

Malapportionment, Gasoline Taxes, and Climate Change

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Abstract: Gasoline taxes vary widely among industrialized countries, as does support for the United Nations' effort to curtail the use of fossil fuels to address the climate change problem. We argue that malapportionment of the electoral system affects both the rate at which governments tax gasoline and the extent to which governments participate in global efforts to ameliorate climate change. Malapportionment results in a "rural bias" such that the political system disproportionately represents rural voters. Since rural voters in industrialized countries rely more heavily on fossil fuels than urban voters, our prediction is that malapportioned political systems will have lower gasoline taxes, and less commitment to climate change amelioration, than systems with equitable representation of constituents. Furthermore, it is unlikely that malapportionment is an endogenous variable, correlated with the error term in our models, because levels of malapportionment were established at the founding of nations in most cases--sometimes centuries before the introduction of gasoline taxes and awareness of global warming. We find that malapportionment is negatively related to both gasoline taxes and support for the Kyoto Protocol to the United Nations Framework Convention on Climate Change (where "support" is measured as the duration of the spell between the signing of the Protocol and ratification by the domestic legislature).

Introduction

Gasoline taxes vary widely around the world, as do efforts to join other nations in limiting greenhouse gas emissions via the Kyoto Protocol. The reasons for these variations are not obvious. For example, countries as similar in their cultural, political, and legal traditions as the United States and the United Kingdom lie at opposite ends of the spectrum in terms of gasoline tax policy and support for climate change amelioration. In this paper, we argue that political institutions help explain the variation in gasoline taxation and global warming policy. Our specific focus is on “malapportionment,” which occurs when geographic constituencies have shares of legislative seats that are not equal to their shares of population. In countries such as the United States, malapportionment has resulted in the systematic overrepresentation of rural interests. Inasmuch as rural voters depend more on fossil fuels than voters in urban districts, we expect malapportioned political systems to produce lower gasoline taxes and less commitment to climate change amelioration than systems with more equitable representation of constituents.

Gasoline taxes influence the level of environmental externalities both nationally and internationally, but government policies do not appear to follow the pattern of an “Environmental Kuznets Curve”: countries at similar levels of economic development have very different fuel policies. Whereas the United States (\$36,235 GDP per capita) and Canada (\$24,925) tax unleaded gasoline at the rate of \$0.10 and \$0.24 per liter respectively, the Netherlands (\$24,747) taxes unleaded fuel at \$1.08 per liter and the U.K. (\$26,864) imposes a tax of \$1.10 per liter. **Figure 1** displays gasoline taxes and prices in 31 countries in year 2004. Note that pre-tax price differentials are small when compared to differences in taxes. Pretax prices range from a low of \$0.39 per liter in the United Kingdom to a high of \$0.49 in Norway and Japan. Thus, the total

price differential between countries can be attributed almost entirely to differential taxation. For example, the tax differential between the United Kingdom and the United States is more than ten times the pre-tax price differential. Consequently, while pre-tax gas prices in the U.S. are slightly higher than in the U.K, gas prices in the U.K. are almost three times higher at the pump.

Countries at comparable levels of development also show different patterns in support for the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which is aimed at combating global warming. Of the Annex 1 countries—those countries for which greenhouse gas cuts are binding—level of development explains little of the variation. In a simple bivariate regression of GDP per capita on Kyoto ratification, the results do not approach statistical significance.¹ **Figure 4** displays the duration in months between the Kyoto Protocol's inception and each Annex 1 country's ratification. Turkey's duration, the last Annex 1 country to ratify, lasted almost four times as long as Romania's duration, the first Annex 1 country to ratify, even though they are separated by only \$200 in their per capita GDP. While a number of factors contribute to a country's decision to ratify the Kyoto Protocol, clearly level of development is not the main driver.

In the next section, we survey the literature on malapportionment and highlight our innovations and contributions. In Section 3, we show that rural constituents in industrialized countries prefer lower gasoline and environmental taxes than urban voters. We illustrate this point with (1) data on rural-urban differences in dependence on gasoline, and with (2) individual-level data from a large cross-national survey. In Section 4, we develop the logic of our claim that gasoline taxes (and gasoline prices) relate negatively to malapportionment. We show that

¹ This same finding holds when running a hazard model like those in Section 4 with a control for EU15 members. However, as reported below, the income variable is significant when run in the fuller model.

countries with political systems that are more malapportioned tend to have lower gasoline taxes (and prices) than countries with systems that equitably represent voters across geographic areas. Furthermore, we emphasize that our results are relatively immune to endogeneity concerns. Levels of malapportionment were established for most countries by constitution decades if not centuries before the onset of gasoline taxes and awareness of global warming. Therefore, malapportionment cannot be a choice variable in these cases. In Section 5, we extend our analysis further into the environmental domain and evaluate the relationship between malapportionment and support for the Kyoto Protocol—the international agreement organized by the United Nations that sets targets for industrialized countries to cut their greenhouse gas emissions. Our findings confirm our expectations: in countries where malapportionment generates a rural bias in the legislature, support for the Kyoto Protocol is lower than in countries with no rural bias, all else equal. The final section concludes with an assessment of the implications of our argument.

2. Malapportionment and Malapportionment Research

A malapportioned political system is one in which the votes of some citizens count more than the votes of others, due to a discrepancy between the share of the population held by electoral districts and the share of legislative seats allocated to districts. Put another way, malapportionment occurs “when geographical units have shares of legislative seats that are not equal to their share of population.”² Malapportionment has deep normative and positive roots in the political science literature but no one has yet examined how it affects environmental policies such as the taxation of gasoline consumption. Furthermore, no research to date has investigated

² Monroe 1994, 138.

the relationship between malapportionment and international environment agreements, such as the United Nations' effort to ameliorate climate change. In this section, we place our innovations within the context of the broader literature on malapportionment.

Malapportionment is normatively important since it violates the principle of equal representation. From the standpoint of democratic theory, this is a problem since representative democracy is grounded on the “one-person, one-vote” norm of electoral fairness.³ Electoral equity requires that individuals possess an equal *right* to participate in elections; it also requires that the votes of citizens are *weighted* equally.⁴ In other words, “the needs and preferences of no individual should rank higher than those of any other.”⁵ Since malapportionment causes the votes of some individuals to weigh more than the votes of others, it is considered a “pathology of electoral systems” and anathema to democracy.⁶

In the 1960s, the U.S. Supreme Court took aim at malapportionment and (re)established “one-person, one-vote” as constitutional doctrine and the democratic norm of political equality and fairness. Court-ordered redistricting of state legislative districts followed *Baker v. Carr* (396 U.S., 1962), and the Court addressed the substantial malapportionment of congressional districts in *Wesberry v. Sanders* (376 U.S. 1, 1964). This decision aimed to ensure that districts of the House of Representative were approximately equal in population. According to the constitution, states are accorded congressional seats on the basis of population. But these boundaries were drawn when the nation was primarily rural and, as cities became more important, state legislators tended to resist reapportionment because changing districts would have required them to undermine the political power of their constituencies and thereby their own chances for

³ Dahl 1971, 2.

⁴ Verba and Nie, 1972.

⁵ Verba, Schlozman, and Brady 1995, 10.

⁶ Taagepera and Shugart, 1989; Snyder and Samuels, 2004.

reelection.⁷ As a consequence, over 235 congressional districts deviated by over 10 percent from the average district size by the early 1960s, and this meant that rural districts were strongly overrepresented in the House of Representatives. By 1972, and as a direct result of the “reapportionment revolution” that followed *Wesberry v. Sanders*, only 50 districts deviated by more than *one* percent from the average.⁸ In short, the practical result of the Supreme Court’s “one-person, one-vote” decisions was an enormous redistricting effort that erased nearly all the malapportionment and rural bias in the U.S. House of Representatives. However, the Senate’s malapportionment was not addressed as it is explicitly rooted in the Constitution and is designed to represent states, not individuals, equally.⁹

In political science, the result of the reapportionment revolution was an explosion of research on the policy and political consequences House redistricting. Political scientists viewed Court-ordered redistricting as a “natural experiment” in which to examine the effects of electoral institutions on policy and political outcomes, with treatments provided by the federal courts.¹⁰ Much of this literature looks at the impact of reapportionment on government spending. For example, McCubbins and Schwartz argue that Court-ordered redistricting created a new “metropolitan majority” in the House of Representatives, and that this caused Congress to redistribute spending to projects and programs that benefited urban voters, such as housing assistance, while reducing expenditures that benefited rural constituencies, such as agricultural

⁷ Eagles, 1990.

⁸ McCubbins and Schwartz 1988, 390.

⁹ The assignment of two senators to every U.S. state regardless of population makes the Senate one of most malapportioned and rural-biased chambers in the world. See Samuels and Snyder 2001.

¹⁰ See Erikson, 1972; Tufte 1973; McCubbins and Schwartz 1988; Cox and Katz 2002; Ansolobehere, Gerber, and Snyder 2002; Lax and McCubbins 2004.

price supports.¹¹ Using time series analysis of federal appropriations, they find that changes in agricultural, regulatory, and transportation policy are driven by the change in urban-rural representation after *Wesberry v. Sanders*. The spending policy consequences of malapportionment in the U.S. Senate have also been the subject of several studies.¹² In each instance, the mechanism behind the urban-rural reallocation of spending is that legislators act as they always do: providing benefits to their constituents in order to enhance their prospects of reelection.

Similar policy effects have been found in other countries as electoral systems became malapportioned, to the disadvantage of cities, as population shifted from rural to urban areas while reapportionment lagged behind. Thies examines the effects of urbanization on agricultural subsidies in Japan and the United States and finds that even after lower house malapportionment was dealt with by the courts in both countries, the policy effects differed due to institutional differences.¹³ In Japan, policy changed quickly after court-ordered reapportionment led urban members to constitute a majority in the lower house of the Diet. In the U.S., the “permanent” rural over-representation of the U.S. Senate combined with powerful House committees headed by pro-rural chairs to delay policy change much longer than in Japan.¹⁴

As the U.S. case illustrates, permanent malapportionment in favor of rural, sparsely populated areas is sometimes built into electoral systems from their origins, especially in geographically large federations. From the Great (Connecticut) Compromise of 1787 to the founding and expansion of the European Union today, smaller states have been able bargain for the creation of a territorial-based upper chamber that overrepresents them relative to their

¹¹ McCubbins and Schwartz 1998.

¹² See Riker 1955; Stewart and Weingast 1992; Lee 1998; and Lee and Oppenheimer 1999.

¹³ Thies 1998.

¹⁴ Thies 1998, 481. See also Horiuchi and Saito 2003.

population.¹⁵ In such cases, a large permanent gap persists in the number of votes required to elect a senator between the most underrepresented and the most overrepresented states: “In Argentina, one vote in Tierra del Fuego is equal to 180 votes in Buenos Aires. In Brazil, one vote in Roraima is worth 144 votes in Sao Paulo, and in the United States, one vote in Wyoming is worth 67 votes in California.”¹⁶ This overrepresentation of rural areas in upper chambers is permanent and has resulted in a significant pro-rural bias in spending policy. For example, studies of rural bias in the U.S. Senate find substantial evidence that expenditures and net per capita transfers are significantly greater in smaller, overrepresented states.¹⁷ In Brazil and Argentina, where constitutional bargains long ago also established upper houses with permanent rural overrepresentation, there are large and persistent overrepresentation effects on expenditures.¹⁸

Many nations have malapportioned systems and severe malapportionment is usually a feature of upper chambers. Samuels and Snyder measure the level of malapportionment in 78 countries and find that the worst cases--Argentina, Brazil, Bolivia, the Dominican Republic, the United States, Switzerland, Russian Federation, Venezuela, Chile, Australia, Spain, Germany, Mexico, South Africa, and Poland—all have extremely malapportioned upper chambers.¹⁹ Yet Samuels and Snyder also find high levels of malapportionment in many lower chambers, challenging the notion that malapportionment is strictly associated with bicameralism.²⁰

Many studies find malapportionment to have policy consequences that benefit the rural sector. As mentioned above, Thies shows that malapportionment in Japan and the United States

¹⁵ Rodden 2002.

¹⁶ Gibson et al. 2002, 176.

¹⁷ Atlas et al. 1995.

¹⁸ Gibson et al. 2002.

¹⁹ Samuels and Snyder 2001.

²⁰ See also Lijphart 1994; and Tsebelis and Money 1997.

perpetuates agricultural subsidy programs that transfer income from urban consumers to rural producers, even in the face of massive shifts of populations toward the cities.²¹ Snyder and Samuels examine malapportionment in 19 Latin American countries and find that malapportionment produces a systematic overrepresentation of rural interests in both lower and upper chambers.²² This is consistent with Lijphart, who notes that “Malapportionment often takes the form of rural or regional overrepresentation.”²³ Similarly, Ansolabehere, Gerber, and Snyder find that, prior to Supreme Court-ordered redistricting in the mid-1960s, malapportionment resulted in an unequal distribution of state government expenditures within the states, in favor of overrepresented rural counties.²⁴ Court-ordered redistricting, however, altered the flow of state transfers to counties, from formerly overrepresented rural counties to formerly underrepresented urban and suburban counties, in a manner that “provides clear evidence of the political consequences of unequal representation.”²⁵

This literature supports a connection between overrepresentation and rural policy bias. Yet, to our knowledge, no one has examined the effects of malapportionment on environmental taxation. The nearest related literature is Fredriksson and Millimet who borrow from Persson and Tabellini to argue that nations with proportional representation (PR) have stricter environmental policies than nations with majoritarian electoral systems.²⁶ Beyond this work, there is little research on the institutional sources of cross-national differences in environmental taxation.

²¹ Thies 1998.

²² Snyder and Samuels 2001.

²³ Lijphart 1994. See also Jackman 1994; Horiuchi 2004; Grace 2006; Lee 1998; Cho 1976; and David and Eisenberg 1961.

²⁴ Ansolabehere, Gerber, and Snyder 2002.

²⁵ Ibid, 769.

²⁶ Fredriksson and Millimet 2004; Persson and Tabellini 2000. For a “veto players” approach to the topic, see also Fredriksson and Millimet 2007.

By the same token, we can find no existing work documenting a link between malapportionment and *international* environmental policy as carried out by international treaties. The closest related work is Congleton and Fredriksson and Gaston who examine the Montreal Protocol and the United Nations Framework Convention on Climate Change, respectively, and find that democracies are more likely to ratify these agreements than autocracies.²⁷ Similarly, Neumayer finds that democracies sign and ratify more international environmental agreements, participate in more multilateral environmental organizations, comply more with reporting requirements under the Convention on International Trade in Endangered Species of Fauna and Flora, put a greater percentage of their land area under protections status, and are more likely to have a National Council on Sustainable Development in their country than non-democracies.²⁸ However, the existing literature showing the effects of domestic political institutions on international environmental agreements has ignored the effects of malapportionment.

Two conditions must obtain for an electoral system's apportionment method to result in an environmental policy bias: (1) political districts must be unequally populated; and (2), politically-relevant groups must be distributed unequally across districts. When these two conditions exist, they "introduce an element of discrimination among voters" by giving some citizens greater voting weight than others (Buchanan and Tullock 1962, 248). In the next section, we establish that politically-relevant groups on the issues of environmental taxation and global warming divide along urban-rural lines.

3. Urban-Rural Differences on Environmental Taxation and Global Warming

²⁷ Fredriksson and Gaston 2000.

²⁸ Neumayer 2002.

Our argument develops from the idea that individual preferences for environmental taxes differ across geographic regions within industrialized countries for pecuniary reasons. In industrialized countries, rural occupations like farming and ranching are more fuel intensive than urban occupations. Rural residents are also more dependent on private vehicles than city dwellers for professional and personal purposes. According to data from the United States Energy Information Administration, rural households in the United States own 22 percent more vehicles than urban households and consume 39 percent more motor vehicle fuel than urban households.²⁹ Rural residents also experience fewer of the observable negative externalities of fossil fuel consumption, such as smog and traffic congestion. All else equal, residents of rural communities should thus prefer lower gasoline taxes than urbanites. Furthermore, since policy-based efforts to address global warming (and other environmental externalities of energy consumption) imply higher fuel taxes and prices, rural residents should also be less supportive of these international initiatives as well.

In **Figure 2**, we use state-level gasoline consumption data from the U.S. to illustrate the differential dependence on gasoline across rural and urban communities. On the Y-axis we plot per capita gas consumption in gallons, by state. On the X-axis, we indicate the share of state population living in “Urbanized Areas” (UA’s), as defined by the U.S. Bureau of the Census.³⁰

²⁹ U.S. Department of Energy, Energy Information Administration, Table A1, U.S. Number of Vehicles, Vehicles-Miles, Motor Fuel Consumption and Expenditures, 2001.

³⁰ The Census Bureau developed the UA measure to provide a better separation of urban and rural territory. “A UA comprises one or more places (“central place”) and the adjacent densely settled surrounding territory (“urban fringe”) that together have a minimum of 50,000 persons. The urban fringe generally consists of contiguous territory having a density of at least 1,000 persons per square mile. The urban fringe also includes outlying territory of such density if it was connected to the core of the contiguous area by road and is within 1.5 road miles of that core, or within 5 road miles of the core but separated by water or other undevelopable territory.” <http://www.census.gov/geo/www/ua/uauinfo.html>

The fitted regression line clearly indicates the negative relationship between fuel dependence and urbanization. The relationship is highly significant ($t = -5.15$) and substantively meaningful: a one percent increase in the share of state population living in an Urbanized Area correlates with a reduction in per capita gasoline consumption of 2.44 gallons per annum.

Just because rural citizens in the U.S. are more dependent on fossil fuels than urban residents does not mean they prefer lower environmental taxes due to this differential dependence. Nor does it mean that rural dwellers in other nations have preferences similar to rural U.S. citizens. To establish the wider applicability of these claims, we draw upon the World Values Survey (WVS), which conducts representative national surveys in 97 countries, containing almost 90 percent of the world's population. Several waves of the WVS include a query on environmental taxation that is well suited to our purpose. Since the WVS contains additional information on respondents' backgrounds and beliefs, we are able to control for factors that might correlate with differential gasoline dependence across geographic regions (such as education and political ideology). Our findings indicate that rural dwellers are substantially less willing to use taxes for environmental purposes than urban dwellers.

Environmental questions have been part of the WVS since the 1989-1990 wave of the survey. One query (V106) asks respondents for their views on environmental taxation: "I am now going to read out some statements about the environment. For each one I read out, can you tell me whether you agree strongly, agree, disagree or strongly disagree? I would agree to an increase in taxes if the extra money were used to prevent environmental pollution." Possible answers are: 1=Strongly agree, 2=Agree, 3=Disagree 4=Strongly disagree.

The WVS contains a geographic indicator which we use to evaluate the relationship between geographic location (urban-rural) and willingness to support higher taxes for

environmental purposes. The variable, “City Size,” ranges from <2,000 for respondents living in communities with less than 2,000 people, to >500,000 for respondents living in cities with populations greater than half a million. **Figure 3** takes the percentage of respondents that answered “Strongly agree” and “Agree” to the environmental taxes query and arranges respondents’ by city size. We restrict the sample to residents of OECD countries since we do not expect rural residents in developing countries to consume more gasoline than urban residents. A positive relationship between support for environmental taxes and city size is evident: moving from the minimum to the maximum categories of city size, there is a 7.9 percentage point increase in the share of respondents that support environmental taxes. To explore the relationship further and control for other factors that may correlate with city size, we move to regression analysis.

There are several factors omitted from **Figure 3** that may vary along urban-rural geographic lines and therefore be the underlying “cause” of the relationship. For example, if city dwellers are more educated on average than rural citizens about the need for governments to tax activities that produce environmental externalities, then we might be mistaking differential environmental education for differential dependence on fuel consumption across the rural-urban divide. Similarly, if cities tend to be more polluted than rural areas, urban dwellers might have greater awareness of environmental problems and therefore be more willing to support environmental taxation than rural residents. Finally, political ideology could plausibly vary geographically, with urbanites more “liberal” and supportive of government intervention to protect the environment than rural residents.

In **Table 1**, we control for these potential omitted variables. The table reports results of ordered probit regressions where the dependent variable is the individual response to the WVS

query, “I would agree to an increase in taxes if the extra money were used to prevent environmental pollution.” For easier interpretation, we recoded responses so that higher values indicate greater support for environmental taxation (1=Strongly disagree, 2=Disagree, 3=Agree, 4=Strongly agree). Additionally, we weight the data to reflect some of the differences between the responding sample and actual population characteristics as reported by the WVS. The WVS documents a number of oversampled groups, some oversampled purposely and others through response rates, so this should help account for some of the sampling bias. Model 1 includes only our variable of interest, “City Size”, which ranges from 1 for respondents living in communities with less than 2,000 people, to 9 for respondents in cities with populations of more than 500,000. Model 2 adds controls from the WVS for knowledge about environmental policy, local environmental conditions, and political ideology. We use “Education Attainment” as a proxy for knowledge about the role of government taxes and environmental externalities. The variable ranges from 1=No formal education to 9=University with degree. The WVS also asks respondents how serious certain environmental problems are in the communities in which they live. We use the response to a query about local air pollution (v109) to control for urban-rural differences in perceived environmental conditions. We recoded responses to range from 1= Not serious at all, to 4=Very serious. To control for the possible overlap between political ideology and urban-rural location, we use “Ideology,” which is a respondent’s self-identified position on a left-right political scale, where 1=Far left and 10=Far right.³¹ Finally, in Model 3 we control for respondents’ concern for the global warming problem, which may also vary by urban-rural location. The WVS asks respondents (V111) to state how serious they think global warming or

³¹ The query (V114) is, “In political matters, people talk of “the left” and “the right.” How would you place your views on this scale, generally speaking?”

the greenhouse effect is for the world as a whole. We recoded responses to range from 1= Not serious at all, to 4=Very serious.

Table 1 reports our results. In every model, our variable of interest, “City Size,” is positive and highly significant. The population of a respondent’s town or city remains positive and significant when we control for the respondent’s educational attainment, political ideology, concern about global warming, and air pollution levels in the respondent’s community—all of which may vary along the urban-rural divide. Note that the signs of all controls are intuitive: respondents with more education are more likely to support environmental taxes, as are people that live in communities with more air pollution and people that express more concern about global warming. Likewise, the negative sign on “Ideology” indicates that conservatives tend to oppose environmental taxes.

Since the substantive meaning of these ordered probit estimates is not directly interpretable, we simulated the change in predicted probabilities caused by moving “City Size” from low to high values using the Clarify software.³² The effect is small but meaningful and highly significant. Moving “City Size” from the 25th percentile (5,000-10,000 population) to the 75th percentile (100,000-500,000 population) increases the probability of obtaining a “Strongly agree” or “Agree” response to the environmental taxes query by just under two percentage points, holding other variables in Model 3 at their means. With the confidence interval ranging from 0.001 to 0.034, this estimate is significant at the 95 percent level.

In this section, we have shown that: (1) gasoline dependence is higher in rural areas than in urban areas in the United States, and that (2) rural inhabitants express less support for

³² Tomz, Wittenberg, and King, 2003.

environmental taxation than urban residents across the OCED.³³ In our regressions, we controlled for a number of non-pecuniary factors that may correlate with respondents' geographic (urban-rural) location—education, ideology, exposure to pollution—and found that the distributional effects of environmental taxation still matter: residents of smaller (rural) communities are more likely to oppose environmental taxes than urban voters.

4. Malapportionment and Gasoline Taxes

In high income countries, residents of rural communities are more dependent on fossil fuel consumption than urban residents; they also express less support for using taxes to deal with environmental externalities. Both facts suggest that rural voters will oppose high gasoline taxes. But will this opposition affect gasoline tax *policy*? In this section, we argue that malapportionment overweights rural districts in the electoral system, leading to lower gasoline taxes. By contrast, in more equitably apportioned systems, urban residents, who outnumber rural citizens in the electorate, should obtain their preferred policy.

Our main dependent variable in this section is the total tax on gasoline, which proxies for environmental taxes more generally.³⁴ Our gasoline tax data are from the International Energy Agency's (IEA) *Energy Prices and Taxes* series and includes all taxes—sales, excise, VAT, etc—paid by the final end-use gasoline consumer. The total gas tax is measured in current U.S.

³³ American public opinion on global warming tracks this pattern. When asked about support for a cap and trade system to limit greenhouse gases in a 2009 CNN poll, a majority of Americans (60 percent) were in favor. However, respondents from rural areas were more likely to oppose the measure, even controlling for education, political affiliation, and income (results available on request).

³⁴ Fredriksson and Millimet 2007 treat gasoline taxes as a proxy for overall environmental policy. We acknowledge, however, that some countries use gasoline taxes to finance road construction projects, which suggests that gas taxes may be motivated by factors other than environmental externalities.

dollars per liter. We use the IEA series on the total tax (US\$/liter) for Premium Unleaded 95 RON gasoline, as it provides the widest country coverage. When the tax on Premium Unleaded 95 RON gasoline is unavailable, we substitute the tax on Premium Unleaded 98 RON or the tax on Regular Unleaded Gasoline.

Our variable of interest is “Malapportionment,” which we expect to have a negative influence on gasoline taxes. Our data on malapportionment is from Samuels and Snyder.³⁵ To measure malapportionment, Samuels and Snyder construct an index, MAL, which is given by:

$$MAL_j = \frac{1}{2} \sum_{i=1}^N |s_i - v_i|$$

where Σ is the summation over all districts i , s_i is the percentage of all seats allocated to district i , and v_i is the percentage of the overall population (or registered voters) residing in district i . To give an intuition of its range, where MAL=0, no citizen’s vote weighs more than another’s. Where MAL=0.3, thirty percent of seats are allocated to districts that would not receive these seats if there were no malapportionment. MAL=1 is the extreme case, where all seats are allocated to one district with only one voter.

Samuels and Snyder provide separate measures of malapportionment for lower and upper chambers in 78 countries.³⁶ As we are interested in the overall level of malapportionment in a political system, we average the values for the lower and upper chambers, but only if the upper chamber is effective and has influence over public policy. To determine whether the upper chamber is “effective,” we draw upon Tsebelis and Money, who code upper chambers according

³⁵ Samuels and Snyder 2001.

³⁶ Samuels and Snyder 2001. We added eight more cases to the dataset, using the same formula: Botswana, Bulgaria, Guyana, Indonesia, Luxembourg, Moldova, the Philippines, and Singapore.

to whether they have effective legislative power on financial (fiscal) legislation.³⁷ If there is no upper chamber, or if the upper chamber is ineffectual on fiscal policy, we use the lower chamber value of malapportionment.

The scatter plot in **Figure 5** provides an initial look at the relationship between malapportionment and gasoline taxes for the 30 countries for which we have data.³⁸ Countries with greater levels of malapportionment tend to have lower taxes on gasoline. Since differences in taxes explain most of the difference in gas prices internationally (see **Figure 1**), we expect the same relationship to be evident in the gasoline *price* data, for which we have greater coverage.³⁹ **Figure 6** plots 67 countries by their gas prices and levels of malapportionment and, although this sample includes many low-income countries, a negative relationship is still evident.

Since levels of malapportionment were determined during the constitutional era for most countries, it is unlikely that our results are subject to endogeneity problems. In fact, the countries with the most malapportioned systems—those with territorially-based upper houses like Argentina, Brazil, and the United States—were purposefully designed at their founding to overrepresent citizens living in less populated regions. Given that these constitutional decisions are distant historical events, it is therefore unlikely that malapportionment is a choice variable influenced by present-day gasoline tax policy. However, it is possible that malapportionment correlates with an omitted variable that is the underlying cause of gasoline taxes. Territorially large countries, for example, may have lower gas taxes because of their size. But if country size is also correlated with malapportionment, as Snyder and Samuels suggest, then countries might

³⁷ Tsebelis and Money 1997.

³⁸ Gasoline tax data for this cross section are from 1995, the modal year for Samuels and Snyder's measurement of malapportionment.

³⁹ End-use gasoline "pump" price data are also from the IEA. As with the gas tax data, we take values for Premium Unleaded 95 RON gasoline but substitute the price of Premium Unleaded 98 RON or the price on Regular Unleaded Gasoline when necessary to expand coverage.

have lower gasoline because their physical size is driving both malapportionment and gasoline taxes.⁴⁰ To control for country size and other possible correlates of malapportionment, we move to regression analysis.

Model 1 in **Table 2** provides a baseline estimate, with no controls. Model 2 controls for country size and federalism since Samuels and Snyder find that malapportionment is correlated with both these variables.⁴¹ Countries with large expanses of sparsely populated territory may have purposefully adopted malapportionment and/or federalism to overrepresent these underpopulated regions. If that is the case, then countries might have lower gasoline taxes because their physical size is influencing their choice of both political institutions and gasoline taxes. To control for this possibility we add a measure of country size (logged square kilometers), and dummy variable for federal systems. In Model 3, we control for the size of the rural population (percent of total population) because we want to show that countries with large rural populations do not necessarily have lower gasoline taxes. Rural residents compose less than 25 percent of the population in OECD countries so it is only when malapportionment overrepresents these interests that we expect to observe lower gas taxes. Model 4 adds three additional controls. The first is level of development (GDP per capita) since citizens in richer countries might prefer higher environmental taxes, according to the logic of the Environmental Kuznets Curve. The second control is CO₂ emissions, measured in metric tons per capita. We control for CO₂ emissions since gasoline taxes might differ nationally, due to variation in dependence on fossil fuels. The third control is for the overall level of taxation (taxes on income, profits and capital gains as a percentage of GDP). We control for this because high tax countries might also have higher gasoline taxes. Finally, in Model 5 we include a dummy variable equal to 1 for countries

⁴⁰ Snyder and Samuels 2001.

⁴¹ Ibid.

with proportional representation electoral systems.⁴² According to Fredriksson and Millimet, PR systems tend to produce higher environmental taxes than majoritarian systems.⁴³ For all data in these models, see **Appendix A**.

In **Table 2**, our variable of interest—malapportionment—remains negative and significant in all models. In Model 1, malapportionment alone accounts for 25 percent of the cross-national variation in gasoline taxes. When we control for country size and federalism in Model 2, the fit improves to 44 percent and there is little impact on the magnitude of the malapportionment estimate. Controlling for rural population in Model 3 does not weaken this result. In Model 4, GDP per capita is positive and significant, in line with Environmental Kuznets Curve reasoning, and CO₂ emissions are negative and significant as expected. But national tax levels appear to be unrelated to gasoline taxes. While overall fit improves to 68 percent in Model 4, malapportionment remains negative and significant. As indicated in Model 5, the control for proportional representation electoral systems has a positive yet insignificant effect.

In **Table 3**, we report substantive effects computed with the Clarify software.⁴⁴ With all other variables held at their means, a shift in malapportionment from its mean value to one standard deviation above its mean reduces the gasoline tax by 15 cents per liter—a large effect. The magnitude of this effect is similar to the effect of country size and CO₂ emissions, but more

⁴² Data on income per capita, land area, rural population, and CO₂ emissions are from the World Bank's *World Development Indicators*. Taxes on income, profits and capital gains are from the OECD (2008) *Revenue Statistics, 1965-2007* (category 1000, which includes taxes on individuals and corporations). The federalism indicator is from Samuels and Snyder 2001. The PR dummy is from the Matt Golder's "Democratic Electoral Systems around the World, 1946-2000" dataset. Values for all variables are for year 1995.

⁴³ Fredriksson and Millimet 2004.

⁴⁴ Tomz, Wittenberg, and King 2003.

precisely estimated. Malapportionment thus has a large effect, both on its own and relative to other variables in the model.

In **Table 4**, we report results using end-use gasoline prices (pump prices) as the dependent variable, instead of gas taxes. As discussed above, nearly all of the variation in gasoline prices is due to differences in gasoline taxes. By using end-use gasoline price, we expand our coverage to 67 countries. In the baseline model (Model 1), malapportionment is negative and highly significant even though the sample includes many developing countries (see **Appendix A** for the country list). We do not expect the rural sector in poor countries to be more dependent on fossil fuels than the urban sector, which may explain why the coefficient estimate is smaller in the baseline gas price model than in the baseline gas tax model. In Models 2 and 3, we control for country size, federalism, and rural population. The results are consistent with those in the gas tax regressions. In Model 4, we introduce controls for GDP per capita, CO₂ emissions per capita and the general level of taxation. Sample size drops in this model since the variable, Taxes on Income, Profits, and Capital Gains, is available only for OECD countries. This developed country context is where we expect our argument about rural bias to be most relevant since rural residents depend more heavily on fossil fuels than urbanites in developed countries. The results in Model 4 support this assumption: when the sample is limited to OECD countries, the coefficient estimate on malapportionment is more than twice the value in Models 1-3. Lastly, Model 5 controls for the type of electoral system (proportional representation) but again the effect is small and insignificant.

5. Malapportionment and Support for the Kyoto Protocol

We have shown that individuals prefer lower gasoline taxes when they come from a more rural setting, and that these preferences affect gas tax policy in malapportioned political systems. In

this section, we hypothesize that the same determinants of gasoline taxes across countries can be used to predict support for international climate change policies. If limiting the emission of greenhouse gases is generally more costly for rural citizens, then we expect rural dwellers to be less supportive of international agreements, like the United Nations Kyoto Protocol, that bind governments to these reductions. As such, we predict that malapportionment—which generally overrepresents the interests of the rural populace—should reduce support for this international environmental agreement.

Environmental problems at the scale of global climate change require an international approach.⁴⁵ However, international environmental agreements have distributional consequences within countries as well as across them. When these agreements require representative legislatures to debate and approve the regulations, the composition of those legislatures and the interests they represent are paramount to the outcome. Our argument about the effects of malapportionment on gasoline tax policy should thus play an equivalent role in the approval of international environmental agreements, like the Kyoto Protocol, that bind countries to reductions in greenhouse gas (GHG) emissions.

As with gasoline taxes, we assert that rural interests have more to lose from agreements that limit GHG emissions than urban residents. In high-income countries, residents of major cities generally push heavy polluters outside their borders while urban density creates environmental efficiencies that make cities less harmful overall.⁴⁶ As a result, rural areas and suburbs produce a larger share of emissions in advanced countries. Research on the United Kingdom, for example, suggests that the highest amounts of CO₂ emanate from the countryside

⁴⁵ See Beron et al. 2003.

⁴⁶ Dodman 2009.

and prospering suburbs, both at the household and per capita level.⁴⁷ In the United States, similar patterns prevail, implying that there are significant geographical differences in the incidence that a carbon tax would impose on households.⁴⁸ If rural and suburban citizens endure higher adjustment costs of meeting GHG emissions targets than urban residents, they are also more likely to oppose such reforms. Put another way, residents of cities should be more willing to support environmental regulations since the burden of GHG reduction falls more heavily on rural citizens.

On the other side of ledger, if climate change has substantial affects on rural economic activities such as agriculture, then rural communities may have a precautionary interest in *supporting* GHG reductions.⁴⁹ The impact of climate change on agriculture, however, varies widely across crops and is expected to be positive in many cases. This is because higher carbon dioxide levels generally cause plants to grow larger and because carbon dioxide makes some plants more water-use efficient, meaning higher yields on less water.⁵⁰ For example, estimates suggest that a doubling of carbon dioxide concentrations in the atmosphere will increase soybean, wheat, and rice yields by 38%, 31%, and 30% respectively.⁵¹ Of course, these “benefits” have to be weighed against the costs to farmers of more unpredictable weather patterns and more extreme weather events. The net effects are difficult to anticipate, especially where adaptive strategies can cushion the impact. According to Karl, et al., “adapting to warmer temperatures and rainfall changes could be as simple as changing planting dates, which can be an effective no- or low-cost option for taking advantage of a longer growing season or avoiding

⁴⁷ Druckman and Jackson 2009.

⁴⁸ Pizer et al. 2010.

⁴⁹ We thank a reviewer for suggesting this issue.

⁵⁰ Karl et al. 2009

⁵¹ National Science and Technology Council 2008, 125.

crop exposure to adverse climatic conditions such as high temperature stress or low rainfall periods.”⁵²

On balance, we think rural communities will be more opposed to initiatives to reduce GHG emissions than supportive because the costs rural actors would bear, in terms of higher fossil fuel prices, are more certain and more unifying than the costs of climate change. Agricultural and other rural economic activities are energy-intensive, meaning that rural residents bear a disproportionate share of the burden of adjusting to higher fossil fuel prices. By contrast, the net effects of global warming on actors within rural communities are difficult to estimate, which tends to divide the sector and constrain its overall support for reducing GHG emissions.

Policymaking at the sub-national level in the United States supports this claim. Many state (and local) governments in the United States have adopted measures to mitigate global warming despite the fact that effective efforts to address climate change must ultimately be global in scope (Engel and Orbach 2008). The Pew Center on Global Climate Change keeps a running tally on this groundswell of state-level GHG initiatives.⁵³ In **Figure 8**, we use these data to plot the total number of environmental initiatives by state governments targeting a reduction in GHG emissions against the percentage of each state’s population that lives in “Urbanized Areas.”⁵⁴ The fitted regression line shows a clear positive relationship, suggesting that states with more urban populations produce more climate change initiatives. The relationship is

⁵² Karl et al. 2009, 73.

⁵³ See <http://www.pewclimate.org/states-regions>

⁵⁴ These state-level initiatives range from explicit limits on the emissions of greenhouse gases from passenger cars, light-duty trucks, and electric power plants to more symbolic statements that are written in a broad and nonbinding manner. See Engel and Orbach (2008).

meaningful in a substantive sense as well: a one standard deviation increase in the share of a state's population living in an urbanized area leads a state to pass 2.7 more GHG initiatives.⁵⁵

Of course, urbanization cannot “explain” all the cases. But key outliers—Washington, DC and Vermont—are exceptions that test the rule. The District of Columbia has many fewer climate change initiatives than we might expect, given that it is completely urbanized, but this likely reflects its restricted governance structure: Washington, DC may not have the same array of policy tools that states have to create environmental initiatives. By contrast, Vermont, the state with the lowest urban population, has produced 17 emissions initiatives, which is one standard deviation (4.9) above the mean (11.7) number of state initiatives. Vermont, however, is not a typical rural state. Vermont is above the U.S. median in terms of median household income and it ranks sixth in the nation in educational attainment, with 33.6 percent of the state's population over 25 years of age holding a bachelor's degree or above.⁵⁶ Just 3 percent of Vermont's employed civilian population, aged 16 and over, work in “rural” occupations: agriculture, forestry, fishing, hunting, and mining. This is a much lower percentage than in other rural states such as Wyoming (10.7 percent), North Dakota (8.2 percent), South Dakota (8.1 percent), Montana (7.9 percent), and West Virginia (4.1 percent). In fact, the bulk of Vermont's workforce is employed in education, health, and social services, manufacturing and retail while just 4,160 Vermonters worked in farming, fishing, and forestry occupations. To quote the *Vermont Encyclopedia*, “Vermont today is more a home to chemical engineers, waitresses, office

⁵⁵ These results are from a Poisson model of percent living in Urbanized Area on a count of state GHG initiatives. A check with a negative-binomial model reveals that non-dispersion is not an issue. Results are available upon request.

⁵⁶ All data in this paragraph are from the U.S. Census Bureau, *Current Population Survey* and the *2000 Census*.

workers, garage mechanics and teachers than it is a haven for hill farmers.”⁵⁷ In short, the socio-economic demographics of Vermont are more typical of an urban state than a rural state. Thus, there is substantial evidence that support for GHG restrictions within the United States varies with the urban-rural composition of states.

We think ratification of the Kyoto Protocol provides a theoretically compelling case on which to test our argument about the effects of malapportionment at the international level of analysis. Unlike state governments within the United States, which are required by the courts to have legislative districts that contain approximately the same number of voters, many national legislatures around the world are malapportioned, to the advantage of rural constituents. Because rural citizens compose a small proportion of total voters in all the developed countries that agreed to binding reductions in GHG emissions under the Kyoto Protocol, we expect them to influence the Protocol’s ratification process only when they reside in countries with malapportioned electoral systems.

No previous study of the Kyoto ratification process identifies malapportionment as a causal factor. Some studies, such as Zarhan et al., derive predictions based on a sociological variant of the Environmental Kuznets-Curve, wherein economic development fosters a shift in national (as opposed to regional) preferences for more environmentally responsible policy.⁵⁸ Other work considers the degree to which nations’ are democratic as conditioning the influence of economic development on ratification behavior and policy outcomes.⁵⁹ Along similar lines, scholars have focused on the size and organizational capacity of environmental lobbies as a

⁵⁷ Duffy, Hand, and Orth 2003, xii.

⁵⁸ Zarhan et al. 2007. See also Frank 1999.

⁵⁹ Bernauer et al. 2010 and Bättig and Bernauer 2009.

factor influencing treaty ratification.⁶⁰ While increases in the size of the environmental lobby does appear to decrease the spell before ratification, Von Stein argues that features of the international agreement itself affect the ratification process; specifically, legalized mechanisms within the treaty and higher compliance standards hamper ratification of the Kyoto Protocol.⁶¹

What these studies lack, in our opinion, is a consideration of the domestic political institutions that connect the preferences of urban and rural voters to the policy outcomes. While we are not the only authors to bring political institutions into the analysis of global climate change policy—scholars have considered the level of democracy and the type of electoral system—our approach differs theoretically and conceptually from any previous study. In models that consider the level of democracy, environmental policy is conceptualized as a public good, and the degree of democracy affects the government’s responsiveness to the public’s demand for this good. In autocracies, for example, where leaders extract larger shares of the country’s wealth, ratification is delayed since leaders themselves pay more of the costs of abiding by an environmental treaty. In democracies, ratification is easier since governments produce higher levels of environmental public goods, reflecting policymakers’ closer connections to the public, and leaders bear lower marginal costs for pollution reduction.⁶² Within democracies, Fredriksson and Millimet use a similar public-goods logic to argue that proportional representation (PR) electoral rules compel political parties toward increasing social welfare, and thus PR systems produce more public goods in the form of environmental policies.⁶³

⁶⁰ Fredriksson et al. 2007.

⁶¹ Von Stein 2008.

⁶² Bernauer and Koubi 2009. See also Roberts et al. 2004, especially fn. 93, and Bernauer et al. 2010.

⁶³ Fredriksson and Millimet 2004

In this work, voters are assumed to have homogenous preferences for the production of environmental public goods like climate change amelioration, and the domestic political institutions that matter are those that induce policymakers to be more or less attentive to the public's demand these public goods. In our argument, by contrast, voters are divided along urban-rural lines on climate change policy and this cleavage is based on pecuniary factors: rural voters are more dependent on fossil fuels than urban voters and thus bear a higher proportion of the costs of adjusting to the Kyoto Protocols' GHG abatement schedule. Given this underlying urban-rural cleavage, we argue that the relevant domestic political institution is malapportionment, as opposed to democracy or proportional representation, since malapportionment usually results in a rural bias to public policies.

To test our argument about the malapportionment bias, we use a replication dataset from Von Stein.⁶⁴ We limit our sample to Annex 1 (industrialized) countries since these countries agreed to mandatory reductions in GHGs on a fixed timetable. Our variable of interest is "Malapportionment."⁶⁵ We expect the coefficient on this variable to be negative, as states with greater malapportionment should be less likely to ratify and less likely to succumb to other pro-treaty lobbying pressures.⁶⁶ Put another way, greater malapportionment increases the spell of non-ratification.

⁶⁴ Von Stein 2008. Our results are robust to similar models produced with replication data from Fredriksson et al. 2007; and Zarhan et al. 2007. In additional tests, we include our variable of interest in replications of Fredriksson 2007; Zarhan et al. 2007; and Von Stein 2008. Malapportionment is strongly statistically significant and performs in the expected direction (results available on request).

⁶⁵ One possible weakness is that our malapportionment data do not reflect any redistricting or reapportionment changes that may have occurred between the time it is measured (by Samuels and Snyder in the mid- to late-1990s) and the ratification timeframe of the Kyoto Protocol. However, a test on a small, random sample found no evidence of such changes.

⁶⁶ The expectation of a negative coefficient refers to the logged hazard ratio from the analysis.

We adjust the construction of our measure of malapportionment to reflect the role that different chambers play in ratifying international treaties. Whereas in our analysis of gasoline taxes, we included the malapportionment score only for upper houses of the legislature that have effective legislative power on fiscal legislation, in our analysis of the Kyoto Protocol, we include malapportionment measures only for chambers that are required to ratify treaties. For example, in the United States, only the Senate is constitutionally required to ratify treaties, so we include the malapportionment value for the Senate only. We utilize data from Hathaway that codes the legal requirement for each house to ratify a treaty before it goes into effect.⁶⁷ This coding scheme allows us to speak directly to the malapportionment bias on treaty ratification and its affect on international politics.

Following the approach in Von Stein and other studies, we use survival analysis to assess our claims.⁶⁸ Survival analysis allows us to estimate a country's "spell" (in months) to ratification. In addition to our main explanatory variable, we include a number of other control variables. As compared to our analysis of gasoline taxes, we believe our analysis of Kyoto ratification and malapportionment is even less likely to suffer from endogeneity. Kyoto and concerns over GHGs are very recent phenomena compared to the constitutional compromises of

⁶⁷ Hathaway 2008. For countries that do not require either house to ratify the treaty, we use the malapportionment value for the house from which the head of government comes. For example, before the Constitutional Reform and Governance Act on 11 November 2010, the United Kingdom followed the Ponsonby Rule, whereby the government negotiates treaties but ratification by Parliament was technically not required. Since the government's influence is in the House of Commons, we use the malapportionment value for the lower house. We use the same procedure for Australia, Canada, and New Zealand where similar power is vested in the executive branch. Lastly, Hathaway does not code Sweden's parliament, the Riksdag, as having formal treaty ratification. In her documentation, there is no clear explanation why, but it is the case that Swedish law requires parliamentary approval for treaty ratification (Chapter 10, article 2 of the Swedish Instrument of Government). We include Sweden in our results, but excluding this case does not change the substantive findings.

⁶⁸ See fn 90.

the countries in our sample. However, as with our analysis of gas taxes, we control for some omitted variables that might correlate with malapportionment. In Model 3, we include measures of land area and a federalism dummy variable. Malapportionment remains negative, and is more significant.

One hurdle for our analysis is the decision of all 15 member-countries of the European Union to ratify the Kyoto Protocol simultaneously via the European Council. For these cases, any variation in malapportionment across these cases cannot explain the variation in ratification. To account for this anomaly, we include an EU-15 member dummy variable.⁶⁹

Both the literature on the Environmental Kuznets Curve, the arguments from Zarhan et al. and recent analysis of environmental treaty ratification patterns make the case that economic development may predict a country's commitment to higher environmental standards.⁷⁰ Countries vary in their level of development and less developed countries are more aware of the costs of limiting their growth by increasing the cost of manufacturing associated with GHGs. To control for this possibility, we include a measure of per capita GDP. We expect this variable to have a positive coefficient, as richer countries will be more likely to ratify earlier. However, we expect a muted effect in the restricted sample of Annex 1 nations.

The magnitude of GHG reduction varies by country. To control for any possible confound with our variable of interest, we control for the size of the cut, or the deviation from the required cut. We also control for the CO₂ emission per capita. Finally, we add a control for

⁶⁹ As an additional check, we ran the analysis excluding the EU cases, and find results very similar to the ones presented. We also used an EU-average of malapportionment for EU-members, since the decision-makers were generally elected or appointed by elected officials subject to the electoral system. In these models, our results—available on request—are even stronger.

⁷⁰ Zarhan et al. 2007 and Bernauer et al. 2010.

proportional representation electoral systems to ensure that any finding is not the result of PR systems signing treaties more expediently.

Table 5 presents the results of our analysis, which support our hypothesis. In Model 1, we begin with a baseline model including our measure of malapportionment. While the coefficient is not statistically significant, the sign is in the predicted direction. Higher levels of malapportionment tend to decrease the probability that a country ratifies Kyoto; put another way, greater malapportionment increases the spell of non-ratification. In Model 2, we add the EU-15 dummy and malapportionment remains negative and become statistically significant. Including logged square kilometers of a country or a federalism dummy only improves the significance of malapportionment. The addition of rural population does not weaken the result. In both models 3 and 4, land area is negative and statistically significant, but does not dampen the effect of malapportionment. Introducing CO₂ emissions, GDP per capita, and target reductions does decrease the significance of malapportionment, although not beyond conventional levels. As expected, the larger a country's target reduction in GHGs, the longer the spell between introduction of Kyoto and ratification. Wealthier countries are associated with ratifying Kyoto sooner, consistent with an Environmental Kuznets Curve. Finally, malapportionment remains significant when adding a control for proportional electoral systems, meaning that this finding is not a relic of PR systems ratifying treaties quicker. Malapportionment's performance in the model is particularly impressive given the relatively few countries which fit the criteria for analysis—35 to 23 in any given model.

Figure 7 below plots the survival function of Model 3 in **Table 5**. By varying malapportionment by one standard deviation above and below the mean level—in this case to zero, since the standard deviations is larger than the mean, and malapportionment cannot be

negative—the plot helps illustrate how higher levels of malapportionment create a significant lag in the time between the establishment of the convention and domestic ratification. Because our measure of malapportionment does not vary over time, the lines show shifts, rather than changes in the slope. The results imply that moving from the malapportionment of the Netherlands (0) to that of Belgium (0.1507) adds roughly five months to the predicted non-ratification spell. Moreover, evaluating the survival function with malapportionment set at that the level of the U.S. Senate (0.3641) increases the model’s prediction out another ten months. This effect provides insight into how malapportionment—an important institutional characteristic of nearly all democracies—affects international political behavior.

6. Conclusion

Some degree of malapportionment is a characteristic of almost all political systems, and deviations from the “one-person, one-vote” principal are very large in some countries.⁷¹ The United States, for example, has one of the most malapportioned systems in the world, due to the Senate, where political power is apportioned equally among the states, regardless of their population. This means that the state with the smallest population (Wyoming) has two senators per million voters, while the most populous state (California) has but 0.06 senators per million voters. Overall, the 21 smallest states have the population of California but 42 Senators compared to California's two.

Given our analysis, we find it no surprise that the rural sector in the United States has mobilized to oppose climate change legislation and that rural legislators have been responsive. Arguing that congressional climate change legislation will impose a massive new gasoline tax on

⁷¹ Samuels and Snyder 2001, 654.

farmers and ranchers, the American Farm Bureau recently initiated a “Don’t CAP Our Future” campaign to derail the legislation.⁷² The campaign’s organizers at the Farm Bureau have encouraged members to place a “Don’t CAP Our Future” sticker on a farmer’s cap and hand-deliver it to a local office of the United States Senate. Senators from rural states appear to be responsive. On October 21, 2009, Kay Bailey Hutchison (R-TX) and Christopher “Kit” Bond (R-MO) released a Senate report entitled “Climate Change Legislation: A \$3.6 Trillion Gas Tax.” According to the report, U.S. farmers and ranchers will incur higher fuel costs of \$550 million in 2020, rising to \$1.65 billion by 2050.⁷³ Speaking at the Capitol Hill news conference that accompanied the release of the Hutchison-Bond report, Texas farmer and livestock producer Richard Cortese expressed the rural sector’s concerns: “Agriculture is an energy-intensive business. I use diesel fuel for tillage, planting, harvesting and spraying. And I use gasoline for service vehicles for checking livestock, utility vehicles and small engines. Having a reliable and affordable supply of gasoline and diesel fuel is very important for my operation to continue to make a living for me and my family.”⁷⁴ Cortese then explained how increasing fuel costs under cap-and-trade legislation raised enormous concerns for farmers and ranchers.

This line of reasoning resonates with the argument of this paper. Net rural incomes would indeed fall disproportionately with the passage of climate change legislation that raises fuel costs since fuel and energy-related inputs account for a significant portion of farm and ranch operating expenses. We show that rural citizens depend more on fuel than urban residents and that rural residents express less support for using taxes to deal with environmental externalities.

⁷² Galbraith 2009.

⁷³ The report is available at

<http://hutchison.senate.gov/resources/HutchisonBondGasTaxReport.pdf>

⁷⁴ Cited in a news release from the American Farm Bureau:

<http://www.fb.org/index.php?fuseaction=newsroom.newsfocus&year=2009&file=nr1021.html>

This evidence supports our premise that the distributional aspects of environmental taxation vary geographically, across urban-rural lines. Yet rural residents are in the minority in developed countries, so we do not expect the rural preference for low environmental taxes to have an effect on policy *unless* the political system is biased. Our core argument is that malapportionment creates such a bias and thereby skews environmental policy toward the interests of rural residents.

To evaluate this claim, we regressed variables that proxy for “environmental policy” on malapportionment. Findings from these analyses support our argument. First, nations with malapportioned political systems have lower gasoline taxes (and lower pump prices) than nations with more equitable representation of urban constituencies. Second, countries with higher levels of malapportionment took longer to ratify the Kyoto Protocol to the United Nations Framework Convention on Climate Change than countries with equitable representation of urban constituents.

These results are important because they show that political institutions—specifically, malapportioned legislatures—can shape both domestic and international environmental policy outcomes. Malapportionment may be steering some of the largest economies and markets away from more environmentally friendly tax policies and delaying agreement on global efforts to combat climate change. In many of these cases, this institutional variation is the result of antiquated and idiosyncratic historical choices. But the evidence points to an unintended and exogenous consequence in the realm of environmental policy. Moreover, our results also help to account for some obvious paradoxes. For example, why do the United States and the United Kingdom lie at opposite ends of the spectrum in terms of gasoline taxes? For countries that share so many cultural, economic, and social characteristics, this is something of a puzzle. In the

United States, but not in England, the voters that are most harmed by high environmental taxes—rural voters—are systematically overrepresented in the political system. To be sure, much of the debate at international environmental conferences will continue to revolve around the exception for developing countries in the Kyoto framework. But it may be no coincidence that discontent over the “free ride” that the treaty gives to developing countries is strongest in the most malapportioned developed countries, such as the United States and Australia. More generally, we have shown that efforts to produce successful action on climate change are, in part, constrained by constitutional compromises over political institutions that are in some cases over 200 year old. Acknowledging these constraints may provide a basis for greater cooperation in the future.

The policy implications of our analysis depend on the underlying causes of malapportionment, which vary by country. For countries that are subject to “creeping” malapportionment—which occurs when electoral districts are not reapportioned at pace with internal rural-to-urban migration flows—the courts should intervene. As the cases of Japan’s national legislature and the U.S. House of Representatives illustrate, court-ordered reapportionment in the 1960s and 1970s led to a reduction in the rural bias of various spending policies.⁷⁵ Regular and effective reapportionment of lower chambers might also reduce the rural bias in environmental taxation.

However, in cases like the United States Senate and the Brazilian legislature, where malapportionment is “permanent” and came about as a result of constitutional bargains establishing highly malapportioned upper chambers, side payments to rural constituencies might allow governments to move forward on environmental agreements. Just as governments have

⁷⁵ McCubbins and Schwartz 1988; Thies 1998.

used subsidies and transfers to encourage farmers to support freer international trade policies, governments might use subsidies and transfers to build rural support for environmental taxes on fossil fuel consumption. It is more efficient (and more practical) to provide transfers to citizens that are harmed disproportionately from a welfare-improving policy like climate change amelioration than it is to revise a nation's constitution to eliminate malapportionment.

Recent climate change legislation in the United States embraces this approach. For example, the American Clean Energy and Security Act (H.R. 2454), which passed the House in June 2009, contains dozens of (more or less efficient) transfers to the rural sector: offset credits for carbon sequestration and methane management, bio-fuel and bio-power subsidies, and direct payments for various environmental land-use programs.⁷⁶ This is *de facto* recognition of the need to compensate rural residents in malapportioned systems to win support for GHG reduction.

⁷⁶ Shipley et al. 2010.

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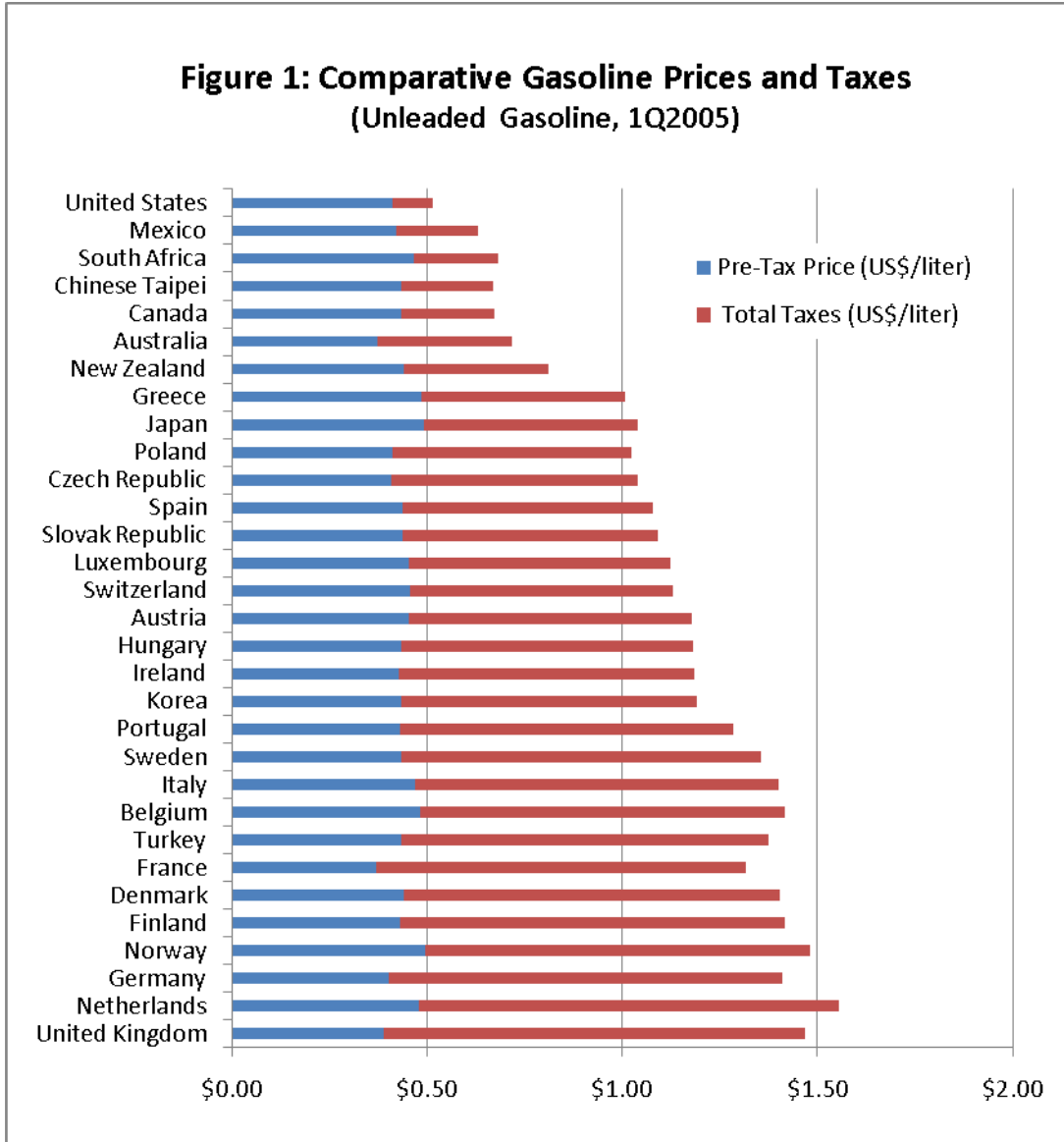
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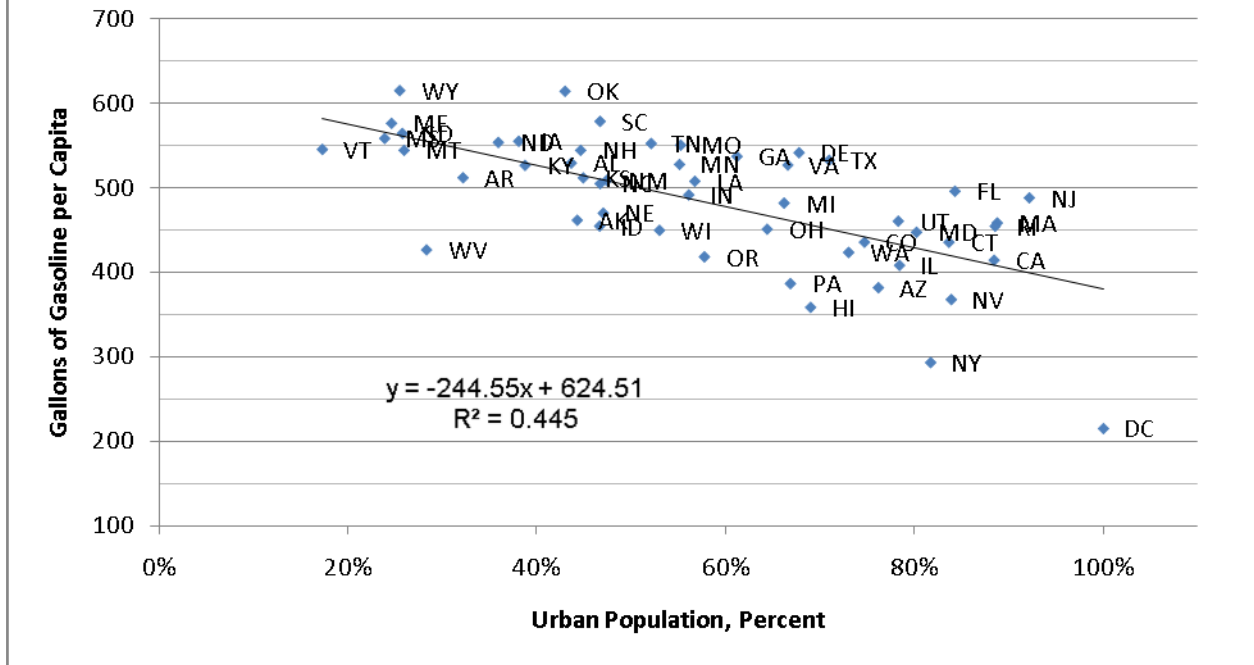
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**Figure 1: Comparative Gasoline Prices and Taxes
(Unleaded Gasoline, 1Q2005)**

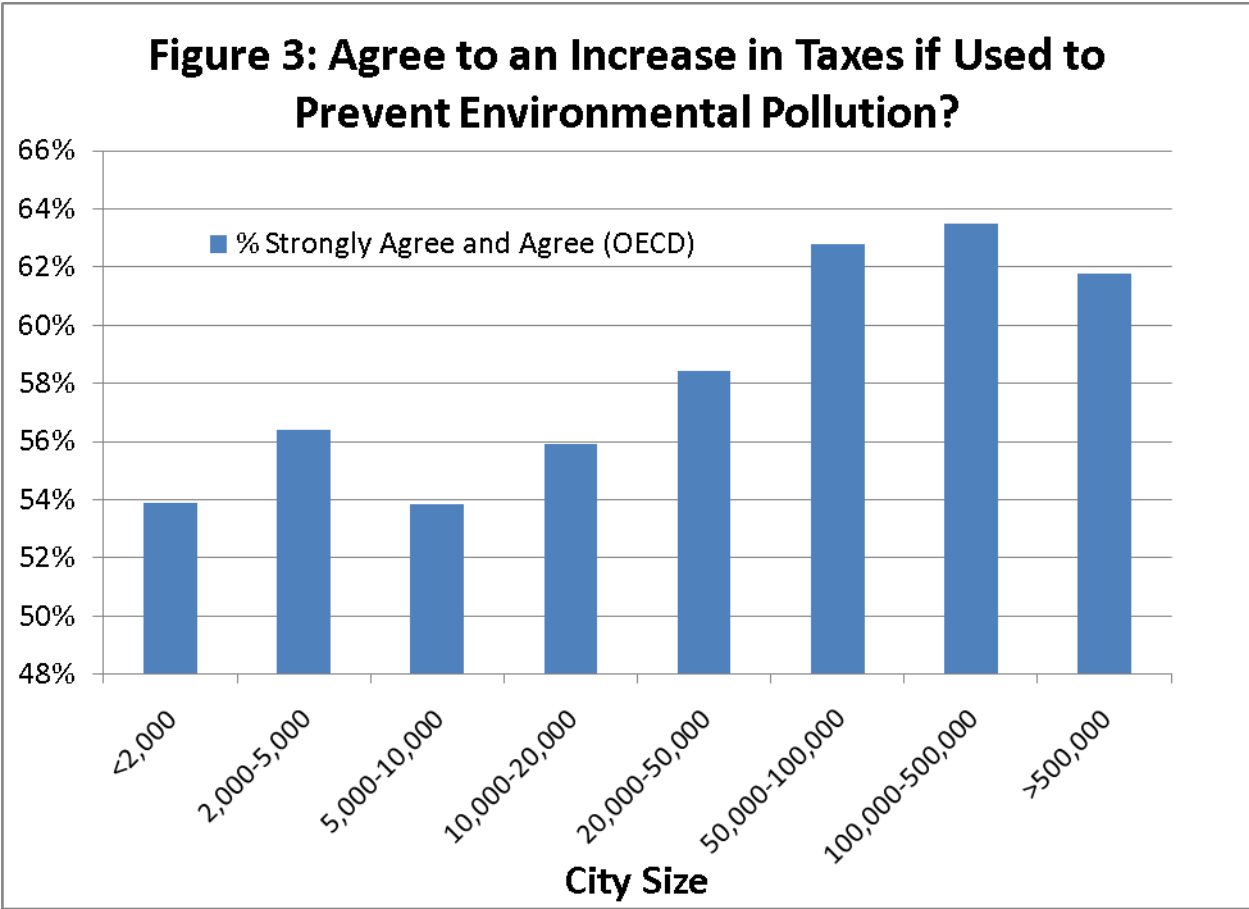


Notes: “Total Taxes” include all taxes that consumers pay as part of the transaction and which are not refundable (sales tax, excise tax, VAT, etc). Gas tax and price data are from the International Energy Agency, *Energy Prices and Taxes: Quarterly Statistics*, 2005.

Figure 2: Urban-Rural Gasoline Consumption

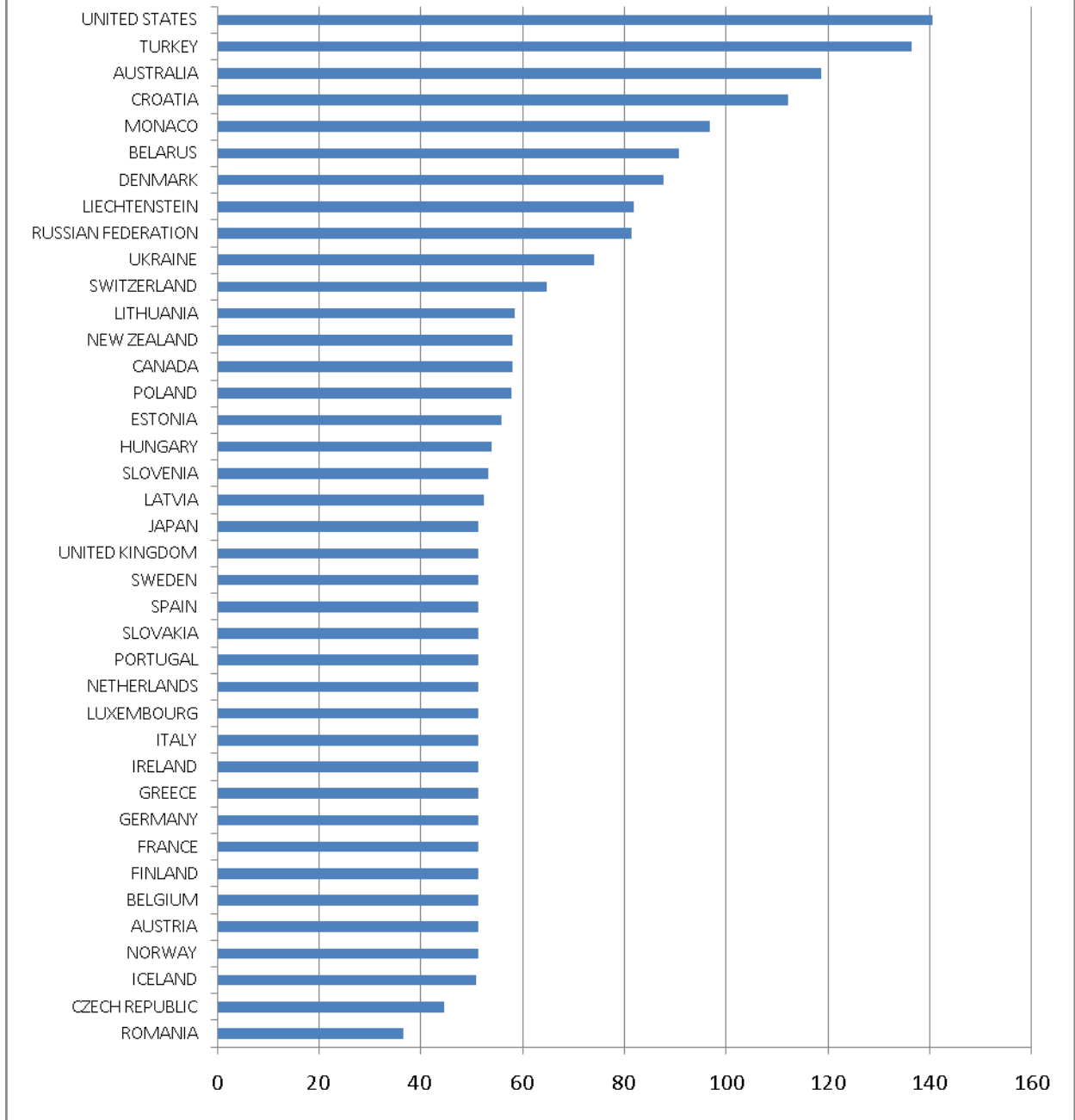


Notes: Data on per capita gas consumption by state is from the California Energy Commission, based on U.S. Department of Energy and U.S. Bureau of the Census data. Urban Population is the share of state population living in “Urbanized Areas” (UA) as defined by the U.S. Bureau of the Census (a UA is a densely settled area of at least 50,000 people).



Notes: The bars indicate the percentage of all respondents that answer “Strongly agree” and “Agree” to the World Value Survey query: “I would agree to an increase in taxes if the extra money were used to prevent environmental pollution.”

Figure 4: Duration until Kyoto Ratification (months)



Notes: Bars represent the time, in months, between the creation of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and domestic ratification. Data for EU members calculated based on the joint deposit of the then 15 members at the UN. The U.S. has yet to ratify. For illustration purposes, the US data is set as 9/30/2009. Data are from UNFCCC's *Kyoto Protocol Status of Ratification*, available at: http://unfccc.int/files/kyoto_protocol/status_of_ratification/application/pdf/kp_ratification_2009_0826corr.pdf.

Figure 5: Malapportionment and Gasoline Taxes



Notes: Gasoline tax data are for year 1995—which is the modal year of the malapportionment data from Samuels and Snyder (2001)—and are from International Energy Agency, *Energy Prices and Taxes: Quarterly Statistics*, 2005.

Figure 6: Malapportionment and Gasoline Prices

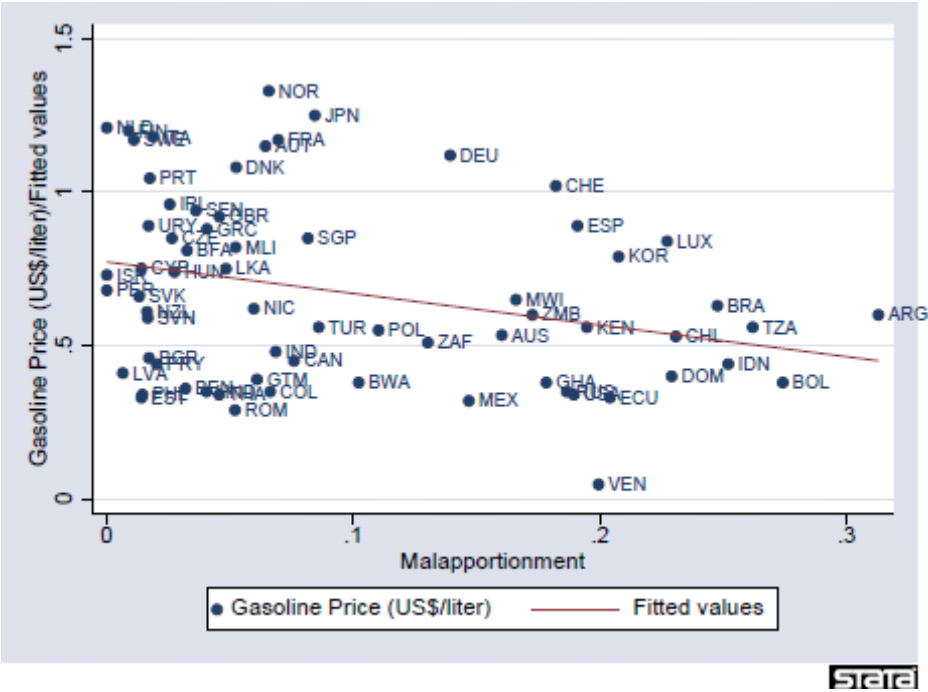
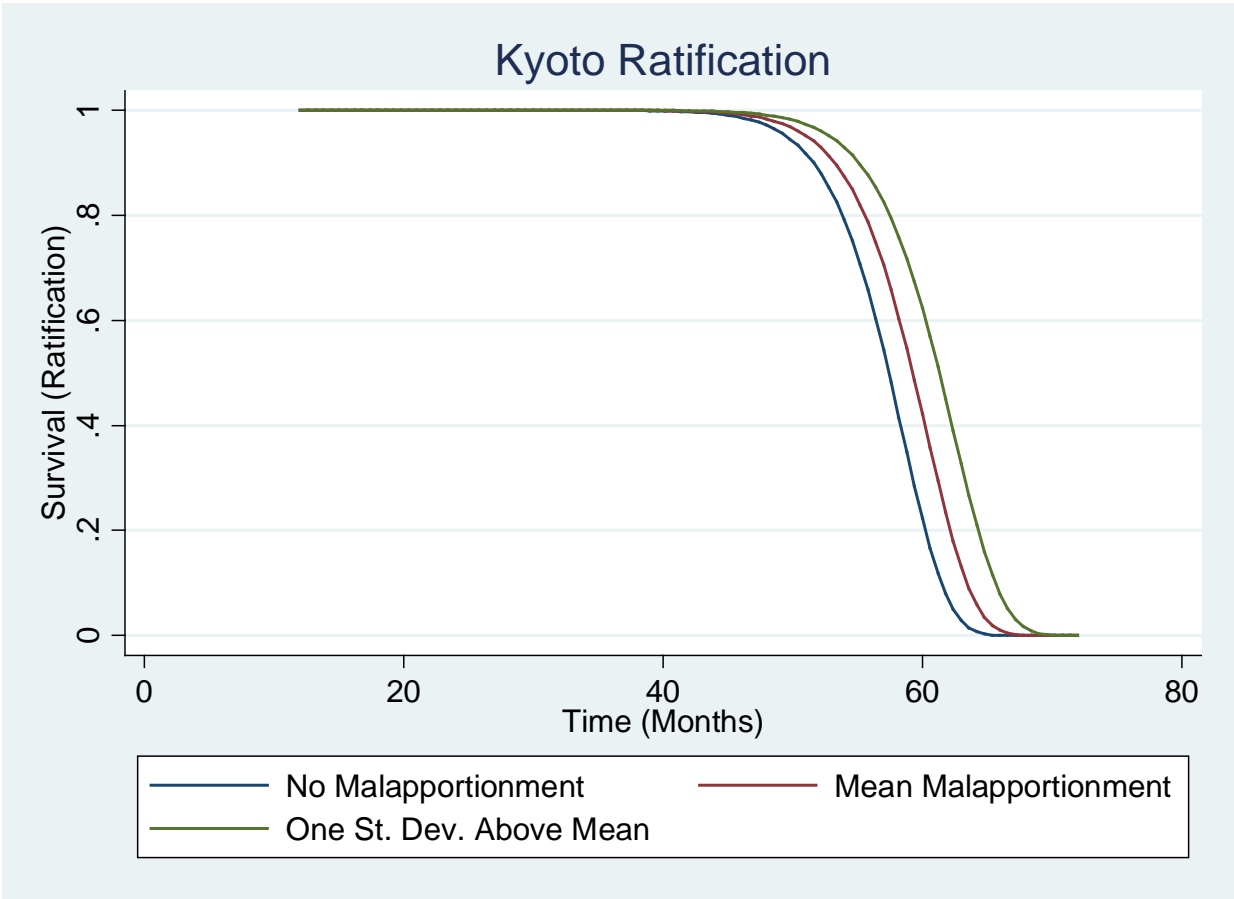
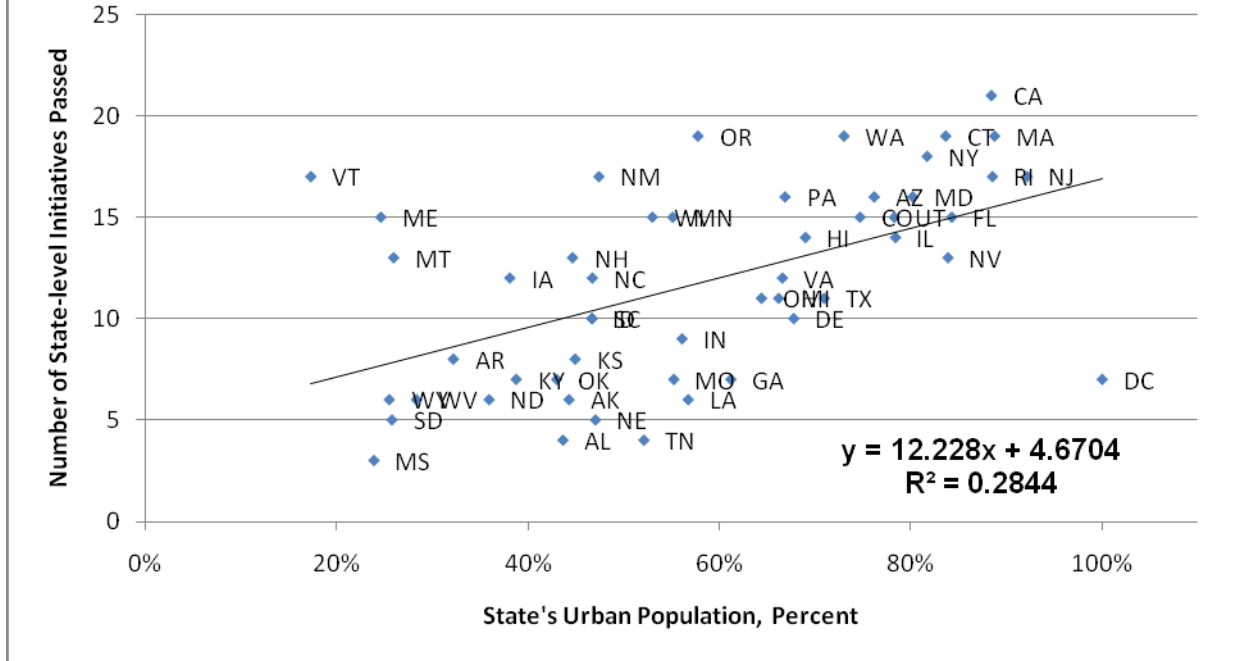


Figure 7: Survival Function Plotted with Varying Levels of Malapportionment



Notes: Plot of survival function from model 3 of Table 5. Mean Malapportionment is 0.076, with a standard deviation of 0.082 for the countries included in model 3.

Figure 8: State Environmental Initiatives



Notes: Data on the number of state-level GHG initiatives is from the Pew Center on Global Climate Change at <http://www.pewclimate.org/states-regions> State urban population is the share of state population living in “Urbanized Areas” (UA) as defined by the U.S. Bureau of the Census (a UA is a densely settled area of at least 50,000 people).

Table 1: City Size and Individual Support for Environment Taxes

Support for Environment Taxes	(1)	(2)	(3)
City Size	0.033 (0.003)***	0.012 (0.005)**	0.011 (0.005)**
Education Attainment		0.092 (0.006)***	0.085 (0.006)***
Ideology		-0.038 (0.006)***	-0.031 (0.006)***
Local Air Pollution		0.057 (0.011)***	0.036 (0.011)***
Concern for Global Warming			0.252 (0.018)***
Observations	35,667	10,198	10,079
Pseudo R ²	0.002	0.0216	0.0307

Robust standard errors in parentheses. * significant at 10%; ** at 5%; *** at 1%

Notes: Ordered probit regressions where the dependent variable is the individual response to the WVS query, “I would agree to an increase in taxes if the extra money were used to prevent environmental pollution.” (1=Strongly Disagree, 2=Disagree, 3=Agree 4=Strongly Agree).

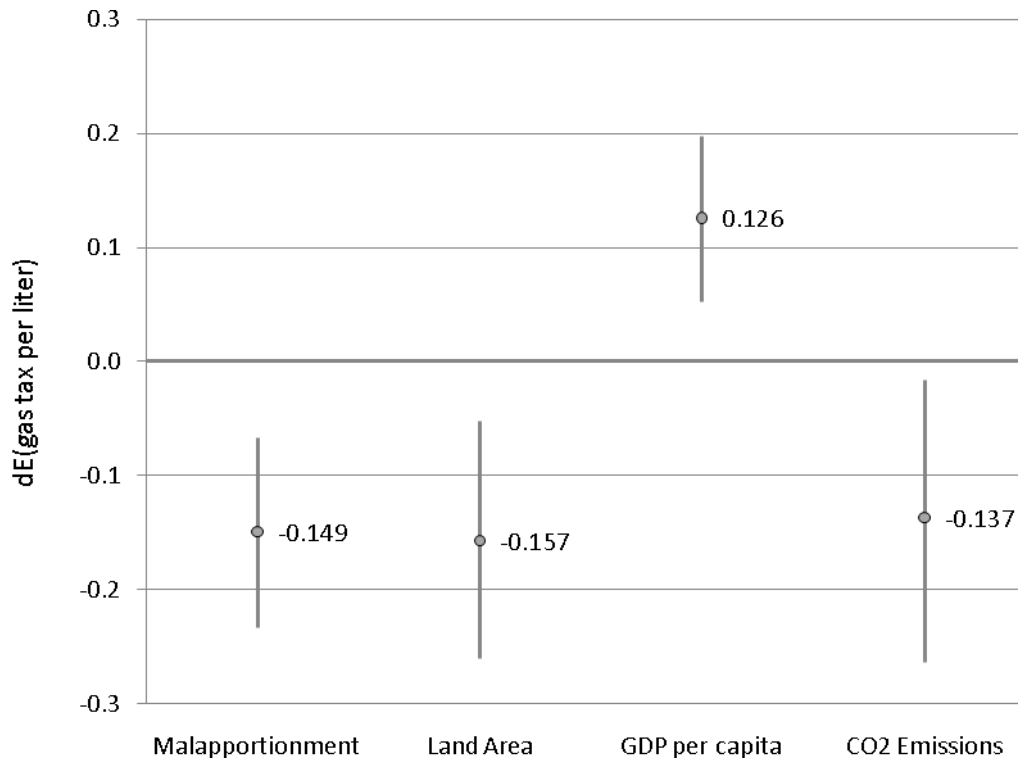
Table 2: Malapportionment and Gasoline Taxes in 30 Countries

Total taxes on premium unleaded	(1)	(2)	(3)	(4)	(5)
Malapportionment	-1.809 (0.592)***	-1.619 (0.482)***	-1.712 (0.539)***	-1.834 (0.520)***	-1.584 (0.624)**
Land Area (sq. km., logged)		-0.163 (0.038)***	-0.165 (0.038)***	-0.130 (0.043)***	-0.119 (0.044)**
Federalism		0.095 (0.104)	0.098 (0.104)	0.130 (0.104)	0.085 (0.104)
Rural Population (%)			-0.002 (0.004)	0.000 (0.004)	-0.002 (0.004)
GDP per capita (in \$1000)				0.014 (0.004)***	0.013 (0.005)**
CO ₂ Emissions (per capita)				-0.019 (0.009)**	-0.020 (0.011)*
Taxes on Income, Profits, and Capital Gains (% of GDP)				-0.007 (0.008)	-0.009 (0.009)
Proportional Electoral System					0.013 (0.117)
Constant	0.683 (0.059)***	1.526 (0.201)***	1.596 (0.220)***	1.380 (0.324)***	1.444 (0.355)***
Observations	30	30	30	26	24
R-squared	0.25	0.44	0.45	0.68	0.64

Robust standard errors in parentheses. * Significant at 10%; ** at 5%; *** at 1%

Note: OLS regression where the dependent variable is the total tax on gasoline paid by the consumer (US\$/liter).

Table 3: Substantive Effects of Malapportionment, Country Size, Level of Development, and CO₂ Emissions



Notes: The values represent the change in the expected value of the gasoline tax as each variable is increased by one standard deviation above its mean, holding other variables at their means. Estimates are from Model 4 in **Table 2**. The whiskers indicate 95 percent confidence intervals.

Table 4: Malapportionment and End-Use Gasoline Prices in 67 Countries

End-use gasoline price	(1)	(2)	(3)	(4)	(5)
Malapportionment	-1.029 (0.345)***	-0.869 (0.329)**	-0.838 (0.328)**	-1.947 (0.663)***	-1.195 (0.618)*
Land Area (sq. km., logged)		-0.112 (0.038)***	-0.095 (0.043)**	-0.139 (0.052)**	-0.096 (0.046)*
Federalism		0.123 (0.097)	0.071 (0.108)	0.082 (0.111)	0.021 (0.098)
Rural Population (%)			-0.002 (0.001)*	0.001 (0.004)	0.004 (0.004)
GDP per capita (in \$1000)				0.020 (0.004)***	0.021 (0.004)***
CO ₂ Emissions (per capita)				-0.024 (0.011)**	-0.034 (0.012)**
Taxes on Income, Profits, Capital Gains (% of GDP)				-0.007 (0.007)	-0.004 (0.007)
Proportional Electoral System					-0.100 (0.149)
Constant	0.773 (0.054)***	1.340 (0.190)***	1.354 (0.205)***	1.693 (0.356)***	1.406 (0.345)***
Observations	67	67	67	27	25
R-squared	0.09	0.15	0.18	0.73	0.74

Robust standard errors in parentheses. * Significant at 10%; ** at 5%; *** at 1%

Note: OLS regressions where the dependent variable is the “pump price” or gasoline price paid by the final consumer (US\$/liter).

Table 5: Survival Analysis on Kyoto Ratification Duration and Malapportionment

	(1)	(2)	(3)	(4)	(5)	(6)
Spell to Kyoto Ratification						
Malapportionment	-4.762 (2.938)	-4.290* (2.529)	-6.716** (3.111)	-6.911** (3.384)	-6.420* (3.432)	-7.333* (4.065)
Land Area (sq. km., logged)			-0.998*** (0.282)	-1.007*** (0.292)	-0.516* (0.281)	-0.591 (0.630)
Federalism			-0.464 (0.741)	-0.500 (0.716)	-1.911 (1.345)	-2.142 (1.560)
Rural Population (%)				-0.00555 (0.0143)	0.0196 (0.0154)	0.0164 (0.0302)
EU-15 Member		1.917*** (0.529)	1.443*** (0.455)	1.422*** (0.454)	1.064 (0.731)	0.996 (1.176)
CO ₂ Emissions (per capita)					-0.0473 (0.0455)	-0.0579 (0.0674)
GDP (per capita, logged, PPP constant)					1.795** (0.879)	2.130** (1.005)
Deviation from 1990 levels					-3.414*** (1.022)	-3.601** (1.566)
Proportional Electoral System						0.161 (0.703)
Constant	-26.99*** (3.646)	-38.72*** (6.491)	-46.75*** (9.475)	-46.66*** (9.508)	-82.81*** (21.32)	-89.02*** (25.43)
Observations	179	179	168	168	168	119
Subjects (Countries)	35	35	33	33	33	23

Notes: Robust standard errors in parentheses. * Significant at 10%; ** at 5%; *** at 1%. These results are from a parametric survival model with a Weibull distribution. The dependent variable is the spell to ratification in months. Results are similar using a Cox proportional hazard model.

Appendix A: Data for Gasoline Tax/Price Regressions

Country	Gasoline Tax	Pump Price	Malapportionment (Fiscal)	Malapportionment (Treaties)	Land Area	Federal	Rural Pop.	GDPPC (\$1,000)	CO ₂ Emissions	Taxes % of GDP	PR
Argentina		0.6	0.31285		6.437	1	11.3	7.18411	3.42409		1
Australia	0.2919	0.5341	0.16015	0.0241	6.885	1	13.9	18.12743	17.08914	15.944	1
Austria	0.7517	1.15	0.0643	0.0472	4.916	1	34.2	21.08811	7.329781	10.83	1
Benin		0.36	0.0319		5.044	0	63.2	0.27994	0.2136348		1
Bolivia		0.38	0.2741		6.035	0	40.6	0.94779	1.084749		
Botswana		0.38	0.1021149		5.753	0	51	2.64314	2.241135		0
Brazil	0.108	0.63	0.2476		6.927	1	22.2	3.61121	1.544518		0
Bulgaria		0.46	0.017077	0.017077	5.044	0	32.2	1.56394	6.709482		
Burkina Faso		0.81	0.0325		5.437	0	84.9	0.18348	0.0617127		
Canada	0.2041	0.45	0.0759	0.0759	6.959	1	22.3	20.16953	14.59159	16.518	0
Chile		0.53	0.23075		5.874	0	15.6	4.26252	3.070952		
Colombia		0.35	0.0662		6.045	0	29.5	2.46231	1.62271		
Cyprus		0.7515	0.014		3.966	0	32	10.56854	7.017083		1
Czech Republic	0.4239	0.85	0.0264	0.0264	4.888	0	25.4	5.10044	11.73182	9.384	1
Denmark	0.7454	1.081	0.0524	0.0524	4.628	0	15	26.59941	10.56939	30.13	
Dom. Republic		0.4	0.229		4.685	0	42.2	1.69447	2.00589		1
Ecuador		0.33	0.204		5.442	0	42.2	1.33469	1.988831		
Estonia		0.33	0.014	0.014	4.627	0	30	2.91867	12.606		0
Finland	0.8256	1.2	0.0088	0.0088	5.484	0	38.6	18.89913	10.25389	16.526	
France	0.9041	1.17	0.0695	0.0695	5.740	0	25.1	19.98969	6.208606	6.987	
Germany	0.824	1.12	0.1392	0.1392	5.543	1	26.7	21.07325	10.18369	11.266	
Ghana		0.38	0.1782		5.357	0	59.9	0.22524	0.2976349		1
Greece	0.5735	0.88	0.0406	0.0406	5.110	0	40.7	9.96591	7.289065	6.428	1
Guatemala		0.39	0.0609		5.035	0	56.9	1.58862	0.7156782		1
Honduras		0.35	0.0404		5.049	0	57.7	1.09849	0.6959132		1
Hungary	0.5205	0.74	0.0274	0.0274	4.954	0	34.8	3.81282	5.575301	8.648	0
India		0.48	0.06845		6.473	1	73.4	0.37181	0.9780166		
Indonesia		0.44	0.2519343		6.258	0	64.4	0.82689	1.169819		1
Ireland	0.5977	0.96	0.0255	0.0255	4.838	0	42.1	16.99357	9.198454	12.703	0

Country	Gasoline Tax	Pump Price	Malapportionment (Fiscal)	Malapportionment (Treaties)	Land Area	Federal	Rural Pop.	GDPPC (\$1,000)	CO ₂ Emissions	Taxes % of GDP	PR
Israel		0.73	0		4.335	0	9.1	17.57395	9.350634		0
Italy	0.7741	1.18	0.0187	0.0187	5.469	0	33.1	17.56899	7.218607	14.157	
Japan	0.6057	1.25	0.0843	0.0843	5.562	0	35.4	35.43854	9.041717	10.274	
Kenya		0.56	0.1946		5.755	0	81	0.41669	0.273396		1
Korea, Rep.		0.79	0.2075		4.994	0	21.8	9.1591	8.257549	6.194	0
Latvia		0.41	0.0065	0.0065	4.793	0	31.2	2.36405	3.723731		0
Luxembourg	0.565	0.84	0.2271838	0.227184	3.413	0	17.1	36.75873	20.29292	14.586	0
Malawi		0.65	0.1659		4.973	0	86.7	0.14264	0.070438		0
Mali		0.82	0.0522		6.086	0	74.5	0.21546	0.0532666		0
Mexico	0.1107	0.32	0.1468		6.289	0	26.6	4.8916	4.031466	4.146	1
Netherlands	0.8736	1.21	0	0	4.530	0	27.2	20.42731	8.957603	10.942	1
New Zealand	0.2815	0.61	0.0163	0.0163	5.428	0	14.7	12.14808	6.829479	22.445	
Nicaragua		0.62	0.0596		5.084	0	46.5	0.66056	0.6080496		
Norway	0.8499	1.33	0.0657	0.0657	5.483	0	26.2	32.21401	7.184297	14.35	1
Paraguay		0.44	0.02025		5.599	0	47.9	1.48784	0.8253438		1
Peru		0.68	0		6.107	0	29.7	1.9755	0.9847465		0
Philippines		0.34	0.0144562		5.474	0	46	0.91258	0.9155324		
Poland	0.2734	0.55	0.11015	0.11015	5.483	0	38.5	3.41156	8.98035	11.072	1
Portugal	0.7273	1.0455	0.0174	0.0174	4.961	0	48.9	9.19702	5.036858	7.937	1
Romania		0.29	0.05195	0.05195	5.361	0	46	1.74166	5.452302		
Russian Fed.		0.35	0.1864	0.1864	7.214	1	26.6	1.61812	10.15001		0
Senegal		0.94	0.0361		5.284	0	60.2	0.42382	0.3828198		0
Singapore		0.85	0.0815281		2.826	0	0	19.35865	11.872		0
Slovak Republic	0.3833	0.66	0.0131	0.0131	4.682	0	43.5	3.1335	7.618766		1
Slovenia		0.59	0.0166		4.304	0	49.4	8.07446	6.994742		0
South Africa	0.2352	0.51	0.13015		6.084	1	45.5	2.96042	9.022507		1
Spain	0.5794	0.89	0.1908	0.1908	5.698	1	24.1	12.05607	5.923406	9.388	0
Sri Lanka		0.75	0.0483		4.810	0	83.6	0.70649	0.3203918		
Sweden	0.7726	1.17	0.011	0.011	5.613	0	16.2	23.5968	5.276309	18.644	
Switzerland	0.6836	1.02	0.18205	0.18205	4.602	1	26.4	32.08259	5.556104	11.913	0

Country	Gasoline Tax	Pump Price	Malapportionment (Fiscal)	Malapportionment (Treaties)	Land Area	Federal	Rural Pop.	GDPPC (\$1,000)	CO ₂ Emissions	Taxes % of GDP	PR
Tanzania		0.56	0.2619		5.947	0	79.5	0.24861	0.1184896		
Thailand		0.34	0.0455		5.708	0	69.7	2.08623	3.152024		
Turkey	0.4234	0.56	0.0859	0.0859	5.886	0	37.9	3.54936	2.768312	4.753	1
United Kingdom	0.6246	0.92	0.0456	0.0456	5.384	0	11	21.34698	9.498077	12.744	1
United States	0.101	0.34	0.1893	0.3642	6.962	1	22.7	29.94164	19.53119	12.838	0
Uruguay		0.89	0.0169		5.243	0	9.5	5.78562	1.404943		1
Venezuela, RB	0.0257	0.0476	0.1994		5.945	1	13.2	5.1196	6.106445		1
Zambia		0.6	0.1725		5.871	0	62.9	0.3046	0.2342636		0