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Political Institutions and Carbon Taxation

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Abstract

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In this paper I explore the effects of political institutions—historical tax structure, political party power, neocorporatism, and federalism—on the implementation of explicit carbon tax (ECT) policies. This represents one of the first quantitative studies of ECT adoptions. The event history analysis shows that administrative capacity, operationalized as indirect tax structure, has a positive effect on the implementation of ECT, but only for the first adopters after which this effect declines. Social democracy is a robust positive predictor of ECT, suggesting left-party power represents greater demand for climate change policy. Federalism has a strong negative effect, meaning this type of political decentralization might make implementation of national-level ECTs more challenging, and decentralization might also reduce the administrative capacity for national-level ECTs. Neocorporatism has a positive effect in some models, suggesting cooperative institutions

facilitate the implementation of ECT policies, which are often characterized by exemptions and rebates for certain sectors and reductions in taxes on labor. Evidence is also found for spatial diffusion of ECT policies spreading outward from Northern Europe.

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1. INTRODUCTION

Starting in the early 1990s and continuing over the last few decades, a number of states have adopted explicit carbon tax (ECT) policies with the specific intention of reducing carbon dioxide emissions as part of an effort to mitigate climate change. Originating in the Nordic social democracies, explicit carbon taxes have since spread to other areas of Europe (such as the UK's Climate Change Levy) and around the world (like the ECTs found in Chile and Costa Rica).

The economic literature on carbon taxation is largely limited to prescriptive publications describing proper design and theoretically modelling their effects (see Engström and Gars 2015; Nordhaus 2007; Yohe 1992). A much smaller set of scholars have researched the determinants of carbon taxation, and only done so with case-based studies (Daugbjerg 2001; Harrison 2010), whereas quantitative studies remain rare. In this paper, I conduct an event history analysis on the political institutional determinants of explicit carbon taxation (ECT). In addition to testing previous theories (effects from political parties and electoral systems), I test for the effects of three additional political institutional variables: administrative capacity, federalism, and corporatism, and find significant associations for each.

The institutional relationships identified in this paper help expand collective understanding of the conditions that facilitate the implementation of carbon tax policies. First, greater administrative capacity, operationalized as indirect tax revenues as a share of gross domestic product (GDP), increases the likelihood of ECT implementation, but this effect diminishes over time. Second, countries with some form of federalism are far less likely to have a national level ECT – this effect is substantively large and one of the strongest predictors in the analysis. Finally, I find a significant positive association between neocorporatism and odds of ECT implementation.

In practice, ECT policies are often filled with exemptions and rebates for certain industries, and these characteristics might increase the political feasibility of an ECT (Harrison 2010). I find neocorporatist political institutions, which facilitate cooperation between government, industry, and labor (tripartism), increase the odds of ECT adoption. Further, this analysis corroborates other research suggesting left party power increases the odds of ECT adoption.

While the findings above speak to the implementation of ECT policies, I also find that not all carbon taxes are equal: existing carbon tax policies vary dramatically in terms of revenues and goods/activities included in their base. This paper identifies important considerations for the categorization of carbon taxes. I identify three waves of ECT implementations occurring over the period. The waves vary differently in terms of prior administrative capacity (which has a diminishing effect) and the revenues generated. While early adoptions generated high revenues, some, but not all, of the later adoptions appear to be mostly symbolic; such ECT policies apply to a small percentage of relevant GHG-emitting goods/activities and/or take place in countries with a low combined implicit and explicit carbon tax revenue measure.

Given this, I use a comprehensive measure to assess a country's overall carbon tax effort: a combined measure of implicit and explicit carbon tax revenues. Certain forms of implicit carbon taxation (ICT) – fuel taxes, energy taxes, vehicle, and transportation taxes – are found in all OECD countries. Countries without ECTs often still employ ICT policies linked to GHG reductions, therefore, the combined measure paints a more inclusive picture. This allows for identifying countries with ECTs but low combined revenue measures, or countries without ECTs that have high combined revenue measures. More importantly, this measure is then used to determine whether administrative capacity constrains a state's ability to generate revenues from the combined measure of ECT and ICT policies. This is tested and I find preliminary evidence suggesting

administrative capacity has a positive relationship with the overall revenue measure, although more sophisticated analyses should be explored in the future.

The findings have implications relevant to climate change mitigation efforts: ECTs might be more politically feasible and more effective in certain national contexts than in others. Centralized, corporatist, and social democratic states with developed administrative capacity for collecting indirect taxes can make the easiest and cheapest transitions to ECT policies. In other words, some contexts present political and fiscal environments conducive to ECT adoption, while others might be more conducive to the adoption or expansion of other alternatives, such as traditional regulation, command and control regulation, emission trading systems, or no policy action at all.

2. WHAT IS A CARBON TAX?

There are two main types of carbon pricing: emission trading systems and carbon taxation. Emission trading systems (ETS) (also called “cap-and-trade”) place limits on emission levels within a defined unit, and allow for the selling of excess emissions in a market to other units who find it more beneficial to pay for additional permits rather than reduce their own emissions. In an ETS, the market determines the price of emitting carbon. In contrast, a carbon tax places a price on energy and fuel consumption proportional to the carbon content contained in the energy source or fuel. ETS gives policy makers precision in the amount of emissions and ECT gives them precision over the price.

If designed properly, a carbon tax reduces the incentive for consumption that leads to CO₂-emissions. An energy tax, on the other hand, only encourages energy efficiency – assuming non-GHG-emitting energy sources make up at least part of the base. But, in addition to encouraging

efficiency of the base, a carbon tax will also incentivize investment in cleaner alternatives since it will not lead to an increase in their price. Again, with respect to carbon-containing energy, cleaner alternatives will be relatively cheaper with a carbon tax than without (Baranzini, Goldemberg, and Speck 2000). Unlike more conventional taxation (such as income, sales, and capital gains taxes) this new type of taxation's stated goal is not to collect revenues but to shape behavior by making dirty energy and fuel more expensive (Backhaus 1999), however, sometimes revenue demands do reemerge as reasons for carbon taxes (Prasad 2010; Rosenthal 2012). Other policies that are effectively the same, or very similar, go by other names: climate change levy, carbon fees, carbon charges, green taxes, and environmental taxes, to name a few. Here I categorize these policies as explicit carbon taxes (ECT).

Long before the first ECT was adopted, or was even conceived, states taxed energy, fuel, vehicles, and transportation. Despite more recently being linked to reductions in greenhouse gas (GHG) emissions (see Braathen 2011; Brand, Anable, and Tran 2013; Bruvoll and Larsen 2004; Davis and Kilian 2011, 2011; Giblin and McNabola 2009; Sterner 2007), these policies, which I refer to as implicit carbon taxes, were not put in place with the intention of mitigating climate change, rather they were used to generate revenues for the state, sometimes used to fund government debt or earmarked for spending on education, roads, and other transportation-related infrastructure.

In some respects, explicit carbon taxes are not really anything new; they are indirect taxes which generate revenues from certain goods. In other respects, explicit carbon taxes represent a departure from more traditional taxation. First, their intent is to shape behavior in order to reduce GHG emissions, not necessarily to generate revenue. Second, the logic behind setting the price is to pro-rate according to carbon contained in the good being taxed, rather than a price based on a

portion of the transaction (ad valorem). The purpose of taxes such as those on labor and capital is to generate revenue for the state, and this is done despite their ‘distortive’ properties, such as increasing the cost of labor or decreasing the returns on investment; these characteristics are tolerated as necessary evils. In contrast, the intent of explicit carbon taxes is to shape behavior through price signals, more in line with ‘sin’ taxes such as those on alcohol, tobacco, and sugar, each framed with the intent to curbing consumption of goods and reduce the negative consequences of their consumption.

ECTs often emerge as a component of a larger project called environmental tax reform (ETR). ETR specifically refers to policies that (a) increase or implement taxes on activities with negative environmental impacts, and (b) reduce other, more distortive taxes (taxes on labor, such as payroll, social security contributions, or personal income taxes) in what is called revenue recycling, making such policies revenue neutral. While ETR policies can include taxes on activities that lead to other forms of environmental degradation (taxes on landfills, waste water, etc.), the bulk of the revenues come from taxes on energy, and often through an ECT.

There is an important aspect of revenue recycling that deserves more attention; if revenues from an ECT are used to replace revenues from taxes on labor, what happens if the ECT is effective in reducing GHG-emitting activities? If they work then it follows that total revenues will ultimately be lower than before the ETR policy. To be sure, many of the policies have built-in increases in the tax per ton of CO₂ emitted, but if the policy works well enough to transition into cleaner alternatives, even if not completely, then the revenues lost from reducing taxes on labor will no longer be replaced. Therefore, with regard to the state, there is a perverse incentive to prevent ECTs, and ICTs, to reduce the consumption of the goods and activities that make up the base. Others have noted this, and some suggesting states do not set environmental tax with a concern for

the environment but with a concern for revenues (Ciocirlan and Yandle 2003; see additional discussion below).

Many have noted that explicit carbon tax policies are often not designed according to economists' suggestions (see Ciocirlan and Yandle 2003). Presumably due to issues of political feasibility, exemptions or rebates – usually for industry, agriculture, and/or transportation – are commonly built-in as part of explicit carbon tax policies, ultimately making them less effective at reducing emissions. Further, it is also possible that pre-existing taxes on fuels, vehicles, and dirty energy are simply reclassified or shifted around to be part of an explicit carbon tax policy.

In this study I use two dependent variables. First, a binary variable for the adoption of an ECT. Second, a combined measure of ECT and ICT revenues to indicate a more complete measure of revenues from tax policies which have been linked to reductions in GHG emissions.

3. PRIOR WORK ON ECT AND ICT POLICIES

Economists have published an abundance of prescriptive papers addressing the proper design of a carbon tax and how a carbon tax should function, but far fewer studies have focused on the conditions that facilitate the adoption of an ECT. The existing studies have focused on three types of determinants: public opinion/environmental values, political factors, and diffusion of policy. Given their similarities in terms of base being taxed, here I discuss the literature on both explicit and implicit carbon taxation for each of the three types.

Public opinion on ECT and ICT policies can be influenced in a variety of ways. There is evidence that lifestyles characterized by high fuel consumption lead to negative views and political resistance to fuel taxes (Hammar, Löfgren, and Sterner 2004). Fuel consumption is greater when incomes are high, population density is low, and gasoline prices are low. Båtstrand et al. (2015)

find territories where coal, oil, and gas are abundant, there are fewer policy proposals for any measures that would leave such energy sources in the ground, including carbon pricing policies aimed at mitigation. Since transportation accounts for approximately one fourth of all global emissions from fossil carbon (Sterner 2012), it is reasonable to posit increases in the price of fuels used in transit could be met with interest group opposition. One test of this theory found state-level gasoline taxes in the US were lower in states with higher employment in trucking (Decker and Wohar 2007).

The relationship between environmental values and explicit carbon taxation has been under studied (Harrison 2010). One reason for this is that measures of comparative environmental values did not exist until the early 1990s (Shwom et al. 2015), the first comparative data from the 1992 Health of the Planet Survey from Gallup. Since the first adoptions occurred prior to the survey, little can be said on this effect on these early adoptions.

Harrison (2010) directly investigates the relationship between politics and the adoption of explicit carbon taxes. In her four-case analysis, she points to three policy maker factors that might lead to explicit carbon tax policies: policy maker beliefs about the environment and carbon taxes, policy maker motivation to appease constituents who want climate change mitigation/carbon taxes, and the institutional environment in which the policy makers operate. Her main findings are that in the cases where a policy was put in place (Finland and Denmark) businesses and industry were able to negotiate exemptions and rebates limiting the effectiveness of the policies, and proportional representation electoral systems facilitate the adoption of explicit carbon tax policies (Harrison 2010). Other studies show political parties have an effect on ECT policies (Daugbjerg 2001) and on general concern for climate change (Shwom et al. 2015).

Despite the framing of ECT policies being environmental purposes, researchers suggest revenue demands have been the true underlying motive. The early environmentally related taxes, in particular, "had no environmental or regulatory objective, but were aimed at raising government revenue" (Bachus and Cao 2011: 41; also see Hammar et al. 2004). Ciocirlan and Yandle (2003) take this notion further, suggesting that not only do states use ECTs to meet revenue demands, but tax prices will be set so that revenues are maximized, which means emissions are not reduced. In the words of the authors, "taxes are raised up to an optimal point beyond which raising them would discourage emissions, and thus revenues" (p. 203). Others have made similar claims. In his analysis environmental taxation, Andersen suggests "Ministries of Finance appreciate the new flow of revenue into their treasuries...but have inclined to find ways to avoid the tax erosion effect that could result from significant environmental improvements" (2000: 28), calling this the "fiscal syndrome," where the price on carbon is set to meet revenue goals, not concern for the environment (2000).

While this claim should not be ignored, it is important to note how the claim might be at odds with the fact that revenue neutrality (or "revenue recycling") is often a main component of ETR. In fact, as revenue recycling might also make an ECT more politically feasible, this means that policies are more likely to pass when intentionally designed to prevent the extraction of additional revenues. Is it possible for policy actors to be motivated by increasing revenues while pushing policies designed to prevent increasing, and possibly erode, revenues of the state? It is feasible the distributional consequences of the taxes could be another motivation, as ECTs are commonly viewed as regressive like forms of other indirect taxation and the personal income taxes (PIT), capital taxes, and inheritance taxes which they replace are viewed as progressive. Or it could be that the initial adoption of a policy can have very different motivations than the motivations of

its continuation; it has been suggested that Ireland's ECT was initially intended to be revenue neutral, but given their revenue needs the IMF strongly suggested they reduce the recycling aspect of their ETR and continue to increase it in light of their fiscal situation (Rosenthal 2012).

4. POLITICAL INSTITUTIONS AND CARON TAXATION

The work noted above fails to consider a few institutional variables, some of which I hypothesize affect both the implementation of ECTs and the revenue generating potential of ECTs and ICTs: historical tax structure, neocorporatism, federalism, and spatial diffusion.

I suspect historical tax structure is important in a few different ways. Since ECTs and ICTs are a form of indirect taxation, countries that have historically relied on higher levels indirect tax revenues likely have 1) greater administrative capacity for and 2) greater societal institutionalization of indirect taxation. If true, each of these propositions would likely facilitate the adoption of ECTs and greater revenue generation from both ECTs and ICTs. Further, some studies have found indirect taxation to be the result of path dependent processes (Beramendi and Rueda 2007; Kato 2003). The path dependent nature of indirect taxation in OCED states, characterized by increasing returns due to large start-up costs (developing administrative capacity) and learning effects (normalization that allows people to interact with the institution in predictable ways).

This argument is a historical institutionalist one, meaning it emphasizes that the institutional context in given a country constrains policy options, and influences the policy preferences of political actors (Steinmo 1993; Thelen and Steinmo 1992). Historical institutional arguments help explain cross-country variation in policy decisions and policy effectiveness, highlighting the importance of historical, country-specific institutional context – in one historical

context a policy might be a feasible and rational option which can be implemented effectively, but not in other contexts with different institutional histories. As Steinmo suggests, “rationality itself is embedded in context. One cannot even define what a rational act is without examining the context of that behavior” (1993:7).

Certain studies demonstrate how tax policies, in particular, have “shaped what policy makers and interest group activists understood to be possible and desirable” (Steinmo 2003: 208). Martin concludes “...the explanation for any particular fiscal policy itself may lie in a previous configuration of public finances, rather than in any other contemporary circumstances” (Martin forthcoming: 5). And with regards to environmental regulation, “A certain regulatory regime that is effective and efficient in one institutional setting may not be effective or efficient in another” (Cole and Grossman 1999: 908). Given this, I hypothesize (H1) that the historical use of indirect taxation in OECD countries creates an institutional context that facilitates the implicit and explicit taxation of GHG emissions.

Taxes are indirect when payments are not transferred to the government directly by the consumer, as is the case with personal income taxation. The payment instead is made by another party, typically a firm, at some point in the supply chain. Indirect taxes include sales taxes, value added taxes (VAT), import and export taxes, and excise taxes, as well as others. Carbon taxes are necessarily indirect taxes: ECTs are mostly made up of excise taxes, except for vehicle taxes and a few special VAT taxes on fuels, and ETR is often focused on increasing these same excise taxes. Therefore, the administrative organization and bureaucratic institutions required to effectively collect revenues from various indirect tax schemes is often very similar, if not identical as in the case of most ICTs, to the administrative capacity required from ECT policies.

One focus of path dependent arguments is the concept of increasing returns, or benefits which increase over time resulting from maintaining a particular institutional course, when compared to alternative courses; or, conversely, the "costs of exit -- of switching to some previously plausible alternative -- rise" Pierson (2000: 252). Such processes are said to be "self-reinforcing sequences," which are "characterized by the formation and long-term reproduction of a given institutional pattern" (Mahoney 2000: 508). The presence of significant startup costs helps explain why policy paths might be maintained; once startup costs are incurred, it is less rational to switch to an alternative that would require its own startup costs (Arthur 1994; Pierson 2000). Because of the costs of switching is non-trivial the policy path is maintained, even if an alternative is more efficient had the startup costs not been incurred (Pierson 2000).

In the case of ECT and ICT policies, their existence represents a type of increasing returns and thus a form of path dependence. States require revenues and switching from indirect tax bases to more direct ones requires incurring costs related to building the administration required to effectively do so. Therefore, I posit there is a path dependent effect tied to the costs of establishing the administrative capacity required for indirect taxation and specifically ECT and ICT policies. In cases where administrative capacity is already developed, it is easy to continue this type of taxation through ECT and ICT policies.

No scholarship has directly tested this hypothesis, but several other scholars have hinted at the relationship. In a general case for the importance of administrative capacity, Milio (2007) finds bureaucratic administrative capacity essential to explaining the regional differences in successful EU Structural Fund implementation in Italy . With regards to environmental taxation, Andersen (2000) suggests the experience of the tax agent, the authority charged with collecting the tax, is an important factor. In describing the "agent syndrome" (p. 37), Andersen explains that when the

agency put in charge of collecting taxes has little knowledge of the base and little experience collecting revenues, tax collection is often unsuccessful. In one such example, the Swedish Environmental Agency was tasked with collecting a tax on batteries, but its attempts to do so were ineffective since it had no relevant experience. On the other hand, water taxes in France and the Netherlands were collected by agencies with a background of handling payments and with extensive knowledge of water management. Because of their experience and established administrative capacity for receiving payments, the agencies were successful at collecting revenues (Andersen 2000).

Speaking directly to the costs of administration, Smulders and Vollebergh (2001) note that building green taxes upon pre-existing excise tax policies is a strategy that is far cheaper to administer, in terms of monitoring, than creating new policies. Further, the authors cite Hoornaert's (1992) observation that the compliance and monitoring controls found in excise taxation are very similar to those that are required for ECT. Some support for this can be found in studies of ECT design: policies in Denmark, Finland, the Netherlands, Sweden, and the UK all entailed increases in existing ICT or VAT policies (Speck and Jilkova 2009).

Another part of the historical institutionalist argument is that the historical employment of indirect taxation normalizes their use. Again, the institutional context influences what is rational and what options policy actors might prefer (Steinmo 1993; Thelen and Steinmo 1992). I argue that the use of ECT and ICT policies to mitigate climate change is likely more politically feasible in states that have historically been able to generate relatively high levels of revenue from indirect taxation. In this context, policy actors are likely to find ECT and ICT policies more preferable when compared to other alternatives such command and control regulation and particularly compared to ETS.

This normalization relates to path dependence theories of increasing returns caused by learning effects. Over time, repeating interactions with institutions allow actors to learn how to better interact with them (Arthur 1994; Pierson 2000). It follows that actors who interact with indirect taxation might prefer to maintain indirect taxation in light of other alternatives. In fact, ECT polices, a type of indirect taxation, are seen as the more predictable, in terms of cost, of the two carbon pricing options (ECT allows predictability in price, ETS allows predictability in emissions). It is much easier to plan for the added costs associated with ECT than it is for the unknown price of emissions in a cap-and-trade system which is the product of the permit market, and some ETS have included price floors and ceilings to address this issue (Meckling and Jenner 2016; Newell, Pizer, and Raimi 2013).

In addition, there are a few noteworthy reasons indirect taxes might be more durable than direct taxes, which could contribute to the path dependent effect. Taxes that single out specific groups, typically true of redistributive direct taxes like those on income or inheritance, are more likely spur organization in opposition by affected groups (Prasad 2006; Wilensky 2002), although the more universal indirect taxes occasionally evoke popular protest (even fuel taxes; see Sterner 2012). In comparison, indirect taxes such as sales taxes and excise taxes are commonly applied universally (except for luxury taxes and sin taxes). Further, Wilensky (2002) notes that some taxes are more ‘visible’ than others; it is difficult for a state to maintain high revenues from visible taxes such as those on income and property. Highly visible taxes are more likely to be met with popular revolt, regardless of their level of revenue generation, when compared to the less visible taxes like those on consumption. However, more recently, Martin and Gabay have challenged this relationship between visibility and collective action (William Martin and Gabay 2017).

A few scholars have used path dependent arguments specifically to explain the cross-national variation in tax structure, particularly the use regressive indirect taxation. Kato (2003) explains the path dependent nature of welfare state's reliance on regressive indirect taxation, where the self-reinforcing mechanism is that regressive taxes are more stable in times of low economic growth. If the regressive taxes are established during times of relatively higher growth they prove durable because they provide reliable and stable revenues to the state, and thus can fund welfare in more recent times where annual growth is relatively lower.

Another path dependent explanation is offered by Beramendi and Rueda (2007). They find that corporatist constraints leave social democracies with little choice but to collect revenues from regressive indirect taxation. Assuming strong demand for welfare spending in countries proportional to the political power of social democratic parties, the authors focus on two scenarios in strong social democratic states: first, in states with low corporatism, where there are little or no institutions of coordination between industry, labor, and government, policy actors are less constrained to pursue progressive taxes on capital and income, and given the redistributive preferences of social democrats they will likely do so. Second, in states high corporatism, institutional agreements prevent increasing taxes on income (a violation with respect to labor) and taxes on capital (a violation with respect to business). Governments in this situation have little choice but to increase taxes on consumption in order to fund the welfare state.

Therefore, I hypothesize (H2) that countries with higher social democratic party power and the presence of strong corporatist institutions, variables linked to indirect taxation and thus the development of the relevant administrative capacity, are more likely to collect higher levels of ECT and ICT revenues.

Given how many studies have pointed to the importance of exemptions and revenue recycling in passing ECT policies and raising revenues, I posit that cooperative institutions are an important factor in the design and political feasibility of ECTs. Neocorporatism (institutions of tripartite cooperation) provides institutions that facilitate cooperation between labor, business, and government which likely influence that passing of ECTs. In a typical environmental tax reform, certain sectors of the economy are granted exemptions and given rebates; labor gets reductions in labor-related taxes, and revenues to the state are (at least in theory) maintained (Harrison 2010). Hsu, Walters, and Purgas (2008) find revenue recycling increases the political feasibility of ECTs, although Fairbrother (2017) finds this effect is eroded when trust in the political system is low. Strong corporatist institutions (even without social democratic political power) likely facilitate cooperation for the exemptions for various producers and reductions in labor taxes that make ECTs more politically feasible, and the ability to cater to different groups through cooperative institutions likely reduces opposition to such policies and allows them to generate higher levels of revenue.

I hypothesize that political decentralization, or federalism, inhibits the ability for a state to adopt an ECT, and generate greater levels of ECT and ICT revenues. Scholars have pointed out that decentralization results in overall lower revenues due to downward competitive pressure between sub-national units (Brennan and Buchanan 1980; Feld, Kirchgässner, and Schaltegger 2010). If a state has decentralized indirect taxation, particularly excises taxes, it is less likely to generate high levels of indirect taxation, which also means they are less likely to have high administrative capacity for a national-level ECT. Further, I also suspect decentralization creates unique challenges to adopting national-level policies in general. Therefore, I hypothesize (H3) that

states with some level of federalism are less likely to adopt a national ECT or generate high levels of combined ECT and ICT revenues.

Finally, I hypothesize (H4) there is an effect of spatial diffusion across Europe, starting at the origin of the ECT (Finland), spreading outward around the world. Diffusion can occur through a variety of mechanisms (Dobbin, Simmons, and Garrett 2007). The most fitting theory in the case of ECTs is diffusion via constructivism; changes in global norms can lead to institutional changes (also see DiMaggio and Powell 1983). Coercion from a supranational organization could be relevant in the case of more recent adoptions (especially in the case of Ireland), but in general, OECD countries, for the most part, have all joined the same international agreements concerning environmental and climate commitments; the sample does not include much variation on this dimension.

Perhaps one exception to this is membership to the EU. In 2003, the EU enacted minimums on fuel taxes across the continent. Some countries were required to increase their rates of ICT taxes on petrol and diesel, although several states were already pricing fuels above the minimums (European Commission 2011). However, in terms of actual environmental impacts, there is no association with EU membership – being a member of the EU does not lead to better ecological outcomes (York, Rosa, and Dietz 2002).

5. DATA

5.1 DEPENDENT VARIABLES

This study looks at two main dependent variables: the adoption of an explicit carbon tax, and an index that combines revenues from ECT and ICT for each country-year. In order to study the adoption of ECT policies I use data from multiple sources regarding ECTs around the world,

according to how it is defined in this study (Carbon Tax Center 2017; The World Bank 2016). Using these sources, I identify when, if at all, OECD countries implemented explicit carbon tax policies with the specific intent of reducing GHG emissions. The Netherlands, Finland, Denmark, Sweden, and Norway all adopted explicit climate change tax policies prior to the available data on revenues (1994-2013), but they remain in the event history analysis. During this period Australia (2012, repealed in 2014), Switzerland, Chile, Germany, Estonia, the UK, Ireland, Iceland, and Latvia implemented such policies.

For the preliminary analysis of revenue generation (not the primary event history analysis), I used data from the Policy Instruments for the Environment (PINE) database created by the OECD and the EEA to make an index for the combined revenues generated from ECT and ICT. The PINE database includes tax revenues on various environmentally oriented tax policy schemes for OECD member states beginning in 1994 and ending in 2013. I individually coded each tax scheme based on whether or not the tax base covers GHG-emitting activities or products. After doing this, the taxes were placed into five different categories: explicit carbon taxes, fuel taxes, energy taxes, vehicle taxes, and transit taxes. Vehicle taxes and transit taxes are not typically included in ECT policies, but studies have found they both can have negative effect on GHG emissions (Brand et al. 2013; Giblin and McNabola 2009), and therefore they are included in this study as implicit carbon taxes.

In certain cases, the energy taxes include revenues collected from non-GHG energy sources such as nuclear energy and non-specified electricity. These revenues were included as they appear to be minor components of the overall tax scheme and are often part of explicit carbon tax policy (as with Finland's energy tax). In the case of Portugal, even though its Tax on Petroleum and Energy products doesn't appear to be geared toward taxing GHG emissions, the sub-schemes that

comprise the policy are specific to fossil fuel consumption, except for one sub-scheme on electricity. During the relevant period, Portugal's renewable energy consumption remained between 15-23% of total primary energy supply, meaning that even this sub-scheme on electricity mostly applied to fossil fuel consumption.

Certain countries are left out of the revenue analysis due to the poor condition of the data. The PINE data for Canada, Mexico, Slovenia, Spain, and the United States are incomplete and missing in most, if not all, years. For Canada, Spain, and the US, this seems to be because the relevant tax policies are for the most part administered at the sub-national level. Each of these countries are classified by the Comparative Political Data Set (CPDS) as "strong" federalist states (Armingeon et al. 2017). Germany and Switzerland are also classified as "strong", but Germany does not have decentralized ICT policies, while Switzerland does have decentralized ICT and a national-level ECT. With regards to the revenue analysis, the omission of Canada, Spain, and the US represents a selection bias based on an important variable: federalism. I use estimated and incomplete data from the OECD to help address the issue, but the data come from the same source as my own revenue calculations, therefore I am hesitant to make any conclusions.

I use revenues instead of tax rates for a few reasons. In practice, explicit carbon tax policies often include exemptions for certain areas of the economy such as industry, agriculture, and transportation (Ekins and Speck 1999). When this is the case, the stated tax rate (often expressed in \$/ton of CO₂, per amount of fuel consumption, or per amount of energy use) might not apply to the entire base of emissions. A nation could implement a carbon tax policy that charges \$100 per ton of CO₂ emitted, but if the policy only applies to fraction of all CO₂-emitting activities, then revenues collected could amount to far less than \$100 per ton of CO₂. Rather than try to create comparable measures of rates on various tax bases (which might not even be possible) in this

paper, main dependent variable is the revenue index divided by CO2 emissions to give calculation that reflects combined ECT and ICT revenues (2010 USD PPP) per ton of carbon dioxide emitted in each year between 1994 and 2013.

Some have challenged the practice of combining revenues from policies which were likely adopted through very different processes. This is a valid criticism; the political processes involved in passing vehicle taxes are likely very different from those for fuel and transit taxation, and probably much more so for explicit carbon taxation. The intentions of each of the policies are different; taxes intended to reduce GHG emissions didn't exist prior to 1990. Gasoline taxes have been used to fund education, infrastructure, and debt. But if these policies are only studied on their own then there is no way of knowing the combined implicit and explicit effort in mitigating climate change through taxation. I believe this is a very important, at the very least interesting, phenomenon to study. Just looking at the revenues from the Carbon Tax in Sweden misses its large amount of revenues collected from fuel taxes. And only looking at revenues from the Carbon Tax would miss any reductions in other taxes on fuel or energy that might have occurred contemporaneously (via revenue recycling). Further, this critique of using a combined measure does not hold, I believe, when it comes to my path dependent argument – the importance is that they are indirect taxes, not the intention in which they were passed.

5.2 INDEPENDENT VARIABLES

The first independent variable is administrative capacity for indirect taxation. To test for the effect of administrative capacity I use Taxes on Goods and Services data from the OECD. In the even history analysis, the explanatory variable is a five-year moving average of indirect revenues as share of GDP, lagged a year (t-1 through t-5). I use a moving average to smooth out the measure

and lag the measure one year so the effects of an ECT implementation will not have an impact in the year. The measure includes revenues for sales taxes, VAT, excise taxes, taxes on imports and exports, and other consumption-based taxes, all measured at the national level.

The variable on federalism is coded as 1 if the Comparative Politics Data Set codes a country in a given year as having either “Strong” or “Weak” federalism (Armingeon et al. 2017). Therefore, the dummy indicates the presence of any level of federalism as defined by the CPDS . Left party power is measured as the percentage of the cabinet occupied by members of social democratic or left political parties (also from the CPDS). The variable for neocorporatism comes from Hicks and Kenworthy (1998). The variable is a composite index which combines measures of business confederations, coordinated wage bargaining, two different measures of tripartite neocorporatism, investor rights and time horizons, and labor-management relations (Hicks and Kenworthy 1998). Unfortunately, the variable for neocorporatism has not been kept up to date, so the variable used in this analysis is held constant at the average from 1960-1989 (prior to the period of all analyses).

The analyses also include a few control variables. Controls for per capita GDP and population were created using data from the OECD and the IMF. The control for GDP also touches on ecological modernization theory, which posits that economic and political development will lead to a reduction in environmental impacts (York and Rosa 2003), and Inglehart's culture shift (1990), which suggests advanced democracies experience a value shift to post-materialist values which might include environmental values. I use a variable indicating the renewable energy share of the total primary energy supply (TPES) to control for the relative size of the taxable base. While not a perfect proxy, this measure will indicate the extent to which a state has an energy supply of fossil fuel that could be subject to an ECT. This of course leaves out taxable fuel, but fuel is likely

to have a stronger correlation to per capita GDP, whereas there is significant variation in terms of renewable energy use across cases. Data on the renewable share of the TPES come from the OECD (OECD 2017).

The sample for event history models using data from CPDS is limited to eighteen OECD countries: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Finland, France, Great Britain, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Sweden, and the United States. Over the period (1990 – 2014) twelve of the eighteen cases implement ECT policies, leaving Austria, Belgium, Canada, Italy, New Zealand, and the United States without an ECT in 2014, the end of the event history analysis.

6. ANALYSIS AND RESULTS

6.1 THREE WAVES OF ECT ADOPTION

When ECT implementations are plotted over time, three different clusters appear. I call these the three waves of explicit carbon tax implementations. The first wave takes place between 1990 and 1992, and includes the early adopters: Finland, the Netherlands, Sweden, Norway, and Denmark. The second wave takes place between 1999 and 2001, and includes Germany and the United Kingdom. The third wave includes Switzerland, Ireland, Australia, Japan, and France. The plot below (Figure 1) shows the year of ECT implementation on the X axis and the five-year indirect revenue moving average (lagged one year) in the year of adoption on the Y axis. Just looking at the countries in the sample with ECT implementations during the period shows that the waves are very different from each other in terms of the variable for administrative capacity/normalization. The first wave ranges from approximately eleven percent to 16 percent, the second around ten percent, and the third wave has a maximum under eleven percent and a minimum around five.

Administrative capacity seems associated with the first wave, but less so with the later waves; the average declines in each subsequent wave.

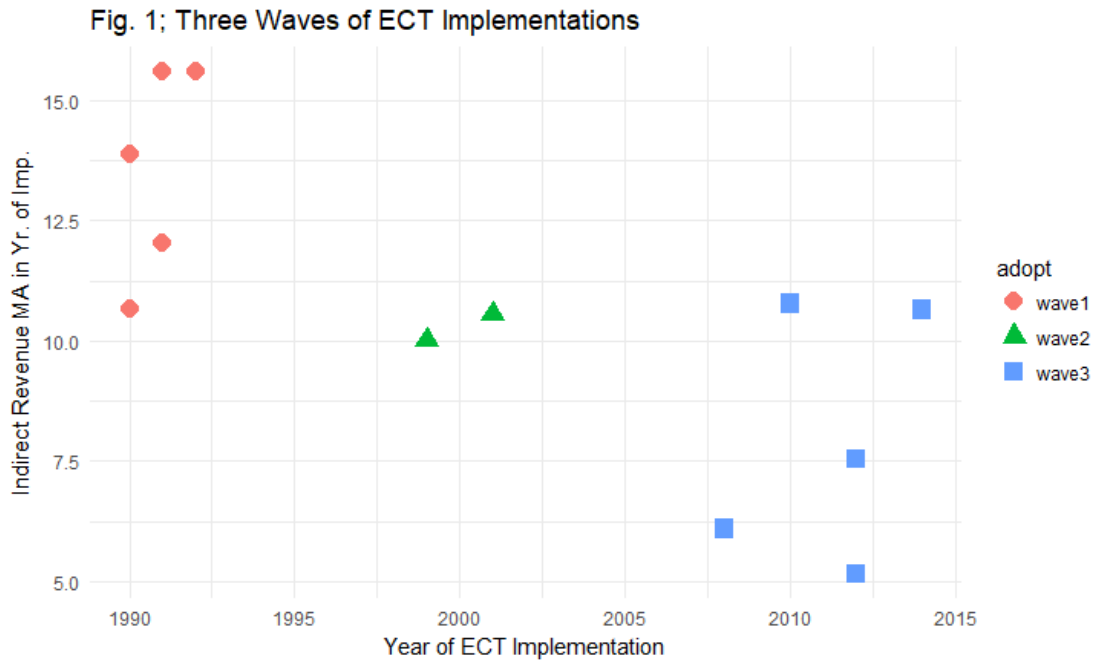


Figure 1. Three Waves of ECT Implementation

In their study of civil service policy adoptions, Tolbert and Zucker (1983) show that in cases where policy adoptions are not forced by a central authority (as is true in the case of ECT adoptions), the “policies diffuse gradually and the underlying sources of adoption change over time” (1983: 25), where “characteristics that make it [the policy] more ‘rational’ to adopt will be important early in the diffusion process” (1983: 30). The rational predictors of policy adoption, in this case administrative capacity for indirect taxation, reduce in predictive power over time and later policy adoptions are more likely to be more symbolic. This idea is tested in the models below.

According to York and Rosa (2003), it might important to keep separate the institutional change (ECT implementation) from the intended effect (reductions in GHG emissions). In this case, we can relax the assumption that an ECT is intended to reduce GHG emissions, and for the

purpose of the study assume a fair measure of the effectiveness of an ECT policy is the revenues generated by it. Therefore, according to my hypothesis, the three waves each have very different administrative capacities and might have correspondingly different revenue-generating potential.

6.2 EVENT HISTORY ANALYSIS

Here I present an event history analysis with the dependent variable the implementation of an ECT. The data are structured so that the country-year in which an ECT is implemented is coded as a one, and all other years coded as a zero. All years post-implementation for a specific country are omitted from analysis so that it ends at the year of implementation. Logistic regression is used to accommodate the dichotomous dependent variable, and because of this, coefficients are displayed in log odds.

The table below presents the results of five different event history models used to test the associations between ECT implementation and historical tax structure, left party power, corporatism, and federalism.

	ECT Implementation				
	(1)	(2)	(3)	(4)	(5)
Time	-0.127	0.482*	0.505*	0.579*	-0.260
IndTax/GDP 5YMA	0.281	0.685**	0.701*	0.996**	0.107
Time*Ind/GDP		-0.050**	-0.064**	-0.077***	
Federalism			-3.546**	-3.949**	-3.328**
Left Party Power			0.042***	0.055***	0.040**
Neocorporatism			0.026	0.054*	0.047*
Renewable/TPES				-0.123	-0.067
GDP Per Cap	0.131	0.068	0.253*	0.356*	0.331*
Population (in mil)	-0.001	-0.010	-0.012	-0.014	-0.003
Constant	-8.385**	-11.961***	-18.361***	-24.951**	-13.321**
N	292	292	292	292	292
Log Likelihood	-47.129	-42.114	-29.607	-26.819	-34.117
AIC	104.258	96.228	77.213	73.638	86.235

* p < .05; ** p < .01; *** p < .001

Table 1. Event History Analysis of ECT Implementation

All models include controls for per capita GDP and population. Model one tests the effects of both time and indirect taxation on ECT implementation – no statistically significant association is found for either variable. However, according to Figure 1, the administrative capacity of each country implementing an ECT varies across time; high indirect taxation matters with the early adopters but less so with the second and third waves. To model this change over time, an interaction between time and the indirect tax moving average is included in model two. Model two indicates this relationship between time and indirect taxation is positive and significant when including the interaction. The coefficient of the interaction is negative and significant, meaning as time goes up (and it automatically does for every case) the effect of indirect taxation on the odds of ECT implementation goes down. This reiterates the notion of the three waves, and that the administrative capacity of ECT adoptions has changed over time.

Model three adds three political variables: a dichotomous variable for federalism, a measure of left party power, and a static measure of neocorporatism. The addition of these three variables increases the magnitude of the coefficients for time, indirect revenues/GDP, and their interaction. Individually, the presence of strong or weak federalism has significant negative effect on the odds of ECT implementation; left party power has a significant positive association – the greater the power of the left leaning party in the cabinet, the greater the odds of ECT implementation; and the measure of neocorporatism has a significant (at $P < 0.1$) positive association with ECT implementation, supporting my hypothesis that institutions of corporatism facilitates ECT designs that make the policies more politically feasible.

Model four adds a variable that measures the share of Total Primary Energy Supply which comes from renewable energy (wind, solar, geothermal, hydro, etc.; does not include nuclear energy). This variable provides a rough proxy for the base of a potential carbon tax. It also might indicate whether there is a interest group effect associated with fossil fuel energy consumption. The effect of this variable is negative but not significant (only at $p < 0.1$). The addition of this variable does improve upon the previous model (both log likelihood and AIC), and increases the magnitude of each of the other variables of interest. The fourth model also indicates a significant association between neocorporatism and ECT implementation, meaning that when controlling for the renewable share of TPES, stronger (static) neocorporatist institutions increase the odds of ECT adoption.

In model five, the interaction between indirect revenues/GDP and time is removed. The exclusion of the interaction reduced the model fit, and reduces the effect and eliminates the significance of indirect revenues/GDP, again offering support for the changes over time in the importance of indirect taxation.

6.3 MODEL SIMLUATIONS

In this section I present plots which display how changes in different variables affect the odds of ECT implementation; all simulations use coefficients from model four in the table above. The first plot shows the powerful effect of federalism (strong or weak) on the predicted probability of ECT implementation. Holding all other variables at their mean, this plot shows the dramatic difference in the probabilities based on the presence or absence of federalism. The presence of federalism reduces the probability to approximately one fiftieth (1/50) of the probability if federalism was not indicated. It supports my hypothesis that federalism makes it less likely that a national-level ECT will be implemented.

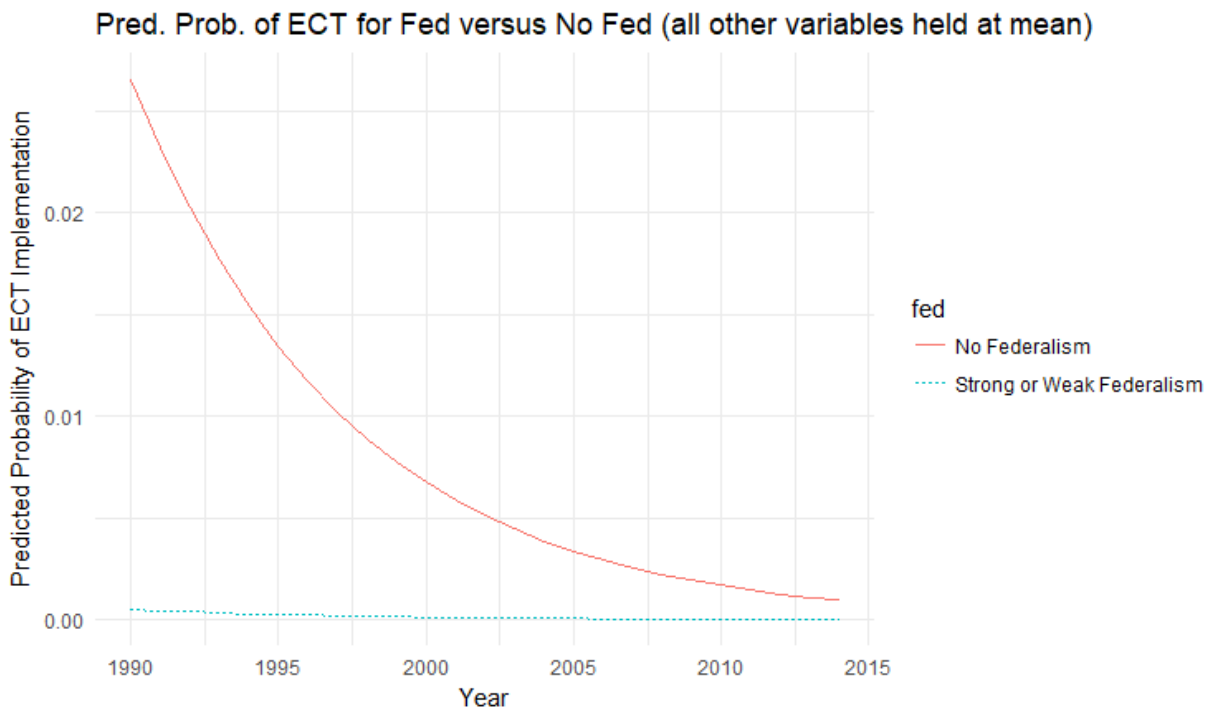


Figure 2. Predicted Probability of ECT for Federal versus non-Federal

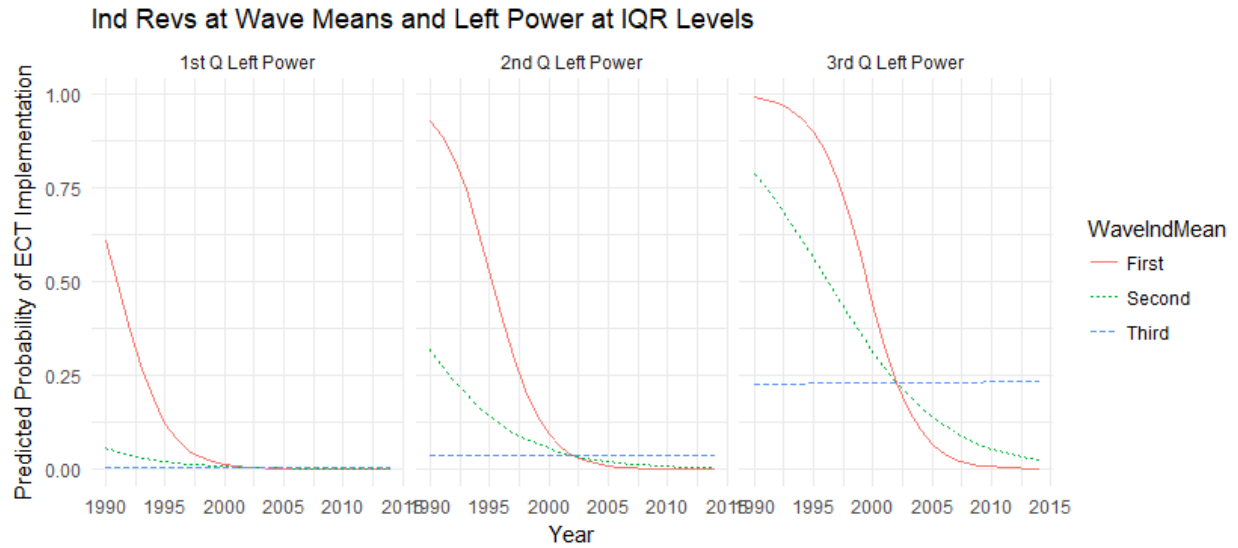


Figure 3. Left Party Power Over Time, Held at First, Second, and Third Quartiles

The plots above display three different sets of simulations. Each plot represents a different levels of left party power, one for the first quartile (24.76%), another for the second (62.67%), and the last for the third (100%) – calculations are limited to cases that adopted in the years of implementation. The three lines on each plot represent the mean level of indirect revenues for each of the three waves (13.87%, 10.29%, and 7.55%). Federalism is set to zero for all simulated values. One thing that stands out is that the probabilities for implementation are greater at lower levels of indirect revenues; the time trend in probability actually increases over time at low levels. At high levels of left party power (the third plot within the figure), the probability is significantly higher for low levels of indirect revenues later in the period.

The next plot shows the probability of ECT implementation over the range (0 to 100) of left party power, one line showing the effect with the presence of federalism and the other without (holding all other variables at their mean). First, this plot shows the strong increase in probability as the left party cabinet share increases. Second, the plot reiterates the strong negative effect of

federalism. The effect of federalism aside, this offers strong support for claims that left party power is an important factor in ECT implementation.

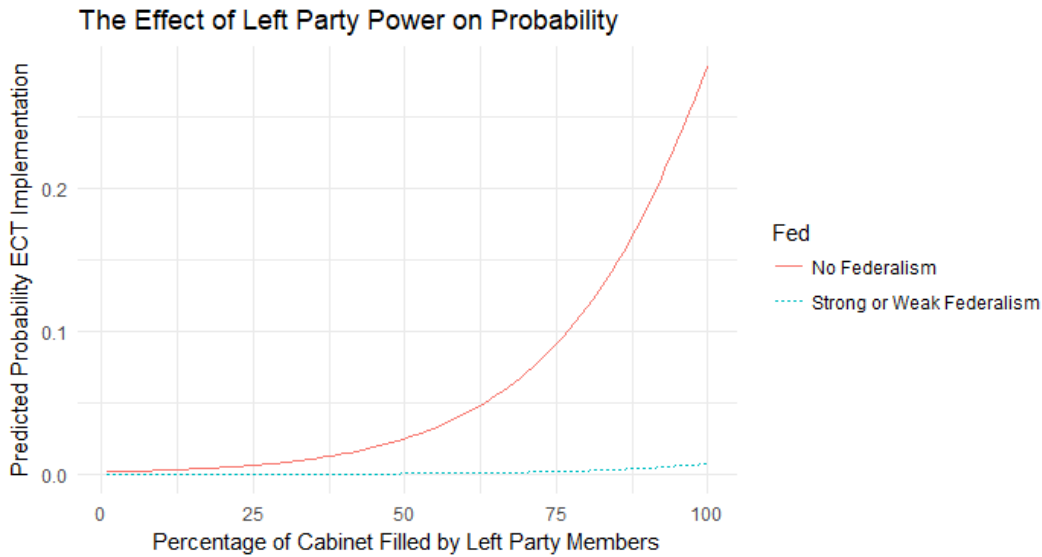


Figure 4. Predicted Probability Over the Range of Left Party Power

6.4 ADMINISTRATIVE CAPACITY AND COMBINED ECT AND ICT REVENUES

In the last two sections I demonstrate how the relationship between administrative capacity/normalization and ECT implementation has changed over time. In this section, I take a look at whether administrative capacity at the time of adoption has an effect on revenues generated from combined ECT and ICT revenues. I use a combined measure of revenues because 1) given the nature of ETR and ECT policies, and the PINE data, revenues cannot be isolated at the unit of aggregation needed (and ECTs are sometimes tacked on to existing ICTs); and 2) the stated purpose of ECT and ETR is to price GHG emitting goods and activities, so overall revenues represent an overall implicit effort at penalizing GHG-emitting activities.

Do administrative capacity and normalization matter for revenue generation? To test for this, I plot the combined ECT and ICT revenues by year on the Y axis and the years since ECT

implementation on the X axis (see below). The lines are colored according to three indirect revenue categories: high, mid ($8 < X < 12$), and low. At least as a share of GDP, the revenues for the high category seem, in general, higher than the low. But the cases in the high category have been around longer and perhaps just had more time to gradually increase their rates and revenues. After all, the PINE data only start in 1994, several years after the early adopters so it is unclear whether they also started at lower points (although it appears unlikely).

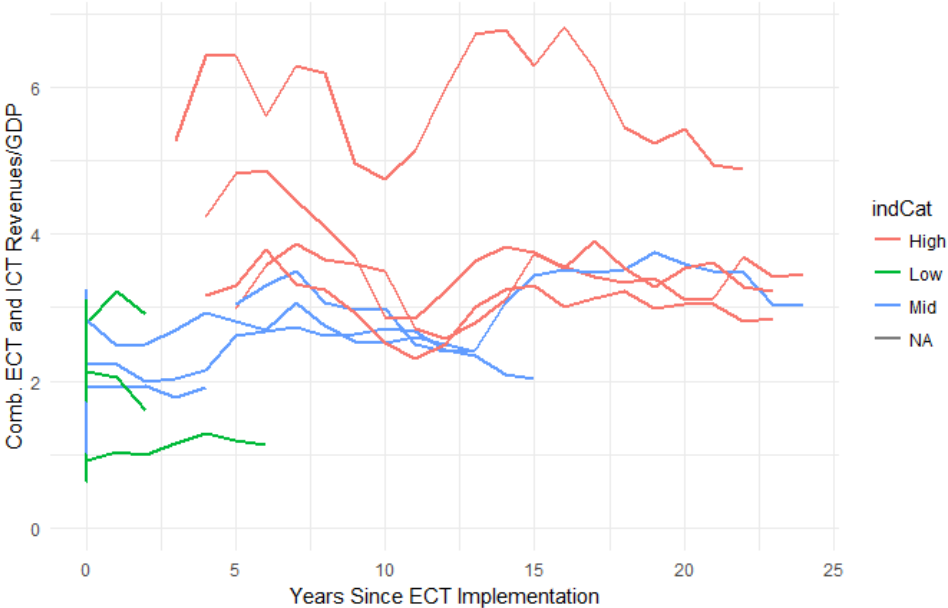


Figure 5. Combined ECT and ICT Revenue After ECT Adoptions

This is preliminary evidence supporting the claim that higher historical indirect taxation leads to greater revenue generating capacity from ECTs and ICTs. In future research, more sophisticated methods will be necessary to substantiate this claim.

6.5 SPATIAL DIFFUSION

The first ECT was adopted in Finland in 1990. The first wave of ECT adoptions includes other nearby countries: Netherlands, Sweden, Norway, and Denmark. ECT policies appear to diffuse outward from Northern Europe. To test this, I measure the distance of each state's capital from Helsinki.

Below is a plot that shows the distance from Helsinki (in thousands of miles) on the Y-axis and the year of ECT adoption on the X-axis. The first wave of adoptions includes states all very close to the capital of Finland. The second wave shows a bit more variation, and the third wave includes a wide range of distances. Even the closest states in the third wave are about as close as the furthest states in the first wave.

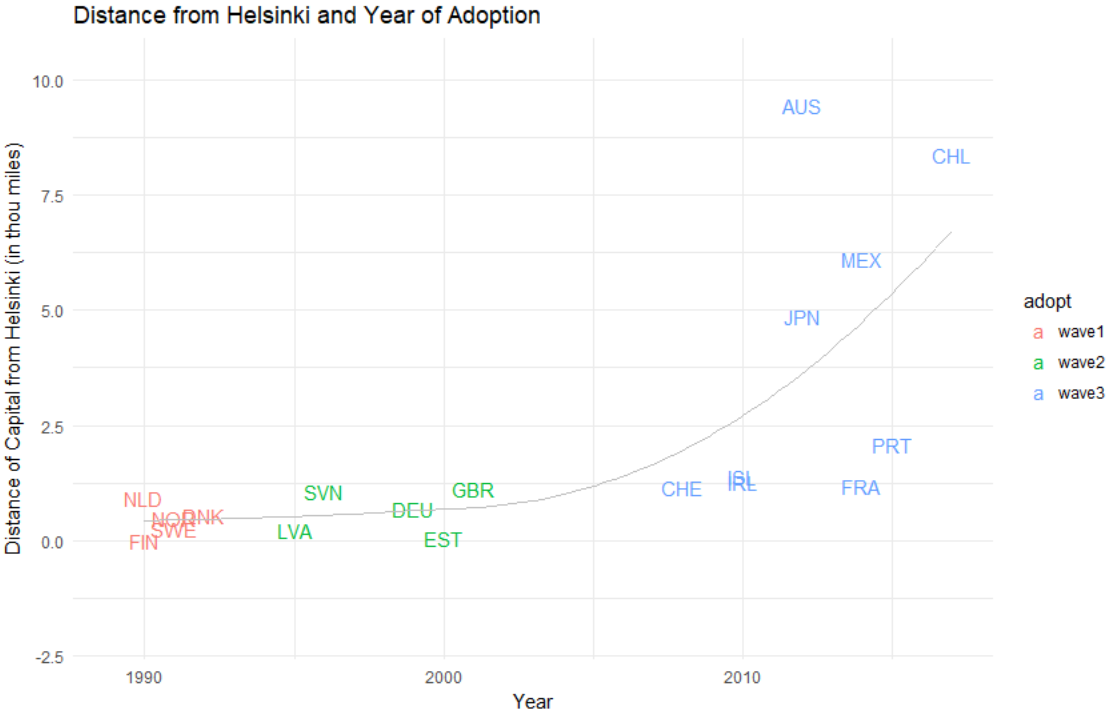


Figure 6. Distance from Helsinki and Year of Adoption

The nature of the adoption of ECT policies and the nature of the policies themselves have changed over time. In the first wave, policies were implemented by states with high administrative

capacity, demonstrated by high indirect tax/GDP ratios, and what I posit to be the political institutional conditions necessary to negotiate passable policies. Adversarial political climates do not facilitate the adoption of ECTs, while the more corporatist, or coordinated market economies, have the institutions facilitating the type of concessions and exemptions that appear necessary to make ECTs politically feasible.

Table 2.

	<i>Dependent variable:</i>	
	Explicit Carbon Tax Implemented	
	(1)	(2)
Time (in yrs)g	0.010 (0.033)	-0.161*** (0.043)
Distance to Helsinki	-0.201 (0.134)	-5.387*** (1.314)
Time*Distance		0.161*** (0.037)
Constant	-3.331*** (0.825)	1.949* (1.184)
Observations	649	649
Log Likelihood	-80.673	-66.959
Akaike Inf. Crit.	167.346	141.919

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2. Event History Analysis of Spatial Diffusion

In the first model, the effects of time and distance to Helsinki (“distance”) are not significant. In the second model, I add an interaction term for time multiplied by distance. This model looks quite different. These results suggest the spatial diffusion occurring over time seen in the plot above is in fact statistically significant. With the interaction term included, the variables for distance has a significant negative association.

The mechanisms for this diffusion are not clear in this simple model. The only thing it allows us to say is that ECT implementations began in states in close proximity to Helsinki and spread outward around the world. It is likely that other variables might help get at the underlying mechanisms, such as trade, international organizations/agreements, etc., but the data only allow this type of study for a subset of states with ECT policies.

7. CONCLUSION

This study investigates the nature of explicit carbon tax implementation. First, I hypothesized that indirect taxation provides administrative capacity necessary for the implementation of ECT policies, but this only seems true early on, during what I call the first wave of adoptions. Later on, indirect taxation played less of a role, which would make sense if some of the later cases were more symbolic, and were not intended to generate large amounts of revenue. It appears that administrative capacity still influences the amount of combined ICT and ECT revenues a state can generate, but this relationship needs to be studied much more closely. Further, the three waves identified highlights the importance to assess these policies along other dimensions instead of focusing on the presence. The revenues generated from different states are not always comparable.

Second, I find that federalism had a strong negative association with the odds of ECT implementation. Countries with political structures of federalism are far less likely to adopt an ECT than those without any federalism. This is an important consideration for when considering ECT policies. As is the case in Canada, it might be that countries with federalism are better suited for subnational ECT policies.

Third, the association between left party power and ECT implementation was robust, confirming what other scholars have suggested in case-based studies (Daugbjerg 2001; Harrison

2010). A shift from 50% to 100% of left party cabinet share increases the odds of ECT adoption by roughly seven times. Fourth, although the variable for neocorporatism left much to be desired, there still was a positive relationship between it and the odds of ECT implementation. This makes sense because of the connections made between exemptions and revenue generation, and the revenue recycling and ECT implementation. Each of these represent cooperation between business, labor, and government. Finally, there is strong evidence that ECT policies spread spatially from Northern Europe, although the mechanisms need much more attention.

Future research should include a deeper analysis into the institutions that facilitate ECT and ICT revenue generation, including a reliable and time-sensitive measure of neocorporatism. This would allow for testing of the path dependent nature of indirect taxation laid out in other research. An updated analysis of the connection between revenue demands and environmental impact should be done, as this has huge implications for the long-term environmental effectiveness of ECT and ICT policies.

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APPENDIX A

It is very important to emphasize that the presence of an explicit carbon tax policy does not necessarily indicate an effective policy measure to reduce GHG emissions. In their challenge to ecological modernization theory, York and Rosa (2003) argue when the dependent variable is the presence of an ecologically-oriented institutional change – in this case the implementation of an ECT – pointing out the existence of such a policy cannot be equated with a claim that the policy is effective. Indeed, there is no consensus as to whether, in practice, ECTs are effective policy tools to reduce GHG emissions.

Proving the effectiveness of ECTs in reducing CO₂ emissions is quite challenging (Sumner 2009). It is difficult to isolate the effects of a specific policy to reduce CO₂ emissions, especially when revenues are recycled into energy efficiency and alternative energy investment, and it is even more challenging when carbon tax policies include large exemptions for industry, agriculture, and transportation, as most do (Ekins and Speck 1999). A review of attempts to do this by Nadel (2016) finds general support for the effectiveness of carbon taxes to reduce GHG emissions (also see Lin and Li 2011). Further, Nadel shows there is strong support for GHG emission reductions resulting from the British Columbia carbon tax – this is important since British Columbia's policy has no major exemptions and has more in common with economists' prescriptions than any other adopted policy. The review also finds support for carbon taxes leading to shifts to cleaner energy and reductions in energy intensity.

Additional scholarship has tested the effects of other taxes which have theoretical justification for reducing GHG emissions: energy, fuel, transit, and vehicle taxes, or ICTs, as I term them. Research supports the claim that GHG emissions can be reduced through energy taxes (Bruvoll and Larsen 2004), as well as fuel taxes (Davis and Kilian 2011; Sterner 2007),

although certain studies disagree (at least, in the short term: see Sipes and Mendelsohn 2001). In addition, fuel taxes can also reduce emissions indirectly by incentivizing innovation in cleaner technologies (Aghion et al. 2016) and by internalizing the negative externalities associated with the combustion of GHG-emitting fuels can help make renewable energy a more viable option in the market for energy (Owen 2006). Although they are the most discussed, taxes on fuel and energy are not the only taxes that can influence activities that result in GHG emissions. Taxes on vehicles (when priced according to the weight and/or fuel efficiency) and road use taxes (like tolls) can also reduce CO₂ emissions (Brand, Anable, and Tran 2013; Giblin and McNabola 2009). Parry, Norregaard, and Heine (2012) even suggest road use taxes can be superior to fuel taxes for reducing emissions.