Partisanship and Carbon Pricing

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ABSTRACT

Rising temperature caused by global warming is a problem for our planet and society. Carbon pricing and in particular carbon taxation is found in recent literature to be one of the most efficient and effective ways of dealing with climate change. Even though a large number of countries have signed international climate deals, the carbon price remains low and only a share of the countries has implemented those instruments. This could be explained by political hurdles. Therefore, this article focuses on the influence of partisanship on carbon pricing. First, I examine the differences between the countries that have and have not implemented carbon pricing mechanisms. Second, I analyse whether political and/or economic determinants influence the rate of carbon taxes in the OECD between 1990 and 2017. The results show that left-wing parties are more in favour of implementing and increasing the rate of carbon taxes. Conservative parties are found to have the biggest resistance dealing with global warming through market-based approaches.

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List of abbreviations and other words

CPI	Consumer Price Index
ETS	Emission Trading System
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
OECD	Organisation for Economic Co-operation and Development
UN	United Nations
U.C.	Under construction
N.A.	Not available

Anthropogenic	Due to human factors

1. Introduction

Carbon pricing is a regulatory instrument of governments to raise the cost of carbon-based fossil fuels. In the last decade, the momentum for carbon pricing has grown worldwide in order to reduce the use of fossil fuels. This momentum has grown due to past, recent and expected problems caused by rising temperatures. Recent years have proven to be the warmest years. The temperature in 2014 has been described as 0.8 degrees above the compared pre-industrial situation. In addition, the ten warmest years, except for 1998, have occurred since 2000 (Giddens, 2015:156). The effects of the increase in temperature are diverse, from extreme heat and drought to cyclone activity and heavy snowfall. The extreme conditions have damaging effects on *"settlements, crops, food, water and energy security"* (World Bank Group, 2015:16). As those effects have large impacts on the earth and the lives of people worldwide, the attention and number of policies of national and supranational governments has increased.

1.1 Effects of human activity on global warming

A growing scientific consensus suggests that this increase in temperature is due to human activity (Gruber, 2009:121; Pearce, 1991). One of the largest causes of climate change has been the greenhouse effect. This effect is essential but can also be problematic for the world. It is possible to live on earth in the current temperatures, due to the greenhouse effect. The temperature on the planet would be around an average of -18°C without the greenhouse effect (NASA, 1998). However, due to the increasing amount of carbon dioxide caused by human activities, the greenhouse effect increased the temperature to the previously stated record numbers, with problematic effects (World Bank Group, 2015:16). The growing attention on supranational level can be found in several agreements. In 1996 and in 2005 the European Union set an agreement in which they announced measures to restrict global warming to a maximum of 2°C above pre-industrial levels. This level has been described as the maximum allowable warming to avoid dangerous anthropogenic interference in the climate (NASA, 1998). In the Copenhagen Accord of 2009, the joint countries followed this line and also listed the 2°C threshold as a goal of which policies should mitigate climate change to (Randalls, 2010:598). The most recent global agreement on climate change has been the Paris Agreement of the United Nations (2015). The agreement has been signed by 195 countries. This first legally binding climate deal has three main goals for the coming years and the future. First, *"Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change* (United

Nations, 2015:3). Second, *"Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food productions"* (United Nations, 2015:3). Third, *"Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development"* (United Nations, 2015:3).

The Paris agreement makes clear that there is global consensus on the risks of climate change for our planet. Several countries have therefor chosen to use environmental regulation to reach their goals by implementing traditional command-and-control regulation and/or market-based approaches. Command-and-control regulation can be defined as the direct regulation for firms or industries which states what is allowed and what is illegal as it imposes limits to the allowed level of pollution or the used methods (Junquera & del Brio, 2016). Command-and-control regulation differs from the market-based approach, as market-based approaches are regulations that encourage behaviour through market signals rather than through explicit levels or methods (Zhang, 2013:87).

A recent draft from the U.N. Intergovernmental Panel on Climate Change (IPPC) shows that the current goals will not be sufficient to keep temperature levels below the strict 1.5°C ceiling (Reuters, 2018). David Roberts (2016) called it the political paradox of carbon pricing. According to the author, the paradox is that the economically most optimal instrument is politically the most difficult. Roberts wonders why there are so few carbon rates in the world high enough to really make a difference *"when every wonk and economist agrees on the merits of carbon pricing"* (Roberts, 2016). So, while there is consensus on the risks of climate change, rapid and far-reaching transitions are rare.

1.2 Variation in carbon pricing

Carbon pricing is widely used as 16 countries have implemented carbon taxes, 34 countries implemented emission trading systems and 14 have implemented both (see Figure 12). The variation between countries on the implementation of carbon pricing mechanisms will be briefly described in the first part of the analysis. Countries of the OECD and the United States and Canada (on subnational level) are examined to find reasons why certain countries have implemented carbon pricing instruments and why others have not. In more depth, a cross panel regression model, consisting data of OECD countries from 1990 up to 2017, will be used to find reasons why some countries have made more rapid and far-reaching transitions in the rate of carbon taxes. Existing literature does not explain the reasons why there is variation in the use of pricing mechanisms. However, existing literature does describe that political beliefs are

associated with the beliefs about global warming, even though this problem is a purely scientific issue. Which makes environmental science for people different than many other fields (Hsu, 2013:281; Leiserowitz, Maibach, Roser-Renouf, Feinberg and Howe, 2012). Recent events in the United States of America show the large impact of partisanship on environmental policy. The election of the Trump administration has resulted in major changes in the environmental agenda of the USA and their policies.

The article is of exploratory nature aiming to shed light on the effects of partisanship, which is seen as politicians or political parties being fully devoted to their own agenda and ideology, on the rate of carbon taxes. Partisanship is measured in the left-right dimension as the main arguments for and against carbon pricing match with this dimension, such as distributional effects, market intervention and the size of government. Additionally, the left-right dimension is proven relevant by recent literature of, among others, Baranzini, van den Bergh, Carattini, Howarth, Padilla & Roca (2017) and Lierse (2012) on taxation in environmental policy using the left-right dimension.

To explore the influence of political ideology on changes in the height of carbon taxation in the OECD, this article analysis annual political and economic data. The data has been used to test five hypotheses. The main focus of this article is to explain whether centre, left- and/or right-wing parties are more inclined to use additional measures to reduce the amount of carbon dioxide which is captured in the research question:

To what extent are changes in the carbon tax rate depending on the political ideology of government?

Next to the main analysis, literature on the implementation of carbon pricing mechanisms in general in the OECD and more comprehensive in the United States of America, Canada and Australia is analysed. The three individual countries are analysed due to their unique characteristics. The United States of America and Canada are unique as their multilevel political system make the differences between political parties on environmental policy clearer. Australia is unique as it is the only country that has both implemented and repealed carbon pricing instruments.

There are a number of motives to explore the political influence on the rate of carbon taxes in this scientific issue. In the current debate around solving environmental externalities, the subject of political acceptance is growing importance (Carbon Pricing Leadership Coalition, 2018). The instruments and strength of those instruments used within OECD countries varies significantly (World Bank Group, 2015:12-14). Countries that have been pioneers in using

carbon pricing instruments now have the highest rates per tonnes of carbon dioxide. It is therefore important to explore why certain countries have implemented carbon taxes and increased their rates and why other countries have not. According to Giddins (2015) a contradiction between the scientific literature and public opinion is growing. While the knowledge and literature on this topic has become stronger, the public opinion has gone in the other direction. This contradiction makes the political role in the climate change discussion more important (Giddins, 2015:157). The importance of science is that it is the only 'touchstone' that can be objective and fair. As it seems that the debate around global warming has become more political, additional explanatory literature on this topic can therefore be useful (Hsu, 2013:289).

The remainder of the article is divided into seven chapters. Chapter two reviews market failures and explains the specific market failure in the relevant market. Chapter three describes the instruments that governments can use to deal with climate change in the environmental setting. The instruments are described to give an overview of the number of policy options that governments, experts and interest groups can use to deal with the increased amount of greenhouse gases. In this overview, a distinction is made between traditional command-and-control regulation and market-based incentives. To give a complete overview on the instruments, both advantages and disadvantages of those instruments, according to scientists and economists, are described. Chapter four describes both theoretical and empirical literature on the political and economic determinants. The part on political acceptance elaborates on the preferences of political parties on the level and use of instruments in both general and environmental settings. The part on public acceptance will describe public preferences found in a study on a referendum in the direct democracy of Switzerland. The remaining of the chapter focuses on economic determinants that can explain differences between countries. Chapter five elaborates on the use of carbon pricing instruments in the OECD, United States of America and Canada. Chapter six explains the used variables and research method in the analysis. Chapter seven sums up the results and chapter eight includes the discussion and conclusion.

2. Background: market failure and government intervention

Whether a government will intervene in a market is an interesting trade-off between liberty and public interest. Who determines whether something is a public interest and does that always allow the government to intervene? It is a long-lasting debate between scholars, experts and

others about the role of the government in society. To give answer to such questions, different approaches exist in theory and practise.

One of the theoretical answers to the first question of this section is the welfare economic approach of economists. It creates a clear and broad perspective on the problems of markets, public interest and government intervention. The welfare of citizens is the key standard in this approach. Using this standard, it is possible to compare different methods of (governmental) behaviour. According to the welfare economic approach, markets contain a price mechanism that is the most optimal form to maximize welfare. However, this is only the case when the market meets certain assumptions (Baarsma et al., 2010:17). If the market is unable to meet those assumptions, so when the price mechanism does not work as it should, the market fails. Thus, it is unable to maximize welfare.

Four forms of market failure are commonly used in existing literature (Baarsma et al., 2010:26). Those four forms of market failure are the concentration of market power (1), asymmetry of information (2), public goods (3) and externalities (4).

The first market failure is the concentration of market power. A market with a large number of suppliers causes the most efficient market, as competition will result in a competitive price level. However, due to several reasons there are markets on which this is not the case. As price or quantity agreements are a logical method to decline uncertainty between firms on a market, complete competition is not very common. The effects of economies of scale can also cause a more dominant firm on a market. Problems occur when a dominant firm abuses the dominance, as the firm is able to behave independently from its competitors and suppliers. This can result in welfare losses (Baarsma et al., 2010:26).

The second market failure is asymmetry of information. A common used example of this failure is the private insurance market. In this market the insured has the most information about his or her behaviour and health, while the insurer does not have or only partially has this information. It is therefore impossible for firms to insure those people, as the people can behave differently when they are insured (Sinn, 1996:2).

The third market failure is due to public goods. The market will not produce public goods, as the benefits of those goods are non-exclusive and non-rival. If one consumes the good, another can still consume it and is not possible to exclude people from receiving benefits of the public good. Consumers can use public goods without paying for it (Baarsma et al., 2010:27).

The fourth market failure is due to externalities. Externalities are the external effects of a good or product that are not internalized in the market price. An example is river pollution caused by firms or industries, which causes costs for fishers that is not paid for by the polluting

actor. As those social costs are not internalized in the price by the market mechanism, the price is lower than it 'should' be. The produced quantity is thus higher than it would be if the social costs were included (Reinhardt, 1999:10). In standard supply and demand theory, the equilibrium (where the private marginal costs and the private marginal benefits cross) is the most efficient price and quantity for the actors in the market. However, the social marginal costs also influence the welfare consequences of production. The marginal social benefits and costs are the private benefits and costs plus the benefits and costs to any actors outside this market that are affected by the production process (Gruber, 2009:124-125). Those marginal social costs of the externality should also be taken into account.

2.1 Market failure in the environment

The greenhouse effect is a necessary effect for the planet. It is the balance between both the input and the output of energy from the sun in our atmosphere. On average two-third of the input of energy from the sun remains in our atmosphere, as one-third of the input is reflected back to space. The earths' land and oceans mainly absorb the input of energy that remains in our atmosphere, due to which it becomes warmer. Greenhouse gases in our atmosphere absorb the other part. If the number of greenhouse gases in our atmosphere increase, the amount of energy that stays in our atmosphere will similarly increase. It is thus the right balance that is needed. As stated before, if carbon dioxide would not be in our atmosphere, it would be an average temperature of -18°C on planet earth. However, too much carbon dioxide is neither desirable. For example, the planet Venus has a very high ratio of carbon dioxide in its atmosphere, which causes a tremendous higher temperature. The surface temperature of Venus is estimated at around 470°C (Uzawa, 2009:11). In both situations, it will probably be impossible to live.

The increase in greenhouse gases is, according to scientists, mainly caused by the use of fossil fuels. The use of fossil fuels such as coal, oil, natural gas and other gasoline products produces carbon dioxide (Gruber, 2009:121). The production of carbon dioxide has costs for other actors than those using fossil fuels. Until the first pricing mechanisms for carbon, those social costs of carbon dioxide were not taken into account by the market as both the producer and the consumer did not pay for the emissions of carbon dioxide into the atmosphere. Thus, the production of carbon dioxide is the externality in the process of using fossil fuels.

The differences between the production of carbon dioxide in countries can be considered very big. The global top-5 countries producing the highest level of carbon dioxide emissions in 2016 are respectively China, the United States of America, India, the Russian Federation and

Japan. The OECD top-5 countries are respectively the United States of America, Japan, Germany, Korea and Canada (Boden, Marland & Andres (2017). Emissions are derived from five different types: oil, coal, gas, cement and gas flaring. They cause respectively 41, 28, 27, 2 and 1 percent of the total amount of carbon dioxide emissions in the OECD (Boden, Marland & Andres (2017). As far as scientists now know, the effects of greenhouse gases are irreversible. Thus, all countries both small and big polluters have to adjust their behaviour. As long as scientists will not be able to create innovating solutions, it is not possible to get the produced carbon dioxide out of our atmosphere (Giddens, 2015:156). The idea that global warming is a problem that creates risks for the future makes it look like there is enough time to solve the problem. However, climate transformations are creating risks in the immediate future. The debate around solutions for climate change is therefore not one that should be conducted on the long run (Giddens, 2015:155).

The Paris Agreement has been the first-ever universal, legally binding global climate deal. The climate deal, which was signed by 195 countries, was the result of the climate conference in December 2015. The European Commission calls the agreement *"a bridge between today's policies and climate-neutrality before the end of the century"* (European Commission, 2015).

The number of pricing instruments in the market shows the growing momentum to stop the increase of produced emissions. According to the *"State and Trends of Carbon Pricing"* (2017), the number of instruments increased significantly. The number of regional, national and subnational carbon pricing instruments increased from 2 in 1990, 7 in 2000, 19 in 2010 up to 47 in 2018 (see Figure 13). Those instruments cover around 15% of the share of global annual GHG emissions (World Bank Group, 2017:13).

3. Government intervention

Governments can use several instruments to intervene in order to decrease the effect of an externality in environmental issues. As the aim of the article is to focus on carbon pricing mechanisms as a new approach towards traditional command-and-control approaches, the categorization of Uzawa's *"Global Warming: Problems and Perspectives" (2009)* has been used. Uzawa (2009) has made a distinction between three instruments to limit the emission of greenhouse gases: command-and-control regulation, carbon taxes and tradable emission permits (Uzawa, 2009:7). This chapter will elaborate on the functioning of those instruments.

3.1 Command-and-control approach

The increase in the use of market-based approaches is a trend of the last ten years. Before this trend, governments mainly relied on conventional environmental policy approaches. Command-and-control approaches are technology based or performance based and have dominated the environmental regulatory field worldwide. Technology based regulation has been used by the government to oblige firms to use standard technology in machinery, processes and procedures. Performance based regulation obliges firms to perform in a certain way with a regulated pollution performance. This could imply a maximum on the produced quantity or on the number of emissions (Aldy & Stavins, 2011:2-3). Performance-based regulation is the most efficient form of command-and-control regulation as firms are allowed to choose the method they prefer to comply with regulation. They could reduce production, use other resources, choose for better technology or increase the efficiency of processes. However, as Aldy & Stavins (2011) describe it: *"neither tends to achieve the cost-effective solution"* (Aldy & Stavins, 2011:3).

3.2 Market-based approach

In recent literature, market-based approaches have gained increased interest. The difference between market-based policy instruments and other instruments is that the incentive to change behaviour can be found in market signals, rather than specific quantity levels or methods (Stavins, 2001:1). The effectivity of market-based instruments is that they do not equalize the total amount of emissions, but they equalize the marginal costs for firms to reduce pollution. The advantage is that firms are not obliged to reduce pollution to a maximum amount of emissions, but that the larger polluting firm is easier able to decrease their total amount of pollution than a smaller firm. It can therefore be called a 'polluter pays principle' (Stavins, 2001:2-3). If a command-and-control instrument should create the same effect, different standards would have to be set for each firm. This would be costly, time consuming and the information will probably not be available for governments.

The global consensus of governments to decrease the risks of climate change through the internalization of costs has resulted in the implementation of pricing mechanisms. The two carbon pricing instruments will be described in the two following sections.

3.2.1 Emission Trading System

In the years around 1990, many economists agreed on the idea of using a system of tradable emission permits as they thought it would be the most promising (Grubb, 1993). An emission

trading system (ETS), as it is currently often called, is a cap-and-trade system. Policymakers must decide the number of maximum allowances and the range of the ETS. The number of allowances is referred to as the cap and the range are the sectors and sources that are capped. A second choice that policymakers have is the option to either freely distribute or sell the permits. The free distribution could be based on historical pollution. If permits will be sold in the auction, those revenues can be used by the government for other purposes (Aldy & Stavins, 2011:5-6).

One of the advantages of a cap-and-trade system is the maximum number of allowances in the emission market, as a decrease of the maximum level of allowances can decrease the total amount of pollution. The price of carbon dioxide does not necessarily have to be very high in order to reduce the level of pollution. This is a quantitative restriction of pollution. However, firms can trade allowances. This results in a more efficient solution than regular command-and-control regulation, because, due to trading, the most efficient firms can decrease their level of pollution on a larger scale. As the less efficient firms can buy allowances, those firms do not have to change their behaviour. The advantages of the pricing mechanism on innovation and sustainability largely depend on the strength of the market signals. If the price of carbon dioxide is high and the allowances are not given away free, firms will get a strong signal to change their behaviour and invest in better technology and other 'cleaner' forms of production.

The current largest emission trading system is EU ETS and is in its third phase. Each phase introduced policy options to improve the functioning of the emission trading system. However, the European Commission has not been able to stop the decreasing prices of allowances in the cap-and-trade system. The economic recession has caused a decrease in the demand of allowances. This has caused a surplus of allowances and a decreasing price. As the surplus of allowances will be spread out over coming years, the expectation is that the price will remain low. The absence of a high carbon price will probably decrease the incentives for firms to lower emissions and to stimulate innovation (Clò, Battles & Zoppoli, 2013:477). Recent studies have shown that, in practice, flexible environmental regulation like emission trading systems causes risks. An increasing number of scholars doubt the efficiency and motives of using flexible environmental instruments. The flexibility of environmental instruments is an advantage but could also be a disadvantage as it causes uncertainty (Teeter & Sandberg, 2017:649). The Porter hypothesis is one example of existing literature that describes the advantages of certainty and the disadvantages of uncertainty. According to his hypothesis *"well-designed and stringent environmental regulation can stimulate innovations, which in turn increase the productivity of firms or the product value for end-user" (van Leeuwen & Mohnen, 2016:63).* In case environmental regulation does not work as it should and it causes uncertainty, it does not

stimulate investment and the development of green capabilities as described by Porter (Porter, 1991). Porter (1991) found that regulated organizations focus on short-term investment, if dealing with uncertainty. In line with Porter (1991), van Leeuwen and Mohnen (2016) found that organizations did not put significant effort in reducing carbon emissions due to uncertainty around the ETS in Australia at that time (Teeter & Sandberg, 2017:660). While difficulties exist, studies on the effects of emission trading schemes do show that EU ETS is able to reduce CO_2 emissions on a large scale by 40-80 million tonnes per year on average, or 2-4 percent of the total that is capped by the scheme (Laing, Sato, Grubb and Comberti, 2014).

3.2.2 Carbon Tax

Carbon taxes have been implemented in several countries over the last three decades. The northern European countries were the first countries to introduce a carbon tax in 1990, some followed in the next two decades and now Northern- and Southern American countries have started implementing a carbon tax (World Bank Group, 2017:13). There are some major advantages of a carbon tax. Instead of similar other taxes, a carbon tax can correct the problem of market failure and in particular an externality. Where other taxes distort a market, an environmental (carbon) tax can correct the market. Implementing a tax results in a double win situation. It is expected that the quantity of emissions will drop due to increased prices and the revenues of the tax can be used to stimulate innovation or to redistribute revenues (Pearce, 1991:940). As described earlier, a carbon tax also decreases the compliance costs for firms. *"This minimum cost result derives from the fact that a tax common to all polluters will give rise to varying rates of abatement determined by individual marginal costs of pollution abatement"* (Pearce, 1991:941). This can be efficient as firms that will have large abatement costs, will choose to pay the tax. On the opposite, firms that have low abatement costs will choose to change their behaviour and produce less pollution. This does not decrease the freedom of firms to choose, which would occur if a quantity restriction was implemented. Another advantage of a carbon tax is the continuous incentive to examine other technologies. The financial costs give firms incentives to look at other, cheaper possibilities. As the prices increase due to the production of carbon dioxide, technologies that will produce less carbon dioxide will also be cheaper. In case of a quantity restriction, the restriction will often be set just above the produced quantity. The incentive for firms to invest in better technology will then be smaller (Pearce, 1991:942). The last major advantage of a carbon tax is the adjustability. New technologies or new information could create a situation in which a policy instrument should be adjusted. A carbon tax is easily adjustable in both height and deductions (Pearce, 1991:942). There are

several sources of new information or new technological innovation that could change the situation. Technological innovation on capturing greenhouse gases or cleaner methods to use fossil fuels. New information on the risks of greenhouse gases or different or sharper global agreements on climate change.

As there are several advantages of a carbon tax, a carbon tax also has disadvantages, as *"no policy measure is problem free"* (Pearce (1991:943). First, if specific elasticities of carbon pricing are unclear for the different activities, it is unknown whether the tax will decrease the quantity of carbon dioxide emissions in practise. Second, carbon taxes will cause a deadweight loss for the economy. If the benefits of the correction on the externality are bigger than the costs, this argument is no real problem. However, if this is not the case this could be a problem for welfare. Depending on the implementation of the carbon tax, the distribution of costs of such a tax could also be a disadvantage. As lower income households spend a higher percentage of their money on fossil fuel, the carbon tax will therefore have a regressive effect (Pearce, 1991:943-944).

3.3 Political hurdles with current market-based approaches

The previous section described the different instruments and the advantages and disadvantages of those instruments. The goal of this article is not to conclude which instrument is the best to use, however understanding the instruments and recent studies on the functioning of those instruments are important.

In the current situation in the OECD, all European countries plus Iceland, Norway and Switzerland are now part of the EU ETS. Therefore, there is no variation between a large number of countries within the OECD and particular between European countries on the implementation and stringency of an emission trading system. However, this variation does exist in case of carbon taxes. Some countries have chosen to implement a carbon tax and to increase their rates, while others have not. Recent literature suggests that those differences can be explained as the taxes are implemented on national level, where political disadvantages exist. According to Pearce (1991) there is larger political resistance as there are more concerns about new taxes (Pearce, 1991:944). Rabe and Borick (2012) found, more recently, results that are in line with Pearce (1991). The authors conclude that carbon taxes face difficult political hurdles and that their research have confirmed those hurdles in sub-federal policy development in the states and provinces in the United States of America and Canada (Rabe et al., 2012:358).

4. Theory

This chapter is divided into four parts and elaborates on the determinants of carbon taxation. The first part of this chapter describes the general effects of partisanship on public policy, the second part focuses on the effects of partisanship on taxation, the third part will elaborate on the economic determinants of carbon taxation and in the fourth part the expectations resulting from the theory are discussed.

4.1 Existing literature on partisanship

As the concept of partisanship is quite vague, this section starts with a small introduction on partisanship in relevant existing literature. Differences between the ideology of political parties and the implementation of policies can be found in a large number of subjects and scholars have explored those differences. Partisanship, also known as partisan politics or party politics, is in this article understood as politicians or political parties being fully devoted to their own agenda and ideology.

It can be found within the trilemma of Iversen and Wren (1998) on equality, employment and budgetary restraints. In which, according to the authors, political parties are only able to satisfy two out of the three described objectives. Social Democrats' ideology is to improve earnings equality and employment growth. Christian Democrats' ideology is to improve earnings equality, but also emphasizes budgetary restraints or fiscal discipline. The Neoliberal' ideology is to achieve both employment growth and fiscal discipline (Iversen and Wren, 1998:513-514). Depending on the ideology being in power, policy outcomes differ.

Another big debate on the subject of partisanship is the debate around welfare state reform. Allan and Scruggs (2004) examined the claim of an "end of partisanship" in their article, in which they found that, despite some claims that partisanship has little impact, *"partisanship continues to have a considerable effect on welfare state entitlements in the era of retrenchment"* (Allan and Scruggs, 2004:496). Governments which were controlled by the left lead to bigger and more rapid increasing welfare states, in the era of welfare state expansion. In opposite, governments which were controlled by the (neo-liberal) right lead to smaller and more rapid decreasing welfare states, in the era of welfare state retrenchment (Allan and Scruggs, 2004:509).

Timmons (2005) described the variation in the effect of partisanship on economic and social consequences. According to his article, the effects of partisanship are less likely to be found in macroeconomic outcomes. However, the effects of partisanship still matter for taxes,

spending and social welfare. The differences are caused by the increasing influence of central banks, globalization and other institutions on macroeconomic outcomes (Timmons, 2005:2).

Recent developments in the United States of America show influence of partisanship on environmental policy. The election of the Trump administration has resulted in major changes in environmental policies. Especially Scott Pruitt, appointed by President Trump as chief of the Environmental Protection Agency (EPA), has had sizeable impact on their energy and environmental policy (PBS, 2018). David Karol (2018) of the Niskanen Center has examined the influence of partisanship in the USA in a recent research paper. In his research paper, scorecards have been used to examine the opinion of members of Congress on the environment. The results show a growing gap between Democratic and Republican members on environmental issues (Karol, 2018:3-4).

4.2 Political determinants of carbon taxation

The examples of Iversen and Wren (1998), Allan and Scruggs (2004), Timmons (2005) and Karol (2018) show that the policies and instruments that governments use, differ when parties with a different ideology are in power. The following two sections describe the effect of partisanship on general and environmental taxation.

4.2.1 Political acceptance of taxation

One of the most used approaches on the influence of political parties is the Power Resource Theory. The assumption in this model is that class organisation affects the outcomes of public policy. The role of political parties is important as they represent the interests of social groups. The idea of the Power Resource Theory is that parties use the power they receive to implement the policies that serve the interests of the people that vote for them (Lierse, 2012:3). Cusack (1996) describes the importance of the left-right dimension as a method to examine the influence of party politics on the role of the government. In this method, lower income groups and labour, represented by left-wing parties, prefer a large and active state. This large and active state acts to regulate market operations. On the other side, higher income groups, represented by right-wing parties, favour a smaller and minimal acting government that respects the working of the market system (Driesen, 2009:10).

Hibbs (1977) and Garrett (1998) found in their empirical studies that economic policy choices are linked to left- and right-wing governments. Hibbs (1977) compared policies on employment and inflation of twelve states and concluded that high unemployment and low inflation rates were linked to centre and right-wing governments, due to the ideology that the

influence of the state should not be big. Opposite to the ideology on the left, the right has tried to decrease the size of the welfare state in the era of welfare state retrenchment as found by Allan and Scruggs (2004). A smaller welfare state and fiscal discipline are two indicators that the government will have less expenditure and thus need fewer revenues to balance the budget.

Garrett (1998) examined the effect of partisanship on taxation and found corresponding results. He concluded that governments with a larger composition of left parties use more taxes. The results of Hibbs (1977) and Garrett (1998) are in line with other existing literature of Andersson (2016), Timmons (2010) and Wagstaff et al. (1999). According to their studies, left-wing voters trust the government that taxation will result in higher social spending, which would in net result in more benefits for left-wing voters than the tax would cost them (Andersson, 2016:8; Timmons, 2010). Existing literature on micro-level studies of tax progressivity of scholars as Wagstaff et al. (1999) have also found that countries with more left rule governments have more regressive taxes compared to countries with more right rule governments.

Scholars have also found significant differences between the amount and level of taxes implemented within and outside the OECD. Compared to left-wing governments, the amount and level of most taxes implemented by right-wing governments are lower (Timmons, 2005:3). Political parties implement taxes as a trade of revenue for a service, due to which citizens allow the government to implement those taxes (Timmons, 2005:3). Tax compliance theories show that citizens pay those taxes, as they believe that they will get something in return for the money they pay through tax. According to Timmons (2005) implementing a tax is therefore a game of credible commitment, in which it is the easiest to follow the path of least resistance. Jean-Baptiste Colbert, previous Finance Minister of France, described this as: *"the art of taxation consists in so plucking the goose as to obtain the largest amount of feathers with the smallest possible amount of hissing"* (Palmer, 2017). In the words of Timmons (2010) it would therefore be easier to tax citizens that benefit on a larger scale from the services of government, than citizens that do not often benefit from those services (Timmons, 2010:207). Which implies that it would be easier for left-wing parties to implement and increase taxes.

4.2.2 Public acceptance of green taxes

The referendum survey in Switzerland in 2000 is a unique and interesting event to examine the acceptance of green taxes in the public space. The uniqueness of Switzerland is caused by its direct democracy, due to which it allows many people to speak out on the subject of fossil energy taxes. On 23 and 24 September 2000, all eligible citizens were allowed to vote on three

different policy possibilities for a tax on fossil fuels (Thalmann, 2003:179). The author has used the data of this referendum survey to test four hypotheses. Those four hypotheses should explain the public approval or rejection of green taxes. The relevant hypothesis is the second hypotheses of Thalmann (2003) which is: *"The acceptance of green taxes is greater among citizens with affinity to left-of-center parties, particularly if the taxes are directed towards producers rather than consumers"* (Thalmann, 2003:181). In the referendum, citizens were asked to vote on three proposals. Two of the proposals were prepared by the administration and one was a citizen-launched initiative (Thalmann, 2003:185). The three proposals had both similarities as differences. Partial or full exemption for heavily dependent industries and the same tax base are the similarities. The timespan, height of tax rate and the use of revenues of the three proposals were different (Thalmann, 2003:186). As all proposals targeted both consumers and producers, the author was unable to test the second part of the hypothesis. However, interesting results were found in the determinants. Swiss citizens that voted in favour of the proposals had a greater affinity with a left-of-centre party. The differences were quite significant as those citizens voted up to 35% to 45% in favour of the proposals (Thalmann, 2003:196). Following the literature of the Power Resource Theory political parties represent the interests of social groups. Therefore, more willingness under left-wing voters would suggest that left-of-centre and left-wing parties would also be more willing to implement carbon taxes.

4.3 Economic determinants of carbon taxation

The last section described the possible effects of political determinants that could influence carbon taxation, while in this section the focus will be on economic determinant that could influence changes in the rate of carbon taxes. Economic circumstances that can influence the development of carbon pricing policies are the development, openness, industry and inflation of countries.

As carbon pricing influences the costs for sectors in the economy of a country, it will also impose additional costs on the economy as a whole. The costs wills be relatively larger for poorer countries than for richer countries (Dolphin, Pollitt and Newbery, 2016:19). Additionally, studies show that there is a connection between the level of economic development and environmental protection, which suggests the existence of an Environmental Kuznets Curve. The upward facing slope of the curve is the level of development which will result in more pollution, but the level of pollution has a maximum. Welfare growth and increased welfare results in environmental awareness, which implies that economic development will cause more environmental protection policy (Usenata, 2018:12)

The introduction of carbon pricing can also have a second negative effect for sectors within a countries economy. If carbon pricing implies higher costs for firms in a certain country, the total costs could become higher than those in other countries. Thus, costs of carbon pricing could result in a competitive disadvantage. This implies that the openness of trade of a country is also a relevant economic circumstance. Openness is the sum of imports and exports of products and services. In case the openness of a country is larger, the negative effect of competitive disadvantage for firms is larger as well. Therefore, it is expected that countries with a larger trade openness are less likely to introduce carbon pricing and are less likely to increase the rate of the instrument (Dolphin et al., 2016:19).

The third economic determinant is the size of the industry. The size of industry can have multiple effects. The effect of above stated determinants can have a larger impact if the size of the industry is larger, which implies that carbon pricing would have a larger impact on countries with a larger industry. Additionally, if the industry is larger it is expected that lobby and interest groups of the industry are also larger. This could cause a larger influence of lobby and interest groups on the outcomes of governmental policies. An analysis of a green tax reform in Germany showed signs that the reform was more in favour of those that were represented by more powerful lobbies (Anger, Böhringer and Lange, 2006). However, a larger industry can also ensure that there is more urge to do something with the larger amount of pollution. Given those different effects, there are no specific expectations about the influence of the size of industry.

The fourth economic determinant is the consumer price index (CPI). The consumer price index is an index that measures the changes in price of goods and services by comparing months, quarters or years. An increase in the consumer price index can be a problem for governments. If the prices increase, a price-induced fall in the 'real' revenues for governments takes place (Tanzi, 2002:154). A number of Western countries, like the Netherlands, Canada and Ireland were the first countries to challenge this problem. Those countries introduced schemes that linked the (income) tax to an index of consumer prices (Allan and Savage, 1974). Thus, a positive relation between the consumer price index and the carbon tax rate is expected, as governments will want to make sure their revenues keep their 'real' value.

4.4 Hypotheses

The theory has described the determinants of both the rate and implementation of carbon taxes. In the analysis, quantitative research will focus on the influence of partisanship on changes in the rate of carbon taxes. However, the first part of the analysis will describe the implementation of carbon pricing mechanisms in both the OECD, United States of America, Australia and

Canada. Therefore, there is a distinction between the hypotheses for those two parts. The hypothesis on the implementation of carbon taxes is hypothesis one, which will be informally tested by analysing the available data on the implementation of those taxes. The hypotheses on the influence of determinants are the hypothesis two up to and including five, which are tested quantitatively.

4.4.1 Hypotheses on the implementation of the carbon tax

As has been described in the previous section, the main argument in the theory is that left wing parties will be more likely to influence carbon pollution, as those parties are more willing to intervene in the market and the left-wing parties see the role of government larger compared to the political parties on the right. Therefore, we expect the following concerning the implementation of carbon pricing mechanisms in the OECD:

Hypothesis 1. A country with a larger share of left-wing seats in its cabinet is more likely to implement carbon pricing mechanisms.

4.4.2 Hypotheses on changes in the carbon tax rate

The arguments in the sections on political determinants of carbon taxation and public acceptance suggest that there is a political preference for left-wing parties over right-wing parties for taxes and the level of those taxes. The main argument in the theory is that left-wing parties are more likely to intervene, while right-wing parties will support the market without intervening. This expectation is captured in the second hypothesis.

Hypothesis 2. A larger share of left-wing seats in a countries cabinet will result in an increase of the carbon tax rate.

Following the line of reasoning of Cusack (1996) and Driesen (2009) existing literature describes that countries with a large and active state will be more likely to regulate market operations. As a result, the following hypothesis is expected:

Hypothesis 3. Countries with a larger government increase the carbon tax rate.

While the second and third hypothesis are based on the expectations from political literature, the last two hypotheses are derived from the economic determinants. The fourth hypothesis is based on the argument that a carbon tax will hit less developed countries relatively more than more developed countries. In which the development of countries will be measured

in the analysis as the height of gross domestic product per capita. Therefore, it is likely that less developed countries will implement less far reaching transitions:

Hypothesis 4. More developed countries will increase the carbon tax rate.

As carbon pricing results in competitive disadvantage and countries with a higher level of openness would be more affected by competitive disadvantage, existing literature suggests the following:

Hypothesis 5. Countries with a higher level of openness decrease the carbon tax rate.

5. Data

5.1 Carbon taxes and cap-and-trade mechanisms worldwide

As has been discussed in earlier sections, pricing mechanisms have been implemented in different ways over time and place. The first pricing mechanism was implemented in 1990 in Finland. The percentage of greenhouse gas emissions covered by pricing mechanisms was around 1 percent up until 2004 and the number of instruments used worldwide was eight. The low percentage of gases covered was caused by the size of the countries and their share in global pollution. The implementation of EU ETS in 2005 increased the number of countries involved in carbon pricing and the share of gases covered. EU ETS is a cap-and-trade system that operates in 31 countries, which are all 28 European countries plus Liechtenstein, Norway and Iceland. EU ETS was the first emission trading system to be implemented worldwide, after 8 countries had introduced a tax on carbon dioxide. In the years between 2005 and 2010 six countries and one region have implemented a pricing mechanism and introduced either a tax or an (national) ETS. The differences within countries increased in those years. In Canada the province of British Columbia introduced a carbon tax, while Canada did not have such a mechanism in place (World Bank Group, 2017:13). In the United States of America, Northeast and Mid-Atlantic states have chosen to implement the Regional Greenhouse Gas Initiative, the first market-based program in the USA. The organisation has described their program *"a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachussets, New Hampshire, New York, Rhode Island and Vermont to cap and reduce CO_2 emissions from the power sector* (RGGI, 2018).

The trend of pricing mechanisms increased significantly after 2010. The number of instruments implemented on regional, subnational and national level increased in both the

number of instruments as the percentage of greenhouse gases covered. The number of instruments increased from 19 in 2010 to 21, 24, 32, 36, 37, 40, 45, 47 in respectively all following years. In the Republic of China, the largest polluting country worldwide, the government has started a pilot in originally six provinces and has added two provinces over the years (World Bank Group, 2017:13). The pilot in China covers about 70% of the amount of greenhouse gases, compared to the EU ETS. The Chinese government will introduce a national ETS in the coming years, using the experience from the pilots. The size of a national Chinese ETS has been estimated around 1.7 times the size of EU ETS (Financial Times, 2017). A second unique example is Australia, as they introduced a carbon tax in 2012 but repealed the mechanism in 2014. The functioning of the mechanism only lasted two years, due to elections.

5.2 Carbon taxes and cap-and-trade mechanisms in the OECD

In the previous section, worldwide trends have been described and interesting cases have been pointed out. This section will elaborate on the relevant mechanisms in the OECD. The rate of those mechanisms implemented in the OECD countries are analysed in the quantitative analysis in chapter seven. Figure one describes the countries and regions that have implemented carbon taxes and their year of implementation. As the figure shows 16 countries and 2 regions within Canada have implemented a carbon tax between 1990 and 2017.

Country	Since	Country	Since
Finland	1990	Iceland	2010
Poland	1990	Ireland	2010
Sweden	1991	Japan	2012
Norway	1991	Australia	2012-2014
Denmark	1992	France	2014
Slovenia	1996	Mexico	2014
Estonia	2000	Portugal	2015
Latvia	2004	Alberta (Canada)	2017
Switzerland	2008	Chile	2017
British Columbia (Canada)	2008		

Figure 1: Carbon taxes implemented in OECD countries

Figure 2 shows the countries and regions that have implemented an emission trading system. EU ETS and RGGI have been implemented by several countries and states. EU ETS has been implemented by 31 countries, which are the member states of the European Union, Liechtenstein, Norway and Iceland. RGGI has been implemented by Connecticut, Delaware, Maine, Maryland, Massachussets, New Hampshire, New York, Rhode Island and Vermont. Individually, three other countries and seven regions have implemented an ETS. Australia has, as described earlier, implemented and repealed an ETS in respectively 2012 and 2014.

Country	Since	Country	Since
EU ETS	2005	Australia	2012 – 2014
Switzerland	2008	Quebec (Canada)	2013
New Zealand	2008	Korea	2015
RGGI (United States)	2009	Washington (United States)	2017
Tokyo (Japan)	2010	Ontario (Canada)	2017
California (United States)	2012	Massachusetts (United States)	2018

Figure 2: Emission Trading Systems implemented in OECD countries

This shows that within the OECD and especially within countries, regions choose to act differently on implementing carbon pricing. In Canada, the national government has not (yet) implemented a pricing mechanism, while two regions have chosen to implement an ETS and two regions have chosen to implement a tax. In the USA, the Trump administration has chosen to repeal climate change as a priority, while three individual states and nine states collected in the RGGI have implemented an emission trading system. In Europe, all countries have signed to be part of the EU ETS, but only thirteen of the twenty-eight countries have implemented a tax.

5.3 Partisanship and carbon pricing in the OECD

Figure 3 and 4 give a first overview comparing the political ideology and the choice for carbon pricing instruments. In figure 3 all countries are described that have implemented a carbon tax, while in figure 4 the other countries of the OECD, which have not implemented a carbon tax, are shown. The data in the three right columns show the share of seats per position in the left-right dimension. The database and codebook of Armingeon et al. (2017) have been used to give cabinet compositions a value. Cabinets with a hegemony of left-wing parties have a value of one, dominant left-wing cabients have a value of 2, balanced cabinets have a value of three, dominant right-wing cabinets have a value of 4 and cabinets with a hegemony of right-wing parties have a value of 5.

Country	Since	CC	% Right	% Centre	% Left
Finland	1990	3	47,35	7,27	45,32
Poland	1990	1	13,04	53,67	0,00
Norway	1991	5	0,00	0,00	100,00
Sweden	1991	4	15,26	8,22	75,34
Denmark	1992	1	100,00	0,00	0,00
Slovenia	1996	2	50,00	31,86	2,53
Estonia	2000	2	66,67	0,00	33,33
Latvia	2004	2	66,67	33,33	0,00
Switzerland	2008	2	57,14	14,29	28,57
Iceland	2010	5	0,00	0,00	88,86
Ireland	2010	2	80,00	0,00	13,33
Japan	2012	1	6,44	90,60	0,00
Australia	2012-2014	5	0,00	0,00	100,00
United Kingdom	2013	1	100,00	0,00	0,00
France	2014	5	0,00	0,00	100,00
Mexico	2014	1	100,00	0,00	0,00
Portugal	2015	2	66,77	0,00	6,03
Chile	2017	5	0,00	0,00	100,00

Figure 3: OECD Countries with a Carbon Tax

This overview on national level data, shown in figure 3, reveals the variation between countries. In 27 years, 17 countries have implemented a carbon tax. The data on the first ten years shows that the use of carbon taxes has not been started by either left or right-wing parties. Both left-wing, centre, right-wing as balanced coalitions have implemented taxes between 1990 and 2000. In the second period, from 2000 to 2010, the data shows a slightly different pattern. In those years, only coalitions with a majority of right-wing parties have implemented carbon taxes. However, the number of observations in this period is low. This could be explained by the introduction of the EU ETS as a large number of countries in the OECD are European countries. In the most recent period, from 2010 up to 2017, the variation of the government composition variable increased. Three countries with a hegemony of left-wing parties and one country with a left-wing cabinet composition implemented a carbon tax. However, three countries with a dominant right-wing cabinet and one country with a dominant centre cabinet behaved similarly.

Country	CC	% Right	% Centre	% Left
Belgium	1	64.29	35.71	0.00
Germany	3	0.00	62.50	37.50
Greece	4	10.91	0.00	67.20
Italy	4	0.58	24.54	68.99
Luxembourg	3	38.89	0.00	61.11
Netherlands	1	38.00	62.00	0.00
Austria	3	0.00	50.00	50.00
Spain	1	0.00	100.00	0.00
United States of America	1	100.00	0.00	0.00
Hungary	1	72.73	0.00	0.00
New-Zealand	4	15.00	0.00	85.00
Slovakia	3	40.00	0.00	60.00
Czech Republic	3	35.29	17.65	47.06
South-Korea	5	0.00	0.00	100.00

Figure 4. OECD Countries without a carbon tax in 2017

Figure 4 shows that countries that have not implemented carbon taxes up to this point are not particularly countries with left-, centre or right-wing coalitions. Four countries have a dominant left-wing cabinet, three countries have a dominant right-wing cabinet, three countries have a dominant centre cabinet and three countries have mixed cabinets. This reveals the diversity of the composition of cabinets in 2017 of the countries that have not implemented carbon taxes.

5.4 Partisanship and carbon pricing in Australia

In the following three sections, three countries are analysed in-depth due to their unique characteristics. The previous section showed less convincing effects of party ideology on the implementation of carbon pricing instruments. The effect of political ideology on environmental policy is clearer in Australia. Australia has three main political parties, the Labor party, the Liberal coalition and the Greens. The other members of parliament are independents. Due to partisanship, additional environmental policies of Australia were uncertain for quite some years. Figure five shows that after eight years the Labor party was replaced by the Liberal coalition. As can be seen in the second column of figure 5, the left-wing Labor party tried to implement carbon pricing mechanisms. Firstly, the party announced the introduction of an emission trading scheme in 2008 but both opponents and proponents were not convinced. After the revision of the emission trading scheme, the leader of the right-wing Liberal coalition, Turnbull did approve but was replaced by Tony Abbott. Abbott did not support the scheme, as he argued that the costs for families and households would rise unacceptably. According to his numbers, it would cost an average family $550 a year and it would be a disadvantage for businesses and the economic growth. He wanted to create incentives for farmers and industries to reduce emissions (Coalition, 2013).

Year	Pricing Mechanism	Administration	Party Responsible	Seats
2008	CAT U.C.	Rudd	Labor	Minority government
2009	CAT U.C.	Rudd	Labor	Minority government
2010	No support	Gillard	Labor	Same number as Liberals
2011	Carbon Tax	Gillard	Labor	Same number as Liberals
2012	Carbon Tax	Gillard	Labor	Same number as Liberals
2013	Carbon Tax U.C.	Gillard / Rudd	Labor	Same numbers as Liberals
2014	CT Repealed	Abbott	Liberal/National Coalition	Majority government
2015	None	Abbott	Liberal/National Coalition	Majority government
2016	None	Turnbull	Liberal/National Coalition	Minor Majority government
2017	None	Turnbull	Liberal/National Coalition	Minor Majority government
2018	None	Turnbull	Liberal/National Coalition	Minor Majority government

Figure 5. Carbon Pricing in Australia.

In 2010, Gillard replaced Rudd as the leader of the Labor party. Due to promises of Gillard in which she stated that her administration would not implement a carbon tax, it seemed as if the climate change momentum was put on hold. However, in 2011 Gillard announced a carbon tax for 2012 as an interim measure before a new proposal for an emission trading scheme. The tax had a height of $23 dollars and lasted for two years.

Carbon pricing was one of the main topics in the election of September 2013 as Tony Abbott, the leader of the Liberals, called the election a referendum on the carbon tax (ABC, 2013). He announced that he would repeal the tax if he would win the election (Coalition, 2013). The liberals won the election in 2014 with a majority government, but it took the Liberal coalition six months to get a majority in the senate to repeal the carbon tax. A study, by consultancy company Pitt & Sherry that tracks electricity use and emissions, noticed a rapid growth in emissions in the months after the repeal. Emission dropped since the introduction of the carbon tax, while an annual growth of 0.8% was measured by the consultancy company after the repeal (Reuters, 2014). According to an article of Crowley (2017) in WIREs Climate Change Journal there are two factors that have determined the decision of Abbott. On one hand, it is according to the article well-known that Abbott does not support carbon pricing as he does not want to impose costs on something that could possibly create a risk in the future, which implies that he does not fully belief in global warming and the problems caused by anthropogenic carbon emissions. On the other hand, many firms in the relevant sectors have been supporting the Liberal party, due to which the lobby work of the industry has influenced his policies (Crowley, 2017:4).

Both factors are a problem to solve the environmental changes due to global warming. However, the second factor mainly supports the theory. According to the literature, the Liberal party has a problem to put costs on households and, as the article of Crowley (2017) shows, the party is depending on the industry. Which creates a case in which a polluter pays principle

seems not possible due to the relation between the industry and the political party. The Liberal party has therefor implemented more traditional regulation and subsidies, but the effects of that policy have been reported worse by the study of Pitt & Sherry.

5.5 Partisanship and carbon pricing in the USA

The political system in the United States of America has made the effects of partisanship on carbon taxation easily visible. The country is useful to analyse as it has both national and subnational levels at which governments and thus political parties decide on environmental policy. As other countries often have several parties that can be elected, the federal and state governments in the USA only consist of the centre-left Democratic Party and the right-wing Republican party. As described in figure 6, states act differently. Those differences are linked to the political party that has the power. The dissimilarity also exists between swing states and safe states. Swing states are the states in which, historically, both democrats and republicans are reasonably able to win. Either the Republican Party or the Democratic Party wins, historically, in safe states. As the fourth and fifth column in figure 6 shows, the states that have implemented pricing mechanisms all are governed by the democratic party and all of those states, except for Virginia, are safe states.

State	Pricing Mechanism	Year	Party responsible	Period
California	ETS	2012	Democrats	1992-2018
Connecticut	RGGI	2009	Democrats	1992-2018
Delaware	RGGI	2009	Democrats	1992-2018
Maine	RGGI	2009	Democrats	1992-2018
Maryland	RGGI	2009	Democrats	1992-2018
Massachusetts	RGGI	2009	Democrats	1988-2018
New Hampshire	RGGI	2009	Democrats	2000-2018
New York	RGGI	2009	Democrats	1988-2018
Oregon	U.C.	2018	Democrats	1988-2018
Rhode Island	RGGI	2009	Democrats	1988-2018
Vermont	RGGI	2009	Democrats	1992-2018
Virginia	U.C.	2018	Democrats	2008-2018
Washington	ETS	2017	Democrats	1988-2018

Figure 6. Carbon Pricing within the USA.

The United States of America consists of 23 republican states, 17 democratic states and 10 swing states. In this article, a state is considered a safe state if the same party has been in charge for over 4 elections. Ten of those seventeen safe democratic states have implemented pricing mechanisms, while all twenty-three republican and ten swing states have not. According to a study by the Yale program on Climate Change Communication and the George Mason University Center for Climate Change Communication this is not in line with the ideas of

citizens. The Power Resource Theory implied that parties would act in the interest of their voters, but according to the survey this is not the case for environmental policy in the USA. The survey was conducted soon after the 2016 election and describes how registered voters view global warming and clean energy policies (Leiserowitz, Maibach, Roser-Renouf, Rosenthal & Cutler, 2016). According to their survey, 66% of the registered voters support a carbon tax if it is a revenue neutral carbon tax. Looking at the differences between parties, 81% of Democrats, 60% of Independents and 49% of Republicans support the policy. In addition, almost eight out of ten voters support taxing climate change related pollution or regulating it. While the opinions of citizens are more in line, the data shows a big difference in the behaviour of the two political parties. Contradictory to the opinion of citizens, a small (but increasing) group of republicans showed interest in a carbon tax. A revenue neutral carbon tax is seen as a possibility to decrease externalities and to keep the size of the government small, by a group in which, among others, former Secretaries of State and Secretaries of Treasury are combined. Economists and big industrial companies like, among others, Exxon Mobil, Total and Unilever support the plan called *"The Conservative Case for Carbon Dividends"* (Wall Street Journal, 2017). The plan has four main pillars. The first pillar is a gradually increasing carbon tax, which is, according to their article the most efficient and effective way. The second pillar is to return all revenues of the carbon tax to American citizens. The third pillar is to implement border carbon adjustments, this would deal with possible competitive disadvantages. Foreign firms importing American goods would receive rebates if that country does not have a carbon price, while the imported products would face fees if the country does not have a price on carbon. The fourth pillar is the elimination of (traditional) regulation (Climate Leadership Council, 2017). This solution seems in line with the ideology of the conservatives in the Republican Party, as described by economists and former Republican chief economic advisers Feldstein and Mankiw: *"Crazy as it may sound, this is the perfect time to enact a sensible policy to address the dangerous threat of climate change. Republicans are in charge of both Congress and the White House. If they do nothing other than reverse regulations from the Obama administration, they will squander the opportunity to show the full power of the conservative canon, and its core market principles of free markets, limited government and stewardship"* (Meyer, 2017).

So, while the interest among republican members is growing, the conservative approach of a carbon tax has not been implemented within the tax reforms of the Trump administration in December 2017. It seems that it is mainly the scepticism towards climate change that has made any changes impossible.

5.6 Partisanship and carbon pricing in Canada

The last individual country described is Canada. Canada is, similarly to the United States of America, interesting as they have different levels of government that implement and use environmental policies. The right-wing Conservative party has been in charge from 2006 up to 2016, but the centre-left Liberal party of Trudeau won the election in 2016. Together with this change in electoral power, the environmental policy of Canada has started to change as figure 7 shows. In Canada, the federal Liberal party of Trudeau has given the provinces an ultimatum to choose their carbon pricing instruments. If a province does not present their chosen instrument before the end of 2018, the general government will impose a cap-and-trade system. Six provinces already, before the federal policy, had a carbon pricing mechanism in place, but seven had not. The provinces that have not implemented a pricing mechanism, have to decide what form of carbon pricing mechanism they want to implement (Good, 2018).

States	Pricing Mechanism	Administration	Party Responsible	Seats
2010	None	Harper	Conservative	Minority
2011	None	Harper	Conservative	Minority
2012	None	Harper	Conservative	Majority
2013	None	Harper	Conservative	Majority
2014	None	Harper	Conservative	Majority
2015	None	Harper	Conservative	Majority
2016	None	Trudeau	Liberal	Majority
2017	CAT	Trudeau	Liberal	Majority
2018	CAT	Trudeau	Liberal	Majority

Figure 7. Carbon Pricing on national level in Canada.

The mechanisms that have been implemented before the introduction of the national policy of the federal Liberal party are shown in figure 8. The general outcome is similar to the results in the United States of America. The right-wing conservative party has not implemented any carbon pricing mechanism in Canada. Either the Liberal party or the New Democratic party governs the six provinces that have implemented mechanisms, which are respectively on the centre and left-wing of the political spectrum.

Province	Mechanism	Implemented in	Height	Party responsible
Alberta	Carbon Tax	2016	15	NDP
British Columbia	Carbon Tax	2008	-	Liberals
Saskatchewan	None	-	-	-
Manitoba	CAT	2016	14	NDP
Ontario	CAT	2016	14	Liberals
Quebec	CAT	2007	14	Liberals
New Brunswick	None	-	-	-
Nova Scotia	None	-	-	-
Prince Edward Island	None	-	-	-
Newfoundland	Carbon Tax	2016	N.A.	Liberals
Yukon	None	-	-	
Northwest Territoria	None	-	-	Consensus
Nunavut	None	-	-	governments

Figure 8. Pricing mechanisms implemented in provinces in Canada.

A recent study in Canada found that 50% of the voters would only vote for a political party that is committed to fighting climate change and there is a growing momentum in Canada as 63% wants action to combat climate change while 37% wants the government to do little or nothing (Anderson, 2017). A different opinion of the Conservative party would therefore be expected. Even expected future Conservative leaders all have come out opposed to the carbon tax. The main arguments of the party against the tax are that the tax would kill jobs and that a real sufficient prize would increase the tax burden too much. Conservatives think this would result in a less innovative and productive economy and causing a growing bureaucracy which supports the theoretical part on the size of government and competitive disadvantage (Woodfinden, 2018).

5.7 Revenue neutral carbon tax

The results from sections 5.4, 5.5 and 5.6 show similarities between the different countries. Political parties with the same ideology prefer the same instruments, which the other party does not. Even though the conservative right is not ready to implement carbon taxes, it seems as if the momentum is starting to change. High-level politicians and/or party leaders have been coming out with new ideas on environmental policy including carbon taxation. Figure 9 has been collected from a study by Carl & Fedor (2016) and is used in this article to find whether the results found in the three unique countries also exist in the other OECD countries. The figure shows the distribution of carbon tax revenues of the countries included in their study. Carl & Fedor have collected the distribution of revenues for the year 2014, therefor the political data included is for the year 2013.

Country	% Right	Green spending	General funds	Revenue recycling
Finland	0.47	0	50%	50%
Norway	1	30%	40%	30%
Sweden	0.54	0%	50%	50%
Denmark	0.27	8%	47%	45%
Slovenia	0.40	33%	67%	0%
Switzerland	0.57	33%	0%	67%
Iceland	0.56	0%	100%	0%
Ireland	0	13%	88%	0%
Japan	0.95	100%	0%	0%
United Kingdom	1	0%	8%	0%
France	0	100%	0%	0%

Figure 9. Distribution of Carbon Tax Revenues. Source: Carl & Fedor (2016).

Countries distribute their revenues on either green spending, general funds or revenue recycling. Green spending includes government spending on or subsidy toward both energy efficiency and renewable energy research. When governments distributes their revenues to general funds, the revenues are not specified or linked to a particular program. Revenue recycling means that governments directly return the revenues to the population through rebates or tax rate cuts. The data shows large variation between the countries that have been included in their study. Some countries use the complete revenue for green spending or general funds, while others balance their revenues over the three. As, for example, Denmark shows, not only-right-wing governments use revenue recycling. However, the data does illustrate that countries with a right-wing government often use revenue recycling as a method to distribute the revenues of their carbon tax. For example Switzerland, Sweden and Finland. This is in line and supports the the theory that right-wing parties are not willing to increase the size of government to deal with environmental problems and this thus shows similarities with the results of the previous sections.

5.8 Carbon tax rate

Following the informal literature review, this last section describes the data that is used to quantitatively test the effect of partisanship on changes in the rate of carbon taxes. To analyse the effects of partisanship on changes in the rate of carbon taxes, economic and political data has been collected from several sources. Data on the rate of carbon taxes has been retrieved from the annual reports of the World Bank Group, Ecofys and Vivid Economics called *"State and Trends of Carbon Pricing",* for example World Bank Group (2017). An up-to-date overview of existing and emerging carbon pricing initiatives around the world is provided by the annual report, on both national and subnational level (World Bank Group, 2017:3).

The independent variables on cabinet composition are derived from the Comparative Political Dataset. This dataset is provided by Armingeon, Wenger, Wiedemeier, Isler, Knöpfel, Weistanner and Engler (2017) at the University of Berne. It is a collection of annual political and institutional country-level data of 36 countries from 1960 up to 2015. The last two years are added by own research and the codebook of Armingeon et al. (2017). The economic indicators in the models are the 'consumer price index', 'size of industry', 'gross domestic product', 'government expenditures' and 'trade'. The economic data for OECD countries has been collected by the World Bank Group in the 'World Development Indicators' database.
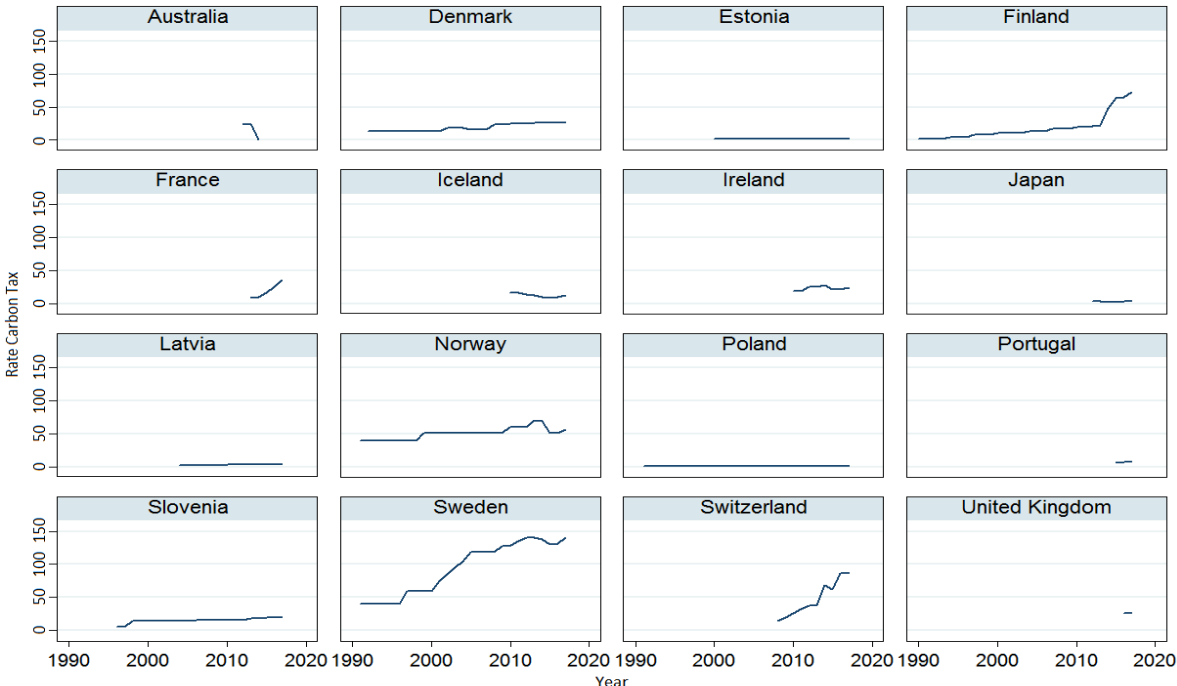

Figure 10. Development Rate Carbon Taxes. Source: World Bank Group.

Figure 10 shows the development of the rate of carbon taxes between 1990 and 2017 for the countries that have implemented a carbon tax. While the countries that have not implemented a carbon tax are left out of the figure, the countries show strong variation. Some countries have changed the rate of the carbon tax to a large extent, while other countries have kept the carbon tax flat. Some have recently implemented carbon taxes, while others have implemented carbon taxes in the early 90's. Estonia, Latvia and Poland show similar behaviour, as the four countries have introduced a low carbon tax which has been in place for a long period of time. Sweden, Finland and Norway have implemented the carbon tax in the early 90's and have increased their rate over time. Sweden is currently at a rate of \$140, Finland has a rate of \$70 and Norway is at a rate of \$56 per tonnes of CO_2.

In the quantitative analysis the dependent variable is the change between years as it is expected that political parties can only influence the changes between years and not the total development over time. Therefore, figure 11 illustrates the differences between years within countries and to show the differences of the changes of the carbon tax between countries.
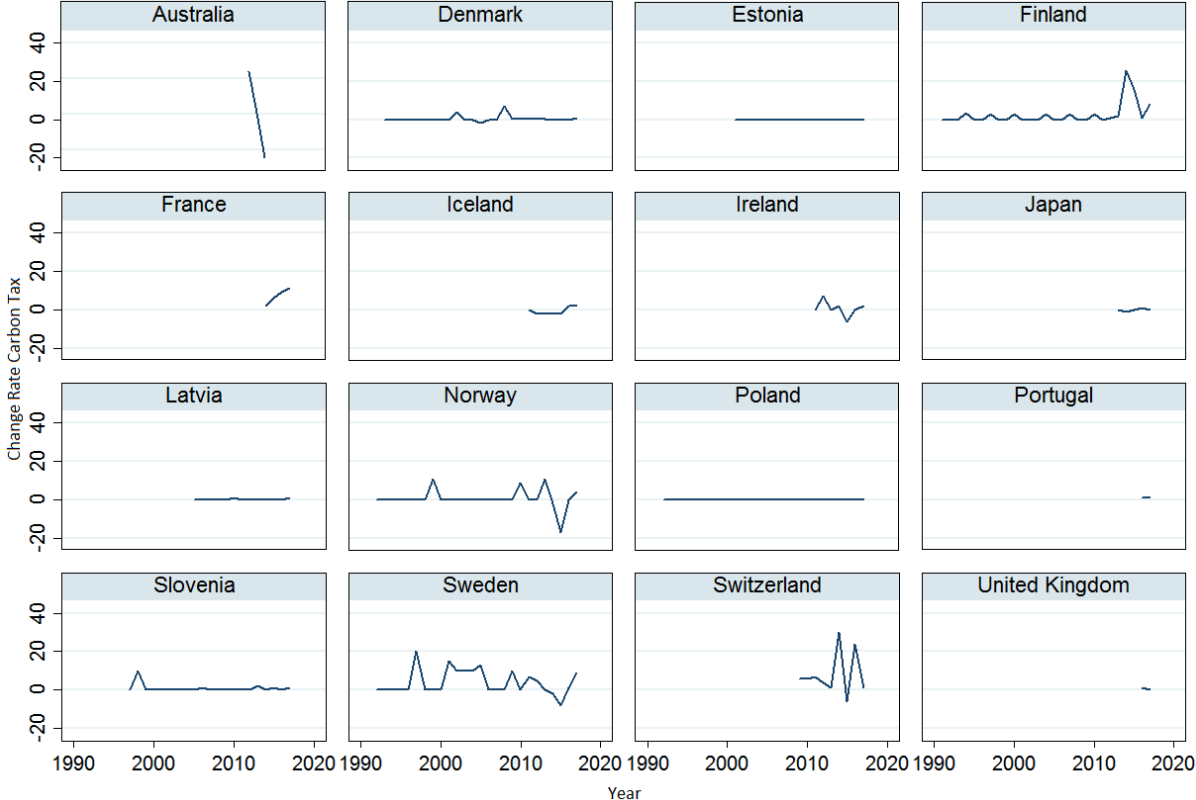

Figure 11. Changes Carbon Tax Rate.

6. Methodology

The previous chapter described the differences in carbon pricing instruments between countries on a national and subnational level in the OECD, United States of America and Canada. The chapter shows that in the OECD both countries with left-, centre- and right-wing governments have implemented carbon pricing instruments. In the United States of America, the effect of party ideology seems larger as only Democratic parties have implemented carbon pricing instruments. In Canada the differences are less extreme, but mainly right-wing parties seem more likely to use the carbon pricing instruments.

To find the determinants of the changes in the rate of carbon taxes, which are illustrated in figure 10, a fixed-effects panel model is used in the next chapter. Political data has been used in the model to quantitatively show whether left, centre or right-wing parties are willing take further steps in reducing carbon pollution. To test the hypotheses, this article has estimated a

series of panel regression in a fixed-effect model. The basic model consists of the following variables.

$$RCT_{it} = \alpha + \beta_1 CC_{it} + \beta_2 GE_{it} + \beta_3 CPI_{it} + \beta_4 GDP_{it} + \beta_5 T_{it} + \beta_6 SI_{it} + \beta_7 AO_{it} \ \varepsilon_{it}$$

The β's in this equation are the parameter estimates. The i's and t's stand respectively for the country and the year of the observation. **RCT**, the dependent variable, is the change of the rate of carbon taxes per year, which is measured in dollars per tonnes of CO_2. As earlier described, the change of the carbon tax rate has been used as it is expected that partisanship has influence on the annual change of the carbon tax instead of the development of the total carbon tax.

CC is the variable on cabinet composition. The Schmidt-Index has been used to categorize cabinet composition, which is an index that categorizes governments on left-wing percentage of coalition seats. If the variable has a value of 1, the composition is a hegemony of right-wing (and centre) parties. If the variable has a value of 2, right-wing (and centre) parties are dominant. If the variable has a value of 3, there is a balance between left and right parties. If the variable has a value of 4, social-democratic and other left-wing parties are dominant. If the variable has a value of 5, the composition is a hegemony of social-democratic and other left-wing parties. Three individual variables, which have been illustrated in previous figures, are the source of the variable. The three variables show the percentage of cabinet posts of respectively right, centre and left-wing parties of the total of cabinet posts (Armingeon et al., 2017). If the percentage of left-wing parties is zero, cabinet composition is categorized as 1. If the percentage of left-wing parties is above zero and below 33.33, cabinet composition is categorized as 2. If the percentage of left-wing parties is between 33.33 and 66.67, cabinet composition is categorized as 3. If the percentage of left-wing parties is above 66.67 and below 100, cabinet composition is categorized as 4. If the percentage of left-wing parties is 100, cabinet composition is categorized as 5.

GE, government expenditure, is defined as the sum of all government consumption on goods and services and is a continuous variable in dollars as the share of GDP. Consumer price index (**CPI**) is defined as the absolute changes in the price level of certain goods and services (OECD, 2018). The variable has been lagged by one year, as it could otherwise be biased by changes in the rate of the carbon tax (RCT). The economic variables trade (**T**) and industry size (**SI**) are continuous variables in dollars as the share of GDP. Trade is the sum of imports and exports of goods and services. Industry is the value added in mining, manufacturing, construction, electricity, water and gas. Countries that are economically developed are expected to increase their tax rates more likely, therefore **GDP** per capita is used as an economic variable

to measure the development of countries in the panel data. GDP per capita will be lower for less developed countries and conversely be higher for more developed countries. The control variable **AO**, the average of the annual carbon tax rates in the OECD, is added to control whether countries behave in the same pattern as other countries in the OECD.

For the analysis of *RCT* in the OECD countries, five models are used. In all models, the dependent variable is the change of the rate of carbon taxes (RCT). The first and second model analyse whether the relation between the composition variable and the changes in the rate of carbon taxes are delayed. Therefore, the composition variable (CC) has been delayed in the first model, while in the second model, contradictory, the composition variable has not been delayed.

The third model is the base model of the quantitative analysis and consists all above stated variables. In the fourth model, the main explanatory variable (**CC**) is a factor variable. The use of a factor variable allows analysing the effects of the different groups on the dependent variable relatively to each other. The fifth model controls for multicollinearity. To control whether the variables are coherent and therefore would affect the effects of the covariates, the third model left out the variables **T**, **SI** and **AO.**

7. Results

Using the basic equation as stated above, five sets of analysis have been undertaken. In all models, the dependent variable is the change of the rate of the carbon tax (**RCT**). The results are presented below.

Regressions Model. Dependent Variable: Change in Carbon Tax Rate (RCT).					
Independent Variables	(1)	(2)	(3)	(4)	(5)
Cabinet Composition			0.58**		
			(2.02)		
Cabinet Composition (2)	0.50	1.05		-1.14	-0.79
	(0.53)	(1.10)		(-0.92)	(-0.67)
Cabinet Composition (3)	0.40	0.46		0.32	0.73
	(0.41)	(0.47)		(0.25)	(0.60)
Cabinet Composition (4)	0.36	-0.21		0.71	0.84
	(0.36)	(-0.21)		(0.63)	(0.76)
Cabinet Composition (5)	2.48**	1.83		3.33**	2.74**
	(2.23)	(1.62)		(2.26)	(2.03)
Government Expenditure			-0.003	0.11	0.33
			(-0.01)	(0.22)	(0.92)
Consumer Price Index (CPI)			-0.026	-0.03	0.004
			(-0.17)	(-0.17)	(0.04)
Gross Domestic Product			0.000031	0.00001	0.000054
			(0.13)	(0.04)	(0.02)
Trade			-0.026	-0.04	
			(-0.64)	(-0.90)	
Industry			-0.11	-0.013	
			(-0.52)	(-0.06)	
Average PCT			0.12	0.21	
			(0.85)	(1.32)	
Constant	1.02	1.08	*4.4*	0.81	-5.91
	(1.47)	(1.65)	(0.29)	(0.05)	(-0.77)
N	201	220	201	201	201
R^2	0.11	0.09	0.28	0.42	0.37

The estimates of the parameters on the cabinet composition (**CC**) variable are the main interest of this analysis. In the first, second, fourth and fifth model, the variable has been split out in its possible categories, thereby threating the variable as a factor variable. The first model is therefor able to show the effect of all categories within the variable, as separate covariates. In this model, the base level is one, which stands for a hegemony of right-wing parties, and therefore it does not have a parameter. The reported coefficients of the cabinet composition

variable reflect the differences in the effect of the other groups relative to the base level, thus the differences compared to the right cabinets. The estimates in those models show the differences between the categories.

The first and second model have been used to analyse whether the relation between the composition variable and the changes in carbon tax rate are delayed. The first model shows the effect of partisanship on the dependent variable with a delay of one year. The results show a significant effect for the fifth group and an insignificant effect for the other groups. Comparing the results of the first model with the results of the second model, the model without a delayed composition variable, two things are most interesting. First, without a delay, the effect of partisanship on the changes in tax rate are not significant for all groups. Second, the effects of group four (4) compared to right wing governments is more in line with the theoretical framework. As it makes sense that it takes time before a government can change policies, we therefor use the delayed composition variable in the other models.

In the third model, the main explanatory variable is a continuous variable. It shows the effect of the cabinet composition (**CC**) variable as a whole. The coefficient shows that there is a positive and significant relation between cabinet composition and the change of the carbon tax rate. This implies that a higher value of the cabinet composition variable, which stands for a larger percentage of left-wing parties in a countries cabinet, results in an increase of the change of the carbon tax rate The other covariates used in the model all behave more or less as expected. The one that stands out is the size of government (**GE**) which is expected to show a positive relationship, but has a small negative relationship with the change of the carbon tax rate. The growth in gross domestic product (**GDP**) is positively related to the changes in tax rate, which supports the idea that more developed countries are easier able to introduce carbon taxation. A countries level of trade (**T**) is negatively related to the dependent variable, which is line with the expectation that competitive disadvantages would be a hurdle to increase the tax rate. The size of industry (**SI**) has a negative parameter, which implies that either the lobby of the industry or the negative effects for the economy has a larger influence on the tax rate than the urge to change a larger sector. However, the covariates do not have any significant effects. The control variable (**AO**) that has been used to measure whether countries behave in the same pattern as other countries in the OECD shows a positive relation, but does not show significance. This is a good sign, as this implies that the behaviour of other countries does not influence the effect of partisanship found.

In model four, the composition variable has been used a factor variable. The parameter of group two, a dominant right wing, shows that the dependent variable declines compared to the

first group. The parameters of group three and four, respectively a balanced composition and a dominant left-wing composition show an increase in the changes of the carbon tax rate, which is in line with the expectations. However, the groups are not significantly different from group one. The last group, cabinets consisting of a hegemony of the left, is significantly different from the right-wing. The estimates of the parameters show that countries with a hegemony of the left increase their tax rate 3.3 dollar more than those on the right. The effect of the composition variable on the change in tax rate found in the first model therefor is created by the countries that left-wing cabinets govern. In the second model, the other covariates are similar to the outcomes of the first model and thus those are not discussed more comprehensive.

The fifth model has been added to control for multicollinearity. Only a model with four variables has been added in the figure, but the results have been controlled for other variants as well. The outcomes of the other models are in line with the third model. The covariates did not show any significant effects in the third and fourth model, which could be caused by multicollinearity. Therefore, the model controls whether the covariates could influence the effect of others. If variables gained a significant effect in this model, this would show that the covariates would be coherent. However, the third model shows that the effects of the covariates on the dependent variable do not change and the effects of partisanship does not change either.

8. Discussion and conclusion

Dealing with the externalities of coal, oil, natural gas and other gasoline products, carbon pricing policies are described as an ideal instrument to reduce those externalities. This article is a contribution to point out why countries use carbon pricing and increase the stringency of carbon taxes. The results presented above support the theoretical idea that the rate of carbon taxes is depending on the ideology of political parties. However, some remarks should be made before continuing to the conclusions.

8.1 Discussion

First, the fact that some that countries have chosen for carbon pricing and carbon taxation in particular does not immediately mean that other countries fail to deal with the risks of climate change. Many countries have other regulation in place that should decrease the amount of greenhouse gas emissions. This article focused on carbon pricing as it is, according to scientists and economists, the most efficient and less costly way to deal with the problems of greenhouse gases and global warming.

Second, the present analysis is based on the available data up to this point. It seems that there is a trend in carbon pricing and therefore it can be expected that other countries will follow. The conservative case for a carbon tax is an example of a plan that, some years ago, would be unheard of. Even though the momentum is growing, it is not completely ready yet. It could be possible that, in a couple of years, most countries have followed. Which would imply that all hurdles have disappeared as the climate change problems have gained more priority for governments.

Third, as this article focused to analyse the change in carbon tax rates it can be possible that a long-term trend is missing in the analysis. Previous research has found that GDP per capita positively affects the implementation and the intensity of carbon taxation. So, even though this article has not found that correlation, there is a possible relation between the development of national income and environmental taxation.

8.2 Conclusion

The results presented in the qualitative analysis show both similarities as differences. The general data on the implementation of carbon taxes in the OECD showed that the differences between countries are large. The data showed that both left-, centre and right-wing parties are willing to implement carbon pricing mechanisms and there is not a particular side that does or does not implement any form of carbon pricing.

The informal qualitative analysis highlighted three countries due to their unique characteristics. The United States of America and Canada, as those countries got more levels at which environmental policy is made. Australia, as the country is unique as it is the only country that has repealed a carbon pricing mechanism.

The case of the USA has made clear that there is a large difference between the centre-left Democratic party and the right-wing Republican party. None of the republican states implemented a carbon pricing mechanism, while thirteen democratic states have implemented carbon pricing. The literature suggests that this is mainly due to the belief in the anthropogenic effects, the conservative fear for a larger government and the economic implications.

The case of Australia showed that environmental policy has a large impact on election. The fact that the elections were seen as a referendum on the carbon tax makes clear that the use of carbon taxation has a political motive. Similar to the USA, the right-wing Liberal party is opponent to the carbon tax, while the left-wing Labor party is willing to implement the tax. The two main motives found against the use of carbon taxation were the influence of the industries' lobby and the (dis)belief in the use of carbon taxation for the possible risks of global warming.

The case of Canada showed similar results on both national and subnational level. The change of the federal cabinet from the right-wing conservatives to the centre-based liberals resulted in a national carbon-pricing program. The same results were found within the provinces. Either provinces were governed by left-of-centre NDP or the Liberal party introduced carbon-pricing mechanisms. The conservatives are afraid that a carbon tax would increase the governmental bureaucracy and that it will negatively affect innovation and productivity.

It was hypothesised that there is a relation between the share of left-wing seats in a countries cabinet and the implementation of carbon pricing mechanisms. The literature analysis has partially confirmed this. It does seem that parties on the left or in the centre of the political spectrum are more inclined to implement carbon pricing mechanisms. However, it seems that the role of strong conservative parties on the right is the main cause of the differences between parties, which implies that it is mainly the conservative parties that have had problems implementing carbon pricing mechanisms. This, even though the people that vote for those parties are becoming more interested in carbon pricing instruments to deal with the environmental changes, which does not support the idea of the Power Resource Theory.

A panel analysis with fixed effects analysed the determinants of the changes in the rate of carbon taxes in OECD countries. Existing literature of several economists on those determinants created the expectations in the theoretical framework. The results show that an increase of the composition variable is significant with the increase in the changes of the carbon rate, which supports the expectation that a larger share of left-wing seats in a countries cabinet will result in a positive change of the carbon tax rate. However, this effect is mainly attributed to the groups with a hegemony of left seats. The analysis was unable to detect any significant effect from the size of government and the carbon tax rate, which implies that it is not one of the most important factors. Identical to the effect of the size of government, the level of trade does not significantly change the rate of the carbon tax. Lastly, it was hypothesised that the financial development of countries would influence the rate of a carbon tax. The results have not shown that correlation, however, as explained in the discussion, this effect could have taken place in the long-term.

Concluding, the results show the existence and importance of partisanship on environmental policy. Assuming that economists are right that carbon taxation is the best option to reduce greenhouse gases and to deal with climate change, it would be useful to convince the parties that are not (yet) inclined to use carbon pricing mechanisms. Therefore, it would be useful to have additional research on revenue neutral carbon taxation as that seems to be the best option for countries on the right-wing of the political spectrum.
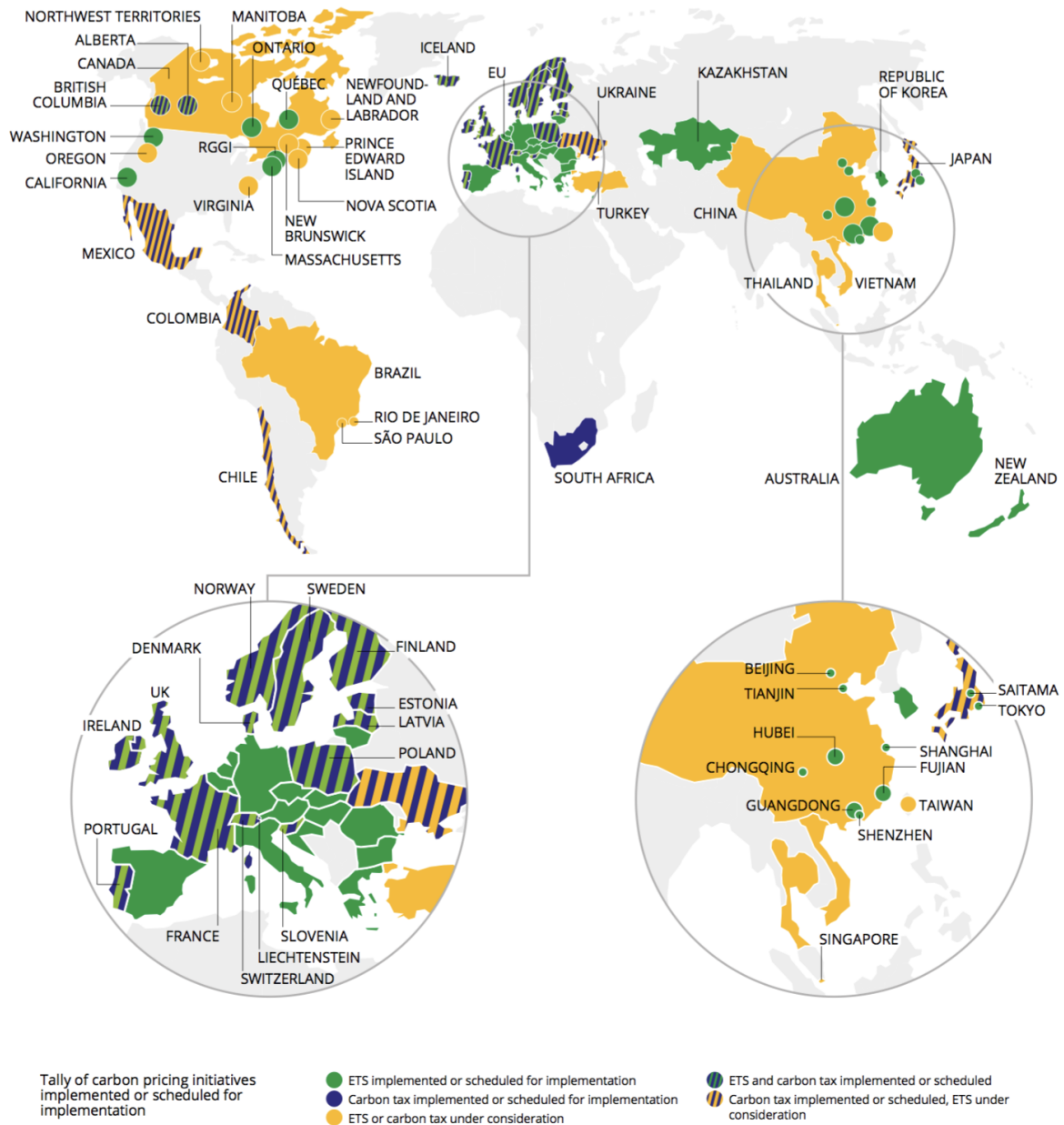
9. Appendix

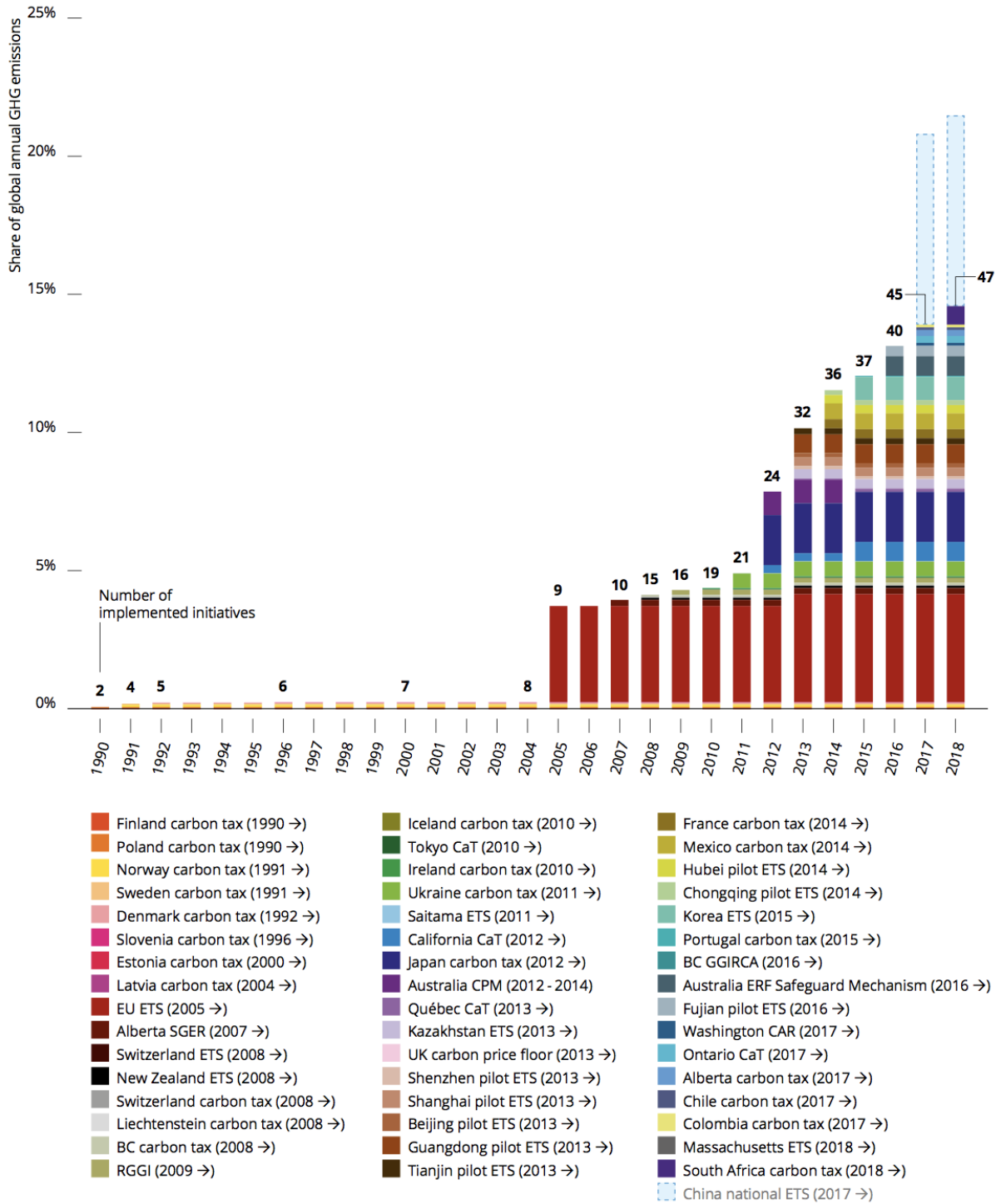*Figure 12: Worldwide Implemented Carbon Pricing Mechanisms*

Figure 13: Share of global annual GHG emissions and number of implemented initiatives.

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