agreements if the measures required for participation do not require undue disruption to established transportation and energy use patterns. If this is true, city planners may be able, in pursuing transit-oriented development policies, to reduce the reluctance of residents to accept policies designed to reduce emissions.

Second, while the exact mechanism by which education influences participation may be unclear, the positive effect is consistent across the models and with prior research. Improving educational attainment may be justified on numerous grounds, but these findings suggest that a more highly educated populace may demonstrate greater willingness to participate in efforts to address climate change or other environmental challenges.

Third, the negative effect of unemployment on participation may indicate the important role economic development policies play in addressing environmental issues. Citizens and representatives in cities with high unemployment rates may be more concerned with economic development than addressing climate change and may be unwilling to accept the perceived trade-off between jobs and reducing emissions. Policymakers and those advocating for measures to address climate change or other environmental issues would be advised to pursue both policies that encourage economic development and endeavor to make the case that reducing emissions can be achieved without reducing employment.

Significant work remains to be done in this area. If the year a city joined the agreement could be obtained, time series data would allow for the estimation of a hazard model that could refine these findings. In addition, these methods could be applied to other municipal environmental agreements to assess the external validity of the findings. Finally, the effect of participation on emissions demands further research.

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[viii] The U.S. Conference of Mayors, the official nonpartisan organization of cities with populations of 30,000 or more, represented 1,210 U.S. cities as of March 19, 2011.
[ix] http://www.usmayors.org/climateprotection/list.asp
[x] Unless otherwise indicated, the terms "city" and "MSA" are used interchangeably throughout this paper.
[xi] P-values from two tailed t-test, allowing for difference in variances across groups; null hypothesis of no difference in means.
[xii] P-values from two tailed t-test, allowing for difference in variances across groups; null hypothesis of no difference in means.
[xiii] Additional unreported models test the influence of the highly correlated variables, population density and public transportation use and unemployment and energy costs. In neither case do the results change significantly.
[xiv][xiv] Per capita income and educational attainment are highly correlated in the sample, thus I use only education in the primary models. A regression with per capita income in the place of educational attainment produced similar results; with population density positively predicting participation (p=0.000), while being in the South was a negative predictor (p=0.049). In this model, median age was a negative predictor of participation (p=0.002) and per capita income was a positive predictor (p=0.000).