Authoritarian Regime Types and Environmental Performance
專制體制與環境表現

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Abstract

Climate change has become an ever-increasingly important topic in a multitude of academic fields. A lot of the research on regime type and environmental degradation has focused on democracies versus non-democracies, and concluded that because democracies outperform in this sector, then democratization could be the solution. However, viewpoints seem to be shifting in terms of whether this research is as accurate in the current environment. This paper attempts to reanalyze this topic with a specific focus on whether certain authoritarian regime types, if any, have an effect on carbon dioxide levels within a regime. I argue that not only will authoritarian regime types have an effect, but that party regimes will have the greatest effect in limiting or decreasing carbon dioxide emissions from 1997-2010. To provide empirical support, I include a vast literature review on the topic and utilize two different quantitative methods of analysis: time-series cross-sectional and spatial analysis using Geographic Information Systems. Statistical results mostly confirm that authoritarian regime type can play a role in determining carbon dioxide emission levels, but on the contrary, it is military regimes and not party regimes that have the greatest effect on CO_2 levels. However, after robustness checks, it seems to be that limitations skew the results due to a short time-frame and small sample size. This results in the secondary analysis concluding that, while positive, regime type is not significant in determining carbon dioxide emissions, but rather that GDP per capita has a greater effect.

Keywords: Authoritarian regime, Environmental performance, Regime type, Carbon dioxide, Party regime, Degradation

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1 Introduction

1.1 Research Motivation

The efforts around the globe to curb environmental degradation have become increasingly large; people from all walks of life are now making an effort to live a "greener" lifestyle either through recycling, buying secondhand clothing, reducing their use of plastics, or by using many other eco-friendly methods. However, these efforts still have a minimal impact on the amount of degradation we are still causing to our environment. With an increasing global population and levels of consumerism, there is a rapid increase in the change of the global climate. According to the National Oceanic and Atmospheric Administration (NOAA), the amount of atmospheric carbon dioxide has increased since the 1960s from 0.6 ± 0.1 parts per million (ppm) growth rate per year to 2.3 ppm per year from 2016-2018 (Lindsey 2020). The United Nations Environment Programme (UNEP) has also verified this and deems that governments should make efforts to decrease their CO_2 emissions so that there is only an increase of 1.5 degrees Celsius by the end of the century (UNEP 2019). Therefore, while civil society must be active in fighting climate change, deforestation, and many other negative impacts on the environment, the fight for a cleaner environment needs to be fought on a larger scale. Therefore, in order to have more of an effect on curbing environmental degradation, governments around the world need to implement more robust environmental policies in order to combat environmental degradation effectively.

When thinking of the environment, most people do not make an association with authoritarian regimes; however, with a rise in authoritarianism across the world, these types of regimes are becoming more important and should be further researched, notably, in the realm of environmental degradation. According to Freedom House, several factors help indicate the rise in authoritarianism: elections, term limits for executives, freedom of expression, rights of migrants, the safety of expatriates, and ethnic cleansing (Freedom House 2019). For all of these factors, there was a decline (besides an increase in cases of ethnic cleansing), and the availability of political rights and civil liberties are questionable (Freedom House 2019). In regards to term limits for executives, for the past 13 years, term limits in 34 different countries have attempted to revise these with 31 of them being successful (Freedom House 2019). All of these factors are a sure sign of the increasing interest of authoritarian regimes. With the rise of China, one of the most

successful authoritarian regimes, promoting and conveying its model of censorship and surveillance, and also by having one of the world's largest and most influential economies, a growing military, and a growing presence in the global world order, it is highly likely that authoritarian regimes are here to stay and will continue to spread (Freedom House 2019). Therefore, it is imperative to the world and our environment that we better understand how this affects our ecosystem and how we can solve it.

With this in mind, it is essential to look at what types of governments tend to have better environmental policies in order to have the most significant impact. After reviewing the literature, one can see that most of the literature does take heed of authoritarian regimes, and it mainly focuses on how democracies are more prone to implement environmental policies. However, some of the literature – Gat (2007), Rosato (2003), Geddes (1999b) – explains that different types of authoritarian regimes can implement effective long-term policies. While most of these policies have focused on the economy or the financial sector, this literature is essential in order to see whether these types of authoritarian regimes can have any effect in decreasing environmental degradation. Therefore, by understanding the possible explanations that causes environmental degradation, future researchers or policymakers can have a better understanding of how to combat this issue.

By utilizing Geddes's, Wright's, and Frantz's 2014 dataset on authoritarian regimes, we can identify that there are four types of regimes: party, military, personal, and monarchy (Geddes, Wright, and Frantz 2014). The literature on authoritarian regimes is limited in terms of the environment and focuses mainly on other vital issues such as the economy, security, regime durability, and public goods provisions. However, the literature also outlines a newer topic known as authoritarian environmentalism, which is a model that allows for a stable, uncorrupt authoritarian regime to implement policies in order to improve environmental outcomes (Gilley 2012). Two important possible explanations that allow authoritarian regimes to improve environmental outcomes depend on the regime's selectorate and democratic institutions. The "selectorate" consists of two groups, one of which being the "selectorate" which is a group of people who play a role in choosing leaders and receiving benefits and exclusive privileges, and a second group known as the "winning coalition" who help the leader maintain their rule and receive benefits from that (Bueno de Mesquita et al. 2003, xvi). Democratic institutions are things like elections or legislatures that are

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generally found in democracies but have been implemented into authoritarian regimes to better connect the regime with its population.

With party regimes being the example, China, one of the most well-known single-party authoritarian regimes, has been doling out environmental projects and policies to help improve environmental outcomes in recent years. According to the World Economic Forum, China has been implementing policies that will allow it to fund a greener future (Song 2018). Certain things like dismantling coal-power plants over a certain length of time, innovating their environmental agency, and transitioning three major industrial cities to be turned into sustainable development zones that will implement the UN's Sustainable Development Goals for 2030. Also, China has been collecting an environmental tax in order to help fund a greener future and a less environmentally degrading economy (Song 2018). While all of these steps are important in regards to improving environmental outcomes, China's CO_2 levels are still rapidly increasing with an output of $0.26GtCO_2$, and have increased global CO_2 emissions (Hausfather 2019). Therefore, since greenhouse gas emissions (GHG) are the most detrimental form of pollution (EPA 2019), yet the most difficult to detect by regular citizens, the question remains whether regimes are using their efforts to gain international recognition and appease its citizens or are trying to actually improve environmental conditions.

Overall, the issue of environmental degradation has been a huge topic around the world, especially with the younger generation. College students or other youth have spurred most environmental movements with one of the most pronounced environmental activists of today being a teenager from Sweden, Greta Thunberg. However, with much of civil society disengaged in public life (Carpini 2000, 341), the rest are limited with their abilities to make a change or make other parts of society care about the environment. Therefore, the role of government is crucial in regards to environmental policy implementation. With this in mind, by looking at different institutional settings, one can have a better idea as to which and what authoritarian regimes can have an impact in the fight for environmental protection. The environment is a critical issue, because not only could further environmental degradation lead to detrimental effects on the environment and humanity now, but it would pose grave risks for our future generations. By adding to the current literature, policymakers and civil society could have a better idea of which or what type of authoritarian regime(s) would best help combat environmental degradation.

1.2 Propose of Research

This thesis aims to fill a gap in the literature by contributing to the unwritten literature on regime type and the environment. This thesis will answer two questions. The first is, "What are the effects of authoritarianism on environmental governance?" This question is essential to this research because it is crucial to look at all types of authoritarian regimes and discover whether the structures of these regimes have a direct influence on the environment. It is crucial to determine whether some or any explanation allow for authoritarian regimes to pursue better environmental policies. Some of the explanations in this research include the selectorate (Bueno de Mesquita et al. 2003) and democratic institutions. Once the explanations are determined, then it will be much easier to determine the significance and results of the second question.

Not only are the possible explanations important, but reviewing which types of authoritarian regimes have a more significant impact on environmental policies can help add to the current research on the issue at hand. Therefore, the second question asked in this research is, "What types of authoritarian regimes tend to have a better environmental performance?" There is quite a bit of research completed on how the conventional wisdom that democracies tend to outperform non-democracies in many different sectors (economics, security, peace, public goods distribution, etc.) is not holding to be consistently accurate. Therefore, if certain types of authoritarian regimes tend to outperform others and compete at the same level as democracies in these sectors, then one can look at environmental protection in a new light.

1.3 Thesis Structure

In this chapter, I have given a brief background on the topic and discussed my motivation for this research and what questions I would like to answer. The latter part of the paper will give a more thorough depiction of the research questions, why the questions were asked, and how to find and what the outcome is. In chapter 2 and 3, there will be an extensive literature review covering many different topics related to this issue, such as regime type and the environment, the impact of the economy, security, public goods, and regime durability on the environment, authoritarian environmentalism, and the possible explanations surrounding authoritarian regime types and

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environmental degradation. Chapter 4 will contain the research design and the plans on proving the hypotheses. Chapter 5, Authoritarianism and Environmental Performance: Time-Series Cross-Sectional Analysis and Geographic Information Systems (GIS), will include a detailed analysis on the authoritarian regimes' environmental performances using time-series cross-sectional analysis. It will also use spatial analysis to map out the levels of GHG emissions in different authoritarian regimes to determine whether there is a pattern in emission levels. Lastly, chapter 6 will be the conclusion, which will include a discussion on the findings of this research and also suggestions for future research.

2 The Selectorate and Democratic Institutions: Possible Explanations

This section will provide and explain the possible explanations that could be responsible for how authoritarian regimes respond and interact with the environment. Two possible explanations will help theorize how authoritarian regime types and environmental performance are correlated; these two possible explanations are the selectorate and democratic institutions. The size of the "selectorate" is an important explanation because it determines how susceptible a government is to its selectorate. Once one knows a government's selectorate, one can better understand how decisions are made and who are making them. Democratic institutions are institutions that are fundamental to democracy, but when implemented into authoritarian regimes, they utilize it to appease the population and validate the ruling party. Collective regimes, especially party regimes, are more likely to implement democratic institutions, and once implemented, tend to be more productive. This is because personalistic regimes tend to focus on private rather than public goods (Bonvecchi, Simison 2017). Democratic institutions are a possible explanation for environmental performance because when regimes implement democratic institutions, they are more likely to provide more public goods, such as environmental concessions, which can, in turn, improve environmental outcomes for these types of regimes.

2.1 The Selectorate

A common mechanism in the realm of international political economy is "the Selectorate Theory," found in Bruce Bueno de Mesquita's *The Logic of Political Survival* (Bueno de Mesquita et al. 2003). In this work, Bueno de Mesquita et al. examine how political selection institutions, or the "selectorate," influence the likelihood that a leader will survive or not. They also look at how the "selectorate" influences a leader's behavior and decision-making practices. While this author's main point is to argue for economic demands, it can easily relate to environmental demands. Since political leaders need to remain in office for both democracies and autocracies, if the people are demanding environmental action from the government, then the government should make concessions. However, this is not always the case, as pointed out by Bueno de Mesquita, because

there is always some group, known as the winning coalition, which helps the leader maintain their power.

The winning coalition is essential because, in order to remain in power, one must have the winning coalition on its side. As stated in the reading, "This group controls the essential features that constitute political power in the system. In democracies, the winning coalition is the group of voters who elect the leader; in other systems, it is the set of people who control sufficient other instruments of power to keep the leader in office. If the leader loses the loyalty of a sufficient number of members of the winning coalition, a challenger can remove and replace the leader from office" (Bueno de Mesquita 2003: 10). These members come from the "selectorate," and in democracies, the winning coalition tends to be larger if the "selectorate" is larger, but in autocracies, the winning coalition is small with a larger "selectorate." Therefore, in autocracies, members of the winning coalition will be more loyal to the leader because there is no opposition, and there is a higher risk of exclusion if one defects (Bueno de Mesquita et al. 2003, 11).

The "selectorate" can be seen as an essential explanation because it outlines how regimes act in order to keep power and appease their selectorate, or more importantly, their winning coalition. This author believes that regardless of regime type, political actors have the common goal to remain in power, and therefore will do its best to maintain its winning coalition. However, the author also points out that if there is a small winning coalition but a large selectorate, then it is more likely that the leader will eventually be challenged (Bueno de Mesquita et al. 2003). However, in authoritarian regimes, this is not always the case. Some authoritarian regimes not only have a small winning coalition and a larger "selectorate," but also have managed to maintain power for decades. Therefore, it is vital to determine which types of autocracies stay in power longer and why. By determining this, one would possibly be able to understand which type can implement better environmental policies.

2.2 Democratic Institutions

The rise of authoritarianism has been seen as an increasing threat to the liberal world order for several decades. Many western liberal-minded scholars are intrigued by how authoritarian regimes maintain their power, but also why young democracies were and are failing. Because of this, there has been much research and literature on the topic of authoritarianism. In regards to this thesis, in

order to have a better understanding as to why specific authoritarian regimes make concessions and provide more public goods to their population can depend on an essential factor, democratic institutions. As David Art cites in his 2012 article when reviewing Jennifer Gandhi's article, *Political Institutions under Dictatorship*, "…these democratic-looking institutions are not simply 'window dressings,' but that they play a central role in the construction, policymaking, economic performance, and durability of authoritarian regimes (Art 2012, 359)."

There are several different examples of democratic institutions, but the main two reviewed in this thesis will be elections and legislatures. Democratic institutions are institutions that make up the basis of democracy, its inner-workings, and fundamental structure. However, these institutions have been implemented in authoritarian regimes over the years in order to placate the population's demands and extend the regime's rule. By implementing these institutions, regimes cannot only concede to specific demands of their population, but it also allows them to allow for more public goods provisions on the local level. These institutions are essential because, once implemented, can help authoritarian rulers maintain stability at the local level, control political opposition, and also maintain their regime's durability (Art 2012).

The importance of democratic institutions in regards to authoritarian regime type and the environment is not only that it can provide for more public goods, such as environmental protection. In regards to regime type, it is emphasized by Bonvecchi & Simison (2017) that these institutions, specifically legislatures for their case, usually are more frequent and more effective in collective regimes (party and military) rather than personalistic (personal and monarchy). The first democratic institution I will explain, elections, especially in a smaller electorate, can provide competition with local officials that can make them appeal to the majority and provide more public goods provisions to help them win re-election (Martinez-Bravo et al. 2012). The other democratic institution I utilize in this thesis, legislatures, is an institution that provides more public rather than private gain by constraining a leader's ability to utilize their power for their gain. Overall, democratic institutions are costly to implement in regards to a leader's legitimacy coming into question, but if not implemented or if ignored when implemented, they can have detrimental effects on the survival of the regime.

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3 Authoritarianism & the Environment: Understanding the Possible Explanations

3.1 The Role of Authoritarian Regimes

The role of government is essential for many things in a society; the government does not only set up the authority and the way a state is run or governed, but it is also responsible for anything that encompasses the state, such as establishing policies and institutions in order for the state to define its territory, population, sovereignty, and international recognition. According to Kirlin (1996), governments must develop effective policies for their public, make decisions that protect civil society, and deliver social services. However, the way that a government is organized or structured can be different based on the form of government established in each state. In authoritarian regimes, the government holds power in establishing laws and policies; however, in different authoritarian regimes, there can be an influence on decision-making due to the size of the "selectorate" and the level of democratic institutions in the regime. Regardless of this fact, authoritarian regimes' primary decision maker in regards to laws and policies come from the government, which makes it very important in regards to the environment.

However, it is essential not to overlook the effect on how government implemented policies have a significant effect on civil society. These policies can be especially crucial in authoritarian regimes where only a select few have the opportunity and ability to influence policy. Cavatorta (2012) explains that the idea of civil society and civic activism typically relates to democracy/democratization; however, in authoritarian regimes, civil activism does not look the same. Civil activism is different in authoritarian regimes because activism occurs in small groups or individuals rather than large, organized groups. Also, non-political issues are sometimes remaining non-political and not always forming into political issues on democratization and human rights. Moreover, activism in authoritarian regimes does not take place in the public sphere but rather must co-exist with state-sponsored civil activism. An example here was a Vietnamese woman, famous for her activism, imprisoned for distributing propaganda against the state. She was not only using the internet as her platform, but she was also pursuing activism at the individual level (Nguyen, Datzberger 2018). This example is essential to this research because it shows that

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it is not just the government that decides what actions to take, but instead that the demands from civil society, while typically constrained by the government, also affect policy implementation.

There are several different types of autocratic regimes; these include party regimes, personalist dictatorships, monarchies, military regimes (Geddes, Wright, & Frantz 2014). All of these regimes classify under the same category of an authoritarian regime, but these regimes can be quite different in terms of how they rule, the policies they will enact, the state relations they create, and many other factors. Recently, there has been an increase in research on which types of autocratic regimes are more prone to openness in terms of economic, security, education, or other types of policies, such as Weeks (2008), Chandra & Rudra (2013), Geddes (1999b). In the field of international political economy, there has been an increasing consensus that autocratic regimes with a larger selectorate tend to incorporate more open economic policies into their agenda. In this context, the selectorate are the ones who are choosing the policies and having an influence on anything else that needs addressing (Bueno de Mesquita et al. 2003). Therefore, in political-economic thought, the idea is that certain autocratic regime types are more likely to have a stable, long-term rule and can, therefore, implement more trade openness and grow their economies (Kailitz, Stockemer 2017). One of the most cited and successful examples in this research is China.

China's success is critical to consider because, in recent years, there has been an increase in the return to authoritarianism (Freedom House 2019), and with this, we need to understand how civil society can have influences in authoritarian regimes' decisions. That is to say that certain types of authoritarian regimes can incorporate more democratic principles and institutions into their system of government, which in turn, allows them to incorporate their civilians' wants and needs better, suppress dissent, and control political opposition. Competitive authoritarianism, a regime that holds democratic institutions but violates the rules often enough that it cannot be considered a democracy (Levitsky, Way 2002, 52), is essential here. According to Wetenschappelijke and the Scientific Council for Government Policy (2007), "Citizens are not just voters (or legal subjects), but participate in all manner of social relationships and structures (Wetenschappelijke, Scientific Council for Government Policy 2007, 119)." The same is true for specific authoritarian regimes. By incorporating democratic institutions into their governmental frameworks, such as elections and legislatures, regimes are more likely to have support from their population because they are more likely to increase public goods provisions (Martinez-Bravo et al. 2012). Also, Geddes (2005)

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explains that elections are a safer and more predictable for authoritarian regimes to gage their popular support and diminish the threat of a military or civilian coup. This example, therefore, emphasizes that the role of government in authoritarian regimes, regardless if it is personalistic, a military regime, a monarchy, or a party regime, plays a significant role in policymaking. Moreover, contrary to conventional thought, authoritarian regimes must eventually take into consideration what civil society demands. This understanding can open up the possibility for authoritarian regimes to consider the importance of the environment.

Elections are an essential type of democratic institution. Not only do they allow leaders to gauge their public support, but they also allow the regime to pacify their population by providing them options to express their demands. In turn, this can help the regime with proper decision making while increasing the durability of their rule. By implementing elections, authoritarian governments can better control the actions of their citizens and officials, especially at the local level. By doing this, local officials are more likely to change their incentives to favor the wants and needs of their local population, which eventually leads to more funding for public goods provision. In China in the 1980s, they implemented village-level elections in order to maintain control in rural areas of the country, which allowed the government to appease voters based on the fact that local officials wanted to appeal to the majority in order to obtain re-election (Martinez-Bravo et al. 2012). Also, by implementing this in a smaller electorate rather than a larger one, the regime itself is not threatened by opposition or the chance of being voted out (Takeuchi 2013). While this case only highlights single-party regimes, the case of Tanzania also shows that dominant-party regimes who also implement elections will also provide more public goods, particularly in more competitive regions, in order to gain support and maintain their rule (Rosenzweig 2015, 83).

Another essential form of democratic institutions is legislatures. A common misconception about authoritarian regimes is that legislatures in authoritarian regimes are unimportant because personalistic regimes still hold onto their power and promote their policies. However, according to Bonvecchi & Simison (2017), legislatures, once established in authoritarian regimes, can constrain the power of dictators because they are costly to ignore, and by looking at the foundations of the legislature, one can determine how powerful it will be. In addition to this, Gandhi & Przeworski (2007) explain that these legislatures foster cooperation and undermine dictators in order to lengthen the regime's survival. For example, when threats arise in an authoritarian regime,

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and a leader must make concessions, this takes the form of policy compromises where legislature or institutions are needed in order for agreements to be agreed upon (Art 2012, 359). By having legislatures, they can allow leaders to answer and concede to these threats without appearing weak (Art 2012, 360). However, while dictatorships and personalistic regimes are essential, Bonvecchi & Simison (2017) also emphasize that legislatures are more effective and influential when the regime's power is collective rather than personalistic. Reuter and Robertson (2015) also explain that authoritarian legislatures help leaders reduce social protest; however, for these authors, the reduction mainly had to do with opposition elites demobilizing their supporters for monetary gain.

In addition to democratic institutions, the other important mechanism that can define which types of authoritarian regimes can improve environmental outcomes depends on what Bueno de Mesquita et al. calls the selectorate. As mentioned in chapter one, the selectorate is responsible for selecting a leader and keeping the leader in office (Bueno de Mesquita et al. 2003). Hankla and Kuthy (2013) also note that states with larger selectorates can adopt better policies that will help it extend and strengthen their regime. The authors state, "First, we argue that autocratic regimes with a larger "selectorate" should have more significant incentives to provide public rather than private goods. As a result, we expect that multiparty, and to a lesser extent, single-party autocracies will tend to prefer more open trade policies than non-party (often personalistic) dictatorships, monarchies, and military juntas. Second, we contend that more stable autocratic regimes will have longer time horizons and, therefore, more significant incentives to adopt policies, such as trade openness, that may strengthen long-run economic performance (Hankla, Kuthy 2013, 492)." As one can see, autocratic regimes with a larger winning coalition and selectorate should be more open to different economic and environmental policies.

For further emphasis, Cao & Ward (2015) concluded that while some authoritarian regimes can concede to some issues, these mostly occur in regimes that are looking long-term and are willing to make investments into different public goods or sectors. They argue this because they believe that regimes with shorter time horizons are not as likely to invest in public goods, like health and education (Cao, Ward 2015). However, for regimes that have a larger winning coalition, a larger state capacity, and more durability, then these types of goods will be provided in the long-term. Therefore, this shows that certain types of authoritarian regimes, such as non-personalist regimes are capable of investing in society. Other authors who negate the mainstream idea of democracies

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and their role of environmental protection are claiming that because autocratic leader(s) focus on maintaining their rule for as long as possible, they may be more willing to concede to some environmental protection in order to extend their length of rule (Klick 2002). Klick (2002) explains that by providing some environmental growth, the ruler can extend its rule by pacifying their people. The author states, "High environmental standards represent one tool the autocrat could use to placate his people without providing them with any revolutionary resources (Klick 2002, 1)." This argument is valid in the sense that all authoritarian leaders want to maintain their hold on power and will be willing to give something minute up in order to extend their regime's duration. Therefore, the idea that only democracies can provide better environmental policies and protection has become increasingly contradictory in recent years.

3.2 Interdisciplinary Approach to Authoritarian Rule

As previously stated, there has been an increase in the importance of authoritarian regimes. Because of this, the literature over the years has expanded to fit many fields. In this section, there will be a discussion on how researchers have linked authoritarian regime types to many other fields. These fields include public goods provision, conflicts and peace, economic development, and regime durability. Because authoritarian regime types have not been researched in regards to the environment, by linking the results of these sections, one can better determine better which type of authoritarian regime outperforms the others. Therefore, for this section, the most important field, and the one linked to the environment, is public goods provision. As will be stated in section 3.2.1, environmental protection is a public good that should be preserved and provided to the public. Therefore, by better understanding how authoritarian regimes promote and provide public goods, one can better understand which type of authoritarian regime will be more likely to improve environmental outcomes. The next section, 3.2.2, will combine the three other fields (conflict and peace, economic development, and regime durability) that discuss which authoritarian regime type outperforms the other in each respected discipline.

3.2.1 Public Goods Provision

As explained by E. Wesley F. Peterson (2000), "Public goods are characterized by some degree of nonrivalry in consumption as well as difficulty in excluding noncontributors from consuming the good (Peterson 2000, 355)." Nonrivalry is that if one person uses that good, it will still be available for use by others and not prevent others from using the good. For noncontributors or non-exclusion, it means that one cannot exclude individuals from using this good. There are many prime examples of public goods, such as education, national defense, and clean air. All regimes should provide these goods. However, this is not always the case, especially in regards to environmental protection in non-democratic countries.

On the other hand, recently, there has been an increase in specific authoritarian regimes providing more and more public goods. In Martinez-Bravo et al. (2012), she and her co-authors discovered that by implementing elections into smaller electorates in rural China, they were able to increase public goods provision, reduce income inequality, and reduce land leasing to outsiders for farming. This result occurred because, in order to remain in power and gain re-election, officials must bend to public will. In addition to this, Tsai (2007, 355) also notes that even when democratic institutions are weak, local officials can still increase public goods provision due to "unofficial rules and norms that establish and enforce their public obligations." Therefore, the types of authoritarian regimes that can hold elections, and in turn, incorporate democratic institutions into the regime, will be more likely to increase public goods expenditures. As noted by Hadenius and Teorell (2006, 6), electoral regimes, such as ones that hold popular elections for parliament or the executive office, can be defined as party regimes that either has no-party regimes (elections are held, but all parties and candidates are prohibited), one-party regimes (all but one party are prohibited from elections), and limited multiparty regimes (candidates can participate in elections outside of the ruling regime).

Moreover, in addition to democratic institutions, another mechanism, the selectorate, also emphasizes the state's ability to provide public goods. Hankla and Kuthy (2013) explain that regimes with a larger selectorate, specifically multi and single-party regimes, should provide more public goods, and because of this, they will be more stable, which will allow them to have longer time horizons and therefore adopt more long-term policies. As noted by these authors, in regimes with a higher number of constituents, it is difficult for them to pay off all of the actors that would

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help them maintain their power. Therefore, they must increase their interest and funds into public goods provision based on the fact that public goods tend to affect society at large (Hankla, Kuthy 2013, 492). Hankla and Kuthy (2013, 494) note that these regimes with larger selectorates (normally party regimes) will also have to rely on a larger winning coalition, and their support can usually be bought by public and even, sometimes, private goods.

Now that we have determined the type of authoritarian regime that will be able to outperform others in terms of public goods provision, it is also essential to better understand the importance of environmental protection as a vital public good that every government provides. According to Matthew J. Kotchen (2014), many environmental qualities classify as a public good, such as air pollution. Kotchen (2014) states, "Under most circumstances, one person's breathing of fresh air does not reduce air quality for others to enjoy, and one cannot prevent people from breathing the air (Kotchen 2014, 271)." In addition to this, he also outlines that other environmental factors included as public goods are water quality, open space, biodiversity, and a stable climate (Kotchen 2014, 272). Recognizing environmental protection as a public good is important because by understanding that environmental protection is a public good and which type of authoritarian regime, if any, can provide more public goods, then we can better understand how to move forward in tackling climate change.

As has been mentioned above, environmental protection is a vital public good that should be provided by all governments, regardless of regime type. However, it is also relevant (especially to this thesis) to note that party regimes will be more likely to provide public goods, and in turn, provide environmental protection, which will result in lower levels of environmental degradation. It is also important to note that the two possible explanations, the selectorate and democratic institutions, have an essential role to play in environmental protection. Therefore, for emphasis, regimes such as party regimes that have larger selectorates and democratic institutions will be more likely to provide more public goods, such as environmental protection.

3.2.2 Miscellaneous Fields

As noted in section 3.2, there has been an expansion of knowledge on authoritarian regime types in different fields over the years. The three fields researched most in-depth will consist of conflict and peace, economic development, and regime durability. These fields are necessary to highlight because while they do not focus on environmental performance, they can provide an idea of which type of authoritarian regime will outperform others and be more likely to provide more public goods for their population. Another reason why it is essential to look at these fields is that there is no research on the relationship between authoritarian regime type and environmental performance. Therefore, one must utilize the existing available literature.

In regards to conflict and peace, dictatorial or authoritarian peace has been the counterargument to the well-cited Democratic Peace Theory (DPT). Geddes (1999a) was one of the first political scientists to promote the idea that different types of authoritarian regimes react differently beyond the status quo. According to Geddes (1999a), "To summarize that argument, military regimes tend to split when challenged, personalist regimes to circle the wagons, and party regimes to coopt their challengers (Geddes 1999a, 1)." Here, Geddes is explaining again how party regimes will tend to maintain and hold power longer than the other two regimes even when facing an economic downturn. This is because personalist regimes tend to end in uprisings, and military regimes tend to end in negotiations because they usually are suffering from internal issues in their own selectorate. Other works like Peceny, Beer, & Sanchez-Terry. (2002), Ishiyama, Conway, Haggans (2008), Letkzian and Souva (2009), and Peceny & Butler (2004) have all expanded on Geddes work and determined that party regimes can produce similar results as democracies in terms of peace and security.

In addition to this, whether states enter or do not enter into conflict can be linked to audience costs. According to Weeks (2008), audience costs are the domestic punishment that leaders would incur for backing down from public threats or threats from the audience. Democracies, as noted through the literature, have higher audience costs for backing out of a conflict. However, Weeks (2008) concludes that single-party authoritarian regimes can also have very high audience costs and generate credible threats that are up to par with that of democracies. Weeks also determines that personalist regimes, new democracies, and unstable democracies will have a more difficult time maintaining their threats. This idea is consistent with Peceny, Beer, & Sanchez-Terry (2002)

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argument. For if audience costs are high, then conflict is more likely to occur for a significant amount of time, and therefore, it would be discouraged to enter into conflict with another single-party authoritarian regime rather than a mixed dyad conflict. This argument, as well as the ones mentioned in this section, defend the argument that authoritarian regimes, primarily single-party regimes, can uphold dictatorial peace (Weeks 2008).

In terms of economic development, the world has seen a rise in different authoritarian regimes developing faster than many democracies. Some have related this to decision making, such as Sah (1991, 70), who explained that a more centralized society, or one with few preceptors such as an authoritarian regime, is more likely to make decisions unilaterally. However, others have focused on coalition size, or in other words, the selectorate. Bueno de Mesquita et al. (2003) argument expands on how an authoritarian regime will behave once economic growth is occurring. They argue that an authoritarian regime will tend to use the income from economic growth primarily amongst the elites and those in power. However, for this instance, coalition size matters. Those with a larger coalition size will have to focus primarily on public welfare, while those with a smaller coalition size will have to focus on the party members and the elites. Therefore, more party-affiliated authoritarian regimes will be able to promote economic growth for the public because it will help them to maintain their place in power.

On the other hand, many other authors believe that increased economic growth has to deal with either the level of repression in a regime or level of public deliberation. Weede (1996) notes that a lot of this growth has to do with how repressive the regime is. In terms of the level of repression, Weede (1996) uses the seven-point scale of democracy, so that ordinary or semi repressive authoritarian regimes as he labels them, would be labeled at partly free. A partly free regime would be considered as ordinary or semi repressive regimes and would allow for higher levels of economic growth compared to other authoritarian regimes. Chandra & Rudra (2013) also work off of this idea but extend this idea to incorporate public deliberation and how it can allow for economic development in authoritarian regimes. According to Chandra & Rudra (2013, 253), it is not a regime type that allows for more or less economic development, but rather it is the level of public deliberation. Decentralized decision-making can help explain why there is a relationship between political regimes and economic growth. The authors' key point is that high levels of public

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deliberation allow for higher economic growth rates and that this growth can only be experienced by negotiation and participation.

In order for a regime to have a high level of environmental performance, it has to have stability. Therefore, the durability of a regime to maintain its power over its civil society is of the utmost importance. When looking at regime transition, it can take many forms, so if a regime is overthrown or a civil war breaks out, then not only will the government, its economy, and its society breakdown, but it can cause significant destruction to its environment as well. For this reason, several authors address the issue of regime transition (Hadenius, Teorell 2007; Geddes 1999a). Regime transition is an important topic because it is imperative to understand which regimes will have the most peaceful transitions in order to gauge which authoritarian regime type will have the least negative impact on the environment.

In terms of the nature of the authoritarian regime transition, according to Geddes (1999a) different types of authoritarian regimes have different transition outcomes. For personalist regimes, they will tend to have late transitions because they will attempt to hold onto their power for as long as possible. Late transitions will possibly result in an uprising or attempted coup to overthrow the regime. As for military regimes, they tend to end in negotiation or bargaining due to most of their transitioning occurring from internal disagreements. As for single-party regimes, it is unclear what the transition outcome is because few transitions have occurred. According to Geddes (1999a), most single-party regime officials believe that there will not be significant changes in the system, so therefore, they will be more inclined to negotiate. In terms of the outcome of the authoritarian regime transition, Hadenius & Teorell (2007) explain the outcomes for monarchies, single-party regimes, military regimes, and multiparty regimes. For monarchies (personalist regimes), they explain that these tend to result in a restricted form of electoral monarchism. For single-party regimes transition outcome, as stated before, is more complicated, but tend to result in dominant or nondominant multiparty systems or military regimes. For military regimes, they mostly result in limited multiparty systems, and more multiparty regimes, they mainly result in democratization.

In conclusion, when looking at these diverse fields, one can notice a pattern occurring. For economic development, conflict and peace, and regime durability, party regimes are most likely to outperform in all of these categories. This can also be related to the explanations, such as a larger selectorate or incorporating institutions. Regardless, by better understanding these fields,

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one can have an idea of which type of authoritarian regime will outperform. As already stated, while these fields do not directly relate to the environment, they can give a better understanding of what should happen in that field based on what is occurring in the ones studied in this section.

3.3 Authoritarian Environmentalism

Authoritarian environmentalism is a concept established to counter the idea of democratic environmentalism and the idea that only democracies were able to obtain high levels of environmental performance. Heilbroner (1974) first established this concept in his work, *An Inquiry into the Human Prospect*. He wrote this during a time not only of conflicting ideologies, where part of the world pushed for authoritarianism, and the other pushed for democracy but also during a time where income inequality was beginning to rise. His main idea behind authoritarian environmentalism was that most democratic regimes would not be able to fix their economic structures to limit the number of inequalities that are inherently built into capitalism. He explains that this issue will pin classes against one another and that the current political institutions in democracies will not be able to transform itself fast enough and reduce the amount of income inequality. Therefore, in this type of desperate situation, Heilbroner (1974) believes that states will begin to resort to authoritarianism.

Gilley (2012) extends this by explaining that there are many alternative concepts and models related to an increase in awareness of environmental degradation, and one of the most popular models is authoritarian environmentalism. Gilley (2012) defines authoritarian environmentalism by stating: "Thus, authoritarian environmentalism can be provisionally defined as a public policy model that concentrates authority in a few executive agencies manned by capable and uncorrupt elites seeking to improve environmental outcomes. Public participation is limited to a narrow cadre of scientific and technocratic elites, while others are expected to participate only in state-led mobilization for implementation. The policy outputs that result include rapid and comprehensive response to the issue and usually some limits on individual freedoms (Gilley 2012, 288)." Several characteristics develop due to environmental issues that can be fixed with the non-participatory nature of authoritarian regimes: public ignorance, public irrationality, free-riding, the need for immediate action, the lack of availability heuristics to motivate social action, and multi-stakeholder veto players (Gilley 2012, 292). However, while all of these characteristics are

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important, Gilley's key point is that while authoritarian environmentalism will bring a necessary push towards environmental change, the issues of lacking social concern due to the separation and prohibition of representatives outside the government will not only make authoritarian approaches to better environmental performance more critical, but it will also make them more difficult.

In addition to Gilley's work, Beeson (2010) also establishes the importance of the structure of authoritarian regimes and their ability to produce effective environmental outcomes. In Beeson's article, he focuses solely on East and Southeast Asia and their historical legacy with authoritarianism. He also emphasizes that there has been a rise in illiberal, authoritarian regimes (Diamond 2008), and especially with the prominent rise of China, the possibility of authoritarianism increasing, especially in Asia, is highly possible. His main argument is that regardless of the adverse effects on civil and human rights that come with authoritarianism, Beeson (2010) believes that authoritarian regimes will be more capable than other forms of government at confronting environmental challenges. His reasoning is due to the centrality of power. It states, "In such circumstances, forms of 'good' authoritarianism, in which environmentally unsustainable forms of behavior are simply forbidden, may become not only justifiable but essential for the survival of humanity in anything approaching a civilized form (Beeson 2010, 289)." Because of this reasoning and the fact that regimes such as China have experienced economic growth by prioritizing it over political issues, Beeson (2010) believes that governments will choose to implement authoritarianism in order to combat the environmental issues of the future.

Hypotheses

Based on the theoretical arguments made in the three proceeding sections, I derive the following hypotheses:

H1: Authoritarian regime types will have an effect on environmental performance.

H2: Out of all other authoritarian regimes, party states will outperform other types of authoritarian regimes and have a positive impact on environmental performance.

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4   Research Design

4.1   Dependent Variable: Carbon Dioxide (CO_2) Emissions

The dependent variable examined in this paper is the amount of carbon dioxide emissions emitted around the globe measured in metric tons per capita. The data retrieved for this variable is from the World Bank's World Development Indicators (WDI) compilation, and it covers the 1997-2010 period (World Bank 2019). I chose this response variable over others based on the starting date from the Kyoto Protocol: 1997. This agreement was put into effect to reduce the levels of greenhouse gas emissions internationally. One hundred ninety-two parties in the United Nations are a part of the Kyoto Protocol, and 84 countries have signed onto the agreement (UNFCCC).

The World Bank identifies carbon dioxide emissions as a greenhouse gas emitted from the burning of fossil fuels and the manufacturing of cement. They state that these emissions include CO_2 produced during the consumption of solid, liquid, gas fuels, and gas flaring (World Bank 2019). Greenhouse gas emissions are the most detrimental form of environmental degradation because not only does it lead to temperature increases, which can affect other parts of the ecosystem, but it also can stay in the atmosphere for up to thousands of years (EPA 2019). Other forms of degradation, such as deforestation, air pollution, and water pollution may be more apparent in everyday life, but they tend to be more easily manageable and tend only to affect the area where the degradation is occurring.

4.2   Independent Variable: Authoritarian Regime Type

To test the impact of regime type on carbon dioxide emissions, I apply the data collected by Geddes, Wright, and Frantz in 2014 on authoritarian regimes from their dataset, "Autocratic Breakdown and Regime Transitions: A New Data Set." In their dataset, authoritarian regime types are broken down into four main categories, which include party, military, personal, and monarchy. However, several subcategories are included to make up these four main categories: party-based, party-military, party-personal, party-personal-military, oligarchy, indirect military, and military-personal (Geddes, Wright & Frantz 2014).

For Geddes, Wright, and Frantz (2014), several main occurrences need to happen in order for a regime to be considered autocratic: a leader comes to power undemocratically, military intervention in competitive elections, or informal or formal rules inhibit competitive elections. The authors also note that an autocratic regime can switch when there is a successful competitive election when a government is ousted and replaced by a different regime, and when policies are changed and implemented that effectively alter the way leaders are chosen. Geddes, Wright, and Frantz (2014) also note that the selectorate is essential when determining the type of authoritarian regime. For party regimes, it is the dominant-party dictatorships, for monarchies, it is the royal family, for military regimes it is the military institution, for personalist, it is the individual dictator, and for oligarchies (classified under party regimes) it is competitive elections but with most of the population still powerless (Geddes, Wright, and Frantz 2014, 317-18).

Using Geddes, Wright, and Frantz's 2014 dataset, I was able to identify 81 authoritarian regimes and 51 authoritarian regimes that did not switch to another type of regime during 1997-2010. While most research on regime type and the environment focuses on how democracies outperform autocracies, and while this is still majorly true, research and results are beginning to show some authoritarian regimes to make efforts to control CO_2 emissions. A party regime such as China, which is also the most significant greenhouse gas emitter in the world, has recently been showing signs of slowing CO_2 emissions in 2018 (Korsbakken, Andrew, Peters 2019). While this is nearly a decade after the end of the dataset's timeline, it is still showing that authoritarian regime types could possibly be a good indicator of CO_2 emission reduction.

4.3 Control Variables

In addition to this, I will also be adding several control variables to test how these variables affect carbon dioxide emissions and authoritarian regimes type. These control variables will cover economic, demographic, and industrialization variables. I will briefly describe each of these variables.

All of the control variables are retrieved from the World Bank's World Development Indicators database to attribute to whether economic, demographic, and industrialization factors contribute to specific authoritarian regimes having higher CO_2 emissions. In regards to economic factors, having higher rates of economic growth can be linked to higher CO_2 levels due to a preference for economic growth over environmental protection. Poorer countries that have low levels of

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economic growth are said to have lower levels of CO_2 emissions, according to Azomahou, Laisney, and Van (2006). Azomahou, Laisney, and Van (2006) also point out that developed nations, such as Western liberal democracies, are more likely to have higher CO_2 emissions due to financial, technological, or other vital resources. However, when looking at the World Bank's data, CO_2 emissions in places like western Europe and even the US had either began to level off or decrease around 2014 (World Bank 2019). Therefore, trade as a percentage of GDP is used to refer to trade openness (to the world), and GDP per capita is measured in current US Dollars (US$).

In regards to demographics, having a higher rate of population growth and a more densely populated area can significantly affect the environment and also the number of resources needed to provide the population with daily means. In addition to this, urban areas tend to exacerbate climate change in the city and surrounding areas, according to Grimm et al. (2008). The demographic variables are population density and urban population growth, both provided by the World Bank (2019). Population density is measured by the number of people per square kilometer of land area, and urban population growth is measured by the annual percentage of growth in urban areas (World Bank 2019). In regards to the industrialization variable, industrialization is an essential factor for both CO_2 emissions and authoritarian regimes because most Western liberal democracies have already undergone industrialization. In contrast, in many autocracies in other parts of the world, industrialization is ongoing or just beginning. Industrialization is also a central agent in the reduction of environmental quality in a state, according to Cherniwchan (2012). Therefore, I selected industry measured as a percentage of GDP to represent the industrialization variable (World Bank 2019).

4.4 Model Selection

The central research method for this research will be conducted through quantitative analysis. Primarily, I will be using time-series cross-sectional analysis in order to examine how autocratic regimes test from 1997-2010 in regards to their CO_2 emissions. In addition to completing the time-series cross-sectional analysis, I will also be utilizing Geographic Information Systems (GIS) by mapping out the levels and fluctuation of CO_2 emissions in the four different authoritarian regime types. I will be utilizing different databases and sources, with the central database being the World Bank, where data will be pulled for the dependent and control variables. I will also be utilizing the

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database prepared by Geddes, Wright, and Frantz (2014) as my primary dataset in order to outline the types of authoritarian regimes.

By applying time-series cross-sectional analysis with random effects (RE), I will be able to test the relationship between authoritarian regime type and the level of carbon dioxide emissions within each regime. There are two main benefits when testing variables using the random effects model. Both of these benefits are due to the nature of the data utilized in this thesis. First, because I use country-level data, by using the RE model, the data can be measured properly and at the right level (Bell, Jones 2015, 135-136 as cited in Chang, Wei 2019, 330). Secondly, because the sample size in this thesis is small and includes climate and geographical variables which are time-invariant, the RE model allows for estimations to be made and out-of-sample observations to be predicted, which makes this model the most preferable (Clark, Linzer 2014; Baltagi 2008; Bell, Jones 2015, 136 as cited in Chang, Wei 2019, 330).

In addition to this, I will take into consideration the problem of reverse causality and endogeneity. In order to avoid these issues, I will lag all dependent variables by one year. All things combined, the RE model in this paper is:

$$CO2_{c,t+1} = \alpha + \beta Authoritarian_{c,t-1} + GDPcap_{c,t-1} + trade_{c,t-1} + population_{c,t-1}$$
$$+ urban_{c,t-1} + industry_{c,t-1} + \alpha_c + \delta_t + \mu_{c,t-1}$$

where i stands for country and t stands for time, and I test authoritarian regime types (Authoritarian) against my y-variable, CO2, which controls for individual and time effects with it. The control variables and x-variable represented in this equation, in the case for removing reverse causality, are started at one year before that of the y-variable, represented by $t - 1$. As for $\alpha_c + \delta_t$, this represents the controls for individual fixed effects and time fixed effects, and $\mu_{c,t}$ represents the idiosyncratic error term.

In addition to this, in order to increase the robustness of the research and make sure that the hypothesis and results are valid, I will also be utilizing a second method, spatial analysis using Geographic Information Systems (GIS). This form of analysis will allow me to not only include visual results through mapping, but it will also allow me to include some other figures such as a boxplot and a parallel coordinate map to better understand the data and look for any possible outliers. In order to obtain more efficient results, several regressions will be run and we will also test for clustering through the Local G* clustering map to see if there is any correlation in certain

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areas between regime type and carbon dioxide emissions. I will also include a bubble chart to see the relationship between regime type and CO_2 emissions and the relationship between GDP per capita and CO_2 emissions.

Lastly, the main form of analysis in this section will be based on three regression models: a classical regression model, a spatial lag regression model, and a spatial error model. The reasoning for this is that after testing several distance weighted variables with different distance bandwidths and different numbers of nearest neighbors, the results concluded that all three of these models should be tested. For example, the bandwidths set to the automatic setting (6,639.41) showed positive results to test for spatial lag and error, but 10,000 km and 20,000 km did not show any significant results.

To conclude, when looking at the methodologies and data used, it is also imperative to look at feasibility and data transparency. In terms of authoritarian regimes' data transparency, because of these regimes' secretive and confidential nature, it usually is challenging to obtain data from these types of regimes. Because of this, there is the possibility of the data being skewed or incorrect in order to best present the leader or party's best interests. However, while keeping this in mind, caution was taken when reviewing databases and data sources. While there are some issues of missing or unavailable data for specific authoritarian regimes, after reviewing the data, I believe that there is enough to run a comprehensive analysis. Therefore, while I believe that there will be some issues of feasibility that will be uncovered during this research, I believe that I can still provide a comprehensive analysis on this relevant issue we are still dealing with today.

5   Results: Time-Series Cross-Sectional Analysis & Geographic Information Systems

5.1   Time-Series Cross-Sectional Analysis

Before discussing the statistical results of this research, we will first provide summary statistics through several tables provided in this section below. In the first portion of this section, we will cover the summary statistics of the main analysis: time-series cross-sectional analysis. These statistics will include number of observations, frequency of the variables, standard deviation, maximal values, minimal values, and skewness. We will also include some graphs depicting the relationship between authoritarian regime type and CO_2 emissions over the chosen timeline. In the second portion, the regression results will be shown.

5.1.1   Summary Statistics: Time-Series Cross-Sectional Analysis

In order to better understand the data and what the relationship was between the variables carbon dioxide emissions (metric tons per capita) and authoritarian regime type, we first reviewed the data and determined which authoritarian countries are the largest emitters of CO_2 in each regime type. When looking at figure 5.1, the results show a large gap between the top emitter for monarchies and the other top emitters in other regimes. For party regimes, Singapore is the top emitter, for military regimes, it is Algeria, for personal regimes, it is Russia, and for monarchies, it is Kuwait. While it is not shown in this graph, in general, it is monarchies that can be considered the top producers of per capita carbon dioxide emissions. However, when looking at overall emissions measured in kilotons, the results show a much different estimate with China being the top CO_2 emitter by a long shot with over 800,000 kt by 2010. The other four top emitters (Russia, Saudi Arabia, Iran, and Kazakhstan) rest under 200,000 kt. However, in this research, we will be utilizing per capita CO2 emissions in order to have a better variation.
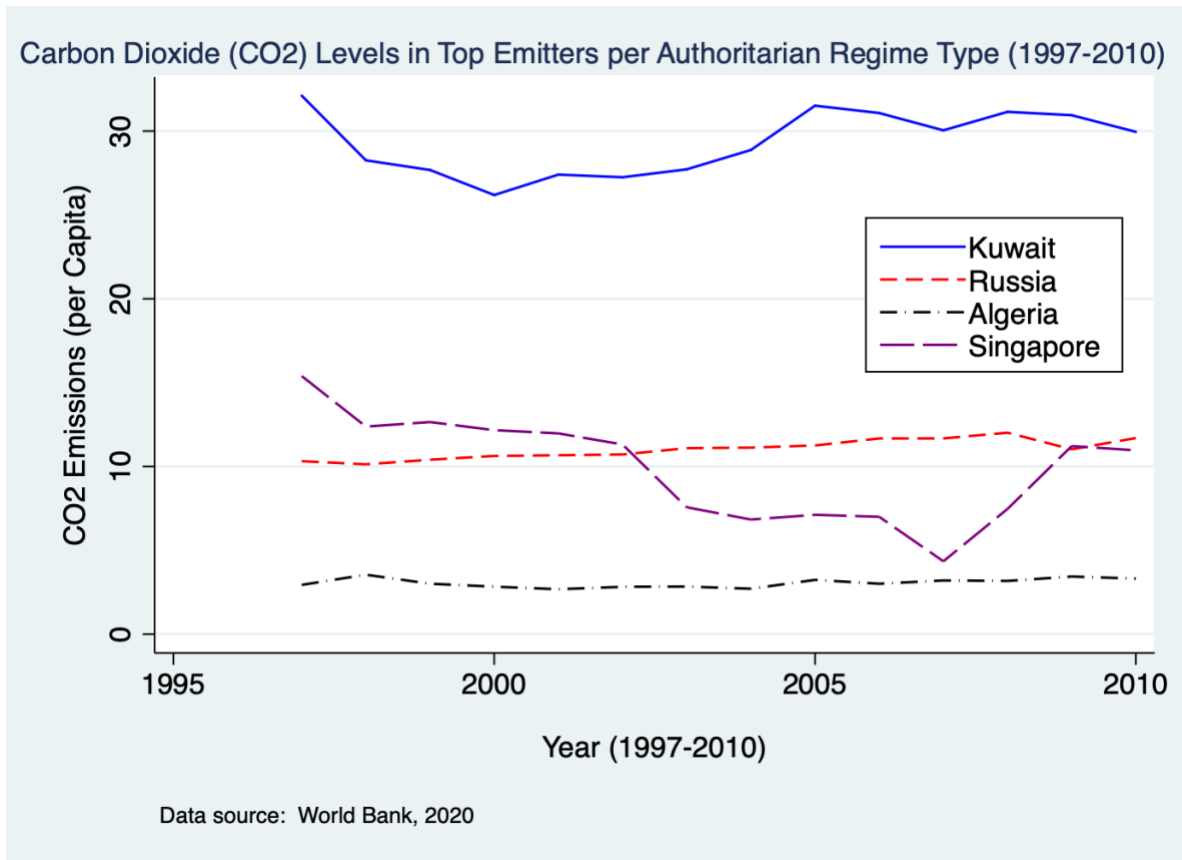
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Figure 5. 1: Top Five Carbon Dioxide (per Capita) Emitters (1997-2010)

In addition to this, one can also look at Figure 5.2 to gain a better understanding of the relationship between authoritarian regime type and carbon dioxide emissions. This figure shows on average how the four different types of authoritarian regimes have performed in carbon dioxide emissions from 1997 to 2010. The solid line, representing monarchies, are shown to perform the worst, while the other three regime types (party, military, and personal) are averaging between 2-3 metric tons per capita. Based on the literature, the hypothesis we chose focused on party regimes outperforming any other type of authoritarian regime type. However, based on this preliminary figure, one can notice that military regimes are emitting the lowest amount of CO_2 (metric tons per capita) emissions. This could be due to several reasons, such as fewer observations to pull from or low levels of development; however, this could possibly have no effect on the final results.
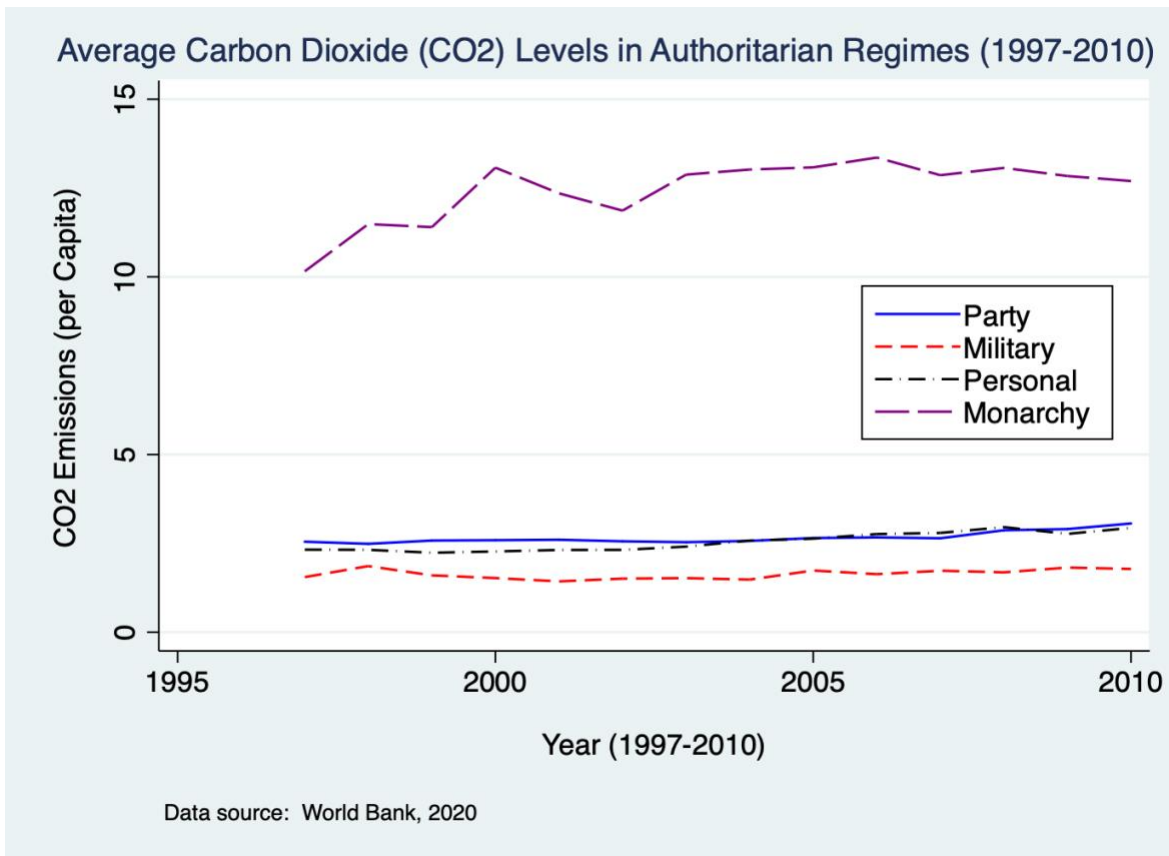
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Figure 5. 2: Average CO_2 (Metric Tons per Capita) Emissions in the Four Different Authoritarian Regime Types (1997-2010)

After seeing the results in Figure 5.1 and 5.2, it is important to understand which countries are in what authoritarian regime type. Therefore, in Table 1, one can better understand out of all fifty-one regimes utilized in this research, which ones are categorized into which authoritarian regime type. For monarchies, one can see that out of the seven countries considered as a monarchy, four of them are ranked as the top four carbon dioxide (per capita) emitters. The other three monarchies (Eswatini (Swaziland), Jordan, and Morocco), all have lower levels of CO_2 emissions (per capita), which show that these other four monarchies are skewing the results for the other three monarchies. This is more than likely the result of these four monarchies being large oil producers, including Russia which is labeled as a personal authoritarian regime.

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Table 1: Summary of Countries Per Regime Type

Country	Regime Type			
	Military	Monarchy	Party	Personal
Algeria	1	0	0	0
Angola	0	0	1	0
Armenia	0	0	0	1
Azerbaijan	0	0	0	1
Belarus	0	0	0	1
Botswana	0	0	1	0
Burkina Faso	0	0	0	1
Cambodia	0	0	1	0
Cameroon	0	0	0	1
Chad	0	0	0	1
China	0	0	1	0
Congo, Dem. Rep.	0	0	0	1
Cuba	0	0	1	0
Egypt	0	0	1	0
Eritrea	0	0	1	0
Eswatini	0	1	0	0
Ethiopia	0	0	1	0
Gabon	0	0	1	0
Gambia	0	0	0	1
Guinea	0	0	0	1
Iran	0	0	1	0
Jordan	0	1	0	0
Kazakhstan	0	0	0	1
Korea, North	0	0	1	0
Kuwait	0	1	0	0
Kyrgyz Republic	0	0	0	1
Lao PDR	0	0	1	0
Libya	0	0	0	1
Malaysia	0	0	1	0

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Morocco	0	1	0	0
Mozambique	0	0	1	0
Myanmar	1	0	0	0
Namibia	0	0	1	0
Oman	0	1	0	0
Russia	0	0	0	1
Rwanda	0	0	1	0
Saudi Arabia	0	1	0	0
Singapore	0	0	1	0
Sudan	0	0	0	1
Syria	0	0	1	0
Tajikistan	0	0	0	1
Tanzania	0	0	1	0
Togo	0	0	0	1
Tunisia	0	0	1	0
Turkmenistan	0	0	1	0
UAE	0	1	0	0
Uganda	0	0	0	1
Uzbekistan	0	0	1	0
Vietnam	0	0	1	0
Yemen	0	0	0	1
Zimbabwe	0	0	1	0
Total	2	7	24	18

All variables utilized in this study can be found in Table 2. Table 2 also provides summary statistics, such as number of observations, mean, standard deviation, minimal values, maximal values, and skewness for the main variables utilized in this research that are likely to influence the amount of carbon dioxide emissions in authoritarian regimes. In particular, I control for trade as percentage of GDP, GDP per capita in US$, population density as a percentage of the total population, urban population as percentage of total population, and a variable for industrialization which is the value added as a percentage of GDP from industries, including construction.

Table 2: Summary statistics

	N	Frequency	St. Dev	min	max	skewness
CO2 (metric tons per capita)	713	713	6.11	0.02	35.92	2.63
Regime Type	765	765	0.79	1.00	4.00	-0.72
Party	765	360	0.50	0.00	1.00	0.12
Military	765	30	0.19	0.00	1.00	4.75
Personal	765	270	0.48	0.00	1.00	0.62
Monarchy	765	105	0.34	0.00	1.00	2.11
GDP per Capita (US$)	743	743	7779.02	102.60	55494.95	3.50

5.1.2   Results: Time-Series Cross-Sectional Analysis

This paper examines whether the presence of a certain authoritarian regime type within a country can have an effect on the level of greenhouse gas emissions in a country, specifically carbon dioxide (CO_2) emissions. Further, I hypothesize that regime type will have an effect on carbon dioxide emissions and that out of all authoritarian regime types, party regimes will have the greatest effect at reducing carbon dioxide emissions. Table 3 gives the results for the three models used in the time-series cross-sectional analysis, showing the effect on CO_2 emissions in general (column one), and time-fixed effects (column 3). Column 2 gives the full model without time-fixed effects.

Table 3 outlines all three models used in this thesis. All models used in this thesis include random effects. In addition to this, monarchies are used as the baseline model, and are therefore omitted because of collinearity. The first column outlines the first model used. Model 1 is a generalized least squares regression with random effects where carbon dioxide emissions are regressed with all authoritarian regime types in order to see initial results. In this regression, all 51 regimes are included in this regression, and all regimes (party, military, and personal) are shown to be statistically significant at the 95th percentile (p-value<0.05). The results show that if all authoritarian regimes are present, then carbon dioxide emissions will decrease. However, contrary to my hypothesis, it is military regimes that have the strongest relationship and are less likely to have higher levels of CO_2 emissions.

On the other hand, the results from Model 2 show to have a more profound effect. The second model is another generalized least squares regression which includes all explanatory and control variables. This model, which includes only 46 out of 51 regimes, shows that once the control variables are included, regime type does not have as profound of an effect. While all regimes are still statistically significant in the 95th percentile, once controlling for the economy, demographics, and industrialization, all regime types are not as effective at decreasing CO_2 emissions. Again, in this regression, the results are contradictory to my hypothesis that party regimes will outperform all other authoritarian regime types, and show that military regimes are performing the best.

The control variables included in this regression that are controlling for the economy are trade as percentage of GDP and GDP per capita measured in US dollars. In this regression, controlling for demographics are the variables population density based on total percentage of population and

urban population showing the rate of urbanization in different regimes. Lastly, controlling for industrialization is the value added by industry as a percentage of GDP.

When looking at Model 2, one can see that not only do the control variables decrease the effect of authoritarian regime types, but they are also all statistically significant. GDP per capita has the greatest effect on carbon dioxide emissions out of any of the control variables, so that as GDP per capita increases, so does CO_2 emissions. This could be a result of the Environmental Kuznets curve. This is also true for urban population and industrialization, whereas urban population and industrialization increases, so do CO_2 emissions. This could easily be due to the fact that as industrialization increases, more people will move to urban areas to look for job opportunities, and with more industrial output and human congestion, carbon dioxide emissions will increase. However, for trade, the higher the level of CO_2 emissions, the lower the amount of trade a country does. This effect is contradictory to my original understanding because normally more trade would mean more production, which would result in increased CO_2 emissions. Population density, while statistically significant, also shows the relationship that the less dense a population is, the more CO_2 emissions a country will have. This is contradictory as well because normally the more densely populated a regime is, the more likely it is to have higher CO_2 emissions.
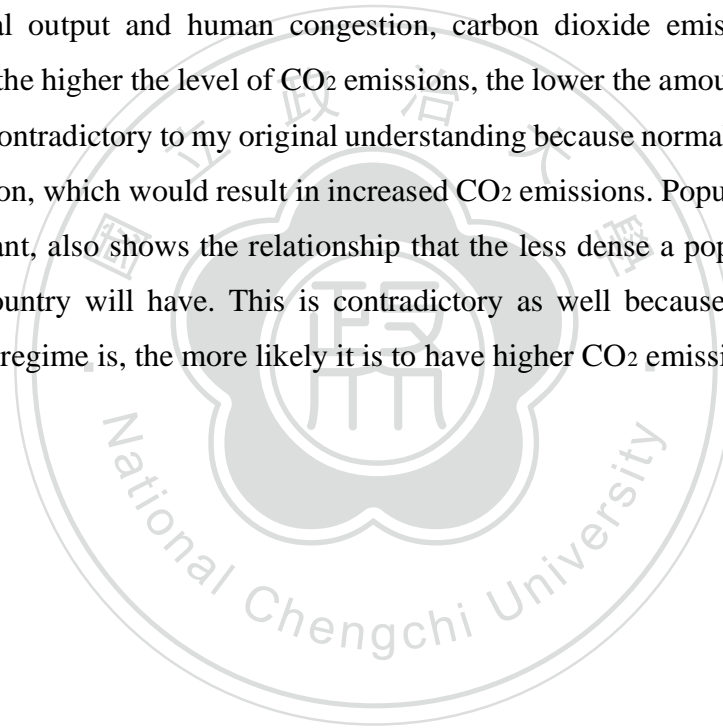
Table 3: Authoritarian Regime Type and Carbon Dioxide Emissions: Models with Random Effects

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
Party	-9.78***	-4.96***	-3.58***
	(2.21)	(1.23)	(1.22)
Military	-10.81***	-6.88***	-4.90**
	(4.12)	(2.19)	(2.15)
Personal	-9.89***	-4.71***	-2.89**
	(2.29)	(1.29)	(1.30)
Trade (% of GDP)		-0.01***	-0.01***
		(0.00)	(0.00)
GDP per Capita (log)		-4.32***	-3.74***
		(0.65)	(0.65)
GDP per Capita ($\log^2$)		0.34***	0.36***
		(0.04)	(0.04)
Population Density		-0.00**	-0.00***
		(0.00)	(0.00)
Urban Population		0.07***	0.08***
		(0.02)	(0.02)
Industry (% of GDP)		0.04***	0.03**
		(0.01)	(0.01)
Constant	12.44***	17.41***	11.06***
	(1.94)	(2.64)	(2.84)
Observations	713	604	604
Number of States	51	46	46

Standard errors in parentheses; Monarchy regimes used as the baseline
*** p<0.01, ** p<0.05, * p<0.1

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Lastly, Model 3 provides the full model while also controlling for time-fixed effects. Because carbon dioxide emissions could possibly be affected by the performance in previous years', time-fixed effects need to be included. By doing so, it allows me to determine whether my hypothesis is correct and whether CO_2 emissions are affected by authoritarian regime types rather than by time.

Furthermore, Model 3 (column 3) shows that military regimes outperform all other authoritarian regime types, then party regimes, and then personal regimes, while monarchies are still omitted because of collinearity. When looking at authoritarian regimes, when large amounts of carbon dioxide emissions are present, it is less likely that the authoritarian regime is a military regime. In addition to this, the results also show that all authoritarian regime types besides personal regimes are statistically significant.

In Model 3, when looking at the control variables, GDP per capita is broken down into two variables: GDP per capita (log) and GDP per capita (log_2). By logging GDP per capita and by then also generating a square term, I am able to control for the Environmental Kuznets Curve (EKC). The EKC is based off the idea that the average income increase would first worsen then lead to an enhancement of the environmental conditions in a country (Grossman, Krueger 1995). Therefore, since GDP is the main control for the economy, it needs to be logged in order to test the effect of the EKC. In this model, GDP per capita is statistically significant and shows that the higher the CO_2 emissions, the lower the levels of GDP. Therefore, these results do not support the Environmental Kuznets Curve hypothesis.

Model 3 also shows that all other control variables, except for industry are statistically significant. Therefore, the results show that industry does not have an effect on carbon dioxide emissions in authoritarian regimes. In terms of urban population, the results are similar to Model 2, where as urban populations grow in an authoritarian regime, so will the levels of CO_2 emissions. Lastly, the results for trade and population density are also the same as in Model 2. As a result, authoritarian regimes with a more dispersed population and lower levels of trade will be more likely to emit more CO_2 emissions.

5.2 Geographic Information System Analysis

The second form of analysis will consist of a spatial analysis that utilizes Geographic Information Systems (GIS). Therefore, in order to better visualize the data, the software "GeoDa" allows me to incorporate better methods to determine how the data is structured.

5.2.1 Summary Statistics: GIS Analysis

In figure 5.3, a boxplot is used to determine whether there are any significant outliers in the data that could skew the results. This figure shows a boxplot with the hinge set at 1.5. Another boxplot that can be used is one where the hinge is equal to 3.0. However, this type of boxplot is more restrictive. For example, with the hinge set at 1.5, there are six out of fifty-one regimes that are outliers. These outliers are Kazakhstan, Kuwait, Oman, Russia, Saudi Arabia, and United Arab Emirates (UAE). However, when the hinge is set to 3.0, there are only two outliers. These outliers are Kuwait and UAE. Therefore, by using the hinge equal to 1.5, one will have a better understanding as to which countries or regimes skew the data and make it higher than necessary. Most of the countries that will skew the data are monarchies, with only one of them, Russia, being a personal authoritarian regime.
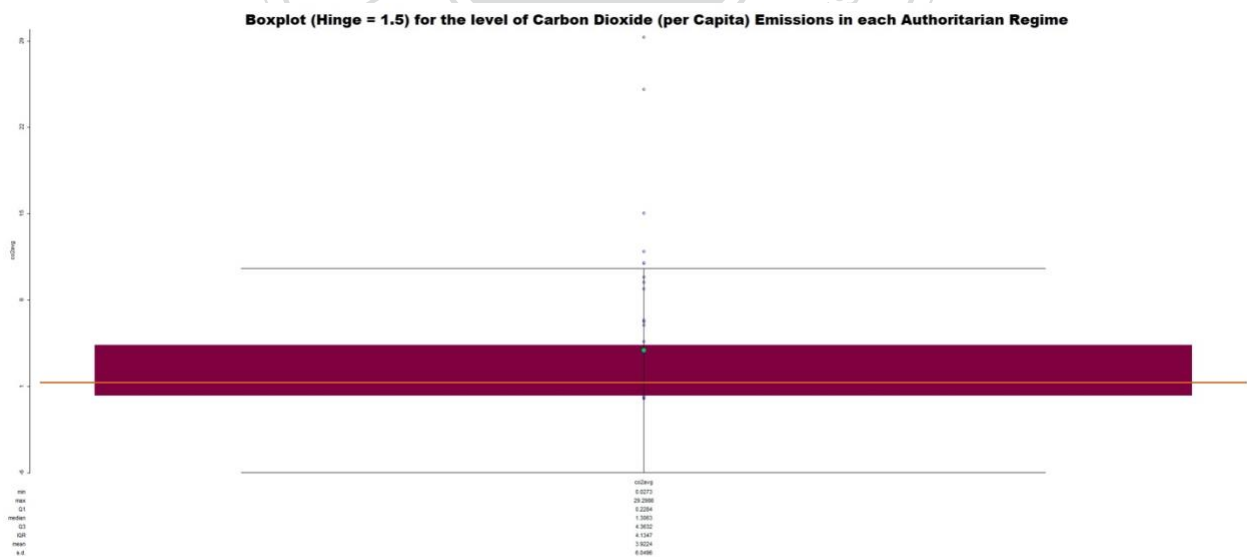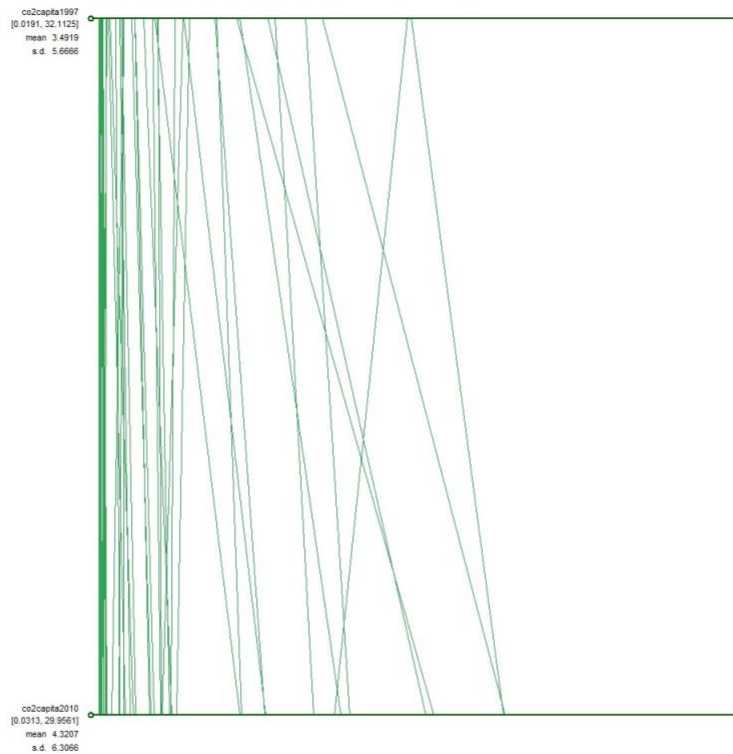

Figure 5.3: Box Map (Hinge = 1.5) to Determine Outliers in CO2 Emissions (Metric Tons per Capita)

Another way to visualize and better interpret the data is through a parallel coordinate map, as seen in figure 5.4. A parallel coordinate plot allows one to plot multiple variables to see how they interact. Therefore, the variables I chose to use in this map are carbon dioxide (metric tons per capita) emissions for the years 1997 and 2010. As one can see from this map, most of the regimes in this dataset have lower levels of CO_2 emissions. Also, most of these emissions do not increase drastically over the course of thirteen years. Even Kuwait, the largest emitter, does not drastically increase but slightly decreases with going from 32.11 to 29.96. However, with the larger CO_2 emitters, they all increase their emissions except for Singapore which decreased its CO_2 emissions from 15.39 to 10.96 metric tons per capita. Also, one can notice that most of the countries that are at the top have increased quite quickly regardless of whether or not they signed onto the Kyoto Protocol in 1997, such as Saudi Arabia (11.14 to 18.91) and United Arab Emirates (15.59 to 18.81).

Parallel Coordinate Plot Representing Change of Carbon Dioxide (per Capita) Emissions from 1997 to 2010

co2capita1997
[0.0191, 32.1125]
mean 3.4919
s.d. 5.6666

co2capita2010
[0.0313, 29.9561]
mean 4.3207
s.d. 6.3066

Data source: World Bank, 2020

Figure 5.4: Parallel Coordinate Map Representing the Change of CO2 Emissions (Metric Tons per Capita) From 1997 to 2010

In the next part of this section, I will include six different maps created through ArcMap (a program in ArcGIS) that can help one visualize the changes occurring from 1997 to 2010. It also allows

one to see the relationship between the variables and how the different authoritarian regimes perform. Figure 5.5 is a map that shows the main relationship between authoritarian regime type and carbon dioxide (per capita) emissions. As one can see in this map, over time not only are monarchy regimes being outperformed by all other regime types, but also, the majority of these countries have increased their CO_2 emissions.

In addition to this, the other maps show varying results. In Figure 5.6, for the relationship between GDP per capita and authoritarian regime type, most of the regimes do not change much over time, and only a few are increasing or decreasing. Figure 5.7 shows the trend of trade levels during this time period. One can see that most countries, regardless of regime type, have an increase in their levels of trade. Figure 5.8 is a map that shows the changes in population density levels. Most countries maintain a stable population density, except for a few countries which have increased over the years, such as United Arab Emirates (37.61 to 120.39). Next, Figure 5.9 shows the trend of urbanization by seeing how the urban population has changed in each country. Most countries have maintained a stable urban population. It is mainly party regimes with the most urban population growth: China, Vietnam, Laos, Eritrea, and Tanzania, with the exception of Yemen (personal). Lastly, Figure 5.10 is a map of industrialization; it shows the value added from industries as a percentage of GDP. Most regimes have seen growth in this area with a few having larger increases, such as the Democratic Republic of the Congo, Namibia, Laos, etc. However, some data skews the results due to the fact that there are no entries for Libya in 1997 and 2010 and for Kuwait in 1997.
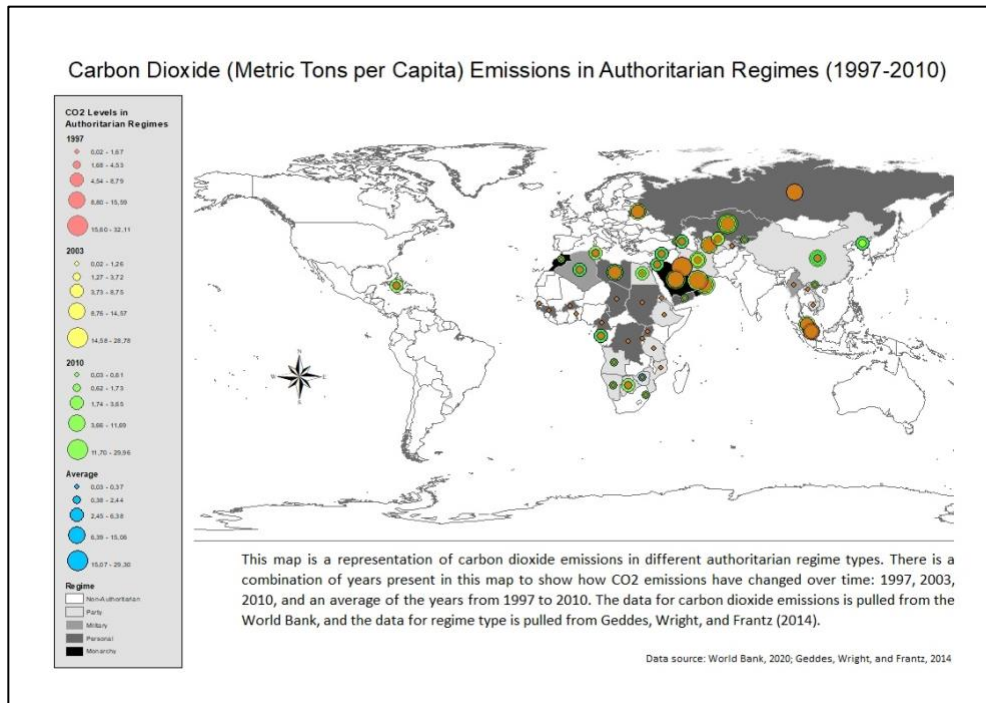
Carbon Dioxide (Metric Tons per Capita) Emissions in Authoritarian Regimes (1997-2010)

This map is a representation of carbon dioxide emissions in different authoritarian regime types. There is a combination of years present in this map to show how CO2 emissions have changed over time: 1997, 2003, 2010, and an average of the years from 1997 to 2010. The data for carbon dioxide emissions is pulled from the World Bank, and the data for regime type is pulled from Geddes, Wright, and Frantz (2014).

Data source: World Bank, 2020; Geddes, Wright, and Frantz, 2014

Figure 5.5: Map for Carbon Dioxide Emissions in Authoritarian Regimes (1997-2010)

Gross Domestic Product (GDP) per Capita Levels in Authoritarian Regimes (1997-2010)

This map is a representation of GDP per capita levels in different authoritarian regime types. There is a combination of years present in this map to show how GDP per capita levels have changed over time: 1997, 2003, 2010, and an average of the years from 1997 to 2010. The data for GDP per capita is pulled from the World Bank, and the data for regime type is pulled from Geddes, Wright, and Frantz (2014).

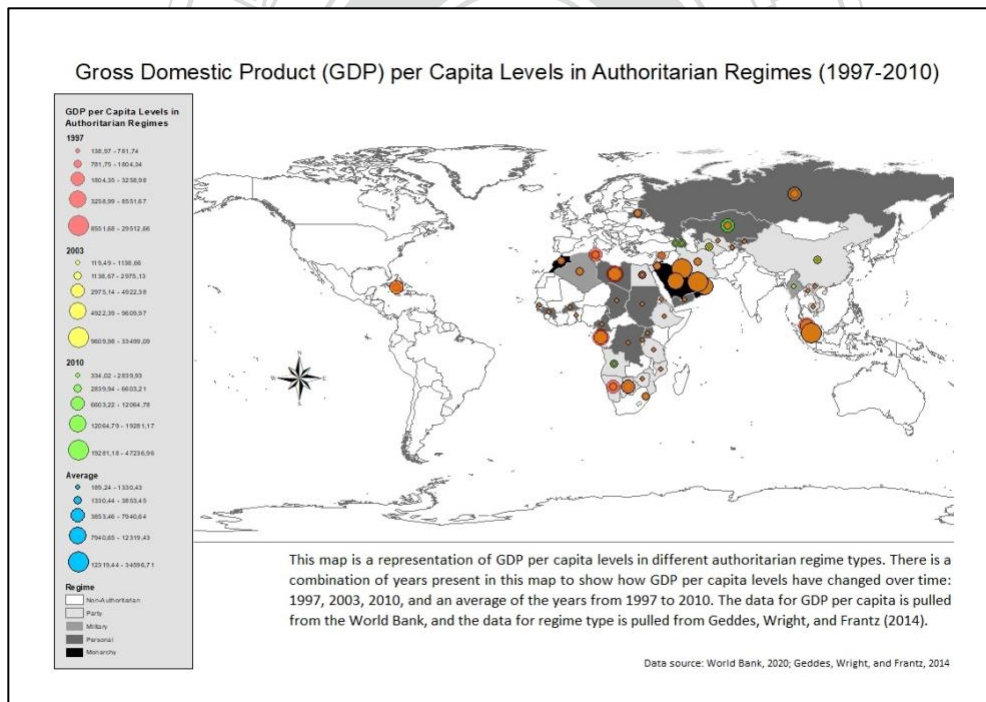Data source: World Bank, 2020; Geddes, Wright, and Frantz, 2014

Figure 5.6: Map of GDP per Capita Levels in Authoritarian Regimes (1997-2010)
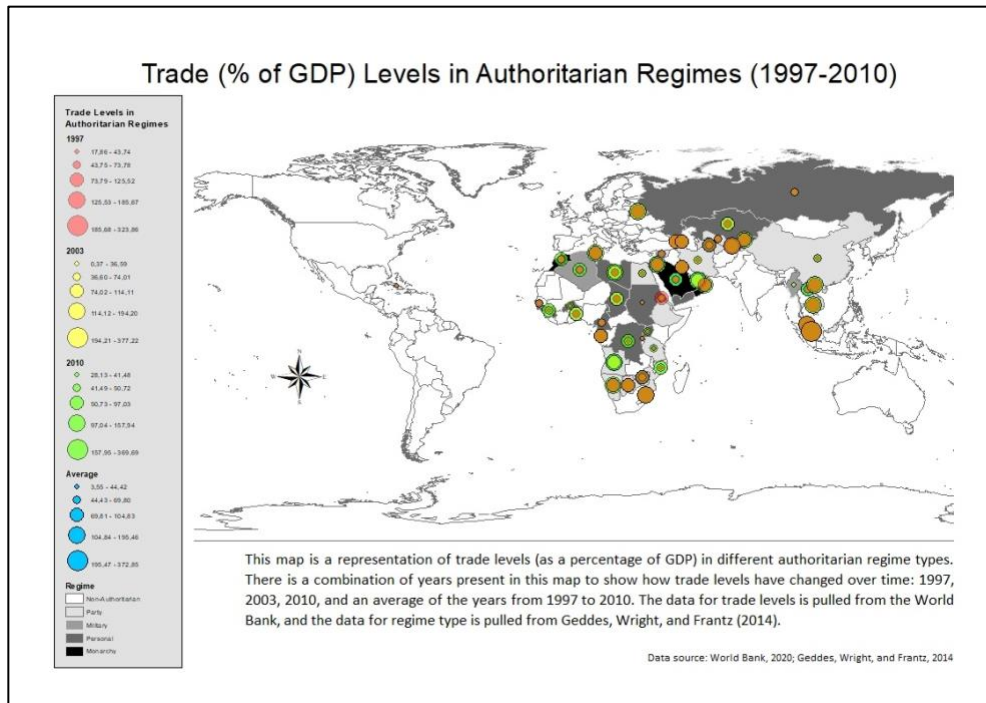
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Figure 5.7: Map of Trade Levels in Authoritarian Regimes (1997-2010)
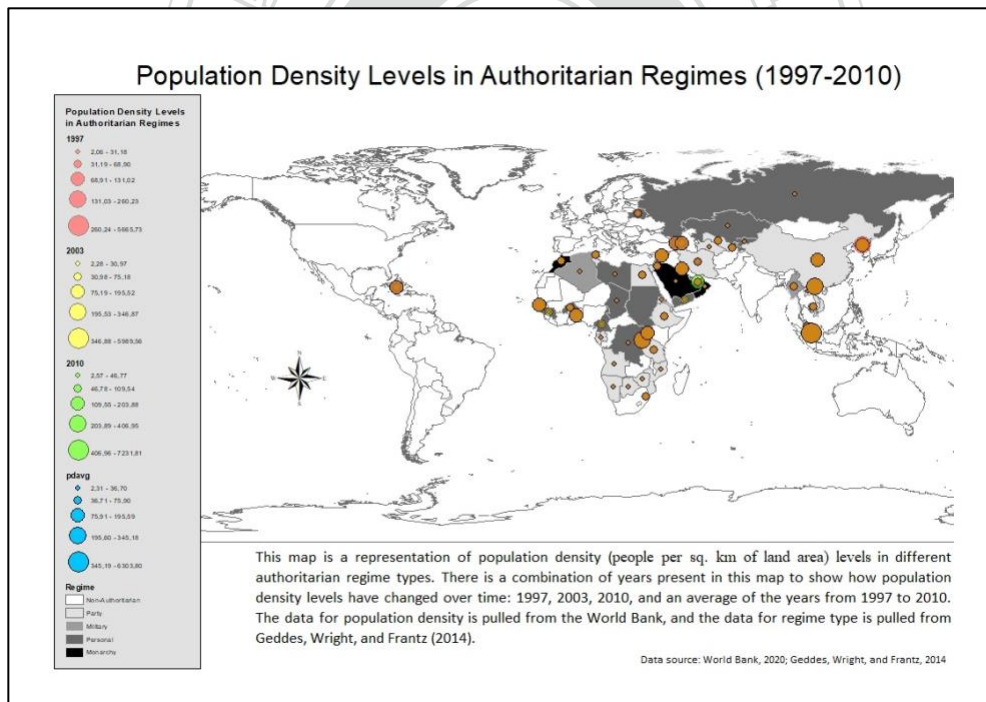

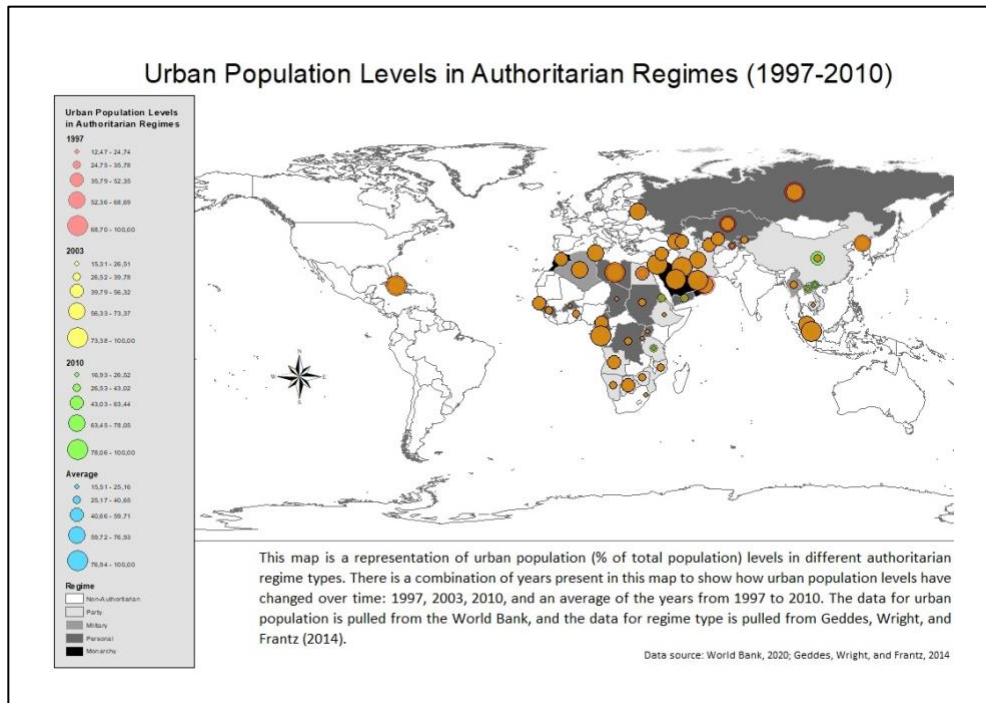*Figure 5.8*: Map of Population Density Levels in Authoritarian Regimes (1997-2010)

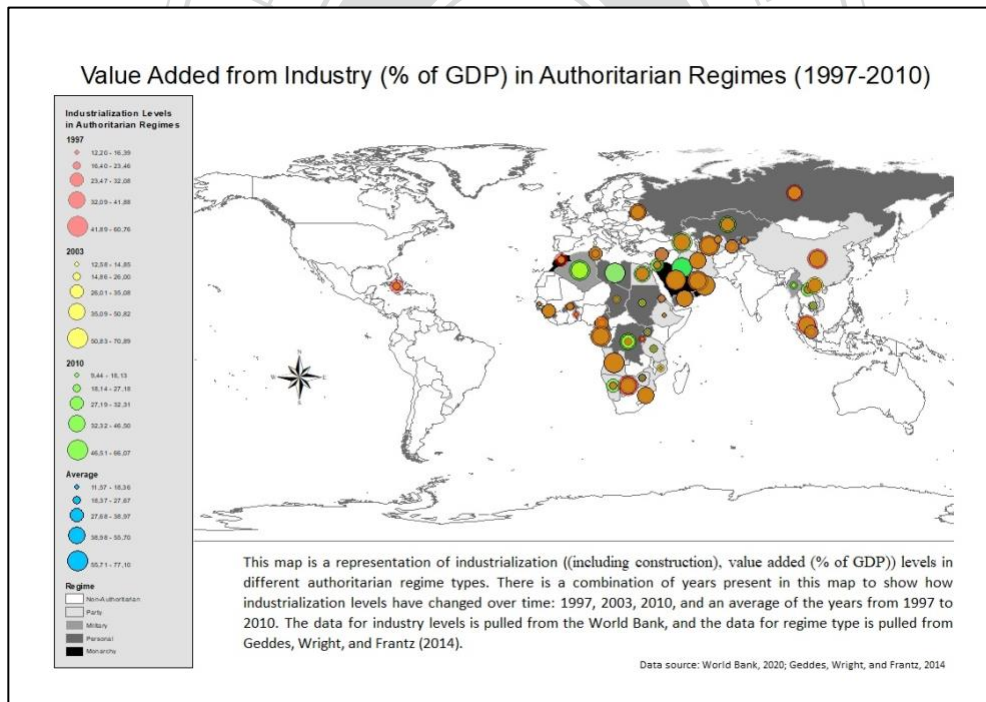*Figure 5.9*: Map of Urban Population Levels in Authoritarian Regimes (1997-2010)

Figure 5.10: Map of Industry Levels in Authoritarian Regimes (1997-2010)

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5.2.2   Results: GIS Analysis

This section presents the results of the estimations for carbon dioxide emissions measured in metric tons per capita and its relationship to authoritarian regime type. The results were produced using the GIS software GeoDa, and are presented using multiple forms of analyses. As stated prior, I hypothesize the effect of authoritarian regime type on carbon dioxide emissions will be more profound in party regimes than in all other types of regimes, where party regimes will be less detrimental to the environment and have fewer CO_2 emissions. The following models allow for a visualization of these results.

Figure 5.11 and Figure 5.12, gives some preliminary results on the effect of adding weighted variables in the data to test the relationship of regimes and their CO_2 emissions by using a Local G* clustering map. In order to do this, you must include a weighted variable that lets you test the spatial relationship of regimes with their own neighboring regimes. For this research, we are using distance weight rather than contiguity weight because the nature of the data is based on point data rather than polygon data. Therefore, using distance weight, I set the nearest neighbors function to the five closest neighbors, so that the spatial relationship for CO_2 levels will be based on the five nearest neighbors to each regime. Because of this, one can see that there are three areas in red that denote high levels of spatial clustering. These regimes are Ethiopia, Oman, and Tanzania. This shows that these regimes not only have high levels of CO_2 emissions, but also their five neighboring regimes also have high levels of CO_2 emissions. Furthermore, there are five areas in blue that denote low levels of spatial clustering. These regimes are Cameroon, Cuba, Gabon, Syria, and Togo. This shows that these five regimes have low levels of CO_2 emissions and so do their five neighboring regimes.

Local G* Cluster Map: Weight = 5 Nearest Neighbors

Figure 5.14: Local G* Cluster Map with the Distance Weight Set to the 5 Nearest Neighbors

Additionally, in Figure 5.12, I set the nearest neighbor function to the ten closest neighbors, so that the spatial relationship for CO_2 levels will be based on a wider range of neighboring regimes. Because of this, one can see that the amount of spatial clustering is reduced in both sections. There are now only two areas in red that denote high levels of spatial clustering. These regimes are Ethiopia and Oman. This shows that these regimes not only have high levels of CO_2 emissions, but also their ten neighboring regimes also have high levels of CO_2 emissions. Moreover, there is now only one regime instead of five in blue that denotes low levels of spatial clustering. This regime is Togo. Therefore, this shows that Togo has low levels of CO_2 emissions and so does it's ten neighboring regimes.

Local G* Cluster Map: Weight = 10 Nearest Neighbors

Figure 5.15: Local G* Cluster Map with the Distance Weight Set to the 10 Nearest Neighbors

Regression Analysis

This next section will include several regression analyses using GIS. The three models will include a classical regression analysis, and the other two will incorporate spatial analysis with a spatial lag model and a spatial error model. All three of these models will utilize a weighted file that measures the relationship between a specific observation and its surrounding observations based on distance (km). The distance is set at a standard rate generated by GeoDa: 6,639.41 km. By utilizing spatial analysis, we can determine whether carbon dioxide emissions can be influenced by a regime's geographic location.

Model 1 in Table 4 uses the classical regression model. When first running this regression, in order to test the effect and significance of the relationship between the different authoritarian regime types and CO_2 emissions, I only included the dummy variables for party, military, and personal without any control variables present. Also, just like in the main time-series cross-sectional model, monarchies are used as the baseline model and omitted due to collinearity. Therefore, as consistent with the main analysis's results, Model 1's results concluded that all three regimes are statistically significant with military regimes having the greatest effect.

However, when adding in the economic controls such as GDP per capita (log) and GDP per capita (log2), the effect of the regime dummy variables completely diminished and was no longer statistically significant. In addition to this, even when adding in all control variables, GDP per capita still has the largest effect on carbon dioxide emissions in authoritarian regimes. The control variables used in this classical regression are the same as the ones used in the time-series cross-sectional analysis, yet only GDP per capita (log) and GDP per capita (log2) are statistically significant. In addition to this, the results are very similar in regards to the coefficients and statistical significance of the variables. Trade and population density are still contradictory, which could be a results of omitted variable bias (OVB).

Lastly, when utilizing a weighted file, one must also determine whether spatial auto correlation is an important factor. Therefore, spatial lag and spatial error must also be tested for. Table 5 shows the diagnostics for spatial dependence based on the classical regression. This figure determines whether or not to test for spatial lag and spatial error based on Lagrange Multiplier (lag) and Lagrange Multiplier (error). Based on probability, both of these variables show that they are significant in the 95th percentile (probability < 0.05). Therefore, the results show that spatial lag model and spatial error model must be tested. I also tested this relationship using different weights that incorporate different distances besides the standard distance set up by GeoDa: 10,000 km and 20,000 km. However, there was no evidence to support the use of spatial lag and spatial error using those weights.

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Table 4: Authoritarian Regime Type and Carbon Dioxide Emissions: GIS Results

VARIABLES	(1) Model 1 Classical Regression	(2) Model 2 Spatial Lag	(3) Model 3 Spatial Error
Party	-0.42	-0.89	-0.94
	(1.49)	(1.21)	(1.20)
Military	-2.02	-3.54*	-3.44*
	(2.49)	(2.04)	(2.01)
Personal	-0.03	-0.22	-0.20
	(1.59)	(1.29)	(1.30)
GDP per Capita (log)	-20.62***	-20.34***	-19.25***
	(3.93)	(3.19)	(3.14)
GDP per Capita ($\log_2$)	1.56***	1.55***	1.48***
	(0.25)	(0.20)	(0.20)
Trade (% of GDP)	-0.01	-0.02**	-0.02*
	(0.01)	(0.01)	(0.01)
Population Density	-0.00*	-0.00*	-0.00**
	(0.00)	(0.00)	(0.00)
Urban Population	0.04	0.06*	0.04
	(0.04)	(0.03)	(0.03)
Industry (% of GDP)	0.03	0.02	0.02
	(0.04)	(0.03)	(0.04)
Weighted: CO_2		0.63***	
		(0.21)	
Lambda			0.77***
			(0.16)
Constant	67.04***	63.60***	62.76***
	(14.33)	(11.63)	(11.56)
Number of Observations	46	46	46

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

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Table 5: Diagnostics for Spatial Dependence

TEST	MI/DF	Value	Probability
Moran's I (error)	0.1115	4.5781	0.00000
Lagrange Multiplier (lag)	1	10.9584	0.00093
Robust LM (lag)	1	5.3553	0.02066
Lagrange Multiplier (error)	1	5.6068	0.01789
Robust LM (error)	1	0.0037	0.95142
Lagrange Multiplier (SARMA)	2	10.9621	0.00416

Hence, Model 2 in Table 4 shows the regression results for the spatial lag model. In this model, the results for the coefficients have the same effect as the previous model in the classical regression. In addition to GDP per capita (log) and GDP per capita (log2), trade is the only other control variable which is statistically significant. Therefore, as GDP per capita increases in a regime, CO_2 emission levels are more likely to be higher and increase. Furthermore, the spatial lag regression is not only used to determine the relationship between the dependent and independent variables, but it also calculates for the spatial relationship between neighbors. Therefore, it also adds a weighted variable for CO_2 (metric tons per capita) emissions: Weighted: CO_2. This variable is shown to be statistically significant from its z-value (z-value > 2). However, while this improves the relationship, all of the coefficients are still very small, which still shows that these variables are not enough to determine a strong relationship with CO_2 emissions.

Lastly, Model 3 in Table 4 provides the regression results for the spatial error model. Again, like the previous model, the spatial error model shows that GDP per capita (log) and (log2) have the highest significance. The variables are the same as in the last two models, whereas GDP per capita increases, carbon dioxide emissions will increase. However, population density and trade are still contradictory where as they decrease, CO_2 emissions will increase. Also, the spatial error method also adds in another variable known as Lambda. Lambda is used to calculate the spatial error, which explains whether one has enough variables to determine the validity of the relationship being tested. If Lambda is high, then more variables need to be added. As a result, because Lambda in this regression not only shows to be significant with its z-value being 5.03, but also its

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coefficient is greater than any other variable: 0.77, more variables possibly need added. With these results, we can conclude that what we have is not enough to satisfy proper results.

Furthermore, because these results are contradictory to our first method of analysis, time-series cross-sectional analysis, I have included a bubble chart to show the relationship that regime type and GDP per capita levels has with carbon dioxide emissions. Figure 5.13 shows this. The bubbles in this figure represent CO_2 (metric tons per capita) emissions, the y-axis is used to show GDP per capita levels, and the x-axis shows the type of authoritarian regime. In this figure, one can see that the relationship is somewhat inconstant. For monarchies which are presented in the last column, it seems to be that GDP per capita has the strongest effect, where as GDP per capita increases, so do CO_2 emissions. Also, for military regimes, they seem to have lower GDP per capita levels and lower levels of CO_2 emissions. However, party regimes, located in the first column, seem to be consistent regardless of whatever the GDP per capita levels are. Also, for personal regimes, located in the third column, it shows that most regimes that have higher levels of CO_2 emissions have lower GDP per capita levels.

The Effect of Regime Type and GDP per Capita in Carbon Dioxide Emission Levels
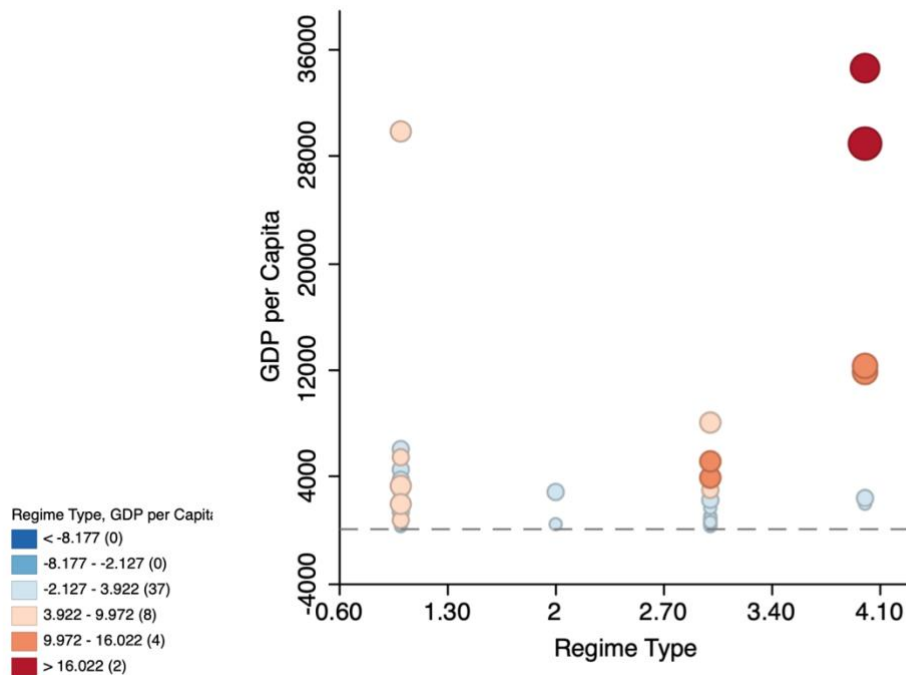

Figure 5.16: Bubble Chart Showing the Relationship Between GDP per Capita and Regime Type on CO_2 Emissions

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6 Conclusion

In this final chapter, I will conclude with three different topics. The first section will be a discussion and analysis of my results that were found in chapter 5. It will also include my final thoughts on the results. In the second section, I will include my reasonings for undergoing this research, why I specifically chose to research this topic, and its importance. Finally, in the last section, I will make suggestions for future research on this topic.

6.1 Discussion

In this section, I will be discussing how to interpret the results, what they mean for my analysis, and how these results possibly came to the outcome that they did. I will first discuss the results from the main analysis in this thesis: time-series cross-sectional analysis. I will explain the results and whether or not I proved or disproved my hypothesis. Secondly, I will discuss the geographic information systems analysis portion of my thesis. I will then explain the implications this second form of analysis had on the outcome of my main analysis. Finally, I will end with the final outcome and takeaways from the results.

In chapter 5, I first utilized time-series cross-sectional analysis with random effects and controlled for time-fixed effects when testing the relationship between authoritarian regime type and carbon dioxide emissions. Overall, the results concluded that authoritarian regime type does play a role in the level of carbon dioxide emissions a certain regime type will emit. However, while I was able to prove my first hypothesis, I disproved my second hypothesis. I originally believed that party regimes would perform best out of all other authoritarian regimes in regards to their level of CO_2 emissions. This was based solely on the literature review and previous studies that focused on economics, regime durability, public goods provision, and dictatorial peace where party regimes always outperformed the other authoritarian regime types. It was also based off two other possible explanations that were found in the literature: the selectorate and democratic institutions. These explanations expressed that when regimes, typically party regimes, have larger selectorates and implement more democratic institutions into their government, they are more likely to provide

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public goods, such as environmental concessions. However, the results from section 5.1.2 show that it is actually military regimes that perform the best out of all types of authoritarian regimes.

Furthermore, this result was true in both forms of analysis: time-series cross-sectional analysis and GIS analysis. However, the differentiating factor between the main form of analysis and the GIS analysis was that the GIS analysis concluded that not only are party regimes not as likely to perform well in terms of lowering carbon dioxide emissions, but also that authoritarian regime type in general does not play a significant role in determining carbon dioxide emission levels within a country. In contrast, the results from the GIS analysis determined that it is economic factors, specifically gross domestic product (GDP) per capita that can help determine why certain regimes have higher or lower carbon dioxide emissions. Therefore, I believe that further analysis needs to be done.

Undoubtedly, these contradictory results need further analysis, yet it is also imperative to determine as to why military regimes outperformed all other types of authoritarian regimes in the main analysis. Regardless of the fact that the GIS results concluded that authoritarian regime type is unimportant, party regimes still tend to outperform all other types of authoritarian regimes in other sectors and therefore, it is important to better understand why the results may have turned out the way that they did.

In section 5.1.2, all three regression models determined that military regimes performed the best. However, there are several possible reasons as to why this is and as to why these results could be skewed. First, and one of the most important things to note, is that when dealing with authoritarian regimes, information can easily be skewed or missing. One also has to consider that there is a very limited number of authoritarian regimes that are present in the world. This can make information very sparse and give one no way possible to increase the sample size. I believe that this is why so many researchers focus on democracies versus non-democracies, because without these other regimes, it is difficult to have enough observations to exhibit significant results. In addition to this, because of the decision to limit the regimes to stable authoritarian regimes, I had to omit any regime that had transitioned at any time period out of my dataset. This left me with only 51 authoritarian regimes and around 700 observations in my dataset, with only two of them being military regimes. While 51 regimes are a decent number to work with, it is still not large enough

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to have thorough results. Therefore, I believe that the results could be skewed due to the limited number of military regimes that were present in the dataset.

Secondly, not only was I limited in terms of the size of my sample and number of observations, but also, I was restricted by my timeline and the number of years I was able to choose from. The reason for starting with the year 1997 was due to the foundation of the Kyoto Protocol. While I could have pulled from earlier years, there was no significant international agreement with as many signatories that had been put into effect and could help decrease greenhouse gas emissions prior to the Kyoto Protocol. Therefore, it was only logical to begin my timeline in 1997. However, because of the lengthiness of international agreements to come into effect, the Kyoto Protocol did not officially go into effect until 2005. Also, because of the fact that the database used (Geddes, Wright, & Frantz 2014) cut off in 2010, I was only able to collect two out of the four years (2008-2012) where signatories agreed to cut their emissions to 5% below 1990 CO_2 levels (CNN 2020). Therefore, I was only able to account for about 14 years in total with this research, with only 5 of these years being in the timeline when the Kyoto Protocol was in effect. This, in total, is not enough to get a valid result and could have helped in disproving my hypothesis.

Lastly, one other reasoning as to why military regimes outperformed party regimes is not only due to the fact that many party regimes have already began industrialization and tend to focus more on economics and less on the environment, but also because the structure of their industries can differ across each regime. This is very evident in Asia where there are many party regimes that have industrialized since the late 20th to early 21st century. The most well-known example is the People's Republic of China, who now has the world's second largest economy, but also the highest levels of CO_2 emissions (kt). It is also important to note that the results did show that party and military regimes were able to have a positive effect on CO_2 emissions.

Furthermore, when discussing regimes and the environment, it is also important to involve and test the Environmental Kuznet's Curve in one's research. Therefore, by logging and then squaring that log, I was able to disprove the EKC's hypothesis that as countries economically develop, their environment will worsen, but that after they have economically developed, they can then focus on their environment. The EKC is not widely accepted in general and has been consistently tested since it was hypothesized. However, it is also important to note that my economic control variables did have varying results. In general, the result from the trade variable showed that as trade increases,

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carbon dioxide emissions will decrease, which is contrary to traditional thought. Therefore, this could possibly be caused by omitted variable bias. Further examination is merited in regards to this issue.

Finally, in order to determine whether the results from the time-series cross-sectional analysis portion of this research were valid, I also conducted a robustness check by utilizing spatial analysis. I conducted this through geographic information systems (GIS) software. The results from this analysis were contradictory to my final results in my main analysis. The preliminary results showed that authoritarian regime type was statistically significant with military regimes having the greatest effect. However, when running the full model using a classical regression model, a spatial lag model, and a spatial error model, I determined that it was not regime type that had an effect on the levels of carbon dioxide emissions in a regime, but rather GDP per capita played the decisive role.

However, when adding the bubble chart into the mix, it showed that not all regime types seem to be as affected by GDP per capita levels, such as party and personal authoritarian regimes. In addition, one must note that regime type dummy variables still have negative coefficients in all of the regressions results. Therefore, while there are still issues that need to be handled, this seems to show that authoritarian regime type may still have a positive result on CO_2 emissions. Therefore, even though GDP per capita is significant, this could be the result of other data issues. This could consist of having a small number of observations, not having many authoritarian regimes present in the world, and also having too short of time frame to have any profound results.

Furthermore, it could also be due to the fact that in the spatial error model, the variable lambda was shown to be statistically significant. This variable is used in this type of model to show whether or not there are missing variables in the analysis and that more variables need to be added. Therefore, one reasoning for lambda being significant could be due to two possible missing values. The first being education; education is an important variable in terms of human capital. The more educated a population, the more likely that people will understand the harm that waste and greenhouse gas emissions have on the environment. However, this was not controlled for in the analysis. In addition to this, natural resources, such as oil were not controlled for. While industrialization was controlled for, oil production can heavily contribute to CO_2 emissions, and

since many of the monarchy regimes are oil producing countries, this could have been a factor in affecting the results.

In summary, this thesis was set up to determine whether authoritarian regime type and more specifically party regime type played any role in determining carbon dioxide emission levels within a regime. However, in the main analysis, the results proved that military regimes performed the best overall. In the secondary analysis, both hypotheses were disproved, and instead it showed that GDP per capita was the defining variable in determining CO_2 emissions within a regime. However, even though the results showed that military regimes are the best at curbing CO_2 emissions, I believe this could most likely be resulting from skewed data due to a lack of observations, short time frame, and any of the other possible factors mentioned earlier in this section.

Furthermore, other issues I ran into in this analysis was obtaining more observations due to many authoritarian regimes transitioning during the time period used in this thesis. Regardless of it limiting observations, I found it important to omit these regimes because they tend to be less stable and could possibly skew results. Also, this lack of data could have made the effect of GDP per capita stronger than authoritarian regime type. However, in regards to party regimes in the main analysis and the poor performance of authoritarian regime type in the secondary analysis, even though these regimes did not perform well regarding CO_2 emissions, it does not mean that they would have performed poorly when utilizing other environmental variables. It also does not precisely mean that certain authoritarian regimes are not making efforts to better their environments. Even if the positive relationship between authoritarian regime type and carbon dioxide emissions as supposed in this paper cannot be established across time and countries, I believe it to be worth further examination in order to understand the details of this conditional relation and why it can possibly be observed in regimes around the world.

6.2 Reasoning

In this section of the conclusion, I will be discussing my reasonings for researching this topic. As already stated, this topic focused on whether there was a causal relationship between certain

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authoritarian regime types and their carbon dioxide emission levels. Previously, I focused more on the effect of democracies versus non-democracies as most other researchers do when focusing on regime type. In the field of international relations, states are the most important actors. Therefore, the type of regime a country has can determine many factors about it: level of freedom, level of economic development, regime duration, etc. Therefore, I knew I wanted to focus on whether regime type could be a causal mechanism for authoritarian regimes in promoting better environmental conditions.

Once I discovered my interest in this topic, and after further discussion with my advisor, he recommended me to look at just authoritarian regime types and exclude democracies. After doing some research, I discovered that all prior research had focused solely on how democracies outperform non-democracies in the environmental sector, and therefore, I knew there was a gap in the research that needed to be filled. In general, I believe that comparing democracies to non-democracies is inconsistent and can lead to biases due to the fact that most democracies had already undergone industrialization at an earlier period. Specifically, many democracies, especially western liberal democracies, had undergone industrialization during the late 19th to early 20th century, and therefore, have been able to develop and decrease their levels of industrialization, which caused a major decrease in their CO_2 levels

Lastly, and most importantly, I believe that by furthering the research done on the environment in the realm of international affairs and the social sciences, we can create more awareness and more understanding as to how to combat environmental degradation. Most of the research on the environment tends to occur in the STEM fields; however, this should not be the case anymore. Not only is this topic under-researched, but also many still believe that the environment has no importance in the field of social sciences and international affairs. It is important to realize that the environment can play an important role in how states interact with one another, and by including more research on this topic, it will increase its visibility in this field.

6.3 Suggestions

In this section of the conclusion, I will finish with some suggestions on what could be done to better this topic for future research. My first suggestion for future research on this topic would be to utilize different environmental variables and economic indicators. Carbon dioxide (CO_2) emissions are the most widely accepted and commonly used variable in regards to greenhouse gas emissions. However, in order to perform a more robust analysis, I believe that other greenhouse gases could be used to determine whether the outcome is different than the one found in this thesis. Some other greenhouse gases that could be utilized are methane, nitrous oxide, and hydrofluorocarbons. As for economic indicators, some could argue that GDP per capita is not the most reasonable variable to include since it can sometimes be skewed due to government investment. Therefore, including additional economic variables could be advised.

In addition to this, as stated in the previous section, many authoritarian regimes have had a shorter regime duration than non-authoritarian regimes. Therefore, it would be important to test other variables that are easier to limit when still developing. For example, these could be air pollution, water pollution, or even deforestation. However, while CO_2 emissions are the most detrimental to the environment and to climate change, these variables are still important and can show whether a regime is attempting to reduce its environmental footprint. Most importantly, even though regimes may not be decreasing their CO_2 emissions does not mean that they are not taking strides to decrease their levels of environmental degradation.

Another suggestion for further research would be to change the method of the robustness check. I find that it would be better to still utilize time-series cross-sectional analysis but with an alternative database to determine whether or not the results are significant. One database that could have been used is the authoritarian regimes dataset by Michael Wahman, Jan Teorell, and Axel Hadenius (2013). Not only would this allow for a different interpretation of authoritarian regime types, but it would also allow for a more current database that includes the years up to 2014. One could also make use of other political variables to test the dummy variables used. Pulling variables from Freedom House or V-Dem is a viable option.

Additionally, in order to fix the issue of data limitations, one could merge together military, personal, and monarchy regimes into one group and test them against party regimes. By doing this, the issue of limited observations would be eased by going from 2 military, 7 monarchy, and 18 personal regimes to 27 regimes for one group. Therefore, one could possibly have enough observations to conclude with significant results. As a conclusion, one would no longer be testing different authoritarian regime types, but rather party regimes against non-party regimes.

Finally, two other suggestions would be to extend the timeline in the future and to add in different case studies. While currently I am unable to access up-to-date data, I believe that in a few years there could be updates to different authoritarian regime datasets that could allow for a more in-depth analysis. Also, in regards to using case studies, by using this method, one could look more closely at certain regime types in order to determine why some regimes may emit more CO_2 emissions than others. Neighboring regimes seem to have an effect on environmental performance based on figures 5.11 and 5.12. Therefore, one could look at the regimes which show high levels of CO_2 emissions in order to determine whether there is a pattern based on regime type. Also, this could allow one to determine other missing factors that are not accounted for in this analysis.
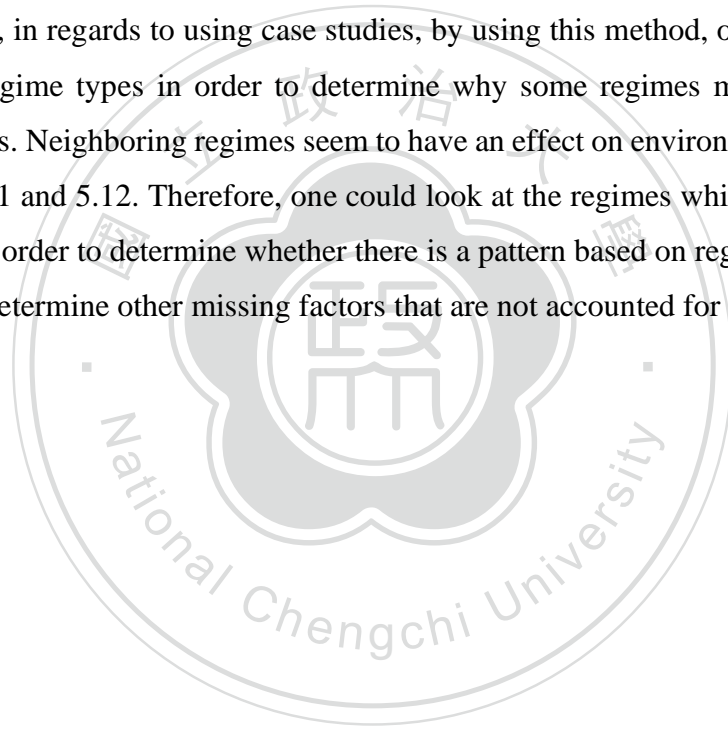
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Appendix

Table 1: Operationalization of Variables

Variables	Coding
Country	**Country (String).** Variable used to list all countries labeled as an authoritarian regime from 1997-2010.
Country_num	**Country (Numeric).** Encoded "country" variable to convert from string to numeric variable in order to test against the other variables in the dataset.
Year	**Year.** Years included in the dataset. Timeline begins in 1997 with the start of the Kyoto Protocol and ends in 2010.
Regtype	**Regime Type (String).** Independent variable used to show the correlation between the four different types of authoritarian regimes against the variable for the environment, CO_2 emissions. The four regimes are coded as "party", "military", "personal", and "monarchy". The "party" variable includes any regimes coded as party-based, party-personal, party-military, party-personal-military, oligarchy, and Iran 1979-2010. The "military" variable includes any regimes coded as military, military-personal, and indirect-military. The "personal" and "monarchy" variables have no other coding.
Regtype_num	**Regime Type (Numeric).** Encoded "regtype" variable to convert from string to numeric variable in order to test against the other variables in the dataset.
Regimesort	**Regime Type Sorted.** The regime type variable is sorted into numeric groups. Coded 1 if regime is party, coded 2 if regime is military, coded 3 if regime is personal, and 4 if monarchy.
CO2 (kt)	**C0$_2$ Emissions (kilotons).** Environmental variable used to show the correlation of the amount of greenhouse gases in kilotonnes emitted by authoritarian regimes by being tested against other independent variables.
CO2 (capita)	**CO$_2$ emissions (metric tons per capita).** Dependent variable used to show the correlation of the amount of greenhouse gases measured

by metric tons per capita emitted by authoritarian regimes by being tested against other independent variables.

CO2 intensity   **CO$_2$ Intensity (kg per kg of oil equivalent energy use).** Environmental variable used to show the correlation of the intensity of greenhouse gases measured in kilograms per kilograms of oil equivalent energy use emitted by authoritarian regimes by being tested against other independent variables.

HFC   **HFC Gas Emissions (thousand metric tons of CO$_2$ equivalent.** One of the environmental variables representing greenhouse gas emissions. Hydrofluorocarbon gas emissions measured in thousand metric tons of CO$_2$ is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

Methane   **Methane Emissions (kt of CO$_2$ equivalent).** Environmental variable representing greenhouse gas emissions. Methane emissions measured in kilotons of CO$_2$ is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

Nitrouso   **Nitrous Oxide Emissions (thousand metric tons of CO$_2$ Equivalent).** Environmental variable representing greenhouse gas emissions. Nitrous oxide emissions measured in thousand metric tons of CO$_2$ is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

Other GHG   **Other Greenhouse Gas Emissions, HFC, PFC and SF6 (thousand metric tons of CO$_2$ Equivalent).** Environmental variable representing greenhouse gas emissions that combines the greenhouse gas emissions hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride and is measured in thousand metric tons of CO$_2$. It is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

Total GHG   **Total Greenhouse Gas Emissions (kt of CO$_2$ equivalent).** One of the environmental variables representing greenhouse gas emissions that groups all greenhouse gas emissions together. It is measured in kilotons of CO$_2$, and is used to show the correlation of the amount

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of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

SF6   **SF6 Gas Emissions (thousand metric tons of CO_2 equivalent).** Environmental variable representing greenhouse gas emissions. Sulfur hexafluoride gas emissions measured in thousand metric tons of CO_2 is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

PFC   **PFC Gas Emissions (thousand metric tons of CO_2 equivalent).** One of the environmental variables representing greenhouse gas emissions. Perfluorocarbon gas emissions measured in thousand metric tons of CO_2 is used to show the correlation of the amount of greenhouse gases emitted by authoritarian regimes by being tested against other independent variables.

Trade   **Trade (%of GDP).** Control variable used to understand whether economic pressures have any influence on the relationship of CO_2 emissions and authoritarian regime type. It is predicted that having higher levels of economic growth can be linked to higher CO_2 levels, so trade should be controlled for.

Gdpcap   **GDP Per Capita Growth.** Control variable used to understand whether economic pressures have any influence on the relationship of CO_2 emissions and authoritarian regime type. It is predicted that having higher levels of economic growth can be linked to higher CO_2 levels, so GDP per capita growth should be controlled for.

Popdens   **Population Density.** Control variable used to understand whether demographic pressures have any influence on the relationship of CO_2 emissions and authoritarian regime type. A more densely populated area can greatly affect the environment and also the amount of resources needed to provide the population with daily means, which shows why population density should be controlled for.

Upop   **Urban Population Growth.** Control variable used to understand whether demographic pressures have any influence on the relationship of CO_2 emissions and authoritarian regime type. Urban areas tend to exacerbate climate change due to increased traffic and

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human pollution, which is why urban population growth should be controlled for.

Industry	**Industrialization (% of GDP).** Control variable used to understand whether industrialization pressures have any influence on the relationship of CO_2 emissions and authoritarian regime type. Industrialization is the central agent in the reduction of environmental quality, which is why industrialization should be controlled for.

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