

Essays on policy diffusion

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Abstract

This thesis consists of three essays on policy diffusion which looks at the conditional diffusion of policies based on domestic political factors. It attempts to shed light on how different domestic political factors affect policy diffusion among independent but interrelated actors such as governments. To start, I argue that understanding the effects of unit heterogeneity or more specifically domestic political factors is essential for the understanding of the policy diffusion process. I speculate that this domestic factors' conditionality is less developed in the literature, for example in contrast to network conditionality, and needs more studies. In three chapters, I look at one theoretical approach using Agent-Based Modelling (ABM) to analyse the effects of domestic politics on the diffusion process, and then it provides two empirical examples in Environmental Spending and Tax Rates Competition. In the first paper/chapter "*Domestic and International Determinants of Policy Diffusion: An Agent-Based Approach*", using ABM simulation I show how differences in domestic politics or actors' and voters' preferences can affect the process of diffusion throughout the whole network of diffusion. This paper focuses on polarisation in voter preferences and conflict between political agents as an example of domestic political factors and shows how changes in such factors can lead to different diffusion macro patterns and characteristics. In the second paper/chapter "*Conditional Political Determinants of Environmental Spending Diffusion*" I look at the conditional responsiveness of different European states based on their government's ideological tendencies. I show that such ideological tendencies can affect the diffusion process and the responsiveness of governments towards international stimuli. I argue that in a polarised policy area such as environmental spending different actors fit the roles of leaders or followers depending on the costs and expectations, which will affect their responsiveness to changes in other jurisdictions. In the third paper/chapter "*Political Determinants of International Tax Rates' Diffusion in Europe*" I look at diffusion conditionality when alternative and related policy choices exist. I show that domestic preferences can translate into different responses in different alternative policy areas and spatial effects can conditionally spill over from one policy area into another policy area depending on actor's preferences. Looking at corporate and personal income tax rates as related areas, this third paper finds evidence that links different level

of domestic conditionality to the level of international determination in different policy areas, provides evidence that competition or diffusion pressure can spill over from one area to another. I propose that ABM as a theoretical tool, better use of econometrics tools and a more understanding of domestic politics can add to our understanding of policy diffusion process.

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Table of Contents

Abstract.....	i
Acknowledgement	iii
Table of Figures	vii
Table of Tables	viii
1 Introduction.....	1
1 - 1 A quick review of policy diffusion.....	1
1 - 2 Policy diffusion, the puzzle and the gap.....	2
1 - 3 My proposition and approach.....	17
1 - 4 The structure of the thesis.....	18
2 Domestic and International Determinants of Policy Diffusion: An Agent-Based Approach	21
Abstract.....	22
2 - 1 Introduction	23
2 - 2 Policy diffusion	25
2 - 3 Polarisation and Diffusion.....	27
2 - 4 Agent Based Diffusion Framework.....	33
2 - 5 Countries, population, policies	36
2 - 6 Agents.....	39
2 - 6 - 1 Agents' Position and Conflict	39
2 - 6 - 2 Agents' utility and decision making.....	40
2 - 7 Networks and information.....	41
2 - 8 Diffusion and simulation	43
2 - 9 Simulation results and discussion.....	49

2 - 9 - 1 Simulation Results and Macro Characteristics.....	53
2 - 10 Conclusion.....	61
3 Political Conditional Determinants of Environmental Spending Diffusion.....	64
Abstract.....	65
3 - 1 Introduction	66
3 - 2 Policy Diffusion and Environmental Spending	68
3 - 3 Theoretical considerations.....	73
Geographical space;.....	74
Economic or development space;	76
Political ideology space;	78
Conditional diffusion and heterogeneous responsiveness.....	79
3 - 4 Research Design	84
3 - 4 - 1 Data	85
3 - 5 Models and Methodology	87
3 - 6 Empirical Findings	90
3 - 7 Discussion.....	96
3 - 8 Conclusion.....	97
4 Political Determinants of International Tax Rates' Diffusion in Europe.....	99
Abstract.....	100
4 - 1 Introduction	101
4 - 2 Theoretical consideration	104
4 - 2 - 1 Diffusion and Tax Competition.....	104
4 - 2 - 2 Diffusion, conditionality and policy alteration.....	109

4 - 2 - 3	Conditional responsiveness and alterative policies	113
4 - 2 - 4	Application: Political Conditional Responsiveness and Taxation Preferences	116
4 - 3	Research Design	120
4 - 3 - 1	Data and data preparation.....	120
4 - 3 - 2	Method	123
4 - 4	Empirical Findings and Discussion	125
4 - 5	Conclusion.....	132
5	Conclusion	134
5 - 1	Theoretical tension between the chapters and overall findings and contributions	135
5 - 2	Limitations, possible extensions and implications	138
6	References.....	141
7	Appendices.....	148
7 - 1	Paper/Chapter 3 Appendix.....	149
7 - 2	Paper/Chapter 4 Appendix.....	153

Table of Figures

Figure 2-1 Sample countries with three agents, two policies and different distribution of voters.....	35
Figure 2-2 Demonstration of different networks	47
Figure 2-3 Shows a sample of the process of diffusion in scenario 1	50
Figure 2-4 Shows a sample of the process of diffusion in scenario 2.....	50
Figure 2-5 Shows a sample of the process of diffusion in scenario 3.....	51
Figure 2-6 shows a sample of the population of countries and implemented policies.....	52
Figure 2-7 Histogram of key macro-characteristics of diffusion in different scenarios	56
Figure 3-1 Environmental Spending of Different States.....	77
Figure 3-2 Average Estimated Conditional Spatial Marginal Effect of Change in Other States.....	95
Figure 4-1 Mechanism of the transfer of conditional international stimuli (pressure)	116
Figure 4-2 Marginal Effects of PIT Spatial Lag and Gov, Left-Right on PIT	130
Figure 4-3 Marginal Effects of PIT Spatial Lag and Gov, Left-Right on CIT	131
Figure 4-4 Marginal Effects of CIT Spatial Lag and Gov. Left-Right on PIT	131
Figure 4-5 Marginal Effects of CIT Spatial Lag and Gov. Left-Right on CIT	132
Figure 7-1 Conditional marginal effect on PIT due to spatial lag of PIT, CIT and VAT	156
Figure 7-2 Conditional marginal effect on CIT due to spatial lag of PIT, CIT and VAT.....	156
Figure 7-3 Conditional marginal effect on VAT due to spatial lag of PIT, CIT and VAT.....	157

Table of Tables

Table 2-1 Parameters distributions and values.....	48
Table 2-2 Summary statistics of simulation of different scenarios.....	53
Table 2-3 Simulation results outcome	58
Table 3-1 Environmental Spending Models Estimation	92
Table 4-1 Summary of Model Estimations.....	129
Table 4-2 – Summary of unconditional and conditional spatial effects of PIT and CIT	130
Table 7-1 – Results of the final model, same models without control variable and same models without country dummy.....	150
Table 7-2 Results of the final model without control variables	151
Table 7-3 – Final models on two randomly selected 90% of data	152
Table 7-4 Summary of Model Estimations with VAT.....	155
Table 7-5 Estimation of final models without control variables.....	158
Table 7-6 Estimation of final models without unit and time dummies.....	159
Table 7-7 Estimation of level dependent variables (tax rates) instead of changes	160
Table 7-8 Estimation of model on random 95% of data	161

1 Introduction

1 - 1 A quick review of policy diffusion

Many policies implemented in independent states or jurisdictions are in fact related to policies in other states or jurisdictions. This internationalization of policies or their spread among nations is commonly referred to as *Policy Diffusion* and has been the subject of hundreds of research studies. Graham, Shipan and Volden (2013) count around 800 papers from late 1960s to late 2000s and show an increasing trend in publication. These hundreds of research papers help us with our understanding of the process, conditions, and consequences of policy diffusion. In fact, one could say that “policy diffusion is not just a term to describe the geographic clustering of policies. Rather, it encompasses a broad array of interdependent policy choices across governments” (Shipan and Volden 2012) .

In the ever more interlinked globalized world, the interdependency between policies in different jurisdictions is becoming an intrinsic factor in policy making and is becoming the subject of more studies among political scientists. One can name numerous examples of the phenomena and its studies in many different areas such as the diffusion of free market policies and reformation (Simmons and Elkins 2004, Simmons, Dobbin and Garrett 2006, Simmons, Dobbin and Garrett 2008, Meseguer and Yebra 2009), smoking ban (Shipan and Volden 2008, Shipan and Volden 2014, Gilardi, Shipan and Wueest 2017), environmental standards and regulations (Prakash and Potoski 2006, Holzinger, Knill and Sommerer 2008, Ward and Cao 2012, Cao et al. 2013, Genovese, Kern and Martin 2017), legalisation and recognition of same-sex marriage (Fernández and Lutter 2013, Kollman 2016, Mitchell and Petray 2016), protests and revolutions (Weyland 2009, Weyland 2012), spread of populism and far-right parties (Rooduijn 2014, Van Hauwaert 2019), and tax diffusion and competition (Holzinger 2005, Plümper, Troeger and Winner 2009, Gilardi and Wasserfallen 2016).

Likewise, the literature of other close subjects such as network analysis and diffusion of information (e.g. through social media) or network economics is also growing every day. The study of policy interdependency between states is also becoming more important with the ever-increasing global trade

and the similarity of many political issues such immigration that policymakers are facing in different countries. Furthermore, the similarity of many political and social movements such as the rise nationalism and populism on both sides of the Atlantic calls for better understanding of the process of policy diffusion among independent but interrelated states. The increasing role of transnational networks in political decision making and the flood of information (true or fake) among voters and actors through social media, add more to this calling. However, while some aspects of policy diffusion are well understood, still despite these numerous insights, it's hard to see the key lessons in some areas of the field. As Shipan and Volden (2012) put it: "*it is hard to see the forest through all of these trees*" and other surrounding forests.

In this introduction, after a quick review of basic mechanisms of policy diffusion, I address the main issue that this thesis tries to address. Policy diffusion generally refers to any form of policy dependency between actors in different jurisdictions, and most of the literature looks at this interdependency itself. This thesis on the other hand, focuses on domestic (and to a lesser extent international) political factors affecting this interdependency. More specifically below three chapter/papers study the conditionality and heterogeneity of diffusion, depending on domestic political factors. In this introduction, I also explain the scope of my thesis and where it fits in the bigger picture of the policy diffusion literature and elaborate the importance of the questions which my thesis is trying to address. Finally, I'll briefly review the structure of this thesis and explain how the three main chapters fit together and address the gap in the literature.

1 - 2 Policy diffusion, the puzzle and the gap

Policy diffusion literature numerates four main mechanisms for the interdependency of policies between independent jurisdictions. In other words, there are four reasons why policies spread between states or are interrelated. These four mechanisms are: learning, competition, coercion and emulation (Shipan and Volden 2008, Marsh and Sharman 2009, Shipan and Volden 2012)

Learning happens when policy makers (or other stakeholders) become aware of the possibility or the outcome of a policy in other jurisdictions. Therefore in a rational framework, they seek or receive

information about policies from other jurisdictions, something that could be called lesson-drawing (Rose 1991). Accordingly, policy spread can start by some policy makers taking initiatives and then once the outcome of that policy is known, other policy makers use that information to implement or not to implement similar policies. Volden, Ting and Carpenter (2008) provide a formal model to contrast such cases with scenarios where decision makers don't have access to public information and have to decide independently whether or not to implement a policy. They show how access to information especially by those decision makers whose preferences do not allow them to bear the cost of experiment, benefit from other's experiences. Therefore, learning can lead to diffusion. A major part of the diffusion literature is either directly or indirectly assumes an underlying political learning mechanism (Gilardi and Wasserfallen 2016).

Competition is another mechanism that causes policy interdependency. Decision makers take into account the outcomes and the effects of policies in other jurisdictions when they want to make their own choices. This means that policy makers may have to react to decisions in other jurisdiction because those decisions will have consequences not only their own jurisdiction but also in another jurisdiction. International competition can happen in many policy areas such as environment or taxation, the two topics that I've looked at as examples in this thesis. Such international competitions could lead to a "race to the bottom" macro pattern, a phenomena that its existence or lack thereof, is frequently studied throughout the literature (Prakash and Potoski 2006, Plümper, Troeger and Winner 2009, Genschel and Schwarz 2011).

Coercion causes policy implementation in case of pressure from stronger states or international organizations such as WTO (Drezner 2001). However coercion is rarely seen or studied as the main cause of diffusion and is suggested to be significant mainly in cases related to developing economies (Marsh and Sharman 2009). In such cases stronger states or international organization may impose restrictions or conditions for their support which then leads to policy diffusion in those developing economies.

Emulation, imitation or mimicry has also been proposed as a mechanism of diffusion, in contrast to learning. Shipan and Volden (2008) argue that it's rooted in the social psychology and the two can be distinguished by the focus on the *action* in learning mechanism in contrast to the focus on the *actor* in emulation. Marsh and Sharman (2009)¹ on the other hand propose that deep intertwined structural forces or modernization and rationalization could drive mimicry. In such cases politicians could implement policy for legitimacy seeking reasons rather than their effectiveness.

To put the above-mentioned mechanisms in a different perspective, one can see that four main factors and their interaction affect the process of diffusion.

(1) **agents** or decision makers such as politicians, activists or bureaucrat decide whether to support or implement a policy in their jurisdiction. While they're considered as independent decision makers, and their decisions are assumed to be based on their own political preferences and beliefs about the outcomes, the implementation of policies in other jurisdictions affects their decision through the four mechanisms numerated above. By learning, politicians can learn about the effectiveness and outcome of a policy or gain knowledge about the political consequences of its implementation. Competition also affects agent's decisions as it updates their expectation of outcomes in their jurisdictions in relation to the outcomes in other jurisdictions. They may emulate other agents for various reasons, and finally their decision may be affected by coercive force of other agents in other jurisdictions. However all of these factors are dependent and conditional on the agent's characteristics and constraints, for example policy makers with different prior beliefs about a policy can come to different conclusions after receiving information from others (Gilardi 2010). This learning, emulation, competition and coercion happen through a network of connections between agents and jurisdictions.

(2) **Diffusion networks** model the flow of information between agents, the interdependency of outcomes between jurisdictions, or competitive effect of policy outcomes. Emulation of agents or their coercive pressure can also be represented by a network². Characteristics of diffusion networks

¹ Based on an older edition of Powell, W. W. and P. J. DiMaggio (2012). The new institutionalism in organizational analysis, University of Chicago press.

² For example, membership of a certain international organization but is less looked at in this way

significantly affect the diffusion process. In other words, diffusion network models how agent's decisions or jurisdiction outcomes are connected to one another. For example, one could assume that geographically closer jurisdictions affect one another more significantly than distant ones. However, one could also look at other diffusion networks beyond geography, such as historical links, trade networks or membership of international organizations (Beck, Gleditsch and Beardsley 2006). The literature is rather rich on the effects of networks on diffusion; however, the key point here is that the characteristics of diffusion networks significantly affect the process of diffusion. Both the political science literature and the social and economic networks literature provide insight into how and through which networks diffusion happens (e.g. geography or trade), and how such characteristics affect the process of diffusion. I shall go into more details further below.

(3) **Policies** themselves also play a key role in the diffusion process. Whether or not the policy makers could implement them uniformly and homogeneously, if their outcomes can be known publicly and promptly and the visibility of an issue, existence of alternative policies, or how an issue is defined or framed are among factors that affect the diffusion process (Brooks 2007, Cao and Prakash 2012, Gilardi, Shipan and Wueest 2017).

(4) **Jurisdictions**, or more specifically institutions and rules governing the implementation of policies – beside actors' preference³ – such as constitutional rules or the number or combination of veto players also affect the diffusion process, and they are also rarely homogeneous. How decision makers translate their preference into policies differs significantly from one jurisdiction to another. This heterogeneity gives rise to a new form of conditionality rooted in the differences in domestic politics of jurisdictions which needs to be studied and accounted for (Lodge 2003, Lenschow, Liefferink and Veenman 2005, Cao and Prakash 2012).

There are other ways to look at the elements of diffusion, but these are common factors throughout the literature. Gilardi and Wasserfallen (2019) review the literature of policy diffusion and put these

³ These jurisdiction factors can sometimes interact with other factors such as the characteristics of the policy innovation or actors' preference e.g. Cao, X. and A. Prakash (2012). "Trade competition and environmental regulations: Domestic political constraints and issue visibility." *The Journal of Politics* **74**(1): 66-82.

factors in a stylized model of diffusion which is formed from; actors (e.g. policy makers), assumptions (e.g. how decisions are made which they propose are mainly made based on result of fact-based assessments), and mechanisms (learning and economic incentives).

Out of the four factors mentioned above, the role of networks in policy diffusion is rather more developed throughout the general literature of diffusion (Beck, Gleditsch and Beardsley 2006, Meseguer and Gilardi 2009, Gilardi 2014). One reason for this development is that the diffusion phenomenon itself has been of interest in a wide range of different subjects, and in all those studies, diffusion network plays a key role. In other words, regardless of what is being diffused (e.g. information or disease), or regardless of between what entities diffusion is happening (e.g. people or states), diffusion network characteristics affect the diffusion process. This gave rise to the study of diffusion in a diverse range of scientific fields such as technological or innovation diffusion, or marketing networks (Walker 1969, Leskovec, Adamic and Huberman 2007, Rogers 2010, Silverman 2011). Therefore, social and economic network literature focuses on the study of the role of networks in the process of diffusion and mainly assumes that nodes (agents) are either homogeneous or their level of heterogeneity is representable by a relatively simple random variable or parameter. For example, in a disease⁴ spread (diffusion) model, nodes can become infected as soon as they come to contact with another infected node, or be immune with a fixed probability rate. This fixed probability represents the level of heterogeneity. The aim of such studies is to build theoretical models that formulate macro related characteristics of the diffusion using micro parameters. For example, such models can calculate the fraction of susceptible or immune nodes, or the threshold needed for the diffusion of infection to a nontrivial segment of the population, based on characteristics of networks. These network characteristics include parameters such as maximum degree among nodes or infection/recovery rate (Kermack and McKendrick 1927, Bass 1969, Bailey 1975, Jackson 2008). Once a formal model is built, then they can be used for empirical studies. For example, in a public information setting, where contagion is based on the total population, if $F(t)$ represents the fraction of

⁴ Such as COVID-19 which is now spreading as I'm proofreading the final version of this thesis

the nodes that are infected or agents that have adopted a policy at time t . Then one could calculate $F(t)$ based on Equation 1-1

$$\text{Equation 1-1}^5: F(t) = F(t - 1) + p(1 - F(t - 1)) + q(1 - F(t - 1))F(t - 1)$$

p represents the innovation rate or the ratio of agents who have not yet implemented a policy but independently decide to so at each time period, and q is the imitation rate or ratio of agents who have not implemented a policy but decide to do so based on the fraction of others who have already implemented a policy in previous periods. Solving Equation 1-1 for $p > 0$ and initial condition of $F(0) = 0$ leads to Equation 1-2.

$$\text{Equation 1-2}^6: F(t) = \frac{1 - e^{-(p+q)t}}{1 + \frac{q}{p}e^{-(p+q)t}}$$

Therefore, one could later calibrate or fit Equation 1-2 to empirical data or the shape of diffusion curve and estimate p and q . This was just a simple example of what such studies aimed for and didn't quite demonstrate the role of networks in the diffusion process. If one assumes that some members of society are immune to a disease with a probability of π and one wants to see if a disease could spread to a nontrivial portion of the population once the immune individuals are removed from the network uniformly at random, then the role of network becomes more significant. If a network has a degree distribution P^7 and $\langle d \rangle_p$ denotes the expected value of d , then Jackson (2008:p. 191) shows that in such a setting π is related to d by Equation 1-3

$$\text{Equation 1-3}^8: \pi = \frac{\langle d^2 \rangle - 2 \langle d \rangle}{\langle d^2 \rangle - \langle d \rangle}$$

This means for example, that in a regular network where all nodes have the same degree⁹ of $\bar{d} = 3$ then the threshold is $\pi = \frac{3^2 - 2 \times 3}{3^2 - 3} = \frac{1}{2}$. Hence, a giant component of population will be infected if less

⁵ Equation 7.1 page 187 (Jackson 2008)

⁶ Equation 7.2 page 187 (Jackson 2008)

⁷ "The degree distribution of a network is a description of the relative frequencies that have different degrees. That is the $P(d)$ is the fraction of nodes that have the degree d under the degree distribution P ." for more see (Jackson 2008) page 30

⁸Equation 7.8 page 191 (Jackson 2008)

⁹ Denoted by \bar{d}

than half a population is immune. Discovering such relations between the network parameters and diffusion characteristics is the focus of such studies. Political units such as countries and states on the other hands are too heterogenous to be modelled in such a way, but briefly reviewing such studies is important to show how different subfields of the literature look at the issue of diffusion and formation of macro-patterns from fundamental basic interaction between units. This is what I propose the literature of policy diffusion should look at more specially. Especially more emphasis needs to be put on the study of the interaction of the domestic layer of decision-making which makes political units unique with the network of diffusion. In this thesis, I'll be proposing that ABM can be used as a solution to do so. In other words, the findings of the literature of network analysis needs to be considered and modelled in the policy diffusion studies with an emphasis on the interaction between the domestic and international factors. But before getting to what I posit that is the gap in the literature, first I'll review how the literature of policy diffusing usually models diffusion networks and measures diffusion effects.

Another area of diffusion studies that has focused on the role or types of networks in the diffusion process falls under the subfield of spatial econometrics and empirical measurement methodologies. Spatial econometrics as a subfield of economics deals with the spatial interaction and spatial structure units in time, cross-section or both (panel) (Anselin 2001). The main aim in such studies, is the identification and measurement of interaction between units within a space represented by a space/network matrix usually denoted by $W_{N \times N}$. If two units of i and j out of N units are connected to one another, or are interrelated, then w_{ij} denotes this connection or the strength of this connection where w_{ii} is 0. Therefore, in its simplest form, if units' variables such as y_i s are affected by other units' factors or y_{i-1} , (*all other units except i*) then such effect can be measured by $\sum_{j=1, \dots, i-1, i+1, \dots, N} w_{ij} \times y_j$ or yW in matrix format. This can be modelled as Equation 1-4 or a Spatial Autoregressive (SAR) model to be estimated.

$$\text{Equation 1-4: } y = \alpha I_N + \rho yW + \epsilon^{10}$$

In Equation 1-4, ρ measures the effect of units on one another through space.

To summarize, much of the effort in spatial econometrics literature goes to developing methods for correct estimation of these spatial effects. One part of this literature focuses on distinguishing between spatial lag/effect vs spatial correlation/error known as the Galton's problem. The main issue here is that when one observes spatial clustering between units (e.g. units that are closer together are more similar) then how one can distinguish if units are interacting with one another (spatial lag or effect) or their similarities come from underlying common exposure to similar factors (Franzese and Hays 2014). Other studies within this literature focus on different dimensions and interaction of time and cross sections with space (Franzese and Hays 2007) or different variable types such as limited dependent variables or duration models (McMillen 1992, Darmofal 2009), or using multiple spaces (Hays, Kachi and Franzese 2009). Accordingly, most of such studies take unit outcomes (such as country level statistics) as dependent variables and look at their relation and effects. Therefore, focus only on measurement of the inter-unit (international) relationship of outcomes while usually assuming unit heterogeneity. While there are other methods that have been used to model policy diffusion¹¹, the literature of political science usually takes this approach using similar methodological tools, and the spatial effects (e.g. correlation) are taken as diffusion effects between units

However, one fact that is regularly ignored in the study of policy diffusion is that the countries, states or jurisdictions where policies are implemented and political actors who make such decisions are rarely homogeneous. Meseguer and Gilardi (2009) call this issue strong homogenizing assumption and suggest it to be a problematic issue throughout the literature¹².

¹⁰ I shall not go into the details of the distribution of ϵ , in a Spatial AutoRegressive (SAR) it assumed to be $\epsilon \sim N(0_{N \times 1}, \sigma^2 I_N)$, an alternative to this model is an Spatial Error Model (SEM) where assumes only spatial clustering. For more details see LeSage, J. and R. K. Pace (2009). Introduction to spatial econometrics, Chapman and Hall/CRC.

¹¹ For example looking at dyads and modelling them as dependent or independent variables which I'll look at a few which used to model conditionality further below.

¹² Their review paper is focused (rather loosely) on reviewing two books but rather acknowledges the strong homogenizing assumption as a wider issue even throughout their own work. The two volumes are Simmons, B. A., F. Dobbin and G. Garrett (2008). The global diffusion of markets and democracy, Cambridge

Gilardi (2010) looks at unit conditional heterogeneity in the learning process. Gilardi (2010) proposes that ideological positions of decision makers affect their prior beliefs in a Bayesian setting. This heterogeneity in priors affects the posterior outcomes even when decision makers receive similar information. In other words, policy makers' beliefs are not independent of their prior beliefs, and these priors lead to a bias in learning. Therefore, Gilardi (2010) suggests that policy makers learn selectively from the experience of others, and finds evidence that right leaning governments tend to be more responsive to information about the electoral consequences, and in contrast, left leaning governments are more sensitive to information on policy effects. Gilardi (2010) emphasizes on this conditionality to show that the process of learning depends on the policy makers' prior beliefs and preferences as well as both policy and political outcome. Gilardi (2010) argues that, in the previous literature, the focus was on policy outcomes and this conditionality is ignored. In other words, Gilardi (2010) propose that beside policy outcomes which their success (or perceived success) can lead to the spread of such policies throughout jurisdictions (Elkins, Guzman and Simmons 2006, Volden 2006), one should also think about the political outcomes and preferences, and one should ask questions such as "what will be the political outcome [for me]?". Such considerations therefore can affect both the learning and implementation process, which themselves could affect the outcome or the perceived outcome by other decision makers, and therefore the inter-jurisdiction diffusion process.

Domestic preferences or prior beliefs can also directly affect the international process of diffusion, as for example other decision makers may infer ineffectiveness or undesirable political or policy outcome from the lack of implementation. Actors depending on their own preferences may also have little or no incentive to initiate policies. Volden, Ting and Carpenter (2008)'s formal model of diffusion shows how difference in ideological positions can lead to some decision makers implementing a policy with unknown benefits, which then could lead to others following these leaders. Once the outcomes became public, other actors can use that information to follow. However, in a more complex setting, where information diffuses throughout a network, or where decision makers receive multiple signals rather than gaining access to public information, interpreting such

University Press. **and** Weyland, K. (2009). Bounded rationality and policy diffusion: social sector reform in Latin America, Princeton University Press.

information is more complex. For example, Jensen and Lindstädt (2012) show that information about corporate tax cuts in left leaning government is received differently than information from right governments. Because left leaning governments are less expected to cut corporate taxes, therefore in such governments, corporate tax cuts will be perceived more seriously by other decision makers. In such cases actors will be more sensitive to these signals in contrast to signals from right leaning governments which are normally expected implement such cuts. Therefore, Jensen and Lindstädt (2012) give an example of how domestic politics on the signalling side affect the process of diffusion.

Domestic preferences or their heterogeneity can also translate into the conditionality of the network of information or diffusion. Ward and Cao (2012) show that for green taxes, policy learning can be conditioned by ideological affinity. Ward and Cao (2012) build a space of ideological affinity based on the median left-right position of the governments represented by $W^{left-right}$ in which ideological position of governments' substitutes their geographical position. Accordingly, the spatial lag in such econometrics model can be interpreted as learning from (or diffusion from) ideologically similar decision makers. In other words, ideologically similar political actors learn from one another. This application of alternative diffusion space by Ward and Cao (2012) to capture conditionality not only presents an example of "space is more than geography" (Beck, Gleditsch and Beardsley 2006) but also provides insight into how the policy diffusion process can be conditional on domestic heterogeneous factors.

Furthermore, the international diffusion process can also be affected not only by preferences and prior beliefs of domestic actors but also by the domestic political decision making process, institutions and rules. Ward and Grundig (2011) refer to this as political friction and propose agent-based modelling to approach such issues. This domestic political friction can significantly affect the diffusion at international level. For example, in complex information or diffusion networks, lack of or delay in policy implementation by multiple actors may send a weak or negative signal to the actors in other nodes. In Ward and Grundig (2011)'s Bayesian¹³ approach, agents update their prior beliefs based on

¹³ Their Bayesian approach in conceptual at agent decision making model rather than empirical statistical Bayesian modeling.

the signal which is the information they receive about other agent's implementation. If agents as decision makers observe implementation by other agents in their network, then they may update their prior beliefs about the effectiveness or political consequences of a policy. However, agents may not be able to distinguish between reasons for lack of policy implementation. In other words, decision makers, especially with networks of conflicting information sources, may not be able to distinguish if the lack of implementation by other agents is due to the ineffectiveness of policy and political preference, or it's rooted in political friction or domestic factors. Therefore, the effect of such domestic factors can be conditional on the characteristics of diffusion networks and vice versa. For example, the implementation of policies throughout network can depend on the combination of political friction and network density, as well as the effectiveness of a policy or its own characteristics¹⁴. If the diffusion network is not dense enough for agents to be aware of other's choices or the level of political friction is so high that too much momentum is required for a policy change, even good¹⁵ policies may never reach a critical mass to be implemented. In contrast to formal game theoretical model of Volden, Ting and Carpenter (2008), leaders may not have any incentive to experiment with new policies to measure their effectiveness and therefore the lack of implementation by others may perpetuate. This in my opinion is analogous to emulation but in the other direction towards keeping the status quo rather than implementing alternative policies.

Looking at empirical researches, while there are studies that look at the domestic characteristics and unit heterogeneity that affect the diffusion process, they are in general topic specific or don't look at the interaction between the network characteristics, diffusion stimuli that each unit receives, and general domestic political factors. One way to look at unit heterogeneity is measuring directly how it affect a diffusion macro characteristic, such as the speed of adaptation using traditional econometrics means. For example, Mitchell and Petray (2016) take an event history approach looking at the factors affecting the speed of adaptation in same-sex marriage, therefore measuring the effect of domestic characteristics such as religiousness on the speed that this adaptation happens. By doing so Mitchell

¹⁴ In fact, at preliminary stages of the first paper in chapter 2, I've replicated their work, in which the saturation or the whole network is very sensitive to this political friction and characteristics of the information network

¹⁵ Effective or politically preferred

and Petray (2016) test for network (neighbour) effects and unit characteristics by adding simple independent variables that capture such effects. In such settings, one macro pattern characteristics is used as the dependent variable and then network effects which will be capturing the effect of other units will be summarized in an independent variable, for example if the biggest neighbour has adopted a policy of not. Therefore, the network of diffusion is modelled very limitedly as another standalone variable in the equation. In this case they will be modelled as factors of an event history model¹⁶ such as a variable representing adaptation by largest neighbour states or the percentage of neighbours already adopted a policy. Such approaches while can be effective in specific policy areas, still lack the ability to model complex information or competition networks (e.g. in tax competition models). One can add more complexity (or interaction) to the model by calculating independent variable in such a way to capture the interaction of unit characteristics with other factors. For example, Prakash and Potoski (2006) use an independent variable that is calculated based on the interaction of network characteristic (trade level) and the unit heterogeneous factor of interest (environmental standard). Therefore, they create an independent variable of bilateral trade (based on the export directly to a country divided by total exports of a county) weighted by ISO 14001¹⁷ adoption to capture the interaction effect between the network (trade) and ISO adaptation. In another approach, Shipan and Volden (2014) use such independent variable formation in a dyadic setting to look at diffusion of anti-smoking laws between U.S. states. In this setting, conceptually each limited (0 or 1) dependent variable represents the learning between two states which can be modelled¹⁸ by independent variables such as state expertise or its interaction with other variables.

These methodological approaches or rather innovations in creating variables that capture unit heterogeneity effects, the diffusion effects or their interactions are not a problem per se and can even be used for modelling different mechanisms of diffusion (Shipan and Volden 2008), however they don't allow for modelling the interaction of a heterogeneous network of information (or diffusion) with heterogeneous unit characteristics. Therefore, I'm not arguing for any methodological deficit but

¹⁶ Cox Proportional Hazards model

¹⁷ An Environmental voluntary standard by International Organization for Standardization

¹⁸ Using probit or even OLS

without modelling and capturing complex interactions, the literature therefore lacks attention to general theories that look at the interaction between the network and unit political characteristics. In other words, the above literature's approaches lack a general or common methodological and theoretical framework for looking at unit heterogeneity in responsiveness to diffusion stimuli caused by domestic political factors and processes. Therefore, I posit that not enough attention is paid to the study of the domestic process as a source of unit heterogeneity which interacts with the network, in the policy diffusion studies.

In this thesis I argue that for deep understanding of the policy diffusion process one should look at the interaction between policy characteristics and domestic political factors. Neumayer and Plümper (2012) propose a spatial econometrics method that allows for modelling the interaction between domestic heterogenous factors and the spatial stimuli which captures the heterogenous diffusion stimuli from all over the space. Using their approach, I focus on the domestic factors in the diffusion process.

One other source of problem, when looking at the interaction between domestic factors and networks, is that formal theory approaches, for example using game theory models such as the one suggested by Volden, Ting and Carpenter (2008) become too complex too quickly when one tries to model domestic political and international processes and their interactions. Such models become even more complex when one adds the characteristics of policy innovations. A comprehensive model in such setting needs to account not only for a multiple layer of decision-making processes but also heterogenous actors within and heterogenous connections between these layers.

However, such interactions are important for understanding of the diffusion process. For example Cao and Prakash (2012) show that characteristics of a policy innovation such as visibility of a pollution issue can be a key factors in the support of veto players throughout the domestic political. Cao and Prakash (2012) show that support of such actors could help or hinder competitive pressure or the race to the bottom, and governments may react to international competitive pressure not by rewriting regulations (de jure policy change) but rather opt for lower enforcement of existing regulations (de

facto policy change). All of the above adds a layer of complexity to the process of diffusion which cannot be understood without better understanding the domestic political interaction and processes.

Furthermore, Brooks (2007) shows that the interaction or the match between the characteristics of a policy innovation and country attributes can determine where and when policies diffuse. Brooks (2007) looking at pension reforms, proposed that the sunk financial and political costs of adaptation affect the diffusion forces in the domestic policy process in addition to country characteristics such as the level of economic development. These factors all together shape the mechanisms of adaptation at domestic level which will determine when and where diffusion happens. In other words, diffusion will happen conditional on the match between these factors. Such financial and political costs are formalized by Braun and Gilardi (2006) in a utility function which I later on use in this thesis. Therefore, Brooks (2007) shows the importance of domestic political processes in the general processes and mechanisms of diffusion which I propose should be studied more both theoretically and empirically. Furthermore, this line of research also shows that decision-makers are often presented with a bundle of policies or in many cases policy alternatives. Genovese, Kern and Martin (2017) take a deeper look into policy diffusion when alternative policies exist and show that ignoring such interactions may result in misleading empirical results. Extending this line of research while looking at domestic political factors is another aim of this thesis.

To summarise, all the initially discussed factors of; network characteristics, unit specific characteristics such as electoral and decision-making rules, preferences of actors and voters within these jurisdictions, and finally the policy characteristics themselves can be sources of heterogeneity in the diffusion process. This means that the response of units such as countries to information or diffusion pressure from other units will be conditional on these factors. These factors also interact with one another when it comes to the process of diffusion. I argued that the role of domestic politics in the policy diffusion still needs to be developed more in the literature.

To put all the above together, I propose that the studies of policy diffusion need to pay more attention to the role of domestic politics in the process of diffusion, both theoretically and empirically, and

specially look at the conditional responsiveness that arises from the interaction between these factors and international stimuli. In other words, more studies need to look at how the interaction between domestic politics (or actors) and international information or diffusion and competition pressure that domestic actors receive, affect the general diffusion process and formation macro patterns.

Therefore, in this research I focus on the domestic political factors which I argued that have been less developed throughout the literature. More specifically I look at the conditionality that is caused by these factors. I propose that such conditionality needs to be modelled theoretically and controlled for and measured empirically. Accordingly, the aim of this research is to look at the effects of general domestic political factors, which one can use ABM for model theoretically and measure empirically as unit heterogenous conditional spatial lag effects.

Gilardi and Wasserfallen (2019) review the policy diffusion literature and suggest that the study of policy diffusion narrowly focuses on policy adaptation or in their words the literature of policy diffusion is “overly focused on the idea that effective policies spread as policy makers evaluate policy outcomes in other units because either they learn from or they compete with them.” and suggest going beyond policy adaptation, such as looking at issue formation stage (Gilardi, Shipan and Wueest 2017). While acknowledging the merit in their suggestion, I on the other hand propose that one way to expand this narrowness is by looking at domestic politics of diffusion in more depth and its interaction with international factors. For example, by looking at how policy makers evaluate policy outcomes when they receive information and how their decisions affect other decision makers, which I believe still needs more in-depth study. I suggest that ABM can help with theory and looking at conditional responsiveness can help with empirical studies and measurement. Therefore, this research attempts to show, how ABM can be used in building general¹⁹ theories of diffusion which takes a deeper look at domestic political factors and processes, and how one can test and measure for their effects empirically.

¹⁹ In contrast to policy area or factor specific theories.

1 - 3 My proposition and approach

I argue that, for better understanding of international policy diffusion process, especially with regards to the formation or lack of international macro patterns, we need to put more emphasis on domestic politics. I propose that the heterogeneity of domestic actors and their interaction with the diffusion network can significantly affect the process of diffusion and therefore the outcome and patterns of policy implementation.

In this research, I focus on the role of domestic politics in the policy diffusion process, more specifically, on how heterogeneity of decision makers affects the process of diffusion. For example, I'll look at how polarization and conflict between agents and voters affect the diffusion of efficient or inefficient policies in different networks and scenarios of diffusion. Another issue that I focus on, is that how domestic political factors, such as the *Left-Right* tendency of governments, affect the responsiveness of them to international stimuli. Finally, I also look at how conditionality of diffusion can depend on the international diffusion pressure (of effect) and in the presence of related policy areas diffusion stimuli can conditionally spill over between areas.

I propose that much of the research in policy diffusion focuses on the international aspects of diffusion and lacks attention to these factors. I argue that the study of the effects of domestic politics is an important factor answering many questions of policy diffusion. For example, when looking at capital tax competition and lack of a race to the bottom, Plümper, Troeger and Winner (2009) show that the size of countries, budget rigidities, and fairness norms can hinder the race to the bottom. This is not a new argument and many studies highlight the importance of political factors and restrictions in different parts of the literature (Simmons and Elkins 2004). However, I believe that mainly because of methodological challenges, literature still lacks depth in how domestic politics and how unit heterogeneity affects the process of diffusion. This is the gap that my thesis addresses. Each of my three papers addresses different but related aspects of this gap. The first paper looks at how theoretical gaps can be filled using ABM and as example looks at how domestic factors such as polarisation affect the diffusion process. The second and the third paper, build theories that suggest how domestic politics affect the diffusion conditionally and test for them empirically.

I take inspiration from different parts of literature to address these issues. Ward and Grundig (2011) propose an agent-based model approach which I used to address the theoretical issues. This approach as mentioned below allows for a level of complexity that is not possible otherwise. Regarding measurement of conditionality, I follow an approach suggested by Neumayer and Plümper (2012) which allows for measurement of conditional spatial lag effects. This modelling allows for direct capturing of conditional unit responsiveness towards international stimuli. My two other papers use this method to capture conditionality taking further inspiration from Gilardi (2010) to take left-right tendency of governments as the conditionality factor.

Finally, I wish to clarify that these papers, individually and collectively, focus on the process of diffusion rather than how it's applied to specific policy areas. Gilardi (2014) suggests that one should “clarify whether the goal is to improve the understanding of diffusion itself or to use diffusion research to explain another phenomenon”, as a good practice in policy diffusion, and I wish to emphasize that my research falls in the former category. This may look obvious at the first glance, however as this thesis consists of three separate independent papers of which two also contribute to other subject areas as well as policy diffusion, I felt the need to clarify this here to avoid any confusion for the reader.

1 - 4 The structure of the thesis

This thesis consists of three papers on the theme of policy diffusion which are written relatively independently and form the next three chapters. As independent papers these three chapters have some overlap and repetition²⁰ which I hope that doesn't bother or bore the reader. On the other hand, I've targeted them to specific topics²¹ and therefore they lack comprehensive review of general policy diffusion literature, but rather a shorter more topic related review. However, I've tried to compensate for this issue by giving a brief review of the policy diffusion literature in previous sections.

The first paper, “*Domestic and International Determinants of Policy Diffusion: An Agent-Based Approach*” looks at heterogeneity among units – i.e. states and agents- purely from a theoretical point

²⁰ Especially in the econometric models review and methodology.

²¹ Mainly taking into account the limitations of publication in general political science journals

of view. Using an agent-based modelling approach, it provides a framework for the study of policy diffusion where decision making agents are in a heterogeneous setting. While different formal and theoretical models exist that allow for the analysis of domestic factors (Chaudoin, Milner and Pang 2015), using an agents based approach opens the door for more complex analysis of policy diffusion. For example, Volden, Ting and Carpenter (2008) propose a formal model that explains how diffusion happens through learning between different countries where they have different preferences, but their models is rather limited regarding the types of domestic actors and network of information. However, using an agent based modelling approach allows for more complexity in such areas, provides more knowledge on how micro changes can translate into macro patterns, and helps in analysis of the interaction between domestic factors such as the distribution of local voters and agent preference with different networks of information. This paper focuses on polarization and conflict between agents and voters as an example, and shows how they affect the implementation of efficient policies. It finds that conflict between agents can lead to the diffusion of efficient policies as voters are provided with a more diverse set of options and agents need to compete for office, while polarisation of voters can lead to implementation of inefficient policies as actors lose incentive to compete with votes and act more ideologically.

The second paper, *“Conditional Political Determinants of Environmental Spending Diffusion”* focuses on the specific area of environmental policies as a polarised policy area. In doing so, it attempts to create a distinction between leaders and followers of a policy area, left and right of the median government position and analyse their different approach towards the same issue based on the political and implementation costs to actors. It proposes that in polarised areas that actors compete for votes, actors that are more expected and can afford initiations take the role of the leader while followers compensate by becoming more responsive. It contributes to the literature as how leadership and followership in such areas affect the responsiveness of decision makers towards international stimuli and finds evidence that less environmentally friendly governments are in fact more responsive to changes in other jurisdictions. Similar to Gilardi (2010), it shows that the ideological preferences of

decision makers can affect their responsiveness to international stimuli using a different conditional spatial econometrics method (Plümer and Neumayer 2010).

And finally the third paper, “*Political Determinants of International Conditional Diffusion of Tax Rates Changes in Europe*” looks at how having alternative but related policy options – i.e. different taxes - affects the process of diffusion and how different governments transfer the signal from one policy (i.e. one form of tax rate changes) into the alternative policy based on their own preferences. The existence of alternative policies is an important factor from a domestic point of view because it makes actors less constraint. From a diffusion point of view, it’s important as it can seriously affect the measurement of outcomes. Genovese, Kern and Martin (2017) address this issue and show that when decision makers face alternative policies, as they usually do, other domestic factors such as reliance on economic flows can play a significant role in policy adaptation. In other words, domestic politics and policy alteration interact with each other significantly when it comes to international policy diffusion process. My third paper, argues and finds evidence for the link between the domestic political conditionality of diffusion and the international diffusion pressure or strength (such as competitions). It also posits that diffusion effects can spill over related areas and empirically tests for it in simultaneous equations specification.

2 Domestic and International Determinants of Policy Diffusion: An Agent-Based Approach

Abstract

Using agents-based modelling this research provides a framework to study the domestic and international determinates of policy diffusion. It shows how agents-based modelling can be used to study policy diffusion in multi-layer settings where voters' and actors' preferences and distributions, decision making rules and the information diffusion networks are heterogeneous and interacting with one another. Through implementation of different scenarios, this paper looks at the characteristics of different macro patterns and how changes in micro level parameters affect these macro characteristics including the conditions that facilitate the diffusion of optimal (Good) policies. Specifically, this paper looks at the effects of polarisation and conflict between voters and decision-making agents on policy diffusion. Simulation results show how conflict between agents can lead to the diffusion and implementation of policies that voters prefer, while in contract, polarisation amongst voters can lead to the diffusion of inefficient policies in some scenarios. Furthermore, simulation and comparison of different knowledge diffusion scenarios show the importance of studying the mechanisms and methods of knowledge diffusion between jurisdictions in empirical studies which could lead to different macro-patterns.

Keywords: Policy Diffusion, Agent Based Modelling

2 - 1 Introduction

Study of the interdependency of policy implementation between independent decision-makers and states or *policy diffusion* has been the focus of many studies over the last few decades (Meseguer and Gilardi 2009, Graham, Shipan and Volden 2013, Gilardi and Wasserfallen 2019). Policy diffusion literature provides us with a good understanding about the fundamental principles of the diffusion process, as to why policies spread around or politicians implements or not implement similar policies (Gilardi 2014). However, the many new challenges that policymakers are facing in different states and ever more interdependency of communities through globalization and social media, alongside new developments in other fields of research such as the social network analysis, calls for more and deeper studies into the policy diffusion process. Policy diffusion process can be very complex and hard to study. However, new applications of methodological tools such as agent-based modelling allows us to examine these complex interactions in ways that previous studies could not.

Many factors at different levels affect the process of diffusion among policy makers. Studies can focus of one or more of these factors, such as the network of information or diffusion (Beck, Gleditsch and Beardsley 2006, Ward and Cao 2012), mechanisms of diffusion (Holzinger, Knill and Sommerer 2008, Shipan and Volden 2008), alternative policies (Genovese, Kern and Martin 2017), or domestic politics (Simmons and Elkins 2004, Simmons, Dobbin and Garrett 2006, Gilardi 2010). However, study of the interaction between these factors or looking at them in a coherent framework is a challenging task because of the level of complexity that each of these factors adds to the problem.

Social science literature has long suggested the use of agent-based modelling simulation as a method to use computational power for addressing this complexity. Agent-based models proved to be capable of providing deep insight specially when researchers are working with multiple heterogeneous decision makers with complex relationships such as political actors and their network of information (Axelrod and Hamilton 1981, Axelrod 1997). Nevertheless, use of agents-based modelling (ABM) simulations is rather limited in the literature of political science and specifically policy diffusion.

Using an agent-based approach and building on previous diffusion models, this research presents an extensive framework to look at domestic political factors and decision-making processes and their interaction in combination with different modes of information diffusion. To show the application of this framework, then I focus on the effects of polarisation on the diffusion process. I argue that current literature of international policy diffusion has not paid enough attention to domestic factors. Policy diffusion by nature is an international process and this lack of attention to domestic factors is a direct consequence of the complexity that adding a new level of political interaction adds to diffusion models. ABM helps to address this complexity and this gap in the literature.

Emergence of macro-patterns (e.g. race to the bottom or the top) and macro characteristics of the diffusion process (e.g. saturation level) are among the key aspects of policy diffusion. The current state of literature provides different models to explain how macro patterns such as S-curve adaptation can form from simple underlying processes (Rogers 2010). Building on the general ABM approach proposed by Ward and Grundig (2011) I add a layer of heterogeneous domestic voters and actors with different preferences, and look at the main macro characteristics of diffusion in different scenarios.

I focus on the spread of information between decision makers and the consequent policy adaptation in independent states. My proposed framework allows for the study of multiple possible diffusion processes in combination with different domestic political factors, for example the diffusion of information between different jurisdictions in contrast to agent-to-agent information diffusion. Therefore, I simulate three different scenarios and look at how domestic factors and especially the polarization of voter's preferences in each scenario affect the macro characteristics of diffusion throughout the community of states.

I show that how different domestic factors and parameters such as variation of voters' preferences, domestic political conflict between decision makers or the number of decision-making agents, affect the main characteristics of policy diffusion such as the speed or the depth of implementation within the community. I also look at how such factors in different scenarios affect the adaptation of optimal

policies based on the preferences of the population of voters. These findings give us insight into which factors in different scenarios affect the diffusion's macro patterns.

2 - 2 Policy diffusion

Literature of policy diffusion falls into two main categories. One side mostly includes theoretical studies that explain why and how diffusion happens in networks or between different political jurisdictions. These studies try to explain the presence or absence of macro patterns of policy diffusion. (Braun and Gilardi 2006, Volden, Ting and Carpenter 2008). In the less theoretical part of this category when studies deal with policy specific issues empirically, such as when researchers are looking at environmental policy convergence or trying to explain why political parties learn from one another, they usually focus on empirical tests to find such macro patterns (Holzinger and Knill 2005, Ward and Cao 2012, Böhmelt et al. 2016) The second group of researches focuses on measurement methods. This part of literature predominantly focuses on development of methods for better identification of diffusion macro patterns (Anselin et al. 1996, Beck, Gleditsch and Beardsley 2006, Franzese and Hays 2007, Franzese and Hays 2008) . This study falls in the first category.

One limitation of most studies in the first category comes from the fact that multiple factors at different levels affect policy interdependence, sometimes at the same time and not always uniformly. Political preferences of actors, characteristics of policies, method and mechanism of diffusion and network of information all affect outcome of the diffusion process (Beck, Gleditsch and Beardsley 2006, Franzese and Hays 2008, Gilardi 2010). Literature on measurement side to some degree has started to deal with such complexities, for example multiple network spatio-temporal lag models (m-Star) can be used for capturing the effect of different simultaneous diffusion networks (Hays, Kachi and Franzese Jr 2010). Or in another example recent econometrics models allow for measurement of conditional diffusion (Neumayer and Plümper 2012, Chaudoin, Milner and Pang 2015). While the measurement side dominantly deals with identification and measurement of macro patterns at an aggregate level, the theoretical side needs to deal with both micro and macro level complexities and

their interaction. Gilardi (2010) looks at the effects of domestic ideological tendencies or prior beliefs or actors in learning from the information and therefore the effect that such heterogeneity has on the diffusion process. Gilardi (2010) argues that different decision makers due to having different prior beliefs treat information differently. In this Bayesian setting, agents who receive similar information due to different priors come to different posterior beliefs and therefore learning is biased. Such information could be about the outcome of policies themselves or their political outcomes and therefore could lead to different policy implementation according to politicians' ideological tendencies or preferences. Therefore, Gilardi (2010) shows how domestic political preferences or differences could be a source of diffusion conditionality. This conditionality could also happen on the signalling. For example, Jensen and Lindstädt (2012) show that information about corporate tax cuts in left leaning governments is taken more seriously by other states than similar changes in right leaning governments. They argue that unexpected behaviour of left leaning governments in such cases sends a stronger signal. Now adding more interacting factors to the analysis of policy diffusion could very quickly raise the complexity of models.²²

As mentioned before, dealing with such level of complexity is a challenging task. Ward and Grundig (2011) propose ABM as a solution. Following this proposition this research builds a framework that allows for all that complexity to be captured. While Ward and Grundig (2011) mainly focus on the diffusion process and transmission of information, I propose a new layer of voters' preference inspired by spatial political competition models. Combining it with a utility-based model of diffusion suggested by Braun and Gilardi (2006) this layer allows the framework to capture jurisdiction heterogeneity as well as answering questions about the adaptation and diffusion of optimal policies based on voters' preferences. This to my knowledge has not been addressed in the literature before.

Therefore, this research attempts to close two gaps in the literature; first, to propose a method for analysis of policy diffusion which can capture a high level of complexity and answer questions that previously were not being addressed in the literature. And secondly, by using the proposed method

²² I've reviewed these factors and their interaction in the Introduction section of this thesis

and analysing the outcome simulations, this research compares different scenarios of diffusion and shows what factors affect main characteristics of diffusion from a domestic politics standpoint.

In summary I build an agent-based model that consists of two levels. At the domestic level, agents implement policies while interact with each other in an international level. Current game theoretical models in literature (Volden, Ting and Carpenter 2008) lack this level of complexity.

2 - 3 Polarisation and Diffusion

As an example, to show the application of this framework in studying the process of diffusion and how it can deal with the complexity of interactive parameters, I focus on the effects of the polarization of voters' preferences on diffusion. Polarisation is as an important factor in policy innovation and adaptation, and while the polarization and its effects on policy choices and innovation by agents (such as parties) has been studied extensively (Ezrow 2007, Dalton 2008, Fiorina 2017), its role in the diffusion process is less understood. Here I use the proposed ABM framework to study the effects of polarization on the macro-patterns and characteristics of diffusion.

In this paper, I define polarization as increase in the variance of voters' ideological positions, or in other words when ideological views of voters or agents become more distant from the political centre (Ezrow 2007, Dalton 2008). An alternative approach, is to look at what is called "affective polarization", which can be defined as dislike, distrust or unwillingness to interact with the voters or agents of other ideological affiliations (Iyengar, Sood and Lelkes 2012, Druckman and Levendusky 2019). Use of variation as the main factor determining polarization among voters is preferable because it's consistent with the one dimensional proximity spatial model of utility that I use in the implementation of the framework (see section 2 - 6 - 2 page: 40) . An alternative to proximity model, is the directional model of voters' preferences (Rabinowitz and Macdonald 1989) where voter's preferences is determined based on the direction of a policy or an agent, rather than their proximity to its position. In other words, voters' behaviour in directional models is determined by who's side they belong to rather than their ideological proximity. It's important to note that the polarization of voters' preferences can itself affect the behaviour of voters. For example, Prados-Prado and Dinas (2010)

show that in less polarized systems, proximity is a more relevant determinant of voters' behaviours, but as the polarization increases, directional dynamic becomes more suitable. With this note, out of necessity to choose one approach out of the two for implementation, to be consistent with the proposed models of Strom (1990) and Braun and Gilardi (2006) which I have later on used in the implementation of my framework, I choose the proximity models as the basis for calculation of utilities and voters' preferences.

The literature of polarization proposes bi-directional interaction between the voters and their level of polarization, and decision making agents such as parties (Ezrow 2007, Orriols and Balcells 2012, Fiorina 2017, Druckman and Levendusky 2019). Ezrow (2007) shows that changes in the variance of voter's preferences affect the variance of policy choices on offer in party systems, while the electoral system can affect the sensitiveness of parties to the variation of voter's preferences. Spoon and Klüver (2015) find evidence that voter polarisation increases the party responsiveness.

On the other hand, beside more general causes of polarization amongst voters such as sociological changes and generational differences for example on environmental issues (Inglehart 1971, Ross, Rouse and Mobley 2019), parties, decisionmakers and media's positions can also contribute to the polarization of voters' preferences (Bernhardt, Krasa and Polborn 2008, Bolsen and Shapiro 2018). Bischof and Wagner (2019) find evidence that elite polarization and radical views gaining political legitimacy can lead to voter's politicization.

Still, with the above-mentioned role that polarisation has on policy implementation and innovation, the role and effect of polarization in policy diffusion is not fully understood. Volden, Ting and Carpenter (2008)'s framework allows for a limited trade-off between the ideological distance between units (or jurisdictions) and cost of adaptation. Such approaches don't address the domestic political factors such as voter's polarisation. In other words, the voters' polarisation as a domestic factor is not theoretically addresses throughout the literature of diffusion. Furthermore, in measurements and empirical studies, only through the conditionality of information networks where ideological distances

are used to build diffusion networks the polarisation is indirectly modelled, and its effects on diffusion is not directly studied (Beck, Gleditsch and Beardsley 2006, Ward and Cao 2012).

I propose that polarization both directly and indirectly affects the diffusion process. Directly through voters' preferences and their support for a specific policy, and indirectly through their ideological position of decision-making agents that represent voters and the level of conflict that these agents have with other agents.

There are two distinctions that need to be made; (1) polarisation vs salience, and (2) polarisation vs the numbers of parties or fractionalisation in the decision-making body (such as the government).

In contrast to the polarisation as the variation of voters' preferences and their deviations from the political centre, salient issues can be defined those issues that are more prominent in mind of citizens²³, require more public involvement (Eshbaugh - Soha 2006) or more agenda attention, from the parties (Koski 2010).

Salience itself affects both the level and the mechanism of policy diffusion. While less salient policies do diffuse amongst the units, more salient issues and policies are more likely to be diffused and more of the literature is dedicated to the study of salient issues (Emmert and Traut 2003, Clark and Allen 2004, Koski 2010). Furthermore, the mechanisms of diffusion can vary between high or low salient policies, for example Koski (2010) shows the importance of non-ideological knowledge brokers in the diffusion of less salient policies in contrast to the more salient policy areas where learning can happen directly between ideological actors such as politicians or parties. Similarly, Clark and Allen (2004) show that unlike more controversial environmental policy domains—partisanship, ideology, party control of government and interest group forces do not have an impact on adoption of less salient environmental policies and such policies are more likely to be implemented based on economic considerations.

On the other hand, polarisation can be linked to salience. For example, empirical studies show that voters put more weight on the polarized issues when faced with a multi-dimensional policy spectrum

²³ <https://pprg.stanford.edu/wp-content/uploads/The-Origins-of-Policy-Issue-Salience.pdf>

and in many cases voters find identifiable choices when parties are divided on issues (Carmines and Stimson 1989, Orriols and Balcells 2012). Similarly, on the supply side of policies, polarisation causes more salience, as for example with more responsiveness on polarised issues, parties put more emphasize on polarized issues in their manifestos (Spoon and Klüver 2015). With regards to the interaction between salience and polarisation in the diffusion literature, Boushey (2016) show that the combination of two can affect the characteristics of the implemented policy due to electoral pressure of some groups, in a way that extends benefit to strong, popular and powerful targeted groups.

All being said, from the theoretical standpoint in a one policy dimension, in this paper I focus on polarisation while an extension of the proposed framework here can in fact accommodate for a multi-dimensional policy space, where the salience can be analysed with the pay-off weight that voters give in their utility function (see Equation 2-1 in page 40). Therefore, I make the distinction between the two in this paper and I will be focusing on polarisation as the issue salience is comparative concept is meaningful only when comparing policy areas.

The second distinction that I make here, is between the polarisation of voters' preference and the number of decision-making agents and their level of conflicts. As mentioned above the, political actors and voters' preference can interact with one another and to control this interaction I vary the number of agents and the levels of conflict that they have with one another. While empirical evidence puts more weight on polarization (or the quality of representation) than the party count (quantity of representation) or fractionalization (Dalton 2008) , in this paper I control for the count and conflict of decision making agents. One should also distinguish between the number of agents and the veto players. While veto players can affect the process of diffusion, for example conditional on the visibility of issues (Cao and Prakash 2012), in this paper I only look at the number of agents with equal weight in the decision making process as to capture the effects of fractionalization in the diffusion.

Using ABM, I implement these two effects in the framework through two separate parameters: (1) dispersion or variation of voters' ideological preferences which varies from simulation to simulation

along one dimensional ideological preferences, (2) the level of conflict between the agents that learn about policies in other jurisdictions and decide whether to support or not to support them in order to be implemented in their own jurisdiction for their voters. Section 2 - 6 - 1 (page 39) details the implementation of these two factors.

From a theoretical standpoint, I argue that these factors affect the diffusion process at two levels. At the international level the polarisation of voters' and the conflict between agents affect the network of information and the signals between agents. As mentioned above, literature of diffusion (Beck, Gleditsch and Beardsley 2006, Plümper and Neumayer 2010, Ward and Cao 2012) looks at the ideological space and distances as a coitional factor affecting the signalling between units and agents. I argue that polarisation systematically affects the ideological space and should be looked at as an independent factor affecting the process of diffusion. I propose that with high polarized voters and agents, the ideological distances between units with difference ideological positions (i.e. distance between left and right wing parties) can increase while agents with similar ideological positions in different jurisdictions can actually become closer to one another in the knowledge network, facilitating diffusion amongst themselves. For example, anecdotally one can look at far right parties or groups in different countries of Europe where their positions gets closer due to knowledge diffusion (Van Hauwaert 2019) while in many cases the polarisation amongst and within sates is increasing. Polarisation also affect the signalling value of information between units, besides the fact that ideological distances affect the level of communication between units and agents, polarisation affects the signalling value of the information received from an ideologically similar/different agents who supports or implements a policy in a similar political environments of a different jurisdiction. This is because such information can help in better interpretation of the voters' pay off value of a policy for vote seeking agents. For example Böhmelt et al. (2016) show that parties learn from other incumbent or successful parties in other countries in order to compete more effectively. I propose that such learning can be affected by the level of polarisation, as voter's preferences are more polarises the information from similar ideological actors become more valuable and the other agents are becoming more and more distant from one another. To summarize, I argue that as ideological dimension

becomes more polarized agents with similar ideological views in different units not only communicate with one another but also put more value on the information they receive from each other. On the other hand, farther agents become less connected and their information becomes less valuable.

At the domestic level, as mentioned above, polarisation also affects the implementation of policies. Once the knowledge about an alternative policy become available to the agents of a unit, polarisation can affect the implementation process. Evidence and arguments on the effects of polarization on policy adaptation is mixed. On one hand, one can argue that higher polarization leads to conflict and inefficient policy making (Powell 1982, Schultz 1996, Lijphart 2012), on the other hand there are some argument proposing that polarisation can invigorate democracies and make parties more responsive (Carmines and Stimson 1989, Dalton 2008, Spoon and Klüver 2015). I argue that when studying diffusion, beside the solely domestic mechanisms, polarisation affects the diffusion through different means. For example, the higher the polarisation of the whole community of the higher the possibility of alternative policies. The wider the ideological variation in different countries and units the more diverse the policy innovations that can diffuse to other counties. I argue this can lead to a positive effect on the efficiency of the policies that can be implemented, however the effect of which can be cancelled out by inefficient policy adaptation at the domestic level due to higher conflict among agents and voters. I propose that ABM can be used to capture the interaction between such factors to shed light on the effects of domestic factors on the whole process. Furthermore, it worth mentioning that, the international and domestic effects of polarization which I briefly discussed above, can also interact with one another. For instance, polarisation at domestic level can impede implementation due to political conflict which could itself lead to lack of implementation by neighbouring countries or jurisdictions. In this paper, I argue that the proposed ABM here can capture the interactive effects or domestic factors such polarisation on key macro-pattern characteristics. In order to do so, in this paper I look at three key diffusion variables, (1) the speed of diffusion which is calculated based on the time passed from an external shock for the system to reach a new equilibrium, (2) the efficiency of diffusion, which can be measured by the percentage of units or countries that implement a more efficient policy according to their voters' preferences, and (3) the level of

saturation, as the percentage of countries or units that have switched from an status quo policy to an alternative policy (which is not necessarily preferred by the majority of voters).

Below explains the diffusion framework and the implementation of the international and domestic factors using ABM.

2 - 4 Agent Based Diffusion Framework

This section explains the diffusion framework that I put forward for modelling and analysis of the diffusion of policies based on learning between agents in different jurisdictions. First, it explains the general characteristics of the framework. Then subsections provide details on different aspects of this framework such as countries, policies, populations, agents and the network of information. Finally, it goes through different scenarios of information transfer and decision-making putting all these elements together explaining how simulations will be conducted.

Policy diffusion literature numerate four mechanisms as the source of policy diffusion: learning, competition, emulation, and coercion²⁴ (Shipan and Volden 2008, Marsh and Sharman 2009, Shipan and Volden 2012). Once a state implemented a policy, politicians or actors in other states can observe the policy and political outcomes of that implementation and use that information for the implementation of similar polices in their own jurisdiction. This diffusion of information gives rise to policy adaptation throughout states and causes policy diffusion. In this paper, I focus on the learning mechanism as the source of diffusion and build diffusion framework based on it below. However, ABM similarly can be used in cases of emulation and with some alteration even in the study of competitive or coercive diffusion.

I propose a diffusion framework that consists of j jurisdictions (e.g. countries). Each jurisdiction represents decision makers with an internally independent process for policy implementation (e.g. a government or a parliament with its own decision-making rules). Jurisdictions also have a population of voters where each individual voter has a policy preference along one dimension²⁵ similar to

²⁴ I've briefly reviewed these mechanisms in the Introduction section of this thesis

²⁵ More dimensions can be added in form of extensions.

common spatial models of politics (Schofield 2007). Each country has i agents who represent political agents (such as parties or interest groups). These agents are actors within that specific jurisdiction and can support a policy. Implementation of a policy happens based on domestic rules when enough support is achieved for that policy. Therefore, agents maximize utility within the decision-making process of each country which could lead to policy implementation in that country. Beside seeking office, agents also have preferences which represents their own political ideology or interest. Agents within each jurisdiction act independently to maximize their own utility based on their own ideological position and the voters that will support them. I'll go into more details about agents' utility function further below. Finally, implementation of a policy in each jurisdiction depends on the overall decision of the agents within that jurisdiction.

In this setting, two²⁶ policies exist, the *status quo* (SQ) and the *alternative* (ALT) which represents policy innovations that could diffuse between states. Policies have two main characteristics, a spatial position and a level of effectiveness. Agents maximize their utility by choosing SQ or ALT based on three factors; (1) ideological position of themselves and the policies, (2) effectiveness of policies, (3) and the popularity of each policy among voters. All countries start with the same SQ policy and switch their policy (i.e. from SQ to ALT) if enough agents, depending on internal decision-making rules, decide to switch²⁷. Assuming political friction, the policy switch within a jurisdiction doesn't happen immediately. Agents must hold their preference for a minimum period of time for the jurisdiction policy to switch. During this time, agents can change or update their support based on the information they receive. Once a policy is implemented in a country, there will be no reversion to SQ. In other words, there needs to be some momentum (e.g. majority) for some time for an alternative policy to substitute status quo. A policy lags variable models this political friction and majority preference for *Alt* needs to be hold for at least this amount of time before the policy changes.

Figure 2-1 shows a sample of three countries in this framework with the position of agents, policies and the distribution of the population. These countries each have three agents with different policy

²⁶ In a more general framework this framework can be extended for more than two policies.

²⁷ In all scenarios, the threshold is if more than 50% of agents switch.

preferences and their own population of voters. The position of the policies is shared between countries. Country 1's population is distributed with preferences around the position 0 (which is the political centre for country 1) while the population of country 2 is on average on the right of the country 1, and the population of country 3 is on the left of country 1. The SQ and ALT positions in Figure 2-1 only represent one case and will change as explained below from simulation to simulation.

Agents' positions are selected from the same probability distribution as of the population and therefore the agents' positions²⁸ in these countries are in a relative position to each other similar to their populations. This is a realistic assumption as it assumes that agents are representatives of voters and they are more likely to be in close ideological positions where there is more voter's density within that country. The next subsections explain more about the details of these elements and their interaction.

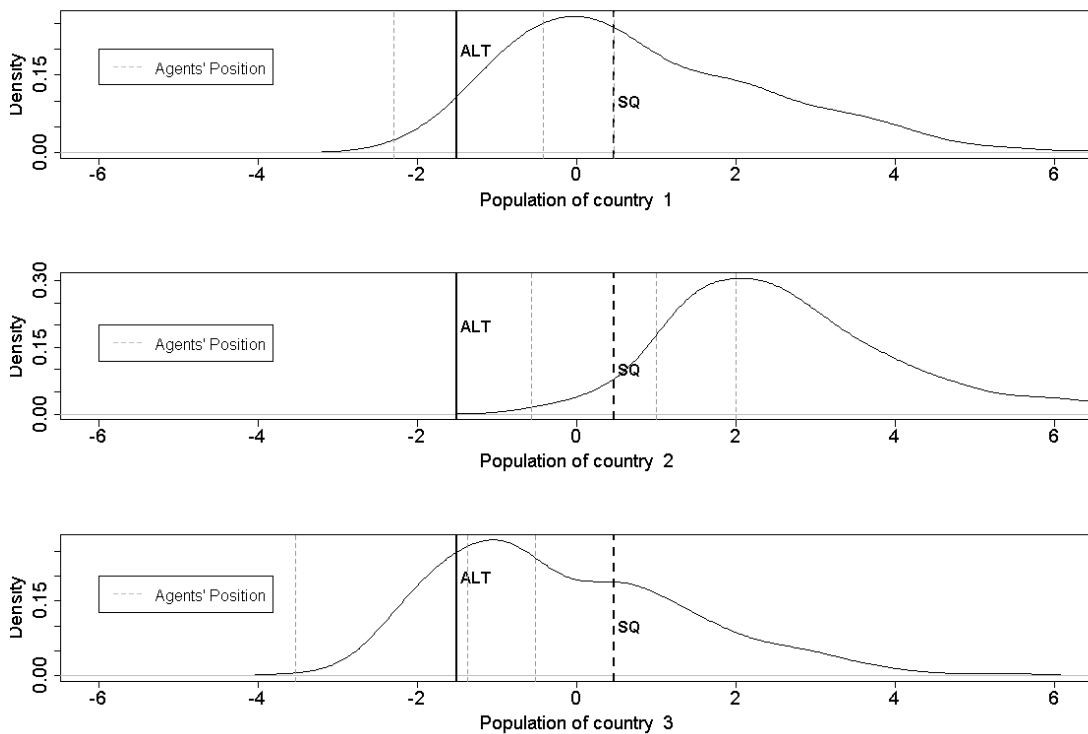


Figure 2-1 Sample countries with three agents, two policies and different distribution of voters

²⁸ Asymptotically or on average

2 - 5 Countries, population, policies

Number of countries and the size of populations will be set randomly at the beginning of each simulation. Table 2-1 in page 48 shows the distribution of these initial random parameters. To capture country unit heterogeneity each country has a location along the policy dimensions. For example, some are assumed to be more left leaning such as country 2 in Figure 2-1 and some are more right leaning on the spatial dimension such as country 3 in Figure 2-1. This left-right tendency in simulated scenarios is distributed normally around 0. The standard deviation of the distribution of countries is set randomly at the beginning of each simulation²⁹. Then population of each country is generated randomly around their positions. The population distribution in all simulations is skewed towards right. I use a gamma distribution to generate the population of the countries with the parameters presented in Table 2-1 following Ward and Grundig (2011). Gamma distribution or beta distributions are very flexible in generating different uni or bimodal skewedness. However, one could use other distributions such as Gumbel to generate this skewedness or population distribution or capture extreme values (Schofield 2007)³⁰. This skewedness of the preferences is one of the main sources of heterogeneity in domestic politics which is rooted in underlying socio-economic distributions of population such as wealth (Benhabib and Bisin 2018).

One key variable in the generation of the voter's population is the standard deviation of voters from the political centre, which represents the polarisation of voters within countries. This number changes from simulation to simulation in order to create variation to capture the effect of. I should also distinguish between the variation of the ideological position of countries which affects the ideological distance between countries.

In the next step of simulation, based on a random selection from the population of all countries a SQ is assigned to all countries. In other words, the position of the SQ is shared among all populations. Each country will also be assigned a certain number of agents from its population. The number of agents is the same among countries but in different simulations. Agents' weights in the decision

²⁹ For details on this and other variables see Table 2-1 .

³⁰ Gumbel distribution commonly is used in modeling the distribution of the expected utility but it also can be used to represent the distribution of population.

making process are assumed to be equal throughout all countries. This assumption can be relaxed, for example, if one equates agents to political parties present in a parliament then different weight can represent their majority or number of seats that they hold in the parliament. *Agents' Position and Conflict* section explains how position of these agents in each country is selected based on the population of voters within that country. That section also explains the distance between the agents representing the political conflict and some other related parameters.

The above steps generate a community of different (heterogeneous) countries with different population distributions and different political agents which all have a common *SQ* policy. The level of polarisation modelled by the variation of voters is fixed in each simulation and is similar in all countries but changes from one simulation to another. Therefore, simulations start from a uniform equilibrium, where all countries have *SQ* and there is no information about *Alt*. Alternatively, simulations can start from different initial conditions such as having a portion of countries or agents implementing *Alt*. In such a setting, one can run a few simulation iterations to reach a new equilibrium based on transition rules. If transition rules (explained below) don't allow for reversion to *SQ* from *Alt* then the portion of *Alt* population can continue to grow steadily similar to entering an external shock to the initial condition that all countries have *SQ*. However, if transition rules allow for reversion the countries may revert back to the initial condition of all *SQ*. Rarely, fixed or dynamic equilibriums form when diffusion networks are fixed and initial conditions are imposed on countries. Therefore, I start from an all *SQ* equilibrium imposed initial condition.³¹

Then, a random number of countries (from 1 to 5 to capture the effect of initial shock in the network) receive an external shock. In a general case, this shock can be implemented on population, agents or any other part of the framework. In the presented scenarios this shock comes in form of the availability of a new alternative policy position. This new alternative policy is the position of the political preference of one of the voters randomly selected from the shocked countries. The spatial position of this new *Alt* policy becomes known to all the agents in the countries that received this

³¹ The case is different to the case that a random number of countries already were aware the *Alt* or were implementing it and the rest which were not aware of them suddenly come to know them because the initial group of countries themselves need to reach an equilibrium internally once they receive the shock.

external shock. In other words, the agents become aware of a new possibility (Alt) to implement instead of SQ and agents of those countries can opt to support this new policy or not. This simple mechanism takes into account different factors. First, because Alt is chosen from the population of a selected group of countries, in long run, the factors affecting the population distribution also affect the possibilities of Alt . This includes the diversity and variation within population, their skewedness and the level of difference between. Secondly, as initially only a limited number of countries become aware of such possibility, policy spread within this group of countries and beyond them to other countries becomes conditional on their characteristics, preferences and their networks.

The information about the possibility of Alt as the key focus of this study remains unknown to other agents and different transmission³² and transition³³ scenarios determine how such information diffuses between agents. Nothing about this new policy is uncertain and similar to SQ it has a randomly assigned effectiveness. However, this assumption can be relaxed in a more complex setting and agents or countries become aware of the effectiveness of Alt only after implementation of t period of time. This would have created two sources of friction. Initially, only extremely politically³⁴ or ideologically³⁵ motivated agents would have supported the implementation of Alt as they would have to risk discovering the effectiveness by themselves. However, still similar to Volden, Ting and Carpenter (2008)'s game theoretic approach those with enough political and ideological motivation would initiate implementation and then the information would have diffused to the rest of the agents. Secondly, after initial implementation, other agents would have to wait t period to discover the effectiveness. In this paper I assume that agents become aware of the effectiveness at the same time that they receive the information about the possibility and position of Alt ³⁶.

³² How information transmits between agents or countries

³³ How countries change from SQ to Alt , or transit from one state to another.

³⁴ Based on the distribution of voters

³⁵ Based on their own ideological position

³⁶ t till agents find out about the outcome is equal to 0

2 - 6 Agents

2 - 6 - 1 Agents' Position and Conflict

Each agent has an ideological political preference position along the spatial ideological Left-Right dimension. Conflict parameter represents the polarization of agents in the policy dimension and the distance between positions they hold with regards to one other. Agents' positions are selected randomly based on the level of conflict, the number of agents, and the population of voters in each country. Level of conflict present the polarisation among agents (e.g. parties) based on an exogeneous factors and varies from simulation to simulation and has the below configuration. Using this external parameter for choosing agents from populations with different levels of polarisation. Agents' selection is determined both by the level of conflict assumed amongst political actors (e.g. parties) and the voter's population. Each agent's position is randomly chosen from a range of voters which covers $\frac{1}{conflict}$ portion of the whole range of the population, starting from the lowest percentile to the highest percentile for each agent. For example, for the conflict=2 and number of agents =3, the first agent will be chosen from [0,0.5] percentile of voters, the second agent from [0.25,0.75] percentile of votes and the last agent from the top half of the voters. Therefore, each range covers $\frac{1}{2}$ or 50% of the whole range of population. This method adds the population distribution and the country heterogeneity factors to the framework proposed Ward and Grundig (2011). Higher levels of conflict and polarisation of voters put more distance between the political positions of agents

Each agent's expected utility from a policy then is determined based on these positions and population distribution of voters who would support such position based on their distance to it. All agents within a country participate in the decision-making process to decide on the implementation of the new policy. This allows for introduction of a new level of complexity that previous models lack (Volden, Ting and Carpenter 2008). Agents decide to support a policy at the domestic level while interact with other agents at the international level to gain information, all while they have to take into account the preferences of domestic population. This two-level analysis therefore allows analysis of the effect of

micro factors such as the distribution of populations and the level of political conflict within states on general macro patterns.

2 - 6 - 2 Agents' utility and decision making

Each agent represents an independent decision-maker. They represent different domestic actors, such as governments, political parties or activist groups. Ideological position of agents and preferences of population determine the expected utility of agents from supporting each policy. This paper uses a generalized version of the model proposed by Braun and Gilardi (2006) to calculate the expected utility of each agent in each jurisdiction.

Partially following Strom (1990), their model assumes that agents seek both policy (based on ideological position and effectiveness) and vote (e.g. seeking office). Therefore, the utility of each agent is calculated as the weighted average of the policy pay off and votes pay off.³⁷

$$\text{Equation 2-1 } U_{ij}^p = w_{ij}V_{ij}^p + (1 - w_{ij})P_{ij}^p \quad 0 \leq w \leq 1$$

U_{ij}^p is the payoff of policy p for agent i in jurisdiction j . V_{ij}^p represents the votes payoff associated with policy p for the corresponding agent - agent i in jurisdiction j - and P_{ij}^p denotes the policy payoff. w_{ij} is the weight of vote's payoff³⁸. The position of a policy determines which policy they prefer and support. If an agent only seeks policy such as a business interest group, then w_{ij} is 0. For agents that show both vote-seeking and policy-seeking behaviour, for example competitive political parties or governments who seek approval, w_{ij} ranges between 0 and 1. In reality, this weighting depends on different factors and varies between countries and changes over time. For instance, w_{ij} is higher where there is more conflict between political parties at election times. It also varies depending on the importance of policy area and how important issues in that area are for the election outcome³⁹.

³⁷ The original model doesn't distinguish between jurisdiction and agents implicitly assuming only a one decision maker in each jurisdiction.

³⁸ Obviously $1-w$ denotes the weight of utility from supporting policy

³⁹ Here, I assumed that w does not change over time or policy dimension. But assumption can be relaxed depending on the research question

Braun and Gilardi (2006) also add a policy effectiveness factor to the model. m_j^p represents the effectiveness of policy p in jurisdiction j . In this paper's setting this effectiveness factor is fixed and known to agents, but both of these assumptions can also be relaxed⁴⁰. Putting all the above together, Equation 2-2 shows the expected utility of supporting policies for agents.

$$\text{Equation 2-2 } EU_{ij}^p = m_j^p U_{ij}^p \quad 0 \leq m_j^p \leq 1$$

Where EU_{ij}^p is the expected utility of policy p for agent i in jurisdiction j , accounting for the effectiveness of that policy as well as the payoffs.

Based on this model, each agent at each cycle of simulation calculates the expected value of supporting each policy.

While this framework allows for analysis of the diffusion of different types of information such as effectiveness of policies or the positions of median voters, for this research, I focused on agents becoming aware of the existence of the *Alternative* policy and its characteristics (i.e. position and effectiveness). Accordingly, in the simulations presented here; at the initial cycle agents only have access to the position of *SQ*. After initial shock; agents in the shocked countries become aware of the existence of *Alt* and can calculate the expected value of its adaptation. Other agents receive information about this new *Alt* policy based on the network and connections that they have with other countries and agents in different scenarios. This allows me to look at the effects of domestic factors such as polarisation on the diffusion.

2 - 7 Networks and information

In this framework diffusion of information can happen between countries, agents or even the populations. I simulated static (where the network of information is fixed throughout each simulation) and dynamic (where the network of information changes in each time step) networks of information between countries and agents. Formation of connections and distances between the nodes in information networks is based on the distances between countries or agents depending on the scenario.

⁴⁰ I've talked about this assumption and it's implication and link to other models in section 2 - 5

These distances represent the geographical or ideological space which is usually used in the literature of the spatial econometrics for building the W matrix. Therefore, connection or signalling between two nodes – agent or country – depends on the connection or the distance between them and a general probability of connection or an exogenous density of networks. The connection networks are built differently in different scenarios.

The three scenarios are, (1) fixed or static network of information between countries, (2) a dynamic network of information between countries that changes in each time cycle, and (3) a dynamic network of information between agents that changed in each time cycle. In the static scenario, one connection network is built at the beginning of each simulation, while in a dynamic or signaling scenario the network/signals changes (is rebuilt) after each time period. In other words, in each time period, some information can diffuse between agents and in the next time period some other agents can transfer information. Each of the three scenarios presented in this paper is based on information diffusion in one of the above forms. In the static settings, agents become aware of Alt based on a static network of neighbours. This network is fixed and is based on the ideological distances between countries or agents. In the dynamic/signalling setting a network is built in each time cycle and information travel through this network between countries or agents.

The networks are build based on the probability of connection between two nodes which are calculated based on the distance between two nodes (countries of agents). Table 2-1 show the distributions and parameters used. These numbers are not arbitrary and are selected in a way to represent the full range of computational and theoretical possibilities from the minimum characteristics of the networks to the limits of computational complexity. For example, the number agents start from 3. Having one agent in each country would eliminate the possibility of domestic politics, with two agents in each country, either the framework would require to model a special case of consensus between the two agents for implementation or the framework would needed change to account for implementation of policies in a country when one out of the two agents (e.g. based on popular vote) supported a policy. Therefore, I start starting from three agents with simple majority rule and policies switch from SQ to ALT when enough agents form a majority to implement ALT . In

other words, as a general practice in ABM (Epstein 1999), parameters are selected to provide the minimum characterisation of a realistic model but in a way that produces enough variation so key variables such as population polarisation can be studied. For instance, as a key parameter of study population standard deviation varies from 0.8 to 1.6 but the population gamma is constant at 0.8 only to produce limited realistic level of skewness.

Probabilities are standardized between all the possible connections of that node similar to row-standardization in spatial econometrics. While row standardization is not advised in empirical measurement literature, (Neumayer and Plümper 2015) in ABM when generating the networks row standardisation is necessary to ensure comparability between simulations and scenarios. For instance, if the distance between two nodes and a third node (countries or agents depending on the scenario) is equal, and then the probability of such connections happening in the network will be equal. This produces a standardized network among different scenarios and these three scenarios only differ in their network of information.

For example, two countries are connected in a static country-to-country network with an exogenous probability. This probability is set randomly⁴¹ at the beginning of the simulations and normalized based on the distances between countries. In other words, countries are more likely to be connected to the countries that are closer to them. To put it numerically, if p denotes the probability of connection between any two countries in the network, then the probability of connection between two countries of i and j is $p_{ij} = \frac{d_{ij} \times p}{\sum_{for\ all\ j} d_{ij}}$ where d_{ij} is the distance between the two countries⁴². The probability of the connection of two agents is calculated similarly. Information diffuses between countries or agents through these connection networks. I explain these difference scenarios below.

2 - 8 Diffusion and simulation

As mentioned above, in each scenario diffusion happens only with respect to learning about the existence of an alternative policy. This means that there is no competition between countries and only

⁴¹ Based on parameters presented in Table 2-1

⁴² To recall, this distance is calculated based on the position of the countries along the ideological dimension. The same position that their population where generated around it at beginning of the simulation.

agents within a country compete for votes. Through learning, agents learn the existence and the characteristics of a policy such as the ideological position of the ALT and its effectiveness. Therefore, agents receive perfect information about all the parameters of Equation 2-1 and Equation 2-2. This process starts by a knowledge shock to some agents. Agents in the countries that receive an external shock learn about this alternative policy and then others who are connected to them learn from them. Below are the steps followed in each simulation:

- A random number of countries receive a shock and learn about *alt*.
- All agents in those countries that received the shock learn about *alt*.
- **Scenario 1 – Country-to-Country static network:**
 - A fixed random network between the *countries* is built.
 - Each agent decides to support *SQ* or *Alt*
 - As time passes agents can switch to *Alt*⁴³.
 - If the majority of agents in a country prefer *Alt* for the randomly assigned time lag, then that country implements *Alt*.
 - If a country switches to *Alt*, all the countries which are connected to it learn about *Alt*⁴⁴.
- **Scenario 2 - Country-to-Country dynamic/signalling network**
 - A random network between the *countries* is built. This network changes at the end of each time period (e.g. a new randomly generated network replaces it).
 - Each agent decides to support *SQ* or *Alt*
 - As time passes agents can switch to *Alt*.

⁴³ As in this paper, both the position and the effectiveness of policies are fixed and known, once agents chose their preferred policy there won't be any change back to SQ, however if once relaxes these assumptions then agents may switch back and forth between SQ and Alt depending on the information their receive through their network.

⁴⁴ Similar to the previous footnote, as the agents don't change back their support, countries won't change back to SQ once they've switched to Alt. However, if agents did in fact switch back, then once could either impose an external restriction to present the political friction and not allow the countries to switch back for a time period, or allow countries to switch back and forth between SQ and Alt

- If the majority of agents in a country prefer *Alt* for the randomly assigned time lag, then the country implements *Alt*.
- If a country switches to *Alt*, at each period all the countries which are connected to it learn about *Alt*.
- **Scenario 3 – Agent-to-Agent contagion**
 - A random network between the *agents* is built. This network changes at the end of each time period.
 - Each agent decides to support *SQ* or *Alt*
 - If an agent switches to *Alt*, all the agents which are connected to it learn about *Alt* with an exogenous probability of contagion.
 - If the majority of agents in a country prefer *alt* for the randomly assigned time lag, then the country implements *alt*.
- Cycle continues.

To summarize, all countries start with the same *SQ* policy and some of the agents after an external shock become aware of an *Alt* policy. This knowledge then diffuses to other countries through a network of information communication between agents or countries. In scenario 1, the network is fixed and is formed based on the ideological distance between countries. Countries that are closer together in their political preferences are more likely to be permanently connected to each other. This case is analogous to geographical contiguity or long-term membership of international organizations. In this case countries become aware of *Alt* if their neighbours implement *Alt* and all the agents within that country receive the same information at the same time. Scenario 1 simulates the cases where network of information or diffusion is assumed to be fixed and this is common assumption in the literature of spatial effect measurements.

In scenario 2, a new network of information forms at each cycle. Again, ideologically closer countries are more likely to connect at each cycle, making it more probable for closer countries to learn from one another. This network changes from one simulation cycle to the next cycle and it represents the

case that jurisdictions send signals to other jurisdiction about a new policy and closer countries are more likely to receive it. Similar to scenario 1, all agents within each country receive the same information. Scenario 3 however relaxes this assumption and agents communicate directly with each other, through their connection network depending on their ideological distance and a probability of contagion. Same as scenario 2, the network between agents changes from cycle to cycle. However, in each agent-to-agent network, agents transfer information with a fixed probability of contagion⁴⁵.

Figure 2-2 shows an abstract model of information contagion networks if the probability of contagion was 1. In this figure large circles represent countries and smaller ones represent agents. In simulation model the probability of connection and contagion is calculated based on the distance of two country and agent while here for better demonstration it's 1. Black circles are the ones that have become aware of the *Alt* and have implemented it (support it). Again, for simplicity of presentation I've only represented the case that all the agents that have become aware of the *Alt* have implemented it. In actual simulation scenarios agent may or may not support the *Alt* depending on their expected utility from it.

⁴⁵ I added this to control for the disparity between number of agents and countries, otherwise scenarios would not have been remotely comparable.

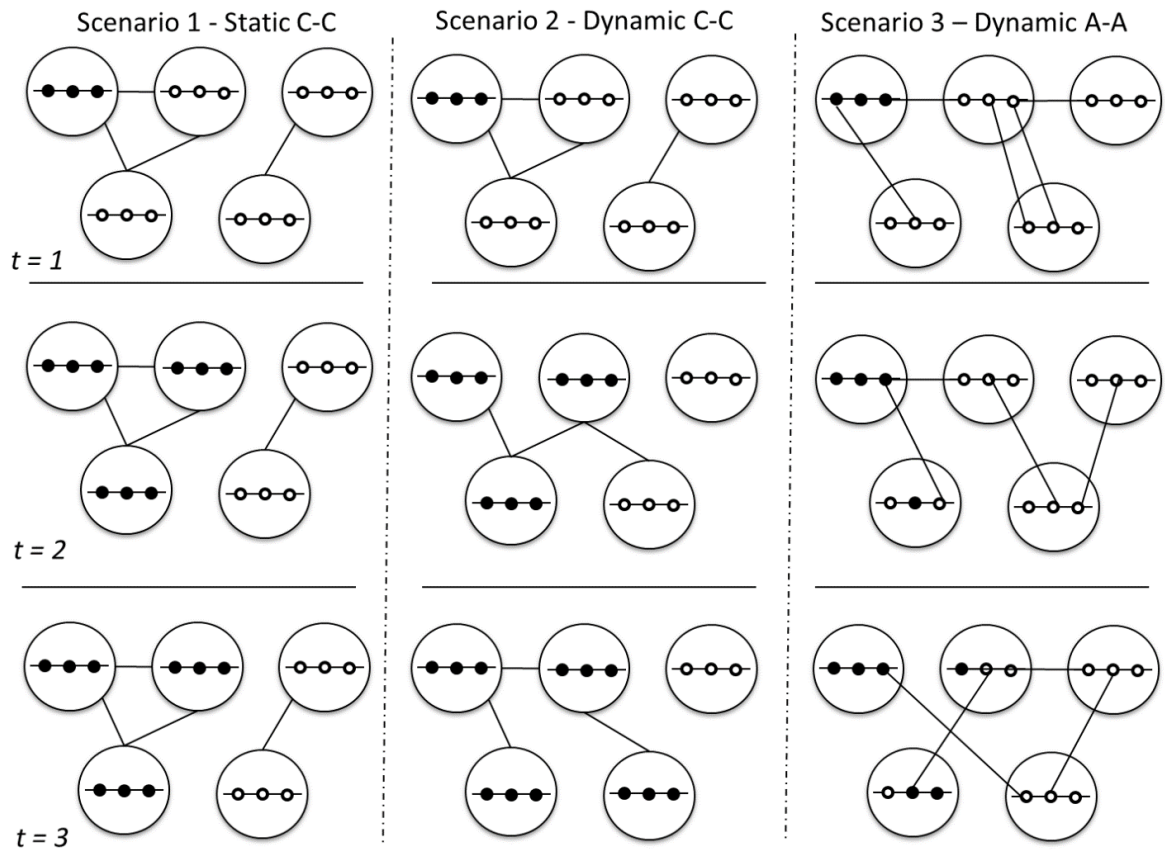


Figure 2-2 Demonstration of different networks

Table 2-1 details all the parameters used for all three scenarios and the probability distribution use for generation of random numbers. It also shows which scenarios use which of these variables.

	Parameter	Distribution/ Calculation	Range/ Value	Static C-C	Dynamic C-C	Dynamic A-A
Countries	Jurisdictions/States	Uniform	From 10 to 50 by 10	Yes	Yes	Yes
	Position of Countries	Normal	Mean = 0	Yes	Yes	Yes
	Standard Deviation of Countries' Position	Uniform	From 0.125 to 1.5 by 0.125	Yes	Yes	Yes
	Friction Policy Lag	Uniform	From 3 to 5 by 1	Yes	Yes	Yes
	Number of Countries Shocked	Uniform	From 1 to 5 by 1	Yes	Yes	Yes
	Majority	Constant	0.5	Yes	Yes	Yes
Population	Population Size	Uniform	From 100 to 500 by 100	Yes	Yes	Yes
	Population	Gamma		Yes	Yes	Yes
	Population Mean		Mean = Position of Countries	Yes	Yes	Yes
	Population Std	Uniform	From 0.8 to 1.6 by 0.2	Yes	Yes	Yes
	Population Gamma	Constant	0.8	Yes	Yes	Yes
Policy	Policy Positions	Randomly chosen from the position of voters in population of the countries that received shock		Yes	Yes	Yes
	Policy Effectiveness	Uniform	From 0.2 to 1 by 0.1	Yes	Yes	Yes
Agents	Number of Agents	Uniform	From 3 to 7 by 2	Yes	Yes	Yes
	Agents' Weight	Equal		Yes	Yes	Yes
	Conflict between Agents	Uniform	From 2 to 4 by 1	Yes	Yes	Yes
	Position of Agents	Uniform within range depending of conflict		Yes	Yes	Yes
	Pay-off Weight	Uniform	From 0.2 to 0.8 by 0.1	Yes	Yes	Yes
Network	Probability of Connection for Countries	Uniform	From 0.05 to 0.35 by 0.05	Yes	Yes	No
	Agents/Countries Distance	1/(Absolute position difference)		Yes	Yes	Yes
	Agent Network Density	Uniform	From 0.005 to 0.10 by 0.005	No	No	Yes
	Probability of Contagion in Agents	Uniform	From 0.05 to 1 by 0.05	No	No	Yes

Table 2-1 Parameters distributions and values

2 - 9 Simulation results and discussion

This section first details the process and outcome of the simulations. Then, I go into a detailed analysis of how factors such as polarisation will be affecting key macro diffusion indicators in each scenario. Finally, I discuss the different effects of factors in different scenarios.

For the purpose of this research I ran simulation of scenarios independent from each other, scenario 1 ran 5000 instances, and scenario 2 and 3 around 2000 times⁴⁶. In each simulation, all the parameters were generated based on the random distributions provided in Table 2-1 independently and the time cycles. Due to limited resources and for presentation reasons, total time was capped to 50 cycles however all simulations reached equilibrium before $t=50$ ⁴⁷. Each of these cycles presents a period of time (for example a year or an election cycle) that political decisions makers need to change their preferences. I assumed equal and synchronized time cycles between different jurisdictions, however this assumption can be relaxed in other implementations.

Figure 2-3, Figure 2-4 and Figure 2-5 show examples of the ratio of countries and agents adopting alternative policies which is preferred to the SQ both by the majority agents and voters in in three different scenarios in one simulation. It shows that the level of saturation can change drastically between scenarios even with other similar parameters. This difference between scenarios is due to the different way that information travels between agents and countries. This is a specific case and is presented deliberately to show that even with preferable alternative policies, still due to lack of information network, some countries may not become aware of such policy innovations.

Figure 2-3 shows a case in which less than 20% of countries and agents adopt the alternative policy. In this specific case a new equilibrium is achieved before the 20th time cycle through a country-to-country static network of information as an example of scenario 1. Figure 2-4, on the other hand, shows a simulation of diffusion through a dynamic network of information between countries as an example of scenario 2. It shows a new equilibrium of over 90% adaptation of the alternative policy in

⁴⁶ These are approximate numbers in the latest implementation, results are similar in different runs with different seeds

⁴⁷ In other settings this may not be the case, especially if agents and countries switch back and forth with policies.

the 35th time cycle. Finally, Figure 2-5 represents a case of agent-to-agent information diffusion. In this case around 70% of countries adopt *Alt* and a new equilibrium is reached before the 20th time cycle.

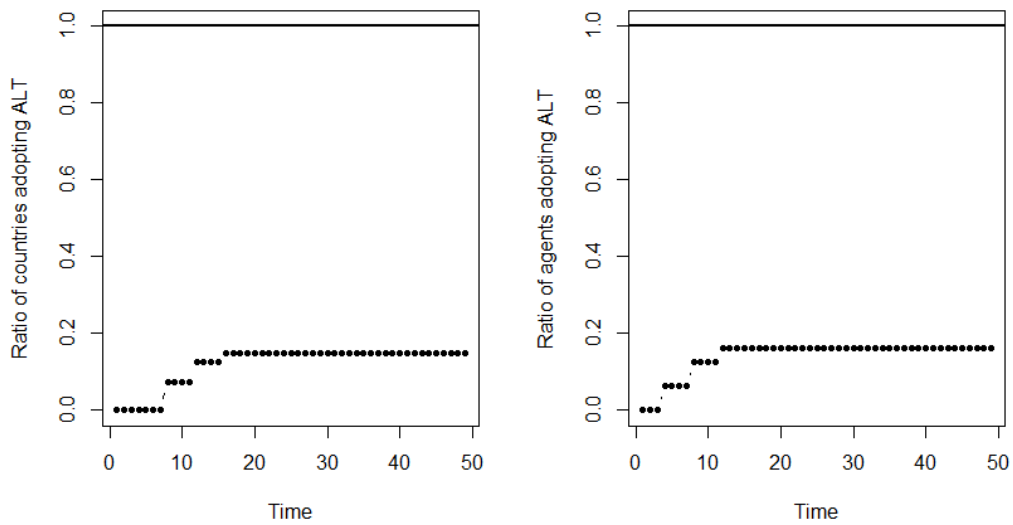


Figure 2-3 Shows a sample of the process of diffusion in scenario 1

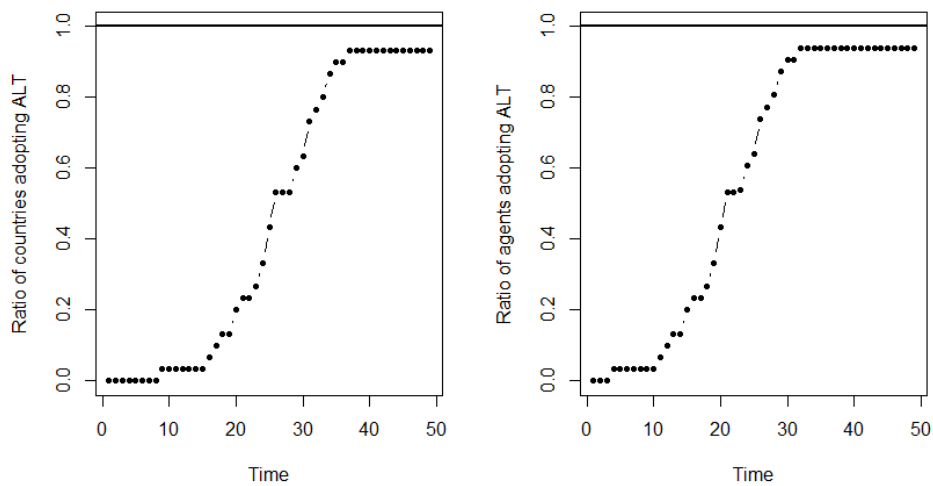


Figure 2-4 Shows a sample of the process of diffusion in scenario 2

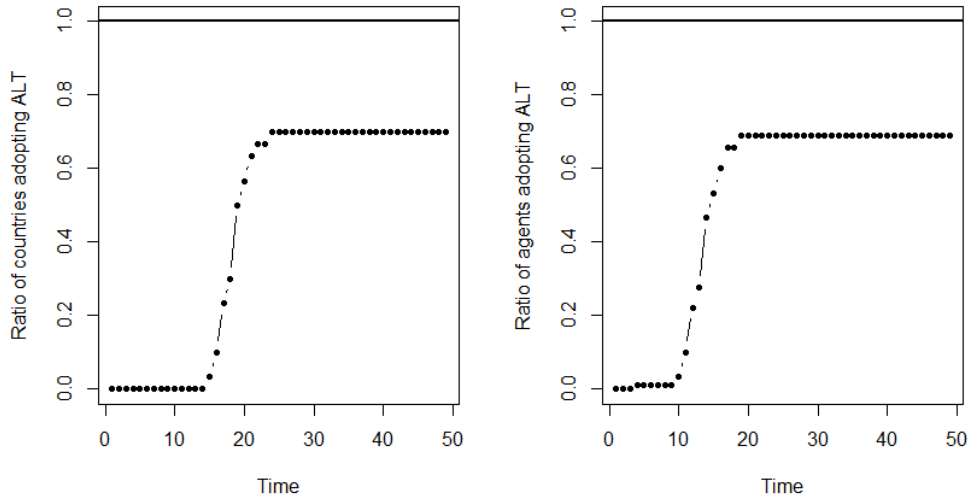


Figure 2-5 Shows a sample of the process of diffusion in scenario 3

These are not average or representative examples and are only random draws. Because simulations were done with multiple initial parameters unless one wanted to fix all of these parameters presenting a representative case would not have been possible and even in that setting, any average case would have been only representative with regards to those parameter settings and not comparable to other cases or other scenarios. The point in presenting these cases is to show that all these three scenarios are capable of producing S-shaped diffusion process and review some macro characteristics of diffusion, and show how method that information diffuses between agents can affect the macro patterns and it's key characteristics such as saturation level. In order to compare these scenarios and look at factors' effects on macro patterns, further below I present statistical analysis of these cases.

In contract to the previous case represented in Figure 2-3 to Figure 2-5, Figure 2-6 shows the population density position of policies and agents and their preferred policy at the end of one simulation. In this case the population of different countries have different preferences and countries that their populations are dispersed more towards right prefer *SQ* which in this case is positioned on the right of the alternative. On the left side, those counties that have more left leaning population will have agents that prefer *Alt* and are more likely to implement it. Therefore, it shows how most populations and agents on the right side of the spectrum still support the *SQ* which is closer to their

ideological preference, but the counties with the population towards left implemented *Alt* if they receive knowledge about the existence and effectiveness of it. Solid and dotted vertical lines show the ideological position of agents in different countries that support *Alt* or *SQ*.

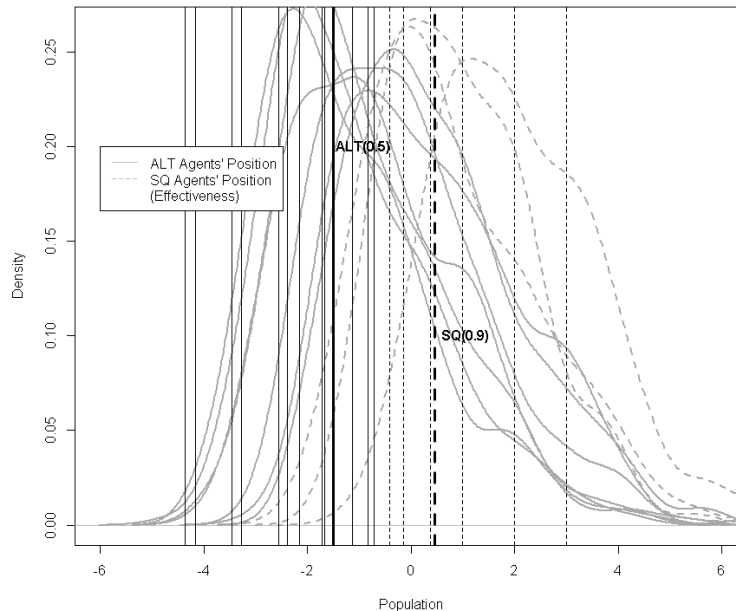


Figure 2-6 shows a sample of the population of countries and implemented policies.

The above examples show that all these three diffusion scenarios can produce familiar macro patterns (e.g. the s-shaped ratio), but these patterns can have some significant differences with regards to their characteristics. I look at three main characteristics of the diffusion process which are mostly used in the literature to look at. These three variables are:

- (1) *Time*: The time that it takes for the community to reach a new equilibrium.
- (2) *% Good*: The ratio or percentage of the countries that have implemented the (Good) policy out of the two by the end of simulations. I define the good or efficient policy as the policy that is preferred by the majority of that country's population based on their ideological position⁴⁸. To calculate this, I identified which of the two polices each

⁴⁸ Alternatively, one could add other factors to this definition such as effectiveness as well, however here I assumed that effectiveness is a characteristic of policy that is affecting agents such as ease of implementation or other rent seeking factors beside the vote and voters only benefit from the ideological position of policy. Furthermore, one could take this effectiveness factor as a public good provision or a country

member of a population prefers and then counted the number of countries which have implemented the policy that is preferred by the majority of their population.

(3) *Saturation*: The ratio of countries that adopt the new policy at the new equilibrium.

While time (or speed) and saturation are commonly used in the diffusion literature to indicate how fast and how deep diffusion happens depending on different factors such as network density. The ratio of countries that have implemented the optimal policy of their population is something that is more useful in understanding of diffusion in political systems. For example, saturation is meaningless if Alt is not preferred by any of the agents. In this case even if the information about the existence of such policy is diffused through the entire network the adaptation cannot happen.

2 - 9 - 1 Simulation Results and Macro Characteristics

Using the outcome of simulations, before looking at domestic factors and polarisation, I first look at the three key macro pattern variables defined above. Table 2-2 below shows the summary statistic of these three variables in simulations of each scenario.

Variable	Static		Dynamic		Dynamic	
	Country-to-Country		Country-to-Country		Agent-Agent	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Time to reach a new equilibrium	10.61444	9.28446	16.87526	12.96326	9.266419	6.017511
% of optimal policy	0.951261	0.0942377	0.868193	0.197129	0.877469	0.1716296
level of saturation	0.159792	0.2020816	0.45379	0.4053814	0.468229	0.3758248

Table 2-2 Summary statistics of simulation of different scenarios

Comparing these three scenarios on how they affect the speed of diffusion – measured by the time to reach new equilibrium – the simulation results show no significant⁴⁹ different between the speed of

level effectiveness factors which all voters equally benefit from it. In other words, my definition of a good policy can be altered in other settings.

⁴⁹ Using t-stat comparing the means of two samples using $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$

diffusion on average in different scenarios⁵⁰. On the other hand, the percentage of countries that have implemented the optimal policy based on the preferences of their population is much higher in the static scenario (at 95%) in contrast to dynamic cases (87%-88%). This means that static networks can convey information in a way that results in more efficient diffusion. One reason is the political nature of dynamic information diffusion. In dynamic information diffusion, agents get connected to other agents or countries in different periods and if those agents have not implemented a policy based on their own political preferences. On the other hand, they are more likely to be connected to some agents than the others, this means that if they have not implemented the policy, the information receivers have less chance of receiving information about alternative policies and therefore are less likely to implement it. While static information networks, may not fully transmit the information throughout the whole community, for example to islands or ideologically distance countries, in most cases countries at least become aware of the alternative police regardless of domestic politics, when such policies are implemented in similar (ideologically close) countries. This shows how domestic politics of some countries can affect the implementation in other countries conditional on the network of diffusion. I should mention, that statistics from different scenarios are not strictly comparable due to many underlying factors that affect the outcomes but one can look at averages, and still one can see that the standard deviation in the static case is much smaller than the other two dynamic cases. The lower standard deviation of variables in the static case shows that the statics cases give more predictable and less diverse diffusion outcomes.⁵¹ This was expected as once the diffusion network is fixed, the diffusion outcome would be totally dependent on the characteristics of that network and agents and domestic politics would play a less important role in the outcome of the diffusion process. The above findings reemphasized the importance of modelling the information network in empirical studies. Accordingly, static scenario has a very low average saturation rate of around 16% in contrast to 45% to 47% in the two other scenarios. This means that many policy implementations in dynamic

⁵⁰ This is due to fine tuning of simulation to make scenarios comparable

⁵¹ One can compare the two independent sample means by calculating the t statistics using $t =$

$$\frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1-1)s_1^2 + (N_2-1)s_2^2}{N_1 + N_2 - 2}\right) \times \left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

for comparing static country to dynamic agent showing statistical significance with more than 99.9% certainly <https://www.socscistatistics.com/tests/studentttest/default.aspx>

cases were sub-optimal from the perspective of voters, but agents succeeded to implement them, based on their own political preference by learning from similar agents. Let's recall that agent also take into account their own ideology and policy effectiveness beside the vote-seeking factor. In other words, agents made these implementations based on their own preferences rather than voter's preferences when they became aware of the *Alt*. In a static setting, countries are permanently networked with similar countries with similar populations and therefore the spread of this sub-optimality is less likely because agents within a country only become aware of *Alt* if it's successfully implemented in another close country. If agents through connection with other similar agents become aware of alternative policies that are more aligned with their own ideological preferences, they may implement such policies regardless of the preference of voters. Therefore, one can conclude that from the viewpoint of voters, it's more important who their country is connected to rather than who their agents are connected to. This international spread sub-optimality is caused directly as a result of domestic conflict between the interest of agents and the preferences of population. Therefore, when diffusion is happening from a country to ideologically neighbouring countries, there is less room for the conflict of interests between principles (voters) and their agents, compared to the case that agents and countries are learning from a diverse range of countries and agents. This finding is important and implies that diffusion researchers should distinguish between the types of information networks when empirically studying and measuring the outcome of diffusion. This also shows that such differences in networks could at least partially answer why some policies diffuse and some don't. This effect as seen in the next sections is conditional on domestic politics factors such as the polarisation and the level of conflict between agents, which I shall investigate in more depth. Figure 2-7 summarised the differences of these variables in three scenarios.

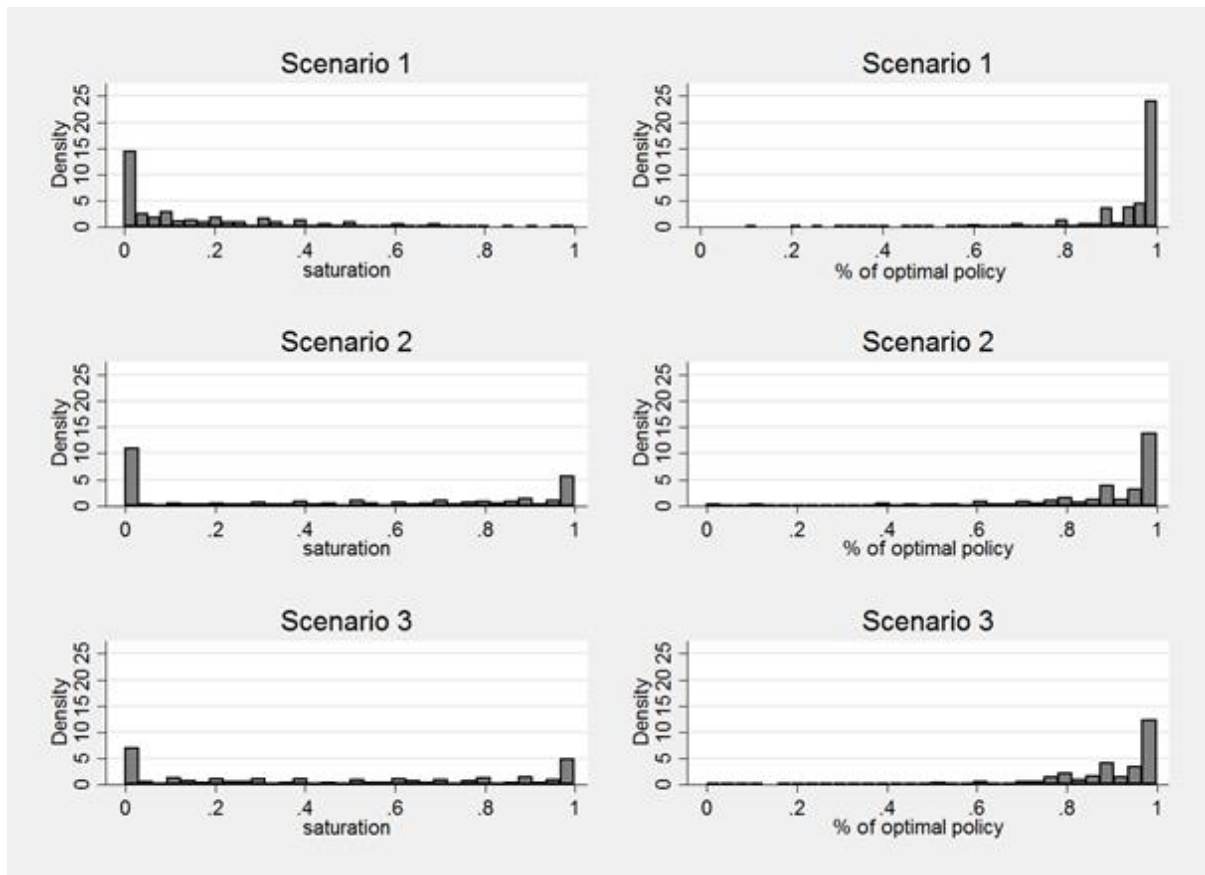


Figure 2-7 Histogram of key macro-characteristics of diffusion in different scenarios

Besides enabling us to compare different scenarios, the proposed framework also allows for the study of the effects of domestic factors on these macro-patterns in different scenarios. Even though, all three scenarios follow a simple information contagion process, simulations show that a small variation in initial domestic conditions and the heterogeneity of countries can make a significant effect in the macro patterns, final equilibrium and the path of diffusion.

Below I look at the characteristics of diffusion in each scenario and then compare them with one another. In order to do so I ran three simple estimation models with these three variables as dependent and domestic factors as independent variables. I focus on the polarisation amongst voters and conflict between agents as an example of domestic factors affecting the diffusion process.

Table 2-3 shows the estimation of these models. For modelling of the time to final equilibrium variable, I used ordinary least squares and for % Good (optimal) policy and Saturation variables I

used fractional probit models as the dependent variables are ratios between 0 and 1 (Papke and Wooldridge 1996).

	Scenario 1 Static Country-to-Country			Scenario 2 Dynamic Country-to-Country			Scenario 3 Dynamic Agent-Agent		
	Time	% Good	Saturation	Time	% Good	Saturation	Time	% Good	Saturation
# Countries	0.080 (0.000)***	0.016 (0.000)***	-0.019 (0.000)***	0.159 (0.000)***	0.003 (0.056)	-0.003 (0.109)	0.019 (0.044)*	-0.000 (0.834)	0.002 (0.134)
Countries Position Std.	1.029 (0.000)***	0.121 (0.000)***	-0.047 (0.043)*	3.108 (0.000)***	0.059 (0.265)	-0.035 (0.540)	1.820 (0.000)***	0.121 (0.020)*	-0.018 (0.756)
# Shocked Countries	3.805 (0.000)***	-0.338 (0.000)***	0.409 (0.000)***	2.084 (0.028)*	-0.231 (0.002)**	0.226 (0.010)*	0.630 (0.214)	-0.101 (0.187)	-0.018 (0.833)
# Shocked Countries Squared	-0.455 (0.000)***	0.031 (0.000)***	-0.037 (0.000)***	-0.287 (0.063)	0.030 (0.010)*	-0.028 (0.047)*	-0.093 (0.263)	0.012 (0.348)	0.009 (0.535)
Population Size	0.001 (0.162)	-0.000 (0.305)	0.000 (0.265)	0.001 (0.606)	-0.000 (0.157)	0.000 (0.458)	-0.001 (0.312)	0.000 (0.183)	0.000 (0.861)
Population Position Std.	-0.058 (0.878)	-0.247 (0.000)***	0.031 (0.380)	-2.518 (0.006)**	-0.229 (0.001)**	0.052 (0.529)	0.064 (0.897)	-0.300 (0.000)***	0.226 (0.006)**
SQ Policy Positions	-0.105 (0.241)	0.110 (0.000)***	0.018 (0.049)*	-1.038 (0.000)***	0.143 (0.000)***	0.025 (0.264)	-0.910 (0.000)***	0.110 (0.000)***	-0.026 (0.278)
Alt Position – SQ Position	-1.928 (0.000)***	0.119 (0.000)***	-0.169 (0.000)***	-2.966 (0.000)***	0.152 (0.000)***	-0.306 (0.000)***	-1.197 (0.000)***	0.068 (0.000)***	-0.263 (0.000)***
SQ Effectiveness	0.242 (0.677)	0.242 (0.000)***	0.011 (0.842)	-0.277 (0.842)	0.054 (0.594)	0.006 (0.959)	-0.449 (0.538)	0.415 (0.000)***	0.196 (0.100)
Alt Effectiveness - SQ Effectiveness	-10.560 (0.000)***	0.632 (0.000)***	-1.040 (0.000)***	-17.285 (0.000)***	0.750 (0.001)**	-2.016 (0.000)***	-4.659 (0.007)**	0.542 (0.023)*	-0.566 (0.045)*
Payoff Weight	0.797 (0.134)	0.498 (0.000)***	0.040 (0.423)	0.977 (0.456)	0.562 (0.000)***	0.035 (0.772)	-0.102 (0.881)	0.977 (0.000)***	-0.070 (0.543)
Effectiveness diff X Payoff Weight	9.933 (0.000)***	-0.433 (0.006)**	1.001 (0.000)***	13.437 (0.000)***	-0.823 (0.005)**	1.823 (0.000)***	3.302 (0.071)	-0.163 (0.590)	1.677 (0.000)***
Probability of Connection	-1.256 (0.236)	0.031 (0.784)	-0.036 (0.724)	-5.393 (0.037)*	-0.071 (0.713)	-0.029 (0.905)	4.059 (0.005)**	0.648 (0.001)**	0.517 (0.032)*
Friction Lag	2.174 (0.000)***	0.003 (0.814)	0.017 (0.160)	2.480 (0.000)***	-0.025 (0.323)	0.029 (0.312)	0.833 (0.000)***	0.053 (0.034)*	-0.009 (0.736)
# Agents in Countries	0.066 (0.678)	-0.025 (0.129)	0.001 (0.951)	-0.398 (0.315)	0.009 (0.768)	-0.019 (0.599)	-1.318 (0.000)***	-0.071 (0.111)	0.001 (0.989)
Position Conflict	0.113 (0.709)	0.143 (0.000)***	-0.016 (0.571)	-0.241 (0.751)	0.225 (0.001)***	-0.066 (0.340)	-0.780 (0.148)	-0.050 (0.511)	0.021 (0.809)
# Agents X Conflict	-0.004 (0.945)	0.012 (0.067)	0.000 (0.984)	0.125 (0.388)	0.000 (0.981)	0.003 (0.789)	0.267 (0.009)**	0.022 (0.122)	0.002 (0.923)
Effectiveness diff X Conflict	1.002 (0.000)***	-0.048 (0.112)	0.089 (0.000)***	2.372 (0.000)***	-0.060 (0.326)	0.210 (0.001)***	0.519 (0.265)	-0.044 (0.538)	-0.153 (0.050)*
Constant	-8.879 (0.000)***	1.457 (0.000)***	-1.462 (0.000)***	1.303 (0.695)	0.939 (0.000)***	-0.390 (0.188)	7.828 (0.000)***	0.691 (0.015)*	-0.651 (0.068)
Observations	5500	5540	5540	1900	1900	1900	1614	1614	1614

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

Table 2-3 Simulation results outcome

At the first glance, the factors that were expected to have a significant effect on diffusion's outcomes show the expected effects. For example, the payoff weight in the utility function of the agents which determines how important vote seeking is for an agent in contrast to their own political preference is positively linked with higher optimal (% Good) policy adaptation, this happened in all three scenarios.

Before getting to polarisation, agents' conflict and the number of agents as the focus of this paper, one can briefly look at the some other interesting domestic and policy factors. For example, SQ position has a positive significant effect on % of Good policy adaptation. Because populations are skewed towards right the more SQ is placed towards right the more likely it is farther away from the median voter's position and more likely that Alt is positioned on its left towards the position of the median voter. Therefore, the value of the position of the SQ has a positive effect on the % Good variable and it makes it more likely that countries adopt the optimal policy. As expected, the difference between the effectiveness of the Alt and SQ positively affects the ratio of optimal policy implementation. However, interestingly this difference decreases the saturation level. This was not expected. If Alt is significantly more effective than SQ then agents should prefer that over SQ and the saturation should go up but this didn't happen. Looking at the interaction between the pay off and effectiveness differences solves this puzzle. Effectiveness's effect on saturation is conditional on payoff. Without a high payoff weights, agents don't have incentive to switch if Alt is too ideologically distant even if it has high effectiveness. The greater the $Alt-SQ$ the Alt will be towards the right end where the population is less dense. These finding show that diffusion pushes countries towards the preference of median voters, which is expected by the setting and consistent with the literature (Downs 1957).

In scenarios 1 and 3, the variation (Std) of the position of countries positively affects the implementation of optimal policies, while this effect doesn't exist in scenario 2. Variation in the position of countries provides all countries with a bigger pool of ideological policies to implement. Furthermore, looking at the results of scenario 1, one can see that if countries are connected to relatively close countries with a fix network, this fix network could help with prevention of the spread of sub-optimal policies. Countries and agents in them become only aware of the polices that have

been successfully implemented in their ideological neighbourhood. This means that *Alts* that are suboptimal but preferred by agents (e.g. due to their effectiveness) would never become available to all agents to be implemented. Because in scenario 1, the network of information is fixed, the counties' position variation has a negative effect on the saturation level as islands can form in the network of counties when they are too distant from each other. This effect goes away in scenario 3. Here, I look at the three parameters of; the polarisation of voters, the number of agents and the level of conflict between agents.

Polarisation represented as the variation (std) of population preferences around the centre has a significant negative effect on the efficient policy implementation in all three scenarios. This means that polarisation caused less efficient policies to be diffused between agents. In dynamic agent-to-agent scenario 3 where the negative effect is more significant, polarisation also causes higher levels of saturation (adaptation of alternative), this means that polarisation causes inefficient policies to be diffused between agents which they could then implement them based on their own preference and not of the voters. In the two other scenarios the polarization doesn't show any significant effect on the saturation, meaning that this negative effect is only attributable to the domestic politics factors in these scenarios. Therefore, these simulation results provide evidence for the argumentation provided before as that polarisation affects the diffusion both at the domestic and international level.

The number of agents doesn't significantly affect the implementation of good policies in any of the scenarios. This finding has interesting implications from the viewpoint of the role of domestic politics in international policy diffusion. Equating agents to key political decision makers such as political parties, means that having a system dominated by a few political parties does not help or hinder the quality of diffusion, unless it causes friction or conflict. This is consistent with previous empirical evidence that put more weight on the quality of conflict between decision makers rather than the quantity of them when it comes to policy implementation (Dalton 2008).

However, the role of conflict between agents was less predictable. The simulation results show that the higher political conflict is linked with more optimal adaptation in scenarios 1 and 2. This is because in presence of a more diverse political representation, population will have a better chance of achieving better presentation. I argue that this is because agents that are more widely dispersed ideologically are more likely to have similar preferences to their voters. Agents with more conflict with other agents, have to account for the vote share that they will lose or gain by supporting each policy. This is important when we remember that in this framework the position of the agents is ideologically determined and doesn't change to seek vote. In other words, the voters can be better represented by a diverse range of agents rather than ones who are clustered around the political centre, because it's more likely that they support a more diverse set of alternative policies that they receive information about. Interestingly this doesn't happen when information diffuses only between agents. In scenario 3, agents only access information about *Alt* if they receive a signal from other agents that has already preferred *Alt* therefore some and especially agents with extreme preferences may never receive or impart information. This shows that for political conflict to be effective in good policy implementation a good flow of information is required.

2 - 10 Conclusion

I argued that policy diffusion studies need to focus more on domestic political factors and their interactions with the international diffusion process. Following Ward and Grundig (2011), I proposed ABM as a tool capable of handling the complexity that these interactive models generate. Accordingly, this paper presented a general framework for using ABM in modelling policy diffusion with a focus on domestic political factors, and looked at effects of different scenarios and factors on macro characteristics of diffusion.

I proposed a theoretical framework consisted of two layers of interaction. At domestic level, agents choose whether implement policies based on domestic factors such as their ideological preferences and the preferences of voters. At the international level, agents interact agents from other countries and transmit information about alternative policies. The proposed framework allows for modelling of diffusion through different mechanisms or scenarios in a heterogeneous world and allows for

calculation of the key diffusion characteristics. The voters' preference layer allows for measuring the goodness of implemented policies as well as being a source of heterogeneity in different jurisdictions. I implemented three different scenarios to show how this framework can be used in comparing different sources of diffusion. The simulations showed that how different settings could model the characteristics of policy diffusion and how agents' interaction could lead to familiar macro patterns of diffusion. Therefore, showing how ABM can be used in studying policy diffusion. The simulation result shows how different methods of information diffusion such as agent-to-agent information transfer in contrast to country-to-country, can affect the diffusion of inefficient policies due to conflict of interest between agents and their voters. Such findings show that while static country to country information diffusion can hinder the flow of information between countries, such hinderance can shield countries from the diffusion of inefficient polices at domestic level. This means that the domestic politics of countries in static networks has a greater effect on the process of information in contrast to agent-to-agent information diffusion, because other countries only become aware of policy innovations after implementation following the domestic processes. In this paper, the domestic politics process was heterogeneous amongst all countries, but one possible extension could focus on the heterogeneity in domestic policy adaptation rules. The implication therefore is that empirical studies at measurement levels need to pay special attention to modelling of the methods of information transfer between units and their domestic politics in order to be able to accurately capture the outcome of diffusion process. Furthermore, the analysis of simulation results provided some insight into how some domestic political decision-making factors such as polarisation, conflict between agents, and the domestic level heterogeneity affect the diffusion process at the international level in different scenarios.

To apply ABM specifically, I looked at polarisation as a key variable in policy diffusion. After arguing that polarisation can affect the diffusion both through the domestic and international mechanism which could lead to complex interaction with other factors, and distinguishing between related factors such as salience, I looked at three key parameters of voters' ideological variation, conflict between agents and the numbers of agents in the implementation process. The simulation

results showed that, polarisation can have a negative effect on adaptation of efficient policies for voters. I argued that this is due to negative effect on domestic politics and diffusion of information at international level. On the other hand, simulations showed that conflict between agents can actually lead to implementation of more efficient policies due to better representation combined with a more diverse policy innovation in the overall community.

I propose that using ABM therefore can help in the analysis of policy diffusion in two main ways. First, researchers can use ABM as a theory building tool which they later can be use in empirical studies to gain better understanding of the diffusion process. For example, in any specific case, after factors and scenarios where modelled, then the simulation results can show the expected relationship between micro and macro factors. In this paper, as an example, I looked at polarisation. Alternatively, researchers can go into more detailed modelling of heterogeneous agents and their interactions in more complex settings and use us as a macro-pattern modelling tool⁵².

Secondly, researchers can use empirical data to calibrate (or estimate) model parameters. These parameters then can be used in predictions or uses to test hypothesis about domestic or international variables. This approach is similar to the mathematical modelling of diffusion process, where one models macro characteristics of diffusion based on micro parameters and then tries to fit it into empirical data (Jackson 2008)⁵³. With ABM, one estimates (or calibrates) the simulation parameters using empirical data

Overall, ABM gives us the flexibility to look at complex interaction between factors that affect the diffusion process at different levels and this paper gave an example of this usage. This paper contributes to the policy diffusion literature by first showing how ABM can help in theory building and second, more specifically, showing how polarisation in voters and conflict between agents can lead to negative and positive effects of the diffusion of efficient policies.

⁵² Look at EUROMOD project which uses ABM in tax micro-simulation
<https://www.euromod.ac.uk/using-euromod/user-resources>

⁵³ I've looked at some of these models in section 1 - 2

3 Political Conditional Determinants of Environmental Spending Diffusion

Abstract

By studying a panel of 30 European countries from 1995-2014, this paper analyses the domestic and international factors affecting diffusion of environmental spending. The main objective of this paper is to look at the conditional responsiveness of the countries and the political domestic factors affecting this conditionality to shed light on the process of diffusion. It argues that a key factor in the responsiveness in polarised policy areas such environmental spending is asymmetric political learning. This paper proposes that governments tend to be more responsive in areas that they are not leading as taking initiatives are costly, in contrast to actors that are expected to make innovations and can risk the political and implementation costs are taking leadership roles. Empirical evidence from the data shows that Right leaning or less environmentally friendly governments are in fact more responsive to changes in the environmental spending by other states.

Keywords: Policy Diffusion, Environmental Spending

3 - 1 Introduction

Public environmental protection spending in Europe grew significantly over the last decade and alongside other environmental issues has become an important part of the political and academic discourse⁵⁴. Both domestic (e.g. socioeconomic and political) and international factors affect environmental policies at national and local levels. Over the last decade or so, many researches focused on the international factors and determinants of international dependency of environmental policies, commonly known as environmental policy diffusion. These studies, cover a wide range of topics such as: looking at the diffusion of different policy instruments, innovations, regulations and taxes; the spread of voluntary adaptation of standards and the effects of competitive pressure between states; and analysis of different environmental races to the bottom or lack thereof (Tews, Busch and Jörgens 2003, Tews 2005, Prakash and Potoski 2006, Holzinger, Knill and Sommerer 2008, Ovodenko and Keohane 2012, Ward and Cao 2012, Cao et al. 2013). However, with regards to the international interdependency of environmental **spending**, the literature is still rather limited. Furthermore, study of environmental policy instruments as a policy area which is determined by both domestic and international factors, provides an opportunity to look at the diffusion process itself. This research has two objectives; first to study the diffusion of environmental spending, and the domestic and international factors affecting it, which is less developed on in the literature of environmental policy diffusion. Secondly, to look at the conditional responsiveness of the countries and the political domestic factors affecting this conditionality to gain a better understanding about the process of diffusion itself. While a vast part of diffusion studies has looked at the political learning in different policy areas (Gilardi and Wasserfallen 2019), and some have looked at domestic heterogeneity caused by domestic processes (Brooks 2007, Cao and Prakash 2012, Shipan and Volden 2014), still the effects of domestic politics and its interaction with the network of information needs deeper understanding. One area that I propose needs further study, is the heterogeneity that is caused by the conditional learning actors and the decisions that make based on their domestic preferences and

⁵⁴ National expenditure on environmental protection (NEEP) rose nearly 2% on average each year from 2006 to 2018 (22.1% total) in EU28 countries. https://ec.europa.eu/eurostat/statistics-explained/index.php/Environmental_protection_expenditure_accounts#National_expenditure_on_environmental_protection

constraint. This conditionality represents itself in the conditional responsiveness that units show when receive international diffusion stimuli. Different methodological approaches can capture this unit heterogeneity and different diffusion studies have looked at it in different policy areas (Prakash and Potoski 2006, Brooks 2007, Cao and Prakash 2012, Ward and Cao 2012, Shipan and Volden 2014, Gilardi and Wasserfallen 2016, Mitchell and Petray 2016), however still many questions main unanswered on how the domestic political factors interact with the network of diffusion. For example, how the salience of an issue for political actors in a polarized policy area affect their responsiveness towards the changed in other countries. As the second but main objective, this paper tries to answer this question and after providing theoretical arguments, empirically test for it using a methodological approach proposed by Neumayer and Plümper (2012).

This paper proposes that environmental spending diffuses between states mainly due to political learning. It furthermore argues that this diffusion is not uniform and depends on domestic political preferences of decision makers. I argue that conditionality exists in policy areas where politicians tend to be more manipulative of spending and such areas themselves are more competitive due to lack of priori ideological beliefs or strong voters' preferences. I propose that this conditionality works in a way that make less innovative policy makers to be more responsive in such areas in contrast to those who have lower costs of policy change, or expected to do so by voters.

First, by using spatio-temporal lag models I test for the existence of diffusion in environmental protection spending in Europe through different spaces of geography, development and the ideological affinity. This implementation is done not only to test for and confirm the diffusion of environmental spending which previously have not been looked at in details in the literature, but also to for form a baseline to model the conditionality based on. Then, I measure the effect of interaction terms between spatial stimuli – in geographical space as the main proxy – and the domestic political preferences of actors, using conditional spatio-temporal lag models. This method allows for direct measurement of heterogeneous conditional responsiveness while controlling for standardized spatial stimuli (in this case geographical space). I calculate the median position of the political preferences of

governments using data from difference sources and combining them with the data about governments and the party election manifestos.

3 - 2 Policy Diffusion and Environmental Spending

This section briefly reviews the literature of three related topics: environmental policy diffusion⁵⁵, environmental spending, and conditional policy diffusion. This quick review, while not exhaustive, will show where this paper sits in the literature and what gap it attempts to fill.

Alongside domestic factors, many different international factors such as harmonization, international or transnational communication, and regulatory or economic competitive pressure, affect the adaptation and convergence of similar policies, and the literature shows that environmental policies are no exception (Prakash and Potoski 2006, Holzinger, Knill and Sommerer 2008, Ward and Cao 2012). The general literature of policy diffusion proposes four main mechanisms for international policy dependency. Learning, competition, coercion and emulation are the four main mechanisms that helps us with the understanding the interdependency of policy among different decision makers (Holzinger and Knill 2005, Shipan and Volden 2008, Marsh and Sharman 2009). Through these four mechanisms states can learn from one another, adopt similar policies due to competitive pressure, be coerced into adopting a policy by more powerful sates or international bodies, or finally just emulate or adopt policies regardless of their objective characteristics (e.g. due to legitimization⁵⁶)⁵⁷.

The convergence and diffusion of environmental policies – in general – have been studied rather extensively in the literature. These studies add to our understanding of environmental policy diffusion with respect to regulation, pollution, innovation, adaptation of standards, and taxes. Overall, the environmental policy diffusion literature proposes that both domestic and international factors affect the implementation of environmental policies or instruments, and these two factors interact with each other. It also provides some theoretical frameworks for analysing the diffusion of environmental

⁵⁵ I've covered the more general diffusion literature in section1 - 1

⁵⁶ Tolbert, P. S. and L. G. Zucker (1983). "Institutional sources of change in the formal structure of organizations: The diffusion of civil service reform, 1880-1935." *Administrative science quarterly*: 22-39.

⁵⁷ For examples and discussion see Gilardi, F. (2012). "Transnational diffusion: Norms, ideas, and policies." *Handbook of international relations* 2: 453-477.

policies, and find evidence that in many areas environmental policies diffuse (Tews, Busch and Jörgens 2003, Busch, Jörgens and Tews 2004, Daley and Garand 2005, Kern, Jörgens and Jänicke 2005, Tews 2005, Prakash and Potoski 2006, Perkins and Neumayer 2008, Jahn 2009, Ovodenko and Keohane 2012, Ward and Cao 2012, Cao et al. 2013, Saikawa 2013, Jordan and Huitema 2014).

Diverse range of studies, look at different policy areas to study mechanisms and networks of environmental policy diffusion such as; Institutionalism or membership of international organizations (Jahn 2009); Trade, translational and intergovernmental linkage, or diffusion of innovation and technology (Prakash and Potoski 2006, Perkins and Neumayer 2008, Ward and Cao 2012); Harmonization (Holzinger, Knill and Sommerer 2008); Concerns about legitimacy or pressure to conform with international norms (Busch, Jörgens and Tews 2004) . Environmental policy diffusion literature also looks at the existence of and reasons for the races to the bottom (Saikawa 2013) or lack of it (Prakash and Potoski 2006) in environmental issues or regulations.

However, while the literature is rather rich with the studies of environmental policy convergence and in the more wider field some attention was paid to the study of convergence of general public spending at regional level or cross governments (Garrett 2000, Sanz and Velázquez 2004, Skidmore, Toya and Merriman 2004, Sanz 2005, Jensen 2011), regarding studying environmental spending, most of the studies focus on individuals and their concerns for environment. For example, Elliott, Seldon and Regens (1997) look at individual characteristics such as income and work status, and general macroeconomic variables, and their link to the individuals' environmental concern and their support for environmental spending. They find evidence that both individual factors and general macroeconomic conditions affect their voters' support of environmental spending. Such studies then link the individual support to general environmental spending. Similarly, regarding common cultural exposure to factors such as socioeconomic status, Pampel and Hunter (2012) focus on different cohorts and the diffusion of environmental concerns between them. Pampel and Hunter (2012) show that different cohorts with different socio-economical exposures can have different attitudes towards environment, based on different roots of concerns which could fit in to different theoretical

frameworks such as post-materialism arguments (Inglehart 2018)⁵⁸ or global environmentalism arguments (Brechin 1999). In the similar line of research, Bakaki and Bernauer (2018) look at a survey of thousands of individuals in Brazil and show that bad economic conditions doesn't significantly affect their support for environmental policies about climate and deforestation. And Bakaki and Bernauer (2017) show that individuals' willingness to support does not necessarily translate into willingness to pay and individual factors such as age, education and political ideology can affect the gap between the two. This is important to review, as arguments for conditionality of diffusion due to domestic politics is at least partially based on political learning between agents (such as parties) in different jurisdictions, for example Böhmelt et al. (2016) show that political parties learn from parties in other counties, specially from incumbent parties and those who have recently won elections.

The above-mentioned studies give us a relatively good understanding of general environmental policy diffusion and what factors affect environmental spending at micro-level; however, the diffusion and interdependency of environmental spending at macro level is remained understudied. Therefore, the gap remains in determining the existence, and understanding of the factors and spaces affecting, the international diffusion of environmental spending. Hence, question such as: if and how the diffusion in different areas such as green taxes or regulatory instruments translates into environmental public spending; or what factors affect the level of spending at each state; or what factors affect the international interdependency of environmental spending; are remained to be studied. Answering these questions is the first objective of this study.

Another objective of this paper is to look at the conditional effects of domestic political factors on policy diffusion. Looking back at the general literature of policy diffusion, from the empirical standpoint distinguishing between different mechanisms of diffusion or factors affecting it is not easy or always possible. Furthermore, interaction between different the mechanisms and the elements affecting the diffusion can be a challenging task. Hence, the general literature of diffusion lacks a coherent theoretical framework to deal with diffusion and difference studies focus of different

⁵⁸ Originally published in 1990

theoretical frameworks to explain diffusion (Meseguer and Gilardi 2009, Gilardi 2014). However, the literature still provides us with some theoretical models that can deal with homogeneous agents and networks (Jackson 2008: chapter 7), or with diverse preferences but in simpler information diffusion settings (Braun and Gilardi 2006, Volden, Ting and Carpenter 2008). This is because, models looking at policy diffusion can become very complex very quickly as layers of complexity can come from the characteristics of the policies (Makse and Volden 2011) or the relation between decision makers and the level of influence that they may exert on each other or at domestic level⁵⁹. Such factors and their interactions are rarely homogenous but generally assumed to be throughout the literature (Meseguer and Gilardi 2009). For example, diffusion usually is conditioned on geographical or ideological distance or level of trade between trades as well as the characteristics and nature of policies (Beck, Gleditsch and Beardsley 2006). In other words, there are many heterogeneous factors affecting diffusion that their effects on the process of diffusion need understanding. Thus, diffusion rarely happens uniformly through space, and there are difference factors that affect this heterogeneity at international and domestic levels. I should clarify that unit heterogeneity is different from spatial conditionality. The spatial conditionality refers to conditionality in spatial stimuli, for example in imparting or receiving information where signals of information are more likely to diffuse to closer nodes or countries in the network. Diffusion networks can present different spaces such as geographical or ideological ones and there form the diffusion network can be conditional on these factors. (Beck, Gleditsch and Beardsley 2006). On the other hand, unit heterogeneity refers to the fact that individual units or countries can themselves be heterogeneous and treat information differently. This heterogeneity is a source of conditionality in the diffusion process. This happens both on the signalling side and on the responding side.

On the signalling side; Jensen and Lindstädt (2012) propose the idea of biased learning with regards to corporate tax cuts. Assuming that right and left leaning governments have different preferences and right leaning governments are more likely to cut taxes, Jensen and Lindstädt (2012) argue that the

⁵⁹ I have looked at the complexity of the study of different factors of diffusion in section 1 - 2

same decision of cutting taxes by different governments will give different information signals to the other countries, and others take tax cuts by left leaning governments more seriously.

Similarly, on the receiving side, the response to this asymmetric signal is unlikely to be uniform between jurisdictions due to domestic factors. Neumayer and Plümper (2012) propose two main factors of unit heterogeneous conditionality: exposure to stimuli and responsiveness to stimuli. Unit characteristics affect their exposure to stimuli, which causes exposure heterogeneity. Different space matrices, for instance non-standardized spatial weight matrices can model and control for exposure heterogeneity. Responsive heterogeneity on the other hand is due to units treating stimuli differently because of their own heterogeneous characteristics. This research focuses on testing and measuring responsive heterogeneity or responsive conditionality. Neumayer and Plümper (2012) argue that beside unit heterogeneous factors such as constitutional or institutional differences in jurisdictions, or the preferences of political actors, responsive units may also be interacting with the policies themselves, and therefore the characteristics of policies is another key factor affecting this responsiveness. For example, left-leaning governments may be less responsive to international tax competition due to their political pretences. This argument is extendable to the learning mechanism of diffusion. Gilardi (2010) argues that prior ideological beliefs cause decision makers to treat similar information differently and show that Left-Right tendency of political actors affects their attitude towards information about unemployment policies in other states. I take inspiration from this and look at the interaction between domestic factors and environmental spending diffusion. While Gilardi (2010) take a Bayesian approach to deal with this domestic responsive heterogeneity, I take a more traditional frequentist approach using the method proposed by Neumayer and Plümper (2012).

It's important to note that domestic political conditionality, usually is related to the characteristics of the diffuses policy⁶⁰. For example Brooks (2007) shows that country attributes such as their level of wealth can affect when and which policies (e.g. depending on the level of sunk cost that they will impose) will diffuse and be adopted. In another example, Cao and Prakash (2012) show how visibility

⁶⁰ I shall look at the combination of domestic political factors and the characteristics of the policy in my next paper/chapter.

of an issue can affect the support of domestic players such as veto players. These findings are important as to show that the characteristic of policy - such as in crease of decrease in environmental spending – will interact with the domestic politics factors and affect the diffusion conditionally. In this paper I will modes and measure this conditionality in form of heterogeneous responsiveness.

Therefore, I propose that the literature studying the conditional policy diffusion is rather thin and factors affecting this heterogeneity are less known. To fill this gap in the understanding of responsiveness in diffusion, as its second objective, this paper focuses on cross-national environmental spending as an example and studies that depending on which factors changes in environmental spending in different European states affect one another. By doing so, this paper contributes to the both the literature of environmental spending and conditional diffusion. It finds empirical evidence to show environmental spending diffusion and more specifically showing how domestic political preference affect the level of responsiveness to international stimuli. Using environmental spending as an example of conditional policy diffusion, it also shows how domestic political preferences (e.g. left-right ideological tendency) can make leaders and followers of policy diffusion and furthermore how such roles affect the levels of responsiveness of these actors.

3 - 3 Theoretical considerations

This section puts forward the general theoretical approach of this research. Drawing inspiration from the general policy diffusion literature and the more specific literature of environmental politics, I propose a theoretical framework looking at both the diffusion through spaces and conditional responsiveness of states to the actions of foreign decision makers.

As mentioned above⁶¹ the general literature of environmental policy diffusion already looked at both international and domestic political factors affect the diffusion process. Policy diffusions can happen through different networks by different mechanism, and domestic factors can interact with the diffusion network in addition to being a source of implementation at domestic level (Holzinger, Knill and Sommerer 2008, Jahn 2009, Bernauer et al. 2010, Ward and Cao 2012).

⁶¹ Section 3 - 2

First, this section explains why one could expect the diffusion of environmental spending as an aggregate indicator like other environmental policies diffuses through three main spaces of (1) geography (2) development, and (3) political ideology. I propose that diffusion happens more within similar countries in these three spaces. This provides the empirical bases of diffusion so later on conditionality could be added to it⁶². In other words, one needs to establish a network of information or diffusion (in this case geography, development or ideology) which could interact with the conditionality factors (in this case domestic factors).

Therefore, afterwards, I argue that environmental spending diffuses conditionally and asymmetrically depending on the domestic factors that condition the impact of foreign factors. I argue that this heterogeneous depends on the political pretences of domestic actors and is due to both difference political competitive pressure and their different treatment of information that they receive from different jurisdictions. Finally, this section proposes two main hypotheses to test this proposed theory of political conditional diffusion.

Geographical space;

In the study of diffusion, geographical proximity plays a key role. With regards to *learning or emulation*, the proposed theories of diffusion focus on lack of perfect information, where decision makers of different jurisdictions learn from the experiences of each other (Dolowitz and Marsh 1996). In this learning process, geographical proximity plays two roles. First, the closer the countries the more contact they have with each other and therefore there will be more information flow between them. This information flow is also affected by common factors such as language or immigration, which are highly correlated with geography. Hence, different actors such as governments, activists, innovators and lobbies can learn more from the actors in other jurisdictions. Secondly, closer jurisdictions have more common problems, especially regarding environment They also are more likely have more similar institutions and therefore adaptation of information that they receive from each other is more effectively and probable due to these institutional and cultural similarities. Turning

⁶² Section 3 - 5 explains the details of modelling

to *competition*; geographical nearness may cause freeriding⁶³ and a race to the bottom in environmental spending. Harmonization through international regimes or regional environmental treaties are also more likely to happen in closer geographical proximities, which will result in diffusion environmental spending amongst close states (Kern et al. 2001, Tews, Busch and Jörgens 2003).

Empirically, as mentioned in previous section, the literature finds significant amount evidence for the geographical diffusion of other environmental policies. However, in some areas the evidence is mixed, such is green taxes. It has been widely argued that to avoid political opposition, many such taxes are frequently introduced solely as higher levels of existing taxes and somewhat slowly. Therefore, failing to internalize the full social costs of pollutants. Such taxes are also often not set uniformly for all pollutants in equal levels due to opposition from different interest groups with strong lobbying powers and therefore in many cases they could barely be distinguished from general revenue generating means. (Jordan, Wurzel and Brückner 2001, Kern et al. 2001, Jordan et al. 2003, Ward and Cao 2012). Therefore, Ward and Cao (2012) don't find any compelling evidence for green tax competition. Therefore, one might want to see if diffusion exists on the spending side or not?

In this paper, I look at the environmental spending as the other side of the coin, and all the above-mentioned interactions and diffusions happen in a spatially correlated manner. I argue that like other environmental policies, environmental spending diffuses through geographical space in closer countries. For example, Gilardi (2010) proposes that policies diffuse among states due to information about two main outcomes: policy outcomes and political outcomes. I apply this to environmental spending and argue that, through geographical and other spaces, environmental spending is

⁶³ Other models, which are not presented here, propose free-riding between actors in different environmental settings:

Konisky, D. M. and N. D. Woods (2010). "Exporting air pollution? Regulatory enforcement and environmental free riding in the United States." *Political Research Quarterly* **63**(4): 771-782.

Delmas, M. and A. Keller (2005). "Free riding in voluntary environmental programs: The case of the US EPA WasteWise program." *Policy Sciences* **38**(2-3): 91-106.

Tulkens, H. (1997). Co-operation vs. free riding in international environmental affairs: Two approaches, Nota di Lavoro.

interrelated. First, when policy makers find out about the successful policy outcomes in other states, they try to implement them in their own jurisdictions. Theoretically, this falls into the models that look at states as policy laboratories and some states become initiators or leaders (Volden 2006, Volden, Ting and Carpenter 2008). In such cases, the information about the success could become public, but it is more likely that closer countries receive such information quicker or have similar challenges. Shipan and Volden (2008) look at the smoking ban and show how different mechanisms of policy diffusion work through the geographical space. On the other hand, such implementation could have individual spill over effects. For example, Poortinga, Whitmarsh and Suffolk (2013) argue that single-use carrier bag charge in Wales could produce positive spill overs⁶⁴, which are more likely to happen in close countries. Regarding political outcomes, political actors may adopt policies because of their perceived successful political outcomes. For example, Böhmelt et al. (2016) show that political parties, learn from and emulate foreign incumbent parties. Therefore, if spending in a certain area is perceived to be popular amongst voters, other political actors may follow.

I propose that, the implantation of regulatory instruments, and market-based instruments (to a lesser extend) need spending. Therefore, the diffusion of environmental innovation and instruments will translate into diffusion of environmental spending. I propose that this diffusion happened geographically, in the aggregate level of spending. One should mention that one mechanism of diffusion such as learning does not necessarily exclude possibility of other mechanisms such competition specially when measuring aggregate factors such as environmental spending. However, I propose that learning in geographical space is the dominant factors of diffusion due to the similarity of environmental issues in geographically close countries who also have more communication with one another for example because of cultural and language similarities.

Economic or development space;

Literature of environmental policy diffusion in many places suggests that competitive pressure plays a key role in convergence of environmental policy adaptation. One source of this competitive pressure

⁶⁴ They don't find strong empirical evidence at the time of study but similar policy later on diffuses to other parts of the UK.

comes from the trade structure or the trade network of the economies (Vogel 1995). For example Ward and Cao (2012) find evidence that trade network of countries affecting environmental tax diffusion among them or Prakash and Potoski (2006) provide evidence that structure of the exporting markets affect the implementation of different environmental standards. Furthermore, one could assume that rather similar economies would compete with each other, and GDP per capita could be used good proxy of economic structure. Figure 3-1 shows the relationship between the environmental spending and the log GDP per capita. I argue that this competitive pressure translates into environmental spending through green lobbies and industries, and therefore environmental spending diffuses through development space.

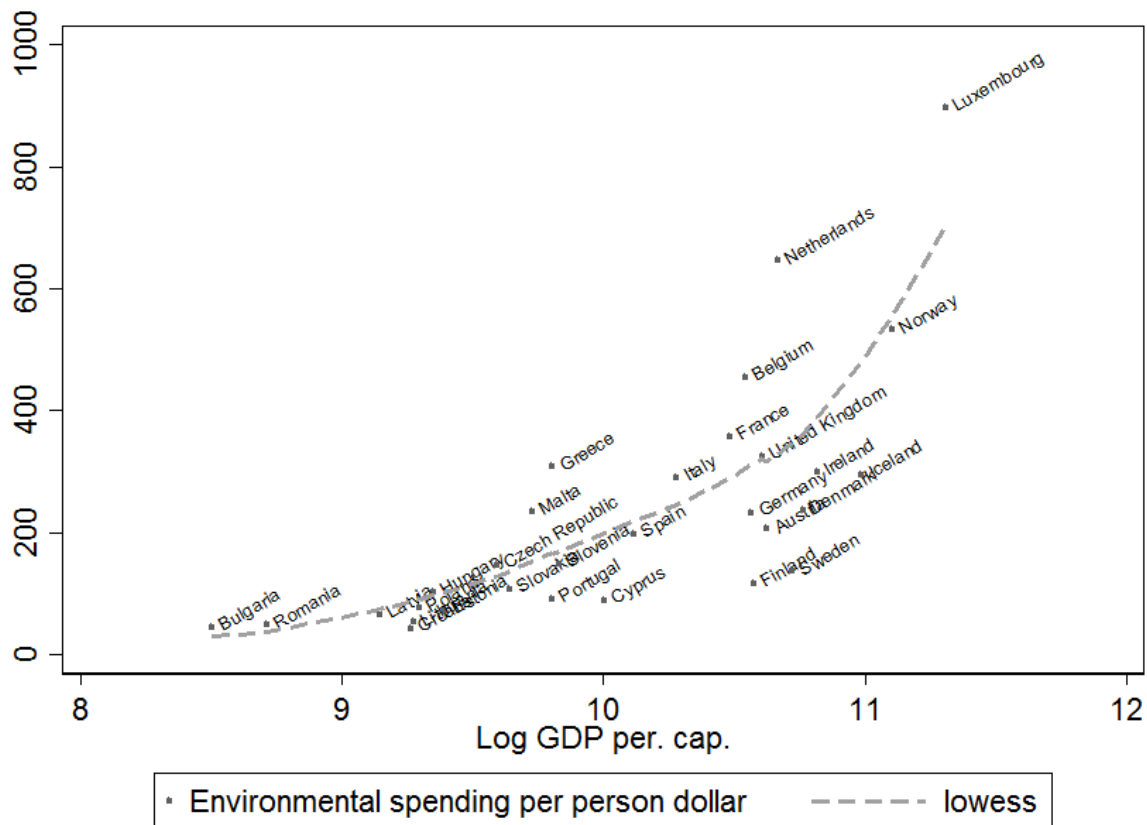


Figure 3-1 Environmental Spending of Different States

Political ideology space;

Like geographical space, actors with similar preferences tend to have more communication with each other, which causes a better flow of information and information diffusion between them. Furthermore, ideologically similar actors – by definition – have closer preferences. Based on this similarity, Ward and Cao (2012) argue that successful lobbying tends to happen between actors with similar preferences while efforts by dissimilar actors are usually unsuccessful due to lack of trust. Additionally success of similar actors for example in lobbying in one jurisdiction encourages the actors of other jurisdictions to make similar attempts to persuade legislators by making private information public or lowering the costs of lobbying (Potters and Van Winden 1992). Another source of diffusion in ideological space comes from the discovery of voters' preferences by office seeking actors. Böhmelt et al. (2016) find evidence that political parties learn from and emulate each other as heuristic attempt to seek more votes. Besides, List and Sturm (2006) propose that despite received wisdom that elections are mainly likely to affect aggregate policy instruments, politicians may have more incentive to focus on policy areas such as environmental policies that constitute a smaller share of total government expenditure and are easier to manipulate. List and Sturm (2006) also find empirical evidence for this theory when comparing environmental spending to general public spending in U.S states. This means that policy makers can be more responsive in policy areas such as environmental spending. I argue that this responsiveness makes diffusion more likely in policy areas that are less salient⁶⁵. Like the geographical space, diffusion of information is more likely between ideologically similar actors. Furthermore, it is more likely that they emulate each other or consider the political outcome of policies. Therefore, diffusion happens more between ideologically similar actors due to similar base. I propose that these information and policy diffusions translate into environmental spending, and therefore environmental spending will between states will be interrelated through ideological space.

⁶⁵ In the time period of this study environmental politics was less salient in comparison to other areas post financial crisis. However, recently it has gained some more importance.

Conditional diffusion and heterogeneous responsiveness

The above arguments support the first objective of this paper, as to argue for the existence of diffusion in environmental spending. They aim to argue for the existence of environmental spending interdependency, so the conditionality of units then be modelled based them. The diffusion mechanism and the diffusion spaces looked at previously are conditional solely on proximity of jurisdictions in different spaces. It's important to distinguish between the network or space conditionality – which assumes that closer countries affect each other more – in contrast to unit conditionality which proposes that units once received spatial stimuli, will treat them differently. While, geographical, development and political spaces are sources of conditionality in diffusion, non-conditional models assume that response of units to the diffusion stimuli⁶⁶ through different spaces is treated uniformly. In other words, I argue that, not only diffusion stimuli that gets to units is conditional on the networks, but furthermore, once stimuli reach the units, units will treat it differently. For example, ideological space models the diffusion network as if there is more diffusion amongst ideologically similar actors to test for example if left leaning or right leaning governments learn more from their ideological neighbours. However, this does not necessarily distinguish between how left or right leaning governments differ from each other in responding to the information that they receive. As mentioned in the previous section,⁶⁷ this specification is rather unlikely, and units rarely uniformly treat diffusion stimuli, but such assumption is very common throughout the diffusion literature and therefore here I'm proposing to relax it and look at conditional diffusion.

For the main objective of this research, I look at this heterogeneous responsiveness. I propose that looking at environmental spending diffusion can shed light on this conditional responsiveness in the diffusion process.

Three main factors affect the domestic responsiveness of agents to international diffusion stimuli. The first factor affecting domestic responsiveness is the level that the policy area itself is determined by

⁶⁶ Information, competitive pressure, etc.

⁶⁷ And also in the Introduction to this thesis

international factors such as competition⁶⁸. If a policy area is mainly determined by international factors or there exists some external constraint imposed on it; then, it's less likely that different domestic actors treat information stimuli differently. For example, defence strategies are usually set long term and membership of organizations or alliances can put external constraints on the level of spending⁶⁹. On the other hand, if a policy area is mainly determined by domestic factors, it's more likely that domestic factors affect it heterogeneously. With regards to environmental issues, literature shows a combination of both international factors such as export markets and tax competition, and domestic factors affecting the diffusion process (Prakash and Potoski 2006, Holzinger, Knill and Sommerer 2008, Ward and Cao 2012). Therefore, providing a suitable policy area to test for conditional diffusion. Accordingly, I argue that governments need to consider both international and domestic factors when it comes to environmental spending, which will be presented at aggregate level of spending.

The two other factors are directly related to the domestic politics in that policy area: How much ideological factors affect a policy area, and how important that policy area is to the voters or political salience of that policy area.

Braun and Gilardi (2006) put forward a utility-based general theoretical framework in which different factors affect the utility of the adaptation of a policy for each policy maker. Such factors include the decision maker's own political preferences as well as the utility that such actors gain from winning office. Further factors are implementation costs and the effectiveness of the alternative policy in contrast to status quo. In such frameworks, all these factors affect the diffusion in a conditional way. Theoretically, in the game-theoretic framework of Volden, Ting and Carpenter (2008) actors wait to learn from others who can bear the risk of initiating or experimenting with an alternative policy. I propose that such differences which lead to waiting or initiating roles will become a source of different level responsiveness in a spectrum of actors. For example, Gilardi (2010) finds that right and left leaning governments can be sensitive to different factors in other countries when looking at

⁶⁸ I looked at this in the next paper chapter of this thesis.

⁶⁹ Such as membership NATO

unemployment benefits, emphasizing the conditional nature of learning in the diffusion process. Accordingly, I propose that such ideological differences (e.g. Left-Right), therefore lead to difference levels of responsiveness based on the role that actors play with regards to a specific policy area. In other words, the cost of implementation (e.g. political risk or assumptions about the preferences of voters) in combination with the ideological position of an actors will determine how likely it is for an actor take initiative in a policy area or wait to get more information from other jurisdictions. In this framework, actors that are more likely to assume leadership roles or are expected to do so, are the ones that have a lower (political or ideological) cost or higher expected utility in initiating policy change. For example, parties with more environmental related agenda are expected to take environmental initiatives and have less political cost doing so due to ideological preferences of their leaders and voters in contrast to less environmentally leaning parties. Therefore, this heterogeneity is partly due to their ideological preferences and vote base, and also partly due to the stickiness of policies (e.g. price level or spending). As soon as one jurisdiction implements a new policy, others learn both about the political outcomes and the costs and the effectiveness of the policy without bearing the costs. Hence, the decision to implement a new policy or wait for other jurisdictions depends asymmetrically on the domestic preferences of the decision maker in each jurisdiction. This means that agents' ideological position can push them towards taking a leading role or becoming a follower in that area.

Furthermore, I propose that this conditionality is itself affected by the polarisation between the actors and voters in the policy area. I argue that polarisation causes different levels of costs for initiation of political actors. The more ideologically distant that actors become from one another, the more they fall into the categories of leaders and followers. Leaders will have lesser political cost of initiating a policy due to their voters expecting them to do so, and therefore can bear the costs of failure. Followers on the other hand, who can't risk implementing initiatives without knowing the policy outcomes and undecided voters' support, will have to wait. In addition to creating leaders and followers, polarisation of agents, leaves a wider group of voters between the ideological position of agents, which vote seeking agents need to consider. This causes followers to become responsive to the

implemented policies. Followers, then will learn if a policy is effective or has the support of voters once leaders who have less cost to initiate have implemented them in other jurisdictions.

Taking the above arguments about polarisation into account, I propose that environmental spending therefore is suitable area for observing this conditionality due to general polarisation in the environmental politics. Voters and political actors are polarised almost in all areas of environmental politics, including recycling (Lybecker, McBeth and Kusko 2013), climate change and energy (Brewer 2012, Fielding et al. 2012, Tranter 2013, Jeong and Lowry 2019), water resources and management (Mollinga 2005, Mollinga 2008), and pollution (O'Connor 2012, Brand and Fregonese 2016). Therefore, based on the ideological position of political actors they will be leaders or followers and therefore less or more responsive to environmental policies in different jurisdictions. One can observe this polarisation along two different single dimensions. (1) the direct environmental salience for ideological actors such as parties, for example parties with specific environmental agenda⁷⁰, and (2) the traditional Left-Right categorisation of parties where more right leaning parties are less concerned with environmental issues in contrast to ideologically left leaning parties and actors⁷¹. I take these two dimensions to test for conditionality.

Polarisation furthermore affects the responsiveness both directly and indirectly through salience. Agents and political actors become more responsive on polarised issues as voters can make clear choices and also polarised issues become more salience for voters and therefore vote seeking agents (such as parties) become more responsive (Ezrow 2007, Spoon and Klüver 2015).

Putting together the effect of polarisation on responsiveness beside the effects of the distance that agents find themselves from other agents, I propose that in polarised policy areas such as environmental spending, one should expect significant conditional responsiveness towards international diffusion stimuli.

Therefore, I propose that diffusion in such policy areas in conditional on the domestic preferences of the actors. I argue that in polarised policy areas such as environmental politics both the ideological

⁷⁰ E.g. cucumber green parties.

⁷¹ See the references on in the paragraph for polarisation on different issues among left and right.

positions of actors and the dispersion of voters along the ideological dimensions will create responsive followers who won't initiate policies but are responsive to changes by other actors. As mentioned above, polarisation furthermore causes salience which itself leads to responsiveness, therefore adding to the responsiveness of followers who now have more information about the policies implemented in other jurisdictions.

For example, conservative or right leaning parties from whom traditionally environmental issues are less salient and are not known to take initiatives about, will find taking initiatives more politically risky and will prefer to continue with the status quo. However, once a policy proves to be popular among voters in other jurisdiction, they will respond to such policies quickly to keep their competitiveness. While providing tangible examples is rather hard without looking at a policy area in depth, anecdotally, one can look at the Conservative government of the UK in recent years⁷² which traditionally is less likely to take environmental initiatives, but once different policies become implemented in other countries and shown success or popularity with voters, they followed suite. One example is the introduction of plastic bag charges in 2015⁷³, where countries such as Finland and Denmark lead the initiative. British Conservative government became responsive as others such as Italy and Ireland followed suit. Another example is the ban on single-use plastics which has been delayed a few times from agenda but finally approved to be done before some other countries of Europe⁷⁴. Similarly, but more related to this research, one can look at the Conservatives' manifesto for 2019 general election. Despite the fact the 2019 election was mainly about the Brexit negotiations, the conservative manifesto made multiple environmental spending promises⁷⁵ in areas such as tree planting. This contrasts with extra CO2 emission cuts which is promised by other parties such as Labour promised⁷⁶ but seemed not to be in areas that proven to be popular among their voters. Measuring such differences in responsiveness is rather a methodologically challenging task and the

⁷² After 2010

⁷³

<https://ec.europa.eu/environment/europeangreencapital/englandplasticbag/#:~:text=England%20has%20become%20the%20latest,been%20placed%20on%20polyethylene%20bags.>

⁷⁴ <https://www.edie.net/news/5/Ban-on-plastic-straws-in-England-pushed-back-to-October-2020/#:~:text=In%20May%202019%2C%20the%20UK,in%20England%20from%20April%202020.>

⁷⁵ <https://www.conservatives.com/news/vote-blue-go-green>

⁷⁶ <https://www.bbc.co.uk/news/election-2019-50552535>

above examples are rather anecdotal than true representatives, however this paper tries to capture exactly such effects empirically.

Therefore, I propose that it is more likely for actors to fall into categories of leaders and learners in a polarised policy area based on their ideological preferences. Political ideological preference can trigger innovation by leaders in area that they have more freedom to experiments due to less political costs, in this case left leaning or environmentally friendly actors. On the other hand, ideologically unmotivated actors – in our case right leaning actors – will wait and see the policy and political outcomes. However, once they have observed the outcomes, they could follow the leaders quickly seeking office in polarised and salient area. This leader/follower division is due to different costs, payoffs and uncertainty in these areas. Thus, I argue that this balance between the costs and payoff, which varies between jurisdictions and actors, causes heterogeneity in responsiveness to spatial stimuli, depending on their political preferences. This means that actors that expect higher costs or lower payoffs from initiating an alternative policy will be more willing to learn and hence more are responsive to the action of agents in other jurisdictions. Putting all the above together, I expect right leaning and less environmentally friendly governments to be more responsive towards changes in other jurisdiction as followers. The following hypotheses formulate this theory to test the expectations regarding the general Left-Right tendency and environmental friendliness of the governments.

Hypothesis 1 general political *conditional responsiveness*: More right leaning governments are more responsive to changes in environmental spending of the foreign countries.

Hypothesis 2 environmental political *conditional responsiveness*: Less environmental leaning governments are more responsive to changes in environmental spending of the foreign countries.

3 - 4 Research Design

This section reviews the design of this research to show how the empirical models test the presence diffusion of environmental spending between states and test for the conditional effect regarding the

hypotheses stated in the previous section. First, the *Data* subsection describes the source of data and the variables including a brief description of the control variables and conditional variables as well as the independent and dependent variables. Then the *Models and Methodology* subsection deals with the methods used for testing the hypotheses proposed and models specification. This subsection first briefly reviews the general specification of spatial lag models usually used in the literature. These models are used to test to the unconditional diffusion through three difference spaces. After that, it details the specification of the models used specifically to test for the conditional hypotheses.

3 - 4 - 1 Data

Data set is a panel of 30 European countries⁷⁷ from 1995-2014. It is based on collection of data from four main sources:

(1) eurostat⁷⁸ is the source of environmental spending and environmental taxes data.

(2) Most control variables' data are extracted from World Bank Development Indicator (WDI)⁷⁹.

(3 and 4) And mapping of the political preferences of governments (i.e. Left-Right⁸⁰ tendency or the level of environmentalism) is calculated based on data from Comparative Manifesto Project (CMP)⁸¹ and ParlGov⁸². These two sources also provide the data of ecological parties elected to parliament.

In total due to missing values and lags, the number of observations used in estimations is 460.

The key *dependent variable* in this research is *change in per person environmental protection spending* in each state in 2013 U.S dollars, which is denoted in equations as Δy_{it} for country i in year t .

⁷⁷ Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom

⁷⁸ <http://ec.europa.eu/eurostat/data/database>

⁷⁹ <http://data.worldbank.org/data-catalog/world-development-indicators>, 2015 version downloaded December 2015

⁸⁰ Based on Budge, I. (2001). Mapping policy preferences: estimates for parties, electors, and governments, 1945-1998, Oxford University Press on Demand.

⁸¹ <https://manifesto-project.wzb.eu/>

⁸² <http://www.parlgov.org/>

Wide ranges of domestic determinants of environmental spending are controlled for. Due to the lack of literature specifically related to public environmental spending, most of these control variables are selected from either the literature of environmental policy and taxes, or general public spending literature mainly following the work of Ward and Cao (2012). These *control variables* are: environmental tax as %GDP⁸³, log of GDP per capita, total public spending as %GDP, economic growth, unemployment and unemployment squared, inflation⁸⁴, each country's median government's Left-Right and environmental protection position and finally a dummy if a member of an ecological party was elected to the lower house.

The median position of the government is calculated based on the position of parties (using their election manifesto data) and the formation of the government. In majority governments, the Left-Right position of the government is equal to the position of party holding the majority⁸⁵. In other cases, such as coalition governments, the position of the government is the median position of the parties forming the government in proportion to the seats that they are holding in the parliament. This variable has three important roles in this research: (1) Control variable to spending in the baseline model (2) It forms the space in which the ideological distance of governments is calculated based on, and (3) It is used to build the spatial conditional variable, which represents the heterogeneity among countries in responsiveness to diffusion stimuli. In the first case, this variable controls for the differences between the spending of the left leaning vs. right leaning governments. In its second use, it forms the basis of a space in which diffusion can be happening through as explained below. Finally, this variable captures the heterogeneity of states regarding conditioning the responsiveness of governments to diffusion. The methodology section provides the detail of these calculations and the inclusion of this variable in models. The environmental protection position (or tendency) of governments is used similarly⁸⁶.

⁸³ The models are robust to \$ *green taxes per person* and their change

⁸⁴ Measured using Consumer Price Index (CPI)

⁸⁵ Measured by variable *rile* in the CMP

⁸⁶ Measured by variable *per501* in the CMP

Main bases for the *independent variables* of this research are the spatially weighted lagged values of the dependent variables of different countries which then will be interacting with the conditional factors. This is *the spatially weighted value of other states environmental spending per capita*. This variable captures the effect of the dependent variable y in other countries on the same variable in country i , Δy_i . Special lagged variables are generally noted by $W\Delta y$ where W represents the weight matrix of a certain space. This research uses three spaces (1) *geographical space* (W_{geo}) where the distance between two states is calculated based on the inverted distance between their capitals⁸⁷; (2) *development space* ($W_{lnGDPpc}$) where the distance between two states is calculated based on the difference between the natural logarithm value of their GDP per capita; and (3) *ideological space* (W_{ideo}) where the distance between two states is based on the difference between the ideological (Left-Right) median position of their governments.

3 - 5 Models and Methodology

Equation 3-1 shows a general spatial lag model as usually presented in the literature where; y_{it} is the dependent variable, α_i represent unit heterogeneity (in fixed effects setting), X is the control variables matrix and β is their coefficient matrix, and finally ϵ_{it} denotes the error term.

$$\text{Equation 3-1 (General Spatial Lag model)} \quad y_{it} = \alpha_i + \rho WY_{it} + \beta X_{it} + \epsilon_{it}$$

As mentioned above, W is the weigh matrix for a certain space, where w_{ij} is calculated based on the distance between units i and j , and $w_{i=j} = 0$. For example, weight matrices of W_{geo} which represents the geographical distance between two states, here is measured by inverse distances between the capitals of two states, meaning that that W_{ij} is the inverse distance between the capital of the two countries of i and j . Therefore, the greater the distance, the smaller it becomes and represents smaller chance of diffusion. Equation 3-2 show a weight matrix for one cross section of the data (for example time t) where N is the number of units (countries).

⁸⁷ Based on the data of Gleditsch, Kristian S. & Michael D. Ward. 1999. "A Revised List of Independent States since 1816," *International Interactions* 25:393-413 available at <http://privatwww.essex.ac.uk/~ksg/mindist.html>

$$\text{Equation 3-2 (Weight matrix for each time)} \quad W_{N \times N} = \begin{bmatrix} w_{11} & \cdots & w_{1N} \\ \vdots & \ddots & \vdots \\ w_{N1} & \cdots & w_{NN} \end{bmatrix}$$

By adding the time dimension of T, this research uses a $W_{NT \times NT}$ weight matrix to model the panel data. Equation 3-3 shows this weight matrix. Effectively what this matrix does, is to weigh in the effect of other units in a certain time. Therefore once estimated, ρ shows the spatial correlation of the units, in other words the spatial effects of y in other units on y_i in country i weighted by W, or in this research the weighted effect of change in public environmental spending of countries on each other weighted by space (e.g. geographical, ideological, or development spaces) in a specific time.

$$\text{Equation 3-3} \quad W_{NT \times NT} = \begin{bmatrix} [W_{N \times N}^{t=1}] & \mathbf{0} & \cdots & \mathbf{0} \\ \vdots & \ddots & \ddots & \vdots \\ \mathbf{0} & \cdots & \mathbf{0} & [W_{N \times N}^{t=T}] \end{bmatrix}$$

Equation 3-3 shows the $W_{NT \times NT}$ matrix as used in this research and Equation 3-4 represents the more specific specification of the models used in this research in models (1-3)

$$\text{Equation 3-4} \quad \Delta Y_{i,t} = \alpha_i + \rho W \Delta Y_{i,t} + \phi_1 Y_{i,t-1} + \beta X_{it} + \epsilon_{it}$$

Each w_{ij} is row standardized. This means that $\sum_{j=1}^n w_{ij} = 1$ for each i . Plümper and Neumayer (2010) emphasise that in row-standardization researchers should pay attention to the theoretical implication of the specification and suggest that not to row standardize sometimes offer a better fit between theory and specification. Row standardization, as its name suggest, standardized the effect of all the network on each unit. In other words, it averages out the effects based on their spatial distance and standardized it for units. No standardization assumes an interaction between the independent variable and spatial weights, meaning that heterogeneity of units will be equal to the spatial weights between units, which is rather unrealistic. If two countries have different distances from another country, it is reasonable to assume that the effects are different in proportion to each other on a unit, but if we want to compare their effect on different units, their effects on different units are unlikely to be proportional to their distances. On the other hand, row standardization without other changes in the model specification assumes a uniform exposure among units, which is also unrealistic. This is the assumption that literature usually makes and ignores the unit heterogeneity and this research wants to

relax. Neumayer and Plümper (2012) propose another method using the inclusion of the interaction term (z), in order to capture this heterogeneity explicitly and modelling conditional spatial dependence, which this paper uses⁸⁸.

Equation 3-5 and Equation 3-6 show the specification of this approach in this research as used in models (4 and 5)

$$\text{Equation 3-5 } \Delta y_{i,t} = \alpha_i + \rho_1 W \Delta Y_{t-1} + \rho_2 [W \Delta Y_{t-1}] \cdot z_{i,t} + \phi_1 y_{i,t-1} + \phi_2 z_{i,t} + \beta X_{it} + \epsilon_{it}$$

$$\text{Equation 3-6 } \Delta y_{i,t} = \alpha_i + \rho_1 \sum_k \left[\frac{w_{i,k,t-1}}{\sum_k w_{i,k,t-1}} y_{k,t-1} \right] + \rho_2 \sum_k \left[\frac{w_{i,k,t-1}}{\sum_k w_{i,k,t-1}} y_{k,t-1} \right] \cdot z_{i,t} + \phi_1 y_{i,t-1} + \phi_2 z_{i,t} + \beta X_{it} + \epsilon_{it}$$

As before, α_i captures the unit heterogeneity (fixed effect), ρ_1 spatial lag and ϕ_1 temporal lag. However, in these models; ρ_2 is the coefficient of the interaction between the spatial lag and $z_{i,t}$. This interaction variable captures the heterogeneity in responsiveness to spatial stimuli conditional on $z_{i,t}$. In this research Left-Right tendency and the level of environmentalism of governments are used as $z_{i,t}$ in models (4 and 5) to test the hypotheses (4.1 and 4.2).

Another issue with the measurement of the spatial effects that needs to be dealt with, is distinguishing between common exposures of units compared to the spatial effect of the units. This is known as the Galton⁸⁹ problem, which for this research means measuring if spatial correlation of countries environmental spending is due to correlated exposure to some common factor such as economic shocks, or it is due to diffusion of policy among those states. There are some econometrics methods⁹⁰ to deal with this issue, however because the main aim of the models used here is to measure the conditional effects, to resolve this issue spatial effects are lagged to one period and $W \Delta Y_{t-1}$ is used in the models as seen in the above equations (Franzese and Hays 2008).

⁸⁸ This discussion is important as to justify the decision for row standardization in this setting.

⁸⁹ For more see; <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095841611>

⁹⁰ For more on distinguishing between Spatial Error Models vs Spatial Auto-regression Models see: Franzese, R. and J. C. Hays (2014). Testing for spatial-autoregressive lag versus (unobserved) spatially correlated error-components, Benjamin F. Shambaugh conference: New frontiers in the study of policy diffusion, University of Iowa, Iowa City.

All the models above are estimated with fixed effects (as specified) using maximum likelihood estimator⁹¹.

3 - 6 Empirical Findings

This section looks at the empirical findings and estimation of models. First, it summarizes and discusses the estimated results of the three unconditional spatial lag models for difference spaces. These three models include spatial lags based on difference spaces. The inclusion of Wy which standardizes the effect of other countries conditional on different spaces makes these models intrinsically conditional but I call these models (1-3) *unconditional* to distinguish them from the two other models that include interaction terms to specifically model the conditional effect of spatial stimuli depending on domestic political factors. I call these two models (4-5) *conditional/interaction*.

Table 3-1 presents estimates of empirical all these models. Models 1-3 are implementations of unconditional spatial lag models regarding hypotheses 1-3, respectively testing for diffusion through geographical, development and political ideology spaces. Model 4 and 5 include the interaction terms to test for conditional responsiveness conditional on domestic political factors. They test for conditional responsiveness depending on general Left-Right tendency and environmental friendliness of governments, taking model 1 (geographical space) as their baseline⁹². This means that the response of each country to other countries standardized changes in environmental spending in previous year will be captured in both the coefficient of the spatial lag and the interaction between the spatial lag and these two variables and described previous sections.

⁹¹ Using maximum likelihood estimation (MLE) in contract to for example Least Squared Logistic Regression of some other Spatial implementation is that while the specification of the models uses is rather different that the general ones in the literature it still worth mentioning that MLE is generally considered to be at least weakly dominant with regards to unbiasedness, consistency and efficiency , for more see Franzese, R. J. and J. C. Hays (2007). "Spatial econometric models of cross-sectional interdependence in political science panel and time-series-cross-section data." *Political Analysis* **15**(2): 140-164.

⁹² I chose geography as a baseline to avoid interaction between network conditionality and responsive conditionality, especially as the coefficient of their interaction is not easy to conceptually interpret

Country fixed effects are included in calculation, however for brevity they are not presented in the tables⁹³. I focus on the short-term effect of the spatial stimuli, which is presented as the coefficients in the table and not the not the long-term equilibrium impact⁹⁴.

⁹³ Because the change over time is used as main dependent variable, I didn't add time specific unit effect in the models.

⁹⁴ As both temporal and spatial auto-regressive models, one could also focus on long-term equilibrium of temporal and spatial impacts. With regards to the long-term equilibrium, another issue that can be focused on is the spatial non-stationary of models due to estimated coefficients that are greater than one. In other estimations including Wy_t as well as Wy_{t-1} resolved this issue, however high correlation between them would have caused multicollinearity. As this research focuses on short term effects, I decided to exclude those variables and focus on the most relevant ones.

y = Δ Env Spending \$ per. person	Model (1) W^{geo}	Model (2) W^{LGDPpc}	Model (3) $W^{Left-Right}$	Model (4) $W^{geo} \times L - R$	Model (5) W^{geo} \times Pro Env
	b/p	b/p	b/p	b/p	b/p
y_{t-1}	-0.109 (0.015)*	-0.248 (0.000)***	-0.242 (0.000)***	-0.108 (0.013)*	-0.100 (0.025)*
Tot. Gov. Spend %GDP	-0.151 (0.782)	-0.586 (0.322)	-0.644 (0.273)	-0.125 (0.815)	-0.207 (0.702)
Log GDP per. cap.	-1.370 (0.583)	4.364 (0.097)	4.196 (0.108)	-1.925 (0.434)	-1.444 (0.559)
Unemployment	-5.339 (0.002)**	-6.218 (0.001)**	-6.200 (0.001)***	-5.196 (0.002)**	-5.247 (0.002)**
Unemployment Squ.	0.165 (0.010)**	0.183 (0.008)**	0.182 (0.008)**	0.159 (0.011)*	0.162 (0.010)*
Growth Rate	0.167 (0.723)	0.205 (0.689)	0.178 (0.727)	0.171 (0.712)	0.180 (0.700)
Inflation	-0.173 (0.373)	-0.179 (0.396)	-0.171 (0.414)	-0.181 (0.345)	-0.155 (0.421)
Green Party Elected	1.559 (0.805)	-0.683 (0.921)	-0.875 (0.898)	1.168 (0.851)	2.015 (0.747)
Green Taxes %GDP	8.277 (0.081)	9.596 (0.063)	9.666 (0.059)	8.056 (0.084)	7.060 (0.135)
Gov. Left-Right	-0.290 (0.079)	-0.317 (0.077)	-0.299 (0.095)	-0.395 (0.017)*	-0.276 (0.092)
Gov Pro. Env. Position	0.500 (0.554)	0.073 (0.937)	-0.016 (0.986)	0.486 (0.559)	1.363 (0.128)
$W^{geo}y_{t-1}$	2.429 (0.000)***			2.528 (0.000)***	3.604 (0.000)***
$W^{LGDPpc}y_{t-1}$		-0.029 (0.835)			
$W^{Left-Right}y_{t-1}$			0.289 (0.023)*		
$W^{geo}y_{t-1} \times Gov. Left - Right$				0.045 (0.000)***	
$W^{geo}y_{t-1} \times Gov. Pro. Env. Pos.$					-0.262 (0.006)**
sigma_e					
Constant	29.277 (0.000)***	31.839 (0.000)***	31.664 (0.000)***	28.833 (0.000)***	29.042 (0.000)***
Observations	460	460	460	460	460

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

Table 3-1 Environmental Spending Models Estimation

Looking at *unconditional spatial models*, general homogeneous spatial effect in geographical space ,in the model 1, $W^{geo}y_{t-1}$ has a positive significant coefficient, which supports the proposition of international interdependency of environmental spending. This effect builds the bases for conditional effects in models 4 and 5 which include the interaction terms will be discussed further below Simply this base model supports both the idea of diffusion in environmental spending and also that this diffusion happens more between countries that are geographically closer together. Model 2 similarly focuses on diffusion through *development* space. Using natural logarithm of GDP per capita as a proxy for economic development this model tests the existence of diffusion between countries with relatively similar economies. The estimated coefficient of $W^{LGDPpc}y_{t-1}$ is statistically

insignificant and its estimated value is negative. This does not provide support for arguments that suggest that environmental spending diffuses amongst countries which are at similar development level⁹⁵. Finally, model 3 concentrates on *political ideology* space. Positive significant coefficient of the spatial lag ($W^{Left-Right}y_{t-1}$) supports the proposition that environmental spending diffuses between ideologically similar governments (measured by left-right leniency).

Regarding control variables; in the models above, there exists a significant temporal effect, as captured by the estimated negative coefficient of the environmental spending in previous year. This temporal autoregressive effect may explain why some other control variables are not significantly correlated with the dependent variables. As expected, the estimated coefficient of the median position left-right position of the governments is negative and at least significant at 10% linking more right leaning governments to decrease in environmental spending in general. All models also show a significant non-linear inverted Kuznets curve shape relation between changes in environmental spending and unemployment. This is similar to the effect that Ward and Cao (2012) found in environmental taxes, which they attributed to governments fiscal policy and business cycles. Ward and Cao (2012) argue that green taxes follow the similar general patterns governments' public finance as tool to address unemployment. Similarly, the empirical findings of this research are consistent with such pattern where governments tend to increase public spending to address unemployment to some level and after that – e.g. when the economy is deep in crisis – governments have to decrease the general level of public spending.

Models 4 and 5 are therefore built based on the Model 1 which captures the diffusion in geographical space and provides the foundation to measure conditionality. Models 2 and 3 can't be used as Model 2 doesn't present any diffusion effect and Model 3 is capturing the network conditionality of ideology and therefore the ideological conditionality built on it will have a double ideological effect.

Looking at models 4 and 5, empirical findings support both hypotheses 1 and 2. The coefficient of the interaction term between spatial stimuli and left-right tendency of the government of a country in

⁹⁵ I should mention that models including Wy_t show a negative spatial lag in development space which can be interpreted as free-riding among countries with similar development level.

model 4 is significantly positive, providing evident in support of hypothesis 1. This means that more right leaning governments are correlated with more responsiveness to spatial stimuli and changes in the environmental spending of other states. Conversely, the coefficient of the interaction between environmental friendliness and spatial stimuli is significantly negative, supporting hypothesis 2. This means, negative correlation between environmental tendency of a government and its responsiveness to changes in environmental spending of other states.

One could also see changes in the magnitude of the estimated coefficient for the unconditional spatial lag between Models 1, 4 and 5. It changed from 2.429 in the baseline model to 2.528 and 3.604. This is due to the multi-collinearity between spatial lags and conditional special lags and shows how not capturing conditionality could result in biased estimation of spatial lags. This has important implications for empirical diffusion research as to suggest that not controlling for conditionality could lead to biased estimations and accordingly biased evidence for or against the existence of diffusion. The magnitude of coefficients when controlling for pro-environmental tendency conditionality is larger than left-right conditionality. This is expected as environmental issues are directly linked to it in contrast to being linked only indirectly to left-right tendency. Looking at these magnitudes and the change in the magnitude of unconditional spatial lag which goes up when we control for conditionality, one could conclude that less environmental friendly and right leaning governments are more responsive to international stimuli and therefore controlling for their effects shows the higher level of diffusion which otherwise would have been averaged out. Therefore, beside statistically significant coefficients of conditional interaction variables, the increase in the magnitude of unconditional spatial lags furthermore adds to evidence in support of hypotheses of the research.

Figure 3-2 demonstrates the estimates average marginal conditional effect of spatial stimuli. X-axis represents the political tendencies of the governments while Y-axis is the spatially standardized stimuli. In other words, Y-axis shows the standardized spatially weighted average of environmental spending changes in the other foreign countries. Finally, Z-axis – shown by colour/contour levels – is the estimated calculated average effect of stimuli (Y-axis) conditional on political tendency of each government (X-axis). Based on models 4 and 5, Figure 3-2 illustrates how more a right leaning or the

less environmentally friendly a government, the more is the estimated effect of the same level of stimuli. Looking at the numbers, this figure indicates that an approximately \$40 decrease in the spatially averaged environmental per person spending of other countries can have a conditional decreasing effect between \$0 to \$160. This \$40 spatially averaged decrease in spending can have little or no effect on governments on the far left of the spectrum while the same amount is correlated with up to \$160 decrease in environmental spending of far-right governments. Similarly, the same \$40 spatially averaged decrease in spending can be correlated with between \$0 to \$120 decrease in spending of countries depending on the environmental friendliness of governments. Figure 3-2 also shows that this conditional effect is not linear and could be different at different levels of stimuli. This also shows that while right leaning governments are more responsive overall, their responsiveness to spending cuts is more significant compare to spending increases. However, this is a general theme on both sides of the political spectrum, meaning that cuts are more likely to diffuse compared to increase in spending.

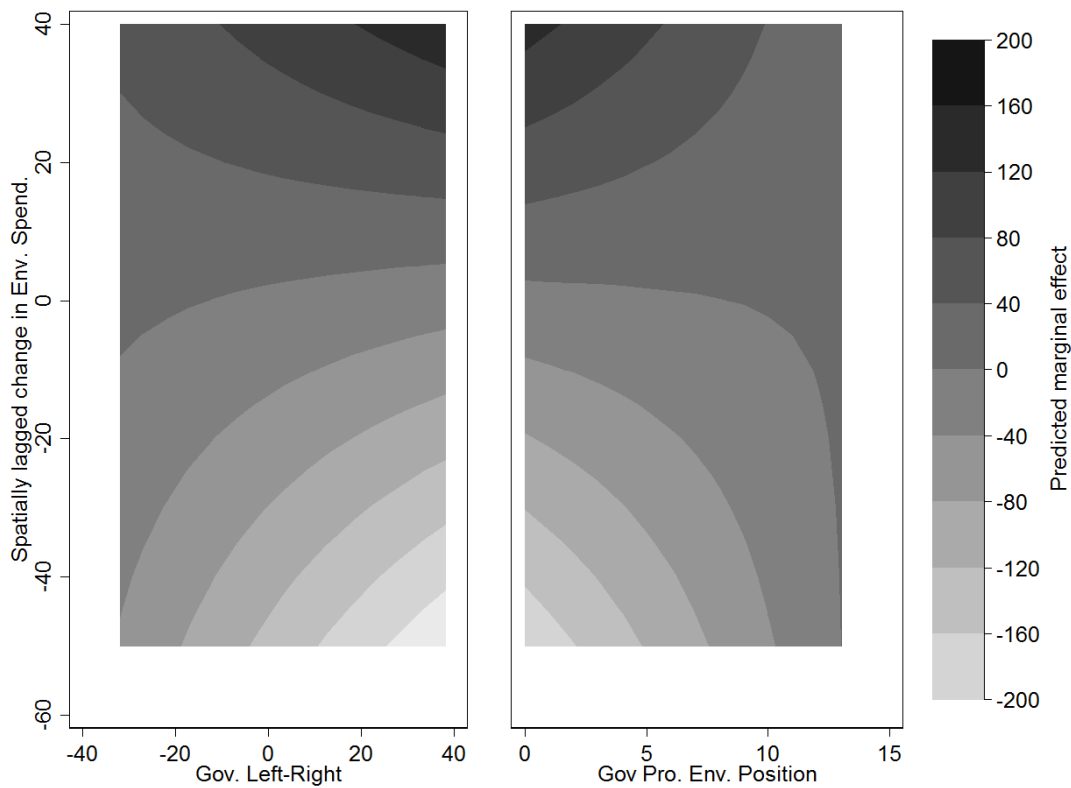


Figure 3-2 Average Estimated Conditional Spatial Marginal Effect of Change in Other States

3 - 7 Discussion

Empirical findings presented above provide support for both propositions of this research. First, they show existence of spatio-temporal correlation in geographical and ideological space; however, this research does not find evidence of such correlation in economic/development space. This lack of such correlations in economic/development space can be explained by the nature of the determinants of the environmental spending's which are mostly domestic rather than international in contrast to other environmental policy instruments such as export markets or trades (Prakash and Potoski 2006). On the other hand, the countries of this study are mostly wealthy developed and therefore there is less development diversity between them, and this could lead to lack of significant diffusion in that space. Therefore, The importance of frontrunners in adaptations of environmental policies could also be much less with regards to the aggregate level of spending and to some degree explain the absence of empirical spatial correlation in developments space (Tews, Busch and Jörgens 2003) . Ward and Cao (2012) also propose that one possible learning mechanism comes from the states with less technical or administrative capacity learning from policies of more abled states. This effect is less significant in environmental aggregate spending and with a closely linked community of countries.

Another factors that contributes to this difference between the convergence of environmental spending and other environmental instruments, is the significant linkage of environmental spending to geographical and local factors. This direct linkage causes environmental spending to be difference in developmentally similar economies due to their natural geographical heterogeneity. In other words, while for example in command-and-control environmental regulatory instruments studies find a spatial correlation because of common export markets (Prakash and Potoski 2006), this does not happen in environmental spending which is more determined by domestic factors.

Empirical findings support the conditional hypotheses and show that both right leaning governments, and those who are less environmentally friendly are significantly more responsive to the changed in other states. I argued that ideological preferences of agents and voters in combination with the costs

and risks of initiation and implementation will lead to actors taking the roles of leaders and followers. Leaders are more likely to initiate policy changes that are more salient to their voters, on the other hand followers will respond to information from other jurisdictions. I proposed that in polarised issues, followers will become more responsive to the information that they receive. This leadership-followership model will cause responsiveness heterogeneity.

This finding in bigger context explains the lack of a race to the bottom in the environmental spending in Europe as vote seeking followers will respond to changes in other jurisdictions. Furthermore, the size of the effects in both dollar values and estimation outputs⁹⁶ shows the need for such controls in empirical studies.

To summarize the above results show: (1) existence of diffusion of environmental spending in geographical and political space; (2) lack of spatio-temporal correlation in economic development space; and (3) conditional responsiveness to spatial stimuli depending on domestic political preferences, in form of more responsiveness of the political followers⁹⁷.

3 - 8 Conclusion

This paper had two objectives. Firstly, to argue for and test the diffusion of environmental spending as an area that is less studied in the literature of environmental politics. The second aim of this research was to study the role of domestic political preferences in the conditional responsiveness in secondary policy areas by using the environmental spending as an example to learn about the sources of heterogeneity.

This paper studied the interdependency of environmental spending between European states and showed that beside the geographical space; diffusion of environmental spending also happens through political ideology space. I argued that such environmental spending policy dependence is expected

⁹⁶ And the differences that is made in coefficients in different models due to inclusion of conditionality effect.

⁹⁷ Section 7 - 1 in page 151 in appendices provides the summary of robustness checks showing the results (the conditional political diffusion effects) are robust.

due to political learning and found evidence to support it. However, no evidence of diffusion in development space was present in empirical tests.

Furthermore, I argued for heterogeneous diffusion and conditional responsibility in polarised policy areas due to asymmetric political learning. I argued that governments tend to be more responsive in areas that they are salient. I propose that this responsive followership is more in polarised policy areas due to more competitiveness, the natural tendency of such policy areas to be manipulated by vote seeking politicians. Using environmental spending as an aggregate of such policy issues this paper found empirical evidence in the support of the theory proposed. Using conditional spatial econometrics models, controlling for geographical distances this research measured the interaction effect of domestic political preferences and standardized spatial stimuli from other states. This showed – as expected – that more right leaning and less environmentally friendly governments are correlated with more responsiveness to spatial stimuli.

This paper contributes to the environmental politics literature by discussing the environmental spending and its diffusion, which is less studied previously. It presents evidence for the existence of geographical and political diffusion of environmental spending in Europe, which I argued is mainly due to political learning. The evidence also showed that this diffusion is conditional depending on the political preferences of governments which are less expected to lead in environmental issues. They are more responsive to actions and decisions of other countries. This finding also contributed to the understanding of the diffusion process itself, especially regarding domestic political factors that affect the conditional responsiveness of decision makers. Evidence showed the importance of controlling for domestic conditionality and the responsiveness of governments that are less likely to be initiators in environmental policy area. This can also explain the lack of a race to the bottom due to political domestic demand.

4 Political Determinants of International Tax Rates' Diffusion in Europe

Abstract

This paper studies conditional policy diffusion between states when alternative and related policies exist. More specifically, it looks at (1) conditional responsiveness of countries to spatial stimuli based on domestic political factors, and (2) how this conditionality is affected by the general responsiveness of a policy area towards international stimuli. It argues that international spatial stimuli in areas that are more internationally responsive such as corporate tax income can translate into other alternative areas such as personal tax income through conditional domestic effects. Looking at diffusion in two categories of tax rates; Corporate Income Tax (CIT) and Personal Income Tax (PIT) in a simultaneous setting, it finds evidence to support this argument. It shows that in more internationally responsive area of CITs, spatial correlation exists more significantly while less conditional domestic effect is observed. However, in PIT where such areas are more domestically determined, the international effects are less direct (in form of spatial correlation) but still exist through domestic conditional factors of the Left-Right governments' ideological tendency. Furthermore, empirical results show that the diffusion effects can spill between policy areas with conditionality.

Keyword: Policy Diffusion, Tax Competition

4 - 1 Introduction

Policy change and implementation in many areas including taxation highly depends on international factors as well as domestic ones (Genschel and Schwarz 2011). This interdependency of policies in different jurisdictions – commonly referred to as policy diffusion – is also on the rise with ever more increasing international trade and globalization (Shipan and Volden 2012, Gilardi 2014, Gilardi, Shipan and Wueest 2017, Gilardi and Wasserfallen 2019). However, in this paper I argue that within the literature of policy diffusion two key areas still need more development. Firstly, the heterogeneity of actors and the effect it has on diffusion, and more specifically the conditional responsiveness of these actors to international stimuli; and secondly, the effects of alternative or related policies on the diffusion process, and the interaction that their characteristics have with domestic political factors; both require more attention. Recently both areas are coming to the focus of policy diffusion researchers (Neumayer and Plümper 2012, Genovese, Kern and Martin 2017). Tax competition, as a prominent example of policy diffusion, has a rich literature with both theoretical and empirical studies (Baturo and Gray 2009, Plümper, Troeger and Winner 2009, Genschel and Schwarz 2011, Razin and Sadka 2012, Gilardi and Wasserfallen 2016, Swank 2016), but still provides an opportunity for the study of policy diffusion with regards to these two lines of research.

Brooks (2007) shows that the interaction of the characteristics of policy innovations and the characteristics of units (e.g. country characteristics such as wealth) can determine when and where diffusion happens and matters, therefore showing the importance of capturing heterogeneity. Looking at environmental policies; Genovese, Kern and Martin (2017) propose that governments are usually confronted with a bundle of policies rather than single policy choices. They show that domestic actors' policy preferences in such situations can affect the diffusion of alternative policies. Therefore, policy diffusion in these areas is conditional on domestic political factors such as actors' reliance on international economic flows. In another example, in the same line of research, Chaudoin, Milner and

Pang (2015) focus on the interaction and weight of systemic and domestic factors and show how such interaction can be modelled in hierarchical settings and how such effects can change depending on time. On the other hand, regarding the measurement of conditional effects and responsiveness of units and the role of domestic politics in international diffusion; methodological developments are opening the way for the study of more complex diffusion processes (Plümper and Neumayer 2010). This paper aims to combine these two lines of research looking at the conditionality and heterogeneity of policy diffusing when alternative policies exist. In order to do so, it uses tax competition as an area of study to empirically measure and compare such conditional interaction effects between connected policy areas, in this case personal and corporate income taxes in European countries.

Therefore, this paper studies the conditional diffusion of tax rate changes and the conditional responsiveness of domestic political actors to changes in other states when alternative policies in those areas exist. To do this; it uses data on two categories of taxes while controlling for domestic political preferences. This research firstly focuses on how policy diffusion works when alternative policy areas interact with each other using taxes as alterative policy areas. And secondly, how heterogeneous diffusion effects in different areas can be modelled depending on domestic political factors using domestic political preference as the main conditional factor of responsiveness. In other words, it shows where and why diffusion between different but related policy areas can be heterogeneous and how this heterogeneity is conditional on domestic political factors.

Domestic and international, and economic and political factors affect taxation and the diffusion of tax rates' changes. However, here I focus on international interdependency, i.e. the effect of changes in different tax rate categories in different countries on each other in different jurisdictions and only control for some common domestic determinants. I look at two factors that affect this international interdependency of taxes; (1) international mobility of goods and services, labour, and capital in each tax area as a key characteristic of each area; (2) domestic political preferences of governments.

First, I provide a theoretical framework looking at multiple alternative policy areas. For capturing the *interaction* and *heterogeneity* between policy areas when alternative policy areas exist, this paper uses

the two categories of taxation; corporate income tax (CIT) and personal income tax (PIT). These categories are not directly alternatives but are generally interdependent.

Later, this paper also looks at the domestic factors that are related to the heterogeneity of units or states when they receive diffusion stimuli. I argue that because the more domestically a policy is determined, the less direct international effects matter, therefore higher levels of direct international diffusion effect will be correlated with lower conditional domestic effects. In other words, in highly internationalized areas (such as corporate taxes) domestic politics matters less, and this will be observed with higher levels of international diffusion and less conditional effect of domestic factors. Furthermore, in related policy areas, still conditional diffusion can happen between policy areas even if some areas are less responsive. In other words, I argue that international stimuli from related areas which are not very responsive can transfer into other areas which are more responsive, and this transformation happens conditionally depending on domestic factors. By looking at these two factors of international mobility and domestic politics regarding these two categories of taxes, I argue that these two policy areas have different levels of responsiveness towards international stimuli based on the combination of these factors. To test this theoretical framework, the final part of theoretical section provides a list of hypotheses in these two tax areas to test for the theory proposed.

Afterwards, research design section provides a summary of the data used, explains the process and model specification, and explains why and how simultaneous spatial models are built and to test related areas. Methodologically the conditional heterogeneity in different policy areas shows itself in different rates of policy diffusion or spatial lags in different areas, and the unit conditional heterogeneity is captured by the conditional domestic factors in each model.

Finally, empirical finding provides evidence as to how when policies become less and less internationally determined, then they are more affected by the domestic conditionality of diffusion, thus supporting the argument of transformation of international signals through domestic conditional action in other related policy areas.

This paper therefore not only provides an insight as to how heterogeneity affects the conditional responsiveness of units but also shows how related policy areas are affected by diffusion in other areas. Therefore, provides additional evidence on how lack of direct international effects is not evidence for lack of diffusion, and diffusion can happen through conditional domestic political factors in other alternative policy areas (Genovese, Kern and Martin 2017) which simultaneous modelling can capture. To summarize, I look at two factors in the process of diffusion which have been less developed throughout the literature. Firstly, by modelling and comparing two related areas of taxes, I show how international diffusion stimuli can affect policy areas heterogeneously conditional on domestic factors and how related areas can affect each other. Secondly, I show how domestic factors such left-right tendency of governments can affect their responsiveness towards international stimuli.

4 - 2 Theoretical consideration

There are three theoretical areas that need to be reviewed, considered and put together to form a coherent framework for understanding conditional diffusion of tax rates when alternative (or related) policy area exists. These areas in order of their discussion below are; First, tax diffusion and competition where I review briefly why tax competition exists or doesn't exist and review the micro-structure of institutions which lead to different diffusion and interdependence levels between personal and corporate income taxes. After that, I review the literature of conditional diffusion and responsiveness and show how domestic preferences affect the diffusion conditionally and how one can measure and model this conditionality empirically. And finally, I look at policy diffusion in multiple related policy areas, where I build the theoretical framework as why one should expect different levels of domestic conditionality in different policy areas.

4 - 2 - 1 Diffusion and Tax Competition

Tax competition and diffusion is known as the quintessential example of policy dependence and therefore, its literature is both rich and relatively mature. Tax competition studies go back to decades ago, where studies try to address if, why, where and when international tax competition exist. There are two ways of looking at tax competition or tax diffusion. One way is purely in economic terms focusing on the tax competition phenomena either theoretically or empirically. This literature mainly

focuses on competitive forces such as capital and labour mobility, however in some cases it also looks at spread of information regarding reforms or new forms of tax instruments (Zodrow and Mieszkowski 1986, Wilson 1999, Plümper, Troeger and Winner 2009, Genschel and Schwarz 2011, Ward and Cao 2012).

On the other hand, one can look at tax competition or diffusion as a prominent example of policy diffusion in a political economy setting where policy makers (with domestic constraint) decide on tax rates. Literature of the policy diffusion also sometimes looks at such cases, as well as mechanism, process and measurement of general policy diffusion (Dolowitz and Marsh 1996, Shipan and Volden 2008, Meseguer and Gilardi 2009, Shipan and Volden 2012). Therefore, while tax competition studies by nature form a part of the policy diffusion process, it's useful to distinguish between the studies that use taxes as an example in order to achieve a better understanding of diffusion process vs. the studies that focus on the taxation itself (Gilardi 2014). Many studies look at tax policies to gain a better understanding of taxation itself due to their importance and complexity and focus different domestic or international factors. In such studies, international diffusion is usually considered one of the many forces interacting. However, like any other policy area, one can look at taxation from the diffusion perspective to gain a better understanding on the diffusion process. A good example for such a case is when tax competition become a force of diffusion and convergence, or related information diffuses between governments (Simmons and Elkins 2004, Jensen and Lindstädt 2012).

The purpose of this research is not to focus on tax competition as an economic phenomena, but is rather to use taxes as a form of policy areas for the study of conditional diffusion. For the purpose of this research I define policy diffusion as any form of interdependence between the tax rates in independent jurisdictions. More specifically, I focus on domestic factors which affect the diffusion of tax rate changes in other states when alternative policies exist. In order to do so, I draw inspiration from the work of Genovese, Kern and Martin (2017) where they looked conditional diffusion when alternative policies exist. I look at how domestic political preferences affect their responsiveness to international stimuli. Accordingly, I shall engage with the tax competition mechanisms and learning

only to the extent that is needed to distinguish between how corporate income tax and personal income tax diffusions are different from one another.

Here I look at the micro-structure and two main mechanism of tax competition and diffusion in two areas of corporate income and personal income taxes. As mentioned above, mobility of capital and labour in these two areas are the sources of competition between jurisdictions. On the other hand, actors in both these areas can learn from other jurisdictions which leads to diffusion. Furthermore, I look at theoretical and empirical reasons as to why competition many not lead to races to the bottom. Finally, I look at the difference between the two areas as to why one is more internationally competitive than the other one building the basis for the key distribution of this paper.

Theoretical debates and arguments on the existence and consequences of tax competition between jurisdictions and localities goes back to decades ago. For example, Oates (1972) suggest that tax competition due capital mobility between localities can lead to inefficiently low tax rates, in contrast to Tiebout (1956) paradigm which proposes that tax competition has an efficient outcome and there will be no gains from tax cooperation between jurisdictions. In any case the debate on, in which cases competition happens to the extent that leads to inefficiencies is still not finalized in the literature, for instance on what fiscal externalities or characteristics of labour marker leads to in efficient corporate or personal income levels (Bucovetsky 2003, Piaser 2007, Razin and Sadka 2012).

However, theoretical models such as Zodrow and Mieszkowski (1986) suggest that in open economies with no rigidities or heterogeneity, one should expect tax competition between jurisdictions due to mobility of capital and labour. Firms and labour force will move to jurisdictions which has less taxes and while there are arguments as to what extend such mobilities are feasible they could trigger races to the bottom. For example, countries can attract capital from high tax countries by lowering their own tax rates which could lead to a race-to-the-bottom (Frey 1990, Sinn 1990). However, empirically there is no race-to-the-bottom in corporate tax rates but there is evidence that effective rates are converging (Hays 2003).

Genschel and Schwarz (2011) reviews the literature of tax competition and show that generally tax competition, arbitrage and diffusion exists in corporate and personal income tax areas in both subnational and international context, however its extent which in many cases lacks a race-to-the-bottom depends on cross-border activities. While Genschel and Schwarz (2011) looks at cross-border activities, there are other economic and political factors that hinder the race-to-the bottom or limit the tax competition in corporate tax rates. For example, Plümper, Troeger and Winner (2009) propose that the ability of governments to compete with other countries for capital depends on its domestic constraints and therefore budget constraint can limit the ability of countries to participate in races to the bottom. Plümper, Troeger and Winner (2009) furthermore add social norms to their model and find equilibria where tax rates don't converge due to country heterogeneity. However, one could argue that both budget rigidities and social norms can change in longer term. Among other factors affecting and limiting tax competition one could look at political constellation. Hays (2003) shows that in majoritarian democracies, median voter pushes the corporate tax rate towards its revenue-maximizing level, while in consensus democracies coalition making constraint keeps the capital taxes below the majoritarian rates. In the same institutional approach, Basinger and Hallerberg (2004) propose that domestic cost to reform such as transaction costs (e.g. due to numerous veto players in the legislative process) and ideological opposition to policy changes can hinder the competitive responsiveness of countries with higher domestic costs. To these mechanisms and restrictions sources one could add other forms of policy interdependence such as learning (Baturu and Gray 2009, Jensen and Lindstädt 2012)

However despite the above arguments, after reviewing the empirical literature one could still argue that evidence shows a significant level of corporate tax competition both in general and in Europe⁹⁸ while its extent doesn't qualify a race-to-the-bottom (Genschel and Schwarz 2011, Devereux and Loretz 2012). One key factor in existence of tax competition is the lack of cooperation between jurisdictions. Holzinger (2005) reviews the evidence for two main explanations for the lack of cooperation in Europe. One key obstacle in the way of cooperation is country heterogeneity specially

⁹⁸ The scope of this study

with regards to the size of corporate tax base. Countries with small domestic tax base have more incentive to enter competitive tax cuts to attract mobile capital in comparison to the ones with larger tax base. Another explanation for lack of cooperation is based on the problems involved in collective action, where countries face a prisoners' dilemma. Holzinger (2005) refines and reevaluates these arguments and proposes two elements in explaining lack of cooperation. First one is the emphasis on identification of weakest links. This means that for a general cooperative tax framework one needs the cooperation of all tax havens. The second factor is the motivation of policy makers as they are not solely motivated by the tax revenue but also by other political and economic benefits, such as having capital moved to their jurisdictions. These factors make corporate income taxation one of the most competitive areas of taxation in Europe.

Similar arguments and theoretical models based on labour mobility, especially with regards to high-skilled labour which pays higher rates, also suggest income tax rate effects within countries (Bucovetsky 2003, Piaser 2007), and some empirical evidence also supports this with regards to high skilled workers (Egger and Radulescu 2009). However, while both theory and empirical research suggest some level of personal income tax competition, I propose that in contrast to corporate taxation, personal income taxes are more domestically determined.

Firstly, I argue that the obstacles that prevent cooperation between countries in corporate taxation are not causing problems with regards to personal income taxation due to the different nature of labour in contrast to capital, such as labour heterogeneity and mobility costs. Therefore the mobility of labour is fundamentally different than capital and accordingly diffusion is more due to political learning (Baturu and Gray 2009) rather than competition. For example, the weakest link arguments by Holzinger (2005) about tax havens is not applicable to the labour market as labour has less choice of mobility especially with regards to moving into smaller economies. Therefore, while cross border arbitrage may happen, one could not expand this to the wider community. Furthermore, alternative political and economic motivations of policy makers which Holzinger (2005) suggests as a factor hindering cooperation would in fact work against a race-to-the-bottom in personal income taxation.

Because lowering personal income tax rates to attract immigrant is rather unlikely when compared to policies that attract capital.

Theoretical arguments put emphasis on the heterogeneity of labour market and mobility cost, and show that mobility of high-skilled workers have different taxation effects than low-skilled workers which may have limited or no tax distortion effect at all (Bucovetsky 2003, Piaser 2007, Razin and Sadka 2012). This is supported by the limited available empirical evidence by Bode, Krieger-Boden and Lammers (1994) which find that the labour movement between EU countries is not driven by tax but rather income. In other words, migrant labourers are mainly looking for better jobs and higher wages and not lower taxes. This is important when one looks at the number of migrants and their heterogeneity. Obviously for high skilled workers high tax progression is more important than tax burden at average wage level tax burden (Egger and Radulescu 2009) but their numbers is rather different and the decision about such tax rates are different than those for lower skilled workers.

Additionally, the fairness norms that limit the race-to-the-bottom in corporate tax competitions (Plümper, Troeger and Winner 2009) are more important and more heterogeneous in personal income tax determinations. For example, Gilardi and Wasserfallen (2016) show that socialization within intergovernmental networks can produce effective norms on appropriate competition which itself leads to moderation of tax competition.

Therefore, I propose that while both corporate and personal income tax rates will be affected by inter-jurisdictional competition and diffusion, personal income tax is more domestically and less internationally determined. This proposition will form the basis of further argumentation of this paper as, I will be arguing that this difference between policy areas will lead to different political conditional responsiveness to diffusion stimuli.

4 - 2 - 2 Diffusion, conditionality and policy alteration

In the most basic diffusion scenario; a unit i (such as a state) implements a policy depending on if and how another unit j within its network implements a similar policy. In this simple setting, implementation or adaptation of a policy by unit j causes (or affects) the implementation of the similar

policy by other units that are connected to it, similar to contagion of a disease or spread of information (Bass 1969, Jackson 2008). While such models are still usable in political settings, they have three main limitations; lack of network complexity, lack of unit heterogeneity and lack of policy diversity.

A simple unconditional connectivity network means that all units are connected to each other in homogeneous way and information or the effect of a policy implementation in units' transfers between them is a uniform manner. Political science literature makes use of such networks in different forms, for example membership of international organizations or sharing of a border between two states (contiguity) (Brinks and Coppedge 2006, Gleditsch and Ward 2006, Mukherjee and Singer 2010). While use of such networks for modelling diffusion can be useful in some cases, diffusion of most political phenomena is conditional on different factors rather than simple contiguity.

This network conditionality is usually modelled in the literature as distance between units, such as geographical or ideological distances and is modelled using the spatial weight matrix (Beck, Gleditsch and Beardsley 2006). The more distant two units of i and j it's less likely they affect each other, where this distance is calculated based on the diffusion mechanism such as information or competitive pressure in geographical or ideological space. For example, Ward and Cao (2012) show that green taxes are more likely to be diffused between governments with similar ideological positions. Other studies in literature use factors such as historical shared ties or trade to build networks (Beck, Gleditsch and Beardsley 2006, Prakash and Potoski 2006). This paper does not address conditionality in networks and only uses a simple geographical distance – as a proxy – to control for the effects between countries in measurements. I focus on expansion of the two other limitations of the basic models and their interaction, unit heterogeneity and policy alteration.

While in other parts of the social network literature units can more easily assume to be homogeneous, in political science the units usually representing states are by nature heterogeneous and complex. Theoretically, heterogeneity of units and actors' preferences are key parts of diffusion process as jurisdictions have different internal rules and actors, interacting to implement a policy. For example, Volden, Ting and Carpenter (2008) in a formal setting show how the preferences' of individual actors

can determine their role in experimenting with new policies or waiting for information from other jurisdictions. In another example, Shipan and Volden (2008) show mechanisms of diffusion are conditional in example about smoking ban, and show for instance that larger cities are better in learning, less fearful of economic spill-overs and less likely to imitate others. These findings show the importance of unit heterogeneity in responding to external simulations. One main source of this heterogeneity is domestic politics and different studies suggest different sensitivity and responsiveness to international factors because of domestic factors such as ideological factors or prior beliefs (Gilardi 2010, Martin 2010). Domestic preferences and constraints can also affect the main characteristics of policy diffusion such as the race to the bottom or lack thereof (Basinger and Hallerberg 2004, Plümper, Troeger and Winner 2009).

One simple way to proxy for domestic politics preferences, is by using the *Left-Right* tendency of policy makers. Jensen and Lindstädt (2012) study the signalling side of this domestic heterogeneity using left-right tendency of policy makers. They find evidence that cutting corporate tax rate signals from left leaning governments is taken more seriously, and attribute this to the credibility of such signals as such tax cuts are unexpected from left leaning governments. In this paper, I focus on the receiving side. Gilardi (2010) takes a similar approach to control for unit responsiveness and show that right and left governments have different sensitivities regarding different types of information, due to their prior beliefs. He finds that right governments are more “sensitive to information on the electoral consequences of reforms, while left governments are more likely to be influenced by their policy effects”.

One other source of heterogeneity is the combination and interaction of policy and country characteristics. Brooks (2007) looks at this combination and shows that diffusion matters when characteristics of a policy is suitable for the community based on their own domestic political and economic conditions. Therefore, for example, the level of sunk cost in pension reforms as a characteristic of a policy innovation in combination to the countries’ characteristics such as wealth, mediate the importance of diffusion in domestic policy choices and governs the diffusion process. In other words, peer adaptation of costly reforms leads to diffusion among middle-income nations based

on the ques from other nations, while low cost and reversible alternatives may not. In the same line of argument, I propose that heterogeneity between the two categories of taxes will also demonstrate similar effect and one should expect different responsiveness due to different characteristics of each policy as well as the interaction between policy alternatives and domestic factors.

While literature emphasizes the importance of capturing or at least controlling for these types of heterogeneity, it still lacks doing so in many places. The limited scope of research addressing asymmetric signalling and conditional responsiveness mainly comes from empirical measurement challenges. For example, controlling for the source of information to address asymmetry of information is an empirically challenging task, especially when they are spread over heterogeneous networks⁹⁹. However, controlling and measuring responsiveness heterogeneity is less challenging. Neumayer and Plümper (2012) review the importance of model specification for capturing this conditionality and propose methods to address its estimation, which I use in this paper.

As mentioned above, unit conditionality has two sides; first the signal or stimuli that are sent from a group of decision makers. The second side is the sensitivity and responsiveness to such signal or stimuli by units receiving it. In both sides, domestic politics plays an important rule. Similar to Gilardi (2010), I focus on the responsive side and the effects of domestic politics on this responsiveness. I look at this responsive conditionality where alternative policies exist.

Till this point, I only discussed the importance and challenges of measuring conditional unit responsiveness, but one other source of heterogeneity in diffusion comes from the characteristics of policies themselves (Shipan and Volden 2012). For instance Makse and Volden (2011) enumerate factors such as complexity and compatibility and show that complex criminal laws diffuse slowly in contrast to compatible ones. I argue that this issue becomes more important when studying multiple policies together.

⁹⁹ During the initial implementation of this thesis, I initially tried to find a way to control for conditional signaling stimuli from all other units as well as receiving heterogeneity, however as each unit may receive information from a great range of units when interacting with other factors such as domestic politics then one needs to aggregate all of the above which causes a lot of information to be lost through aggregation. In other words, **WY** will can be substituted with **WYZ** but then interpreting it will be difficult when it also becomes conditional on the receiving units' characteristics.

Beside the characteristics of policies, the basic diffusion scenario simplifies adaptation into two cases of “*adopt*” or “*not adopt*”. Genovese, Kern and Martin (2017) argue for further complexity and propose that domestic decision makers usually face a policy package rather than one single option. Therefore, actors can accept or reject parts of this package based on their domestic preferences and constraints such as access to economic resources. Genovese, Kern and Martin (2017) show that when alternative policies exist, both domestic and international factors can affect the diffusion significantly, and such effects and their interactions should be controlled for, for correct understanding and measurement of the diffusion process.

This paper extends this line of argument with emphasis on simultaneous modelling and more focus on domestic political factors. Therefore, proposing that conditionality will be dependent on the level of internationalization of a policy area as well alternative policies available to policy makers with heterogeneous domestic preferences and economic constraints.

4 - 2 - 3 Conditional responsiveness and alternative policies

Genovese, Kern and Martin (2017) build around the idea of complementary and substitutionary effects of policies to look at the sources of responsive heterogeneity. In their framework, each country (or units) depending on the economic constraint or preferences shows a different level of responsiveness towards adaptation of alternative policies. Following a similar line of argument, I look at the domestic political preferences of governments (as units). I argue that not only governments’ preferences cause different responsiveness to international stimuli; when facing alternative policies, international stimuli from one policy area can affect the implementation of other policy areas conditional on domestic political preferences.

In other words, I’m arguing for conditionality of responsiveness based on domestic politics when alternative policies exist which could lead to the transfer of stimuli into other policy alternatives. Therefore, this research focuses on the combination of the two lines of research above, on one hand the effect of alternative policies on each other in the process of diffusion and on the other hand the conditionality of diffusion process depending on the characteristics of policy areas and domestic

factors. Accordingly, I look at (1) the characteristics of policy alternatives, and (2) domestic political preferences.

Looking at the responsiveness of each policy area, I argue that if an area is more internationally determined for example due to international competitive pressure, one accordingly expects more international effect in form of spatial effect and less domestic conditional responsiveness. This is because, policies in such areas is mainly determined by international factors and not domestic issues. However, domestic factors will be more effective in the process of diffusion when the international stimuli are moderate, leading to conditional responsiveness. Therefore, I propose that there is an inverse relationship between international policy area responsiveness and unit heterogeneity effect, the more a policy is internationally determined the less domestic factors and therefore unit heterogeneity matters. In other words, conditionality is more important when diffusion in policy area is less internationally determined but not to the extent that one could not expect or measure policy interdependence. This creates a trade-off between the international and domestic determinants of diffusion, if policy is highly internationally determined, therefore one could expect and measure significant spatial lags without much conditional effect. On the other end of spectrum, where policies are mainly domestically determined interdependence is not expected. However, anywhere in between one should expect the domestic factors to affect the international stimuli. Putting all this together, one should also take into account that policy makers are rarely facing one area to act in, and policies have alternatives which will have different levels of international and consequently domestic determination. This paper tries to model such complexity.

Chaudoin, Milner and Pang (2015) look at this in details through domestic and systemic effects as well as the interaction of the two. They propose that one key focus of empirical research should be the weight which researchers assign to these two elements. Distinguishing between these two effects empirically is a rather a tedious task even in a single policy area, especially if one assumes that these effects and their weights change over time.

To address this issue, I propose a comparative approach to measuring conditionality when alternatives are available. I argue that in a standardized setting, one can compare the responsiveness of policy areas based on the magnitude and significance of spatial effects that they have on one another. This heterogeneity in policy alternatives can be measure in setting that looks at all such areas together. This makes the empirical measurement task harder as one needs a simultaneous specification. Therefore, I suffice to a comparative approach where I could compare the responsiveness of areas and test for their interaction.

This framework means that decision makers simultaneously faces international stimuli (information or pressure) in different policy areas, however their responsiveness to these stimuli is heterogeneous as some of these areas are – more or less – internationally competitive. In other words, for example in case of taxes when decision makers come across tax cuts in different countries, the competitive pressure that they face in different tax areas is different because of the nature of different taxes, such as different level of mobility between capital and labour.

Beside this heterogeneity due to the nature of policies, another source is heterogeneity of domestic preferences of decision makers. As mentioned above, I argue that there is less domestic heterogeneity in the areas that internationally determined. However, in this paper I furthermore argue that when alternative policies exist the two factors will interact in a way that international effects can transfer between policy areas. I propose that when decision makers face international stimuli in alternative policy areas, their domestic preference can cause a transfer of effects (or spill over) between areas. In areas that international stimuli have significant effects, the preferences of decision makers are less effective, but stimuli can diffuse into other policy areas conditional on decision makers' preferences. Figure 4-1 shows this transfer of effects.

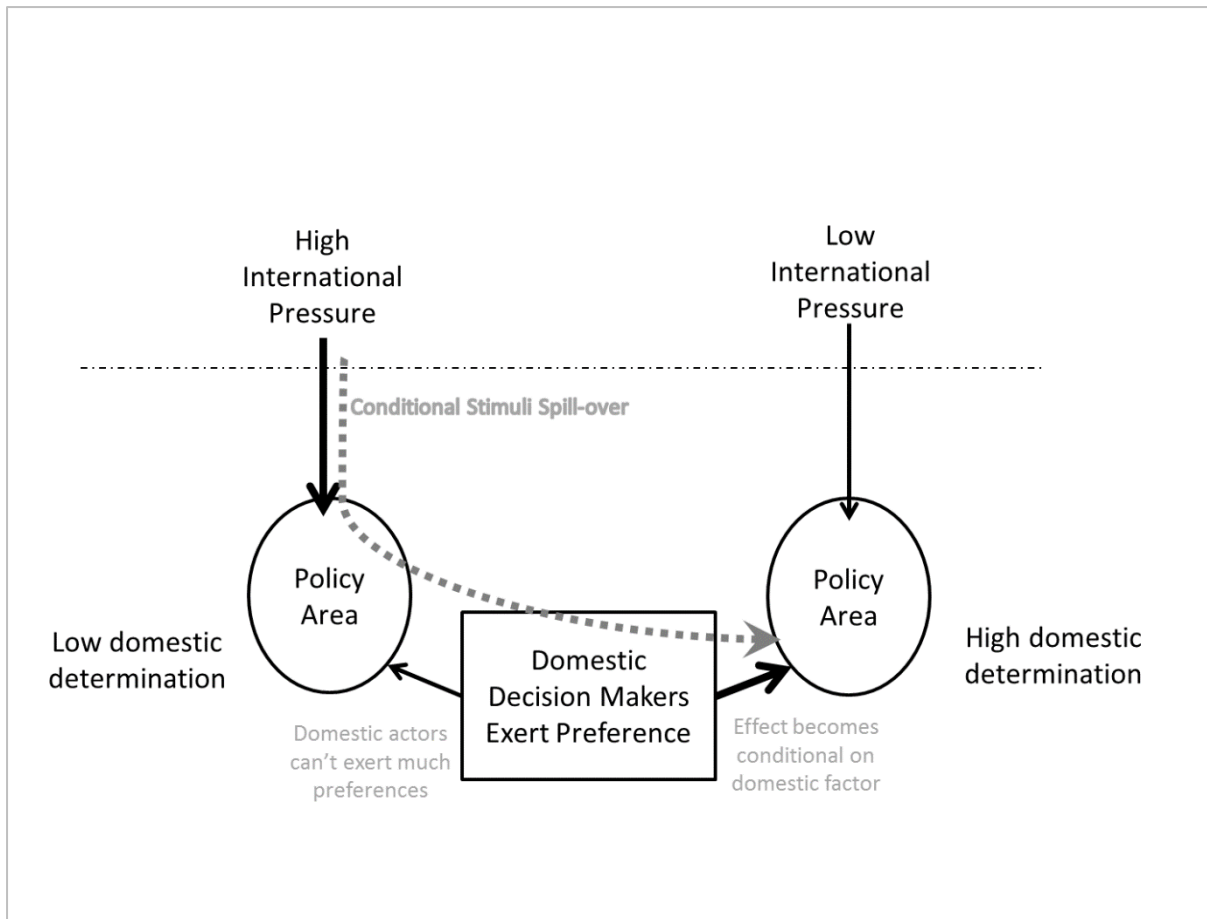


Figure 4-1 Mechanism of the transfer of conditional international stimuli (pressure)

In other words, when decision makers come across policy innovations their reaction is limited by their own domestic politics constraints and therefore accordingly, they may react to international stimuli in another area.

Using different types of taxes as alternatives policy areas for governments, I look at how governments react to a bundle of stimuli, and how their domestic preferences affect the diffusion between alternative policy areas. Combining this bundle of stimuli and alternative policies, with domestic left-right tendency of policy makers as a measure of domestic preferences, this research looks at the heterogeneity of responsiveness when domestic actors face alternative policies.

4 - 2 - 4 Application: Political Conditional Responsiveness and Taxation Preferences

In this section, I put all the above arguments together to build the theoretical propositions of this research. This research looks at two tax categories as policy alternatives; Corporate Income Tax (CIT)

and Personal Income Tax¹⁰⁰ (PIT). I propose that diffusion in CIT is more significant than in PIT and therefore, the states are more responsive when it comes to CIT. I furthermore argue that, this will lead to more conditionality in PIT. Additionally, I argued that in alternative policy areas one could expect inter-policy diffusion. And finally, I propose that this conditionality will be affected by the domestic political preferences.

Let's recall that the literature¹⁰¹ on corporate income tax shows that CIT has a relatively high level of international determination due to capital mobility, tax competition and corporate tax arbitrage. However, many political and economic factors such as the size of a country and its economy or norms at domestic level effect capital tax competition and therefore while a high level of diffusion is expected with regards to CIT, still such diffusion is expected to be conditional on domestic factors. On the other hands evidence shows less competition in PIT between states as labour movement (especially within EU) is more like to be due to wages rather than taxes, and with regards to capital income taxes, better rates motivate saving abroad rather than personal movement (Bode, Krieger-Boden and Lammers 1994, Genschel and Schwarz 2011).

I argued that PIT is more domestically determined both due to less mobility in labour market than other areas and multiple political factors that affect PIT. Based on this argument, therefore, I'm proposing that policy makers will be more responsive in CIT rather than PIT and accordingly one can expect more significant diffusion effect in CIT¹⁰².

Putting all the above points together I propose;

Proposition I: Responsiveness of PIT < Responsiveness of CIT

This proposition is not something new per se but summarised the literature reviewed before in a comparative format which the next and main proposition of this research could be built upon.

¹⁰⁰ Highest income level category.

¹⁰¹ Reviewed in the section 0page 99

¹⁰² Which will be shown empirically as ρ s with higher magnitude

Based on the proposition I, I furthermore propose that one should expect more conditional diffusion in PIT compared to CIT. This is because domestic politics and constraints are more important in a policy area that has less international determination. Based on the inter-policy interaction arguments in the previous section, as PIT and CIT are related areas, one should also expect inter policy diffusion which itself will be conditional. This – in a comparative format¹⁰³ - means that PIT will show more conditional effect from both PIT and CIT changes in other jurisdictions.

In other words, when deciding on CIT changes policy makers of each unit face more international constraint that they must take into account, however when it comes to PIT this pressure is less. Therefore, in contrast to CIT changes, policy makers will have to put more weight on their domestic preference and constraints when thinking about PIT. Such domestic preferences and constraints are different for different actors as they have different ideological beliefs and voter base.

One can summarize these arguments in Hypothesis 1.

Hypothesis 1.1: There is more conditional diffusion effect responsiveness in PIT compared to CIT, as it's more domestically determined.

Hypothesis 1.2: There is more conditional diffusion effect caused by CIT compared to PIT, as it's more internationally determined.

On the other hand, it's important to look at the source of conditionality. Each units' conditional response to international stimuli is based on its domestic political and economic constraints. To proxy for political domestic heterogeneity, which is the source of this conditional responsiveness, I'll look at ideological Left-Right tendency of governments as an example. I argue that different domestic players treat policy areas differently and have different preferences as to how to translate spatial stimuli into policy changes in different areas. This causes a conditional responsiveness to spatial stimuli. I argue that Left-Right tendency of governments makes them more sensitive to different kinds of international stimuli in different types of taxes and respond differently if they can politically make changes or

¹⁰³ Which I shall discuss in the research design

implement policies in different areas. In other words, I look the heterogeneity of policy makers' responsiveness based on their Left-Right tendency.

There are two sources of constraints and preferences at domestic level which will affect the policy makers' response to changes in other countries; preferences of actors and their voters'. Therefore, polarisation in these policy areas between decision makers and voters will lead to different preference and costs of implementation in different policy areas. This means that for example some governments with certain ideological preferences and voter base, will have different preferences and constraints for example with regards to implementing changes in PIT or CIT rates¹⁰⁴. Therefore, I propose that in a relatively polarized areas such as taxation, heterogeneity between domestic actors will lead to conditional responsiveness. This means that one can expect significant conditional diffusion effect based on the left-right tendency of governments as they have difference preferences with regards to taxation. Hypothesis 2 will test for this heterogeneity.

Hypothesis 2: Diffusion in PIT and CIT is conditional on the left-right tendency of governments.

It's important to mention that Hypothesis 2 tests for conditionality within policy areas, which could also be extended to cross conditional effects, and then Hypothesis 1 tests to see if the level of this conditionality is different between policy areas.

Due to the complex interaction between the preferences of domestic political actors and the direction of changes in tax rates which will be aggregated over units and time, it's hard to make predictions as to which policy areas left or right leaning governments will be more responsive to¹⁰⁵. But I briefly propose that right leaning governments are more likely to respond positively to spatial stimuli with regards to CIT, i.e. to get involved in corporate tax completion or a race to bottom. I argue that this is because that international competition is usually in the direction of race to the bottom in which left leaning actors have less preference. On the other hand, Left-leaning governments are more responsive

¹⁰⁴ I have looked at the effects of polarisation theoretically chapter/paper one and how ideological differences can lead to different conditional responsiveness and roles in diffusion in chapter/paper two. Here, in an alternative policy format what matters is some source of heterogeneity so the conditionality will be built upon.

¹⁰⁵ I did make in argumentation as to responsiveness in other areas such as environmental spending in chapter/paper 2

to stimuli about PIT where ideological factors are most effective¹⁰⁶. Making argumentation on cross area conditionality is more complex.

I wish to emphasize that the main argument of this paper is not policy areas specific or about different forms of taxation, but rather that if a policy area is less internationally determined the diffusion will be more conditional on domestic factors. One could also expect cross area diffusion and cross area diffusion conditionality in related policy areas. Therefore, making no significant claim about the direction or mechanism of conditionality but mainly about its existence.

4 - 3 Research Design

This section reviews the research design and summarizes the different decisions regarding data preparation, model specification and implementation in this research. First, it provides the details of data and provides information about the sources of data used. It also reviews how some independent variables are calculated. After that – in the method section – it reviews the fundamentals of spatial models and how it was applied to this research before presenting the specification of models and explaining the estimation method¹⁰⁷.

4 - 3 - 1 Data and data preparation

This research uses a panel data of 30 European countries¹⁰⁸ from 1995 to 2014. Eurostats¹⁰⁹ is the main source of data on taxes rates. This includes the data on two dependent variables of Corporate Income Tax Rate (CIT) and Personal Income Tax Rate (PIT) This research uses the World Bank

¹⁰⁶ I understand and acknowledge that the directions of left-right effects that I'm proposing are rather ad hoc and need more in depth study of the mechanism, in other words left-right might be more or less responsive in different tax areas in different directions due to different reasons such as the types of information they receive about the political or policy outcome. However, for the scope of this thesis and this paper I'm focusing on the level and significance of effects in a comparative framework rather than the direction of effects.

¹⁰⁷ As a part of a longer thesis parts of the design (especially model specifications) of this paper is similar to my other paper which is yet to be finalized or published and therefore cannot be referenced. Therefore, some parts may look similar to the other papers as they use similar estimation methods.

¹⁰⁸ Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom

¹⁰⁹ <http://ec.europa.eu/eurostat/data/database>

Development Indicator (WDI)¹¹⁰ for control variables. And finally, the Comparative Manifesto Project (CMP)¹¹¹ and ParlGov¹¹² data are the basis for the calculation of the median position of Left-Right tendency of governments as explained below.

Overall due to simultaneous modelling and missing data, the total number observations in the presented models is 274.

The focus of this research is on two *dependent variables*; changes in Corporate Income Tax Rate for each country i over one year (ΔCIT_{it}) and Personal Income¹¹³ Tax Rate for each country i over one year (ΔPIT_{it}) where t denotes time/year.

This research controls for a wide range of control variables denoted by X_{it} in the following models. These include; Central government debt % of GDP, Unemployment, FDI In and FDI out. The literature is rather diverse on what factors affect taxation and these are most commonly used in all three of the three tax types. Ward and Cao (2012) use these variables when they study diffusion of environmental taxes when looking at domestic and international factors. Based on the models provided by Ward and Cao (2012), this research also adds unemployment rate squared. This is to capture the nonlinear effect of unemployment on taxes. Ward and Cao (2012) argue that as unemployment rises policy makes increase taxes only to a limit and after some point the rise of unemployment beyond that point (e.g. in depressions) actually can be responded by reduction of taxes by governments.

Based on a model by Ward and Cao (2012); median Left-Right position of government for each country at each time is one of the key independent variables of this research. This is the variable that captures the responsiveness of governments to different spatial stimuli. *Gov. Left-Right* is calculated based on the position of the political parties that form each government. If a party has an outright majority in the parliament that party's position on its manifesto is used as the position of government.

¹¹⁰ <http://data.worldbank.org/data-catalog/world-development-indicators> , 2015 version downloaded December 2015

¹¹¹ <https://manifesto-project.wzb.eu/>

¹¹² <http://www.parlgov.org/>

¹¹³ Top bracket

In the cases of coalitions, government's position is calculated based the median of the positions of parties in coalition proportional to their seats in the parliament. To be short, this variable captures how Right or Left leaning a government of a country is for specific years. This Gov. Left-Right variable is used both as control and also as an interaction term with spatial signals to test for and capture the responsiveness of the governments to different spatial stimuli.

Another key group of variables of this research is the spatial lags of these dependent variables and their interactions. These spatial lags are made by multiplying a *weight matrix* (W) and different variables which generally are denoted by y in the literature. This interaction is presented here by $W\Delta y$ and referred to as spatially lagged, where each element of W is the based on inverse spatial distance between country i and j , and $w_{i=i} = 0$. For N countries the W will look like Equation 4-1 at each period of time. For this research these weights are based on the distances between the capitals of the two countries¹¹⁴.

$$\text{Equation 4-1 Weight Matrix for One Period of Time } W_{N \times N} = \begin{bmatrix} w_{11} & \dots & w_{1N} \\ \vdots & \ddots & \vdots \\ w_{N1} & \dots & w_{NN} \end{bmatrix}$$

Adding time - T years - to the weigh matrix gives $W_{NT \times NT}$ as in Equation 4-2.

$$\text{Equation 4-2 Weight Matrix for N countries and T years } W_{NT \times NT} = \begin{bmatrix} [W_{N \times N}^{t=1}] & \mathbf{0} & \dots & \mathbf{0} \\ \vdots & \ddots & \ddots & \vdots \\ \mathbf{0} & \dots & \mathbf{0} & [W_{N \times N}^{t=T}] \end{bmatrix}$$

This research uses row standardized form of weigh matrices. This means that the sum of the weights of each row adds up to one, in other words that $\sum_{j=1}^n w_{ij} = 1$. This ensures that each country receives standardized stimuli from each other country which is standardized based on their spatial distance. Plümper and Neumayer (2010) warn against row standardization without sufficient theoretical model specification considerations. For the purpose of this research row standardization is appropriate based on two theoretical reasons. First; without this standardization, spatial stimuli will interact with the

¹¹⁴ See, Gleditsch, Kristian S. & Michael D. Ward. 1999. "A Revised List of Independent States since 1816," *International Interactions* 25:393-413 available at <http://privatewww.essex.ac.uk/~ksg/mindist.html>

spatial distance meaning that heterogeneity of units will be based on the spatial weights. This would mean that distant countries from main groups of countries would be less likely to be affected by spatial stimuli. While is a reasonable assumption in many settings, in a political setting of information and policy diffusion in Europe where most countries are in communication and interaction with each other this is less likely to happen. Another reason that Plümper and Neumayer (2010) warn against row standardization is because that doing so assume uniform exposure among states which is unrealistic in many settings. However, for this research this is what needs to be focused on to capture the conditional responsiveness of units using interaction terms. In fact Neumayer and Plümper (2012) propose a method to do so which is used for this research and explained in the next section.

4 - 3 - 2 Method

Equation 4-3 shows the general specification of spatial lag models.

$$\text{Equation 4-3 (General Spatial Lag models)} \quad y_{it} = \alpha_i + \rho WY_{it} + \beta X_{it} + \epsilon_{it}$$

Focusing on changes in the tax rates, and adding a temporal lag of the absolute values it would transform into Equation 4-4.

$$\text{Equation 4-4: } \Delta Y_{i,t} = \alpha_i + \rho W \Delta Y_{i,t} + \phi_1 Y_{i,t-1} + \beta X_{it} + \epsilon_{it}$$

Having row standardized Ws, Neumayer and Plümper (2012) show that by adding an interaction term for a variable (z), one can capture the responsiveness of units conditional z. This transforms Equation 4-4 to Equation 4-5.

$$\text{Equation 4-5: } \Delta y_{i,t} = \alpha_i + \rho_1 W \Delta Y_{t-1} + \rho_2 [W \Delta Y_{t-1}] \cdot z_{i,t} + \phi_1 y_{i,t-1} + \phi_2 z_{i,t} + \beta X_{it} + \epsilon_{it}$$

Here α_i models unit –country – specific effects, ρ_1 levels of spatial effect, ϕ_1 effect of temporal lag and ρ_2 the effect of the responsiveness of unit based on $z_{i,t}$.

One more technical matter which is commonly referred to as the Galton problem¹¹⁵ refers to the challenge of distinguishing between spatial effects between units from spatial correlation due to

¹¹⁵ For more information on Galton problem in spatial econometrics refer to: ¹¹⁵ For more see; <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095841611>

common exposure. Beside econometrics methods¹¹⁶ one simple solution is using temporal lag $W\Delta Y_{t-1}$ to capture effects rather than correlation (Franzese and Hays 2008).

Putting all of the above together and adding the spatial lag of different tax groups to each other is a simultaneous system of equations setting this research uses specification of equations Equation 4-6 and Equation 4-7.

System of equations used in this research:

$$\text{Equation 4-6 } \Delta PIT_{i,t} = \alpha_{ip} + \phi_p PIT_{i,t-1} + \rho_{p,p} W\Delta PIT_{t-1} + \rho_{p,c} W\Delta CIT_{t-1} + \gamma_{p,p} [W\Delta PIT_{t-1}] \cdot z_{i,t} + \gamma_{p,c} [W\Delta CIT_{t-1}] \cdot z_{i,t} + \phi_{pz} z_{i,t} + \beta_p X_{it} + \epsilon_{it}^p$$

$$\text{Equation 4-7 } \Delta CIT_{i,t} = \alpha_{ic} + \phi_c CIT_{i,t-1} + \rho_{c,p} W\Delta PIT_{t-1} + \rho_{c,c} W\Delta CIT_{t-1} + \gamma_{c,p} [W\Delta PIT_{t-1}] \cdot z_{i,t} + \gamma_{c,c} [W\Delta CIT_{t-1}] \cdot z_{i,t} + \phi_{cz} z_{i,t} + \beta_c X_{it} + \epsilon_{it}^c$$

In the above setting ϕ s show the effect of temporal lags, ρ s will capture the spatial effects and γ s represent the effect of conditional responsiveness based on $z_{i,t}$.

For estimation, this research uses a simultaneous setting. Because none of the dependent variables directly used in the structure of the other equations, this setting is treated as a set of *seemingly unrelated regressions* (Zellner 1962)¹¹⁷. Due to similar variables on the right hand side of all equation, there will be correlation between the error terms of the equations and treating them as related equations helps with the efficiency of the estimations especially as the numbers of observations is limited. Finally, the models are estimated using three stage least squared which also helps with the endogeneity between variables (Zellner and Theil 1962). This simultaneous modelling is important as to be more accurate when dealing with alternative policies which simultaneously affect each other.

One decision of this research that should be discussed here is with regards to choosing changes in tax rates rather than the levels for modelling dependent variables. This is also important as the right-hand side also includes the lagged values of levels. Plümper, Troeger and Manow (2005) argue that such

¹¹⁶ See: Spatial Error Models vs. Spatial Auto-regression Models see: Franzese, R. and J. C. Hays (2014). Testing for spatial-autoregressive lag versus (unobserved) spatially correlated error-components, Benjamin F. Shambaugh conference: New frontiers in the study of policy diffusion, University of Iowa, Iowa City.

¹¹⁷ Another specification would be to use dependent variables of other equations directly in the other equations which then would require structural vector autoregressive (SVAR) models estimation, however due to spatio-temporal lags, it's unnecessary to do so as it will make interpretations the much harder

model specification is panel setting could be problematic as country specific effects will be captured by the lagged values or unit specific dummy variables and therefore the changes may not be suitably linked to theory. Accordingly, some tax competition studies prefer to look at levels of tax rates rather than changes in them (Gilardi and Wasserfallen 2016). In this research however, I propose that changes are more suitable dependent variables for modelling because of the simultaneous setting. As the purpose of this research is to look at two tax areas simultaneously and compare them, I use the changes which is more comparable than level, especially when one wants to examine the cross-policy effects. In this setting having lagged level values in the right-hand and looking at changes on the left-hand side therefore is more suitably linked to the theory¹¹⁸.

4 - 4 Empirical Findings and Discussion

Table 4-1 shows the estimation results of empirical models. Models (1) and (2) are baseline models without any conditional interaction terms solely including spatial lag of the same dependent variable (CIT or PIT). These two models are estimated individually in contrast to Model (5) which is estimated in a simultaneous setting. Models (3) and (4) include conditional interaction terms of spatial lags with government's left-right tendency in addition to other variables of Models (1) and (2). Model (6) as the focus of this paper is estimated these two models in a simultaneous format. Therefore, Model (6) captures geographical spatial lags (same as Models (1) and (2)), as well as conditional domestic political effects – such as Models (3) and (4) with the interaction variable of government and spatial lags – in a simultaneous setting (similar to Model (5)). These six models provide the empirical evidence to look different theoretical claims; First, in Models (1) and (2) one can look at unconditional spatial diffusion in single policy areas of PIT and CIT as usually is done throughout literature, by comparing the magnitude of estimated spatial lag coefficients in these two models and Models (5) and (6) one can test to see if one area has more significant diffusion effect. Models (3) and (4) add conditionality to the estimation and one can look and see if domestic political factors here presented by left-right tendency of governments has any effects on the diffusion process. Model (5) provides the baseline to look at cross unconditional diffusion effects between alternative policy areas

¹¹⁸ Still the level dependent variable regressions are presented in the appendix 7 - 2

testing to see if PIT changes in other countries have effects on CIT changes and vice versa. Finally, Model (6) puts all the above together and test for cross policy conditional diffusion.

First, looking at the unconditional spatial lags in all models shows the existence of tax competition and diffusion in both PIT and CIT. As suggested, the magnitude of the estimated coefficients of unconditional spatial lags (ρ_s) supports the proposition I as to show more significant levels of spatial effects in CIT compared to PIT. In other words, this shows higher diffusion effect or competitive pressure in CIT changes compared to PIT changes providing the basis for the hypotheses of this research with regards to comparison of effects in alternative policy areas to be tested. This relationship is robust throughout all models and even the different is becomes bigger as conditional effects are added and equations are estimated in a simultaneous setting in Models (5) and (6). The estimated spatial effects of Models (1) and (2) of (22.673 and 43.632) change slightly when political conditional effects are added due to multicollinearity and omitted variable bias in unconditional models, but the bigger change happens when models are estimated simultaneously showing a significant cross policy effect. This is consistent with the significant effects that spatially weighted changes in PIT in other units has on CIT and the change in the estimated spatial lag of CIT from 43.632 in Model (2) to 59.736 in Model (5). This significant effect of spatially lagged PIT on CIT shows cross policy diffusion meaning that changes in the PIT in other countries may have a negative effect on changed in a CIT in other countries. This finding is important as it shows that not considering or modelling alternatives in diffusion can lead to biased estimation of effects. One could argue that this is due to the positive effect spatially lagged PIT has on PIT, in other words when other countries are increasing (or decreasing) PIT, the rest are more likely to do the same rather than changing CIT. As this cross effect is negative and is correlated with the spatial CIT effects, the inclusion of it in the model increases the estimated value of CIT effects meaning that CIT competition is more likely and significant if there are not PIT changes in other countries.

The above findings of the existence of diffusion effects and comparatively more diffusion effect in CIT ($\widehat{\rho_{CIT}}=62.969$) rather than PIT ($\widehat{\rho_{PIT}}=18.463$) in accordance with proposition I, as well as the cross-policy diffusion effects, provide the basis to test for Hypotheses 1 and 2 in Model (6). Estimated

coefficients of conditional interaction effects show that PIT is conditionally affected more by changed in both CIT and PIT in other countries (based on the absolute magnitude of estimated coefficients) in support of the Hypothesis 1.1. Similarly, CIT changes in other countries also have more significant effects on both PIT and CIT in other countries in support of Hypothesis 1.2. Table 2-1 summarises these estimated coefficients from Model (6). On the other hand, the significant value of estimated conditional effects supports Hypothesis 2. For example, statistically significant positive point estimation effect of 1.561 on changes in CIT as the coefficients of the interaction between left-right tendency of a government and spatially lagged changes in CIT in other countries means that right leaning governments are significantly more responsive to changes in CIT in other countries. With regards to PIT however the estimated significant negative effect of -0.976 means that left leaning governments are more responsive to changes in PIT in other countries when changing PIT. As estimations of the effects of interaction between two variables these coefficients cannot be interpreted linearly. Figure 4-2 to Figure 4-5 show the conditional effects of these variables. The x-axis represents the range of domestic political variation while the y-axis shows the change of spatially averaged changes in PIT and CIT. In these figures, the contours represent the marginal effect of these factors on changes in PIT or CIT in countries. Therefore, vertical changes in contour show the changes in PIT and CIT due to changes in other countries PIT and CIT, while horizontal changes in contours represent the effect of domestic left-right tendency. Accordingly, oblique contours show conditionality due to interaction between the two factors. When comparing Figure 4-2 and Figure 4-4 which show the conditional effect on PIT with Figure 4-3 and Figure 4-5 which represent the effect of CIT, one can see that the PIT gets affected more and in a wider range by changes in domestic left-right variables as well as the changes of PIT and CIT in other countries. Looking at the effect of CIT, comparing Figure 4-4 and Figure 4-5 which show the effect of changes in the CIT (on y-axis) with Figure 4-2 and Figure 4-3 which show the effects of PIT changes, one can see that changed in the CIT in other countries has a more effects on the changes of both PIT and CIT.

Besides the existence of conditional diffusion effects, one could also look at the direction of this conditionality. As briefly argued in the theoretical section, the interaction between domestic politics

and the direction of changes in PIT and CIT in other countries makes it hard to make propositions about the direction of conditionality. For example, right leaning governments might be more responsive towards reductions in CIT rates in other countries while less responsive towards increase in CIT rates, in such cases if left leaning governments have opposite preferences then the estimation of conditional effects will depend on whether or not other countries are increasing or decreasing rates. This will become more complicated if different governments have different preferences in a related policy area such PIT, which would lead to complex interaction between cross policy effects. However, when measuring short term diffusion effect such one-year lag in the case of this research, speed of diffusion can also affect the direction of conditionality. For instance, if CIT races quickly towards bottom but only slowly climbs up, then the domestic political preference of towards cutting rates (e.g. in right leaning governments) will be captured by the spatial lags and not the responsiveness towards increase in rates. Such estimations would also depend on the period of study as if there has been an overall increase or decrease in the rates in the community. Overall, not claiming any fundamental theoretical argumentation, the empirical findings for this period of study show more responsiveness in of the right-leaning governments to changes in CIT in other countries. Left leaning governments in on the other hand are more responsive to changes in PIT in other countries when making changes about PIT rates in their own jurisdiction. Finally, with regards cross policy conditional effect of PIT changes in other countries on CIT changes, right leaning governments are more responsive. These are reasonable findings if anecdotally one assumes that the voter base of right leaning governments cares more about capital mobility and left leaning governments about migration and labour mobility. The cross policy conditionality effect of CIT on PIT also shows how international CIT diffusion pressure will translate into PIT but conditionally based on the domestic preference, this effect is higher compared to the PIT changes effect on CIT but right leaning governments seem to be more responsive to PIT changes in other countries when it comes to implementing changes on CIT rates in their own jurisdiction.¹¹⁹

¹¹⁹ Section 7 - 2 in page 155 provides the robustness checks as appendix

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)		Model (6)	
	PITd	CITd	PITd	CITd	PITd	CITd	PITd	CITd
	b/p	b/p	b/p	b/p	b/p	b/p	b/p	b/p
L.Top Personal Income Tax Rate %	-0.181 (0.000)***		-0.193 (0.000)***		-0.184 (0.000)***		-0.176 (0.000)***	
L.Top Corporate Income Tax Rate %		-0.157 (0.000)***		-0.145 (0.000)***		-0.147 (0.000)***		-0.121 (0.000)***
L.Spatially Lagged PITd	22.673 (0.001)***		22.053 (0.002)***		20.101 (0.016)**	-17.098 (0.000)***	18.463 (0.023)**	-18.237 (0.000)***
L.Spatially Lagged CITd		43.632 (0.000)***		44.721 (0.000)***	7.871 (0.570)	59.736 (0.000)***	9.858 (0.465)	62.969 (0.000)***
Gov. Left-Right	0.016 (0.499)	-0.005 (0.702)	0.007 (0.770)	0.020 (0.205)	0.016 (0.501)	-0.001 (0.960)	0.068 (0.019)**	0.033 (0.039)**
Central government debt % of GDP	-0.007 (0.550)	0.012 (0.048)**	-0.006 (0.607)	0.011 (0.084)*	-0.007 (0.550)	0.013 (0.030)**	-0.010 (0.337)	0.011 (0.058)*
Unemployment	0.557 (0.010)**	-0.212 (0.078)*	0.562 (0.009)***	-0.226 (0.058)*	0.559 (0.010)***	-0.209 (0.074)*	0.517 (0.014)**	-0.222 (0.053)*
Unemployment Squ.	-0.015 (0.032)**	0.007 (0.078)*	-0.015 (0.032)**	0.008 (0.041)**	-0.015 (0.032)**	0.007 (0.084)*	-0.012 (0.075)*	0.008 (0.042)**
FDI out	-0.001 (0.808)	-0.003 (0.138)	-0.001 (0.732)	-0.003 (0.191)	-0.001 (0.806)	-0.003 (0.160)	-0.000 (0.933)	-0.002 (0.268)
FDI in	0.004 (0.690)	0.008 (0.149)	0.005 (0.634)	0.006 (0.283)	0.005 (0.658)	0.008 (0.163)	-0.000 (0.984)	0.005 (0.362)
Gov. Left-Right # L.Spatially Lagged PITd			-0.694 (0.211)				-0.976 (0.074)*	0.500 (0.095)*
Gov. Left-Right # L.Spatially Lagged CITd				1.511 (0.013)**			3.992 (0.000)***	1.561 (0.009)***
Constant	6.016 (0.004)***	7.520 (0.000)***	6.411 (0.002)***	7.262 (0.000)***	6.394 (0.003)***	7.561 (0.000)***	6.388 (0.003)***	6.914 (0.000)***
Observations	274	274	274	274	274	274	274	274

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

Table 4-1 Summary of Model Estimations

Estimated coefficients /P-Values	Effects on PIT	Effects on CIT
Unconditional Effect of PIT $W\Delta PIT_{t-1}$	18.463 (0.023)**	-18.237 (0.000)***
Unconditional Effect of CIT $W\Delta CIT_{t-1}$	9.858 (-0.465)	62.969 (0.000)***
Conditional Effect of PIT $[W\Delta PIT_{t-1}] \cdot Z_{i,t}$	-0.976 (0.074)*	0.5 (0.095)*
Conditional Effect of CIT $[W\Delta CIT_{t-1}] \cdot Z_{i,t}$	3.992 (0.000)***	1.561 (0.009)***

Table 4-2 – Summary of unconditional and conditional spatial effects of PIT and CIT

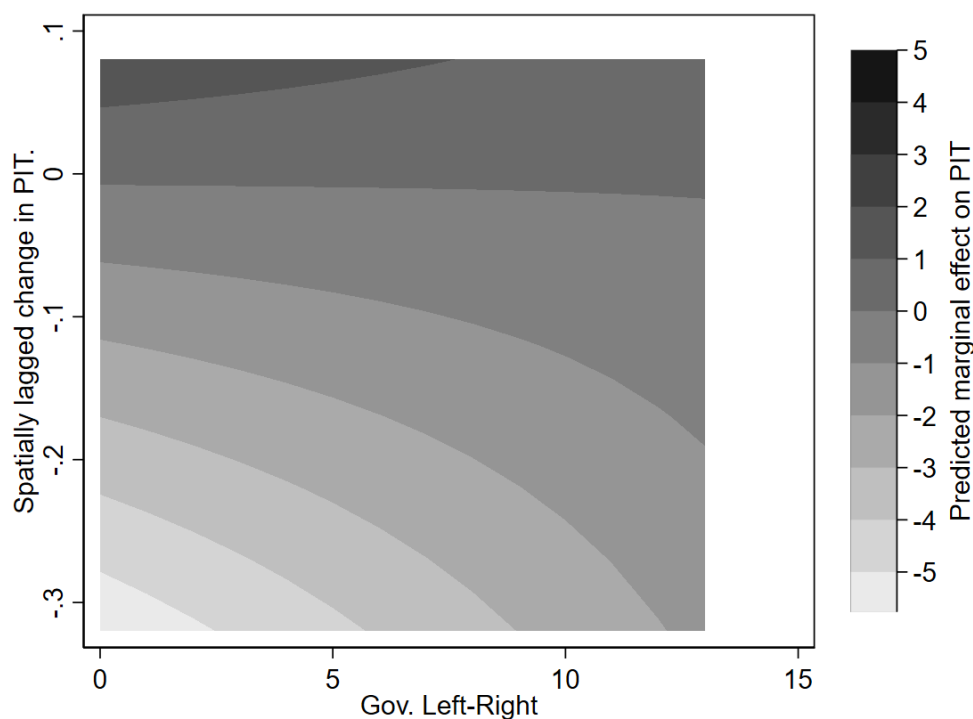


Figure 4-2 Marginal Effects of PIT Spatial Lag and Gov, Left-Right on PIT

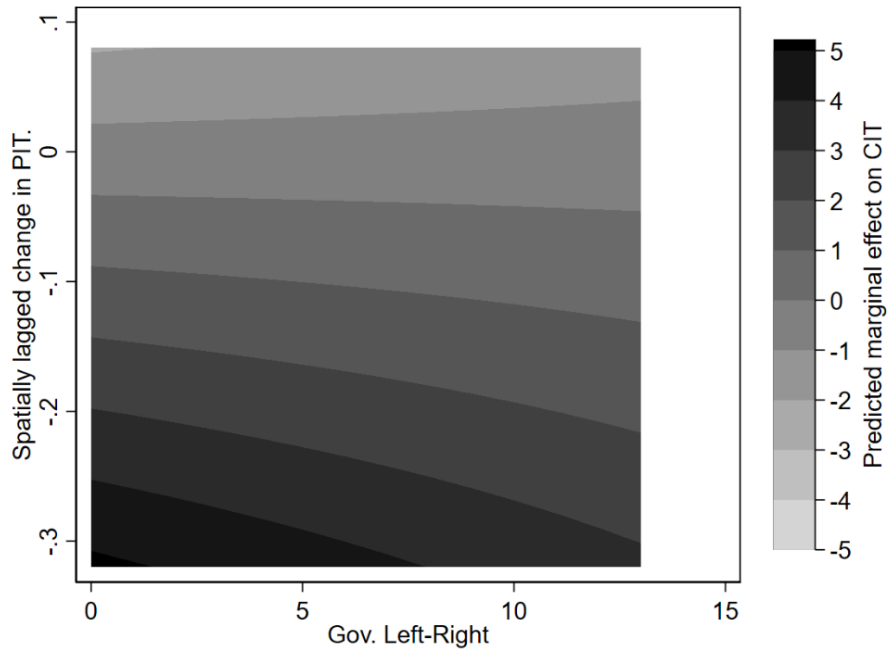


Figure 4-3 Marginal Effects of PIT Spatial Lag and Gov. Left-Right on CIT

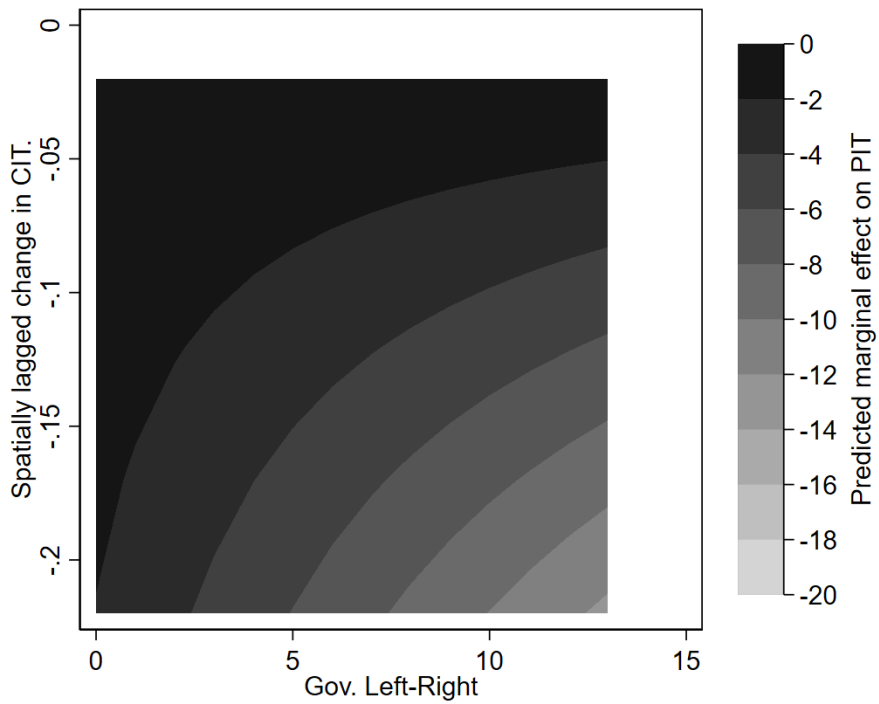


Figure 4-4 Marginal Effects of CIT Spatial Lag and Gov. Left-Right on PIT

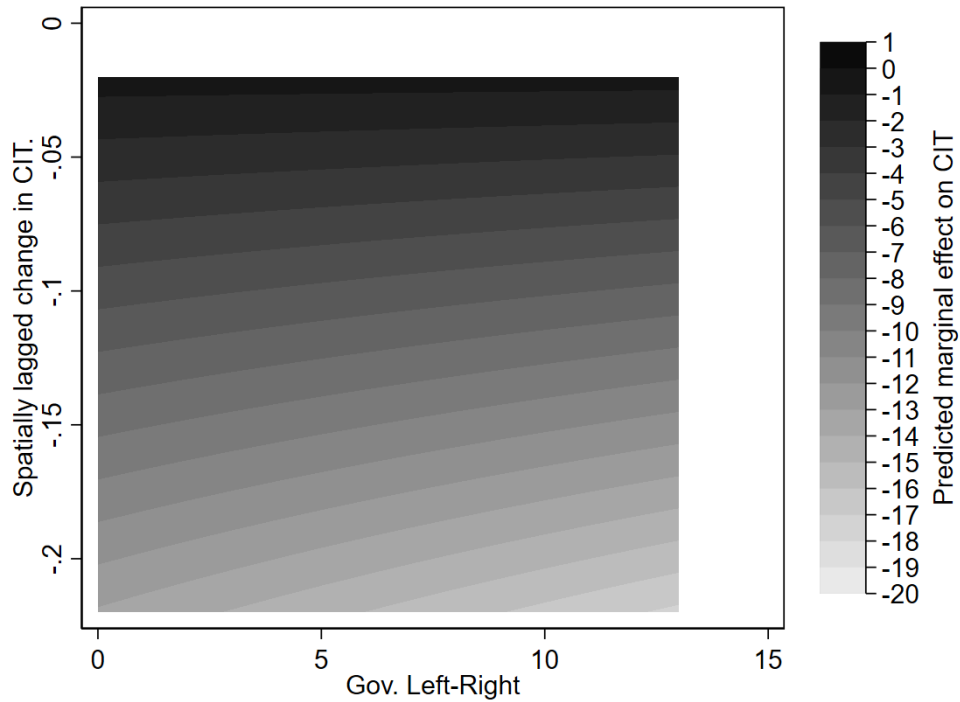


Figure 4-5 Marginal Effects of CIT Spatial Lag and Gov. Left-Right on CIT

4 - 5 Conclusion

This research implemented a set of simultaneous spatial equations on two tax categories to study the political conditional responsiveness of diffusion where alternative policies are available. Taking inspiration from Brooks (2007) as to look at the importance of policy characteristics as well as domestic political conditions of units when it comes to diffusion and following Genovese, Kern and Martin (2017) I argued that when alternative policy areas are available, any modelling of diffusion should take into account this availability as the level of diffusion depends on the general responsiveness of such area. Furthermore, the conditionality of responsiveness can also be affected by such general heterogeneity between policy areas. This paper argued that the more internationally determined a policy the less domestic factors and therefore conditionality of domestic factors matter. This may seem obvious at the first sight, however when this paper also shows that international diffusion stimuli can spill over to other areas. For example, CIT rates have a higher level of international diffusion and lower domestic factors affecting them. Hence, they are less affected by

domestic conditionality, on the other hand PIT is less internationally affected and therefore at domestic levels the effect of international changes is more conditional on domestic factors. But the effect from one can spill over the other. This helps to show that the lack of direct international effect does not necessarily mean the lack of diffusion but rather could be due to heterogeneous responsiveness of domestic players. And when alternative policies exist international spatial stimuli can translate into other alternative policy effects. For example, the effect of changes in CIT in other countries can translate into changes in PIT conditional on domestic decision makers, which if not controlled for may have been mistaken with lack of diffusion.

To conclude, after arguing that two areas of taxation CIT and PIT are related but have different level of international diffusion pressure, this paper showed that in such situations the area with less internationally determined factors will show more conditionality at domestic level. Such conditionality in related policy areas can itself translate into cross policy conditional effect based on domestic factors. This means that governments not only respond differently into international stimuli but can take initiatives in other related areas based on their preference. This research showed that this cross-policy effect will happen based on spill overs from more internationally determined area such as CIT towards more domestically determined area such as PIT conditional on the preference of domestic actors such as left-right tendency of governments. This research contributes to the literature of conditional policy diffusion by showing the existence and the importance of conditional effects that can happen cross policy area. It also provides evidence for the link between domestic conditionality and international determination. And showed how right or left leaning governments respond differently in different policy areas.

5 Conclusion

This thesis looked at the conditional effects of domestic factors on policy diffusion. Using three relatively independent paper/chapters, I tried to shed light on the importance of the role of domestic factors in the diffusion process and provide insight into how these factors affect the diffusion process.

In the introduction, I argued domestic factors are a key part of the international policy diffusion process, and proposed that their heterogeneity is a source of conditionality in the policy adaptation which researchers should take into account when studying diffusion. I briefly reviewed what literature has done regarding the diffusion conditionality and why more needs to be done.

In the first paper/chapter of this thesis, I used Agent-Based Modelling in order to deal with the theoretical complexities of having multiple levels of interaction such as domestic and international. I showed how ABM can be used as an effective tool to capture the effects of heterogeneous domestic actors. Ideally, one can either generate theoretical propositions from ABM which one could later test empirically or calibrates agent-based models to explain and predict multilevel diffusion scenarios. Due to the limitations of this study, being a PhD thesis with limited time and resources, and the way these three papers developed simultaneously over time, I myself couldn't directly links the findings of the first paper to the other two. However, besides showing theoretical possibilities as one of its objectives, the first paper also had some implications about how different micro factors affect macro patterns that help our understanding of the policy diffusion. For example, it showed how limited static connectivity between units can limit the diffusion of sub optimal policies, more specifically I've looked at polarisation and political conflict between agents and voter as specific example of such domestic factors and showed how conflict between the agents can lead to spread and diffusion of efficient alternative policies while in contrast polarisation among voters can lead to the spread and implementation of inefficient policies.

In the second paper, I looked at the unit conditionality empirically. Using environment spending data in European countries, this paper showed domestic political preference can affect the level of

responsiveness to international stimuli. More specifically, in some areas such as environmental spending, less leading political actors can become more responsive to the changes or policy adaptations in other states. Such asymmetric political conditionality can lead to effective followership that explains lack of races to the bottom. I argued that in polarised policy areas such as environmental policy, different political preference and costs for actors will lead into some taking the role of leaders and some becoming responsive followers. While followers can't afford to take policy initiatives in order to be competitive for votes they become responsive.

I looked at domestic conditionality when alternative policies exist or when policy areas are interdependent, in the third paper. Using different types of taxes, I proposed and found evidence that the domestic conditionality is more significant when policies are less internationally determined for example in areas such as corporate income taxation compared to personal income tax. Furthermore, this paper showed that the international diffusion can spill over into other areas which are more domestically determined, this spill over will also be conditional based on the domestic preference.

5 - 1 Theoretical tension between the chapters and overall findings and contributions

I argued that for better understanding of policy diffusion, one must look at the domestic political processes and its interaction with the inter-jurisdictional factors in more depth. I posited that the literature of policy diffusion has a gap when it comes to looking at this interaction due to theoretical complexity and methodological approaches. This thesis in three relatively independent chapters tries to fill this gap. From the theoretical point of view, I proposed that ABM can help with theories that capture both domestic and international layers of policy diffusion. Other formal theoretical tools such as game theory while have been used throughout the literature lack the ability to model all elements of policy diffusion effectively. This inability comes from the complexity that appears when one wants to model multi-layer interaction between decision makers. Reviewing the elements of policy diffusion, one should pay attention to, domestic actors, policy characteristic, networks of diffusion and the decision-making rules within and between jurisdiction. I proposed that as any of these elements can

be a source of heterogeneity, therefore modelling their interaction could be a troublesome task. I showed in my first chapter, how such complexity can be modelled using ABM. Using high computation power, one can model each element of diffusion such as the population of voters in a country, political actors in countries, their domestic interaction and their inter-jurisdictional interactions independently and heterogeneously. This allows for the study of the effects of heterogeneous domestic political factors on the diffusion process. To give an example, I looked at the effects that polarisation in voters' preference and political conflict between agents (representing political actors such as parties) have on diffusion. Looking at different diffusion mechanisms in different diffusion networks which allowed to compare how these factors affect the diffusion, I have looked at macro-pattern characteristics of diffusion such as saturation and the diffusion of efficient or inefficient policies throughout the community. The result showed that conflict between agents can help with the spread of efficient alternative policies for voters as these actors compete for voters, while the polarization among voters has the opposite effect. This is a theoretical proposition that now can be tested empirically. Unfortunately, due to time limitation and the way that this thesis was formed as a part of a PhD thesis, I was unable to test for it empirically. However, this key finding as well as some other less discussed findings – such the fact that the number of agents didn't have any significant effect on the diffusion macro patterns – show how ABM can be used in theory building. It's important to mention that this theory building ability of ABM comes from comparison of different methods of diffusion when parameters of interest varies in different simulations. Therefore, the first paper contributed to the literature of policy diffusion by; firstly, providing a framework on how ABM can be used as theory building tool; secondly, showing the importance of modelling the domestic political process and its interaction with the diffusion network for better understanding of diffusion macro-pattern characteristics; and thirdly providing propositions as how polarisation affects the diffusion as an example which itself is interesting and can now be tested. Following the same line of research, looking furthermore at the effects of domestic political factors on the diffusion, and how these factors cause conditional responsiveness to international diffusion stimuli, the second chapter looks at how in a polarized areas such as environmental politics, domestic preferences and constraints affect the diffusion. I posited that in such areas where political actors have different preferences, these

preferences become a source of conditional responsiveness to the international diffusion stimuli. I argued that some actors due to both political and implementation risks will wait to see what other initiators (leader) will do in other countries. Such actors therefore will be more responsive to diffusion stimuli as to compete for office. Empirical findings support this proposition and shows that both right leaning governments and governments who are less environmentally friendly are in fact more responsive to changes in the environmental spending in other countries. This paper contributes to both the literature of policy diffusion; as to show how such domestic preference are the sources of conditionality, how actors in polarised areas can play the roles of leaders and followers, and how such effects can be empirically modelled. To go one more step further, the third chapter looks at the same conditionality in a multiple and related policy areas. It argues that this political domestic conditionality is directly linked to the level of international determination and as one expects more domestic political influence in areas that have low or moderate international influence. This argumentation can only be tested when one looks at related policy areas such as different types of taxes. Focusing on corporate income and personal taxation, the third chapter argues that based on capital and labour mobility, cooperation between states and the level heterogeneity in each of these areas, political income taxation is less internationally determined and therefore one can expect more political conditionality. Empirical results support both propositions. In addition, using a simultaneous setting, this chapter shows how international diffusion effects can spill over from one area to another one conditionally depending on political factors. This paper contributes to the literature by showing the link between international determination and domestic conditionality and providing evidence for cross policy conditional diffusion effect.

These three chapters together, provide a theoretical framework for study of domestic politics in the diffusion process, look at the effects of polarisation and conflict on the macro-patterns of diffusion, show how such domestic factors can be a sources of different responsiveness in diffusion and how domestic politics in multiple policy areas can be compared and affected by diffusion. While these three chapters are not directly related together they show the importance of domestic factors in modelling and understanding diffusion, provide more insight as to the effect of polarisation and the

political preference of political actors in the spread of efficient or inefficient policies or different levels of responsiveness to international adaptations of policy, and how international determination can have different and complex effects in different but related policy areas.

5 - 2 Limitations, possible extensions and implications

Without a doubt this research has many limitation and areas for improvement. First and foremost, as mentioned above, the application of ABM remained rather theoretical. While, even purely theoretical contributions can provide us with a lot of insight into the policy diffusion process, in an ideal situation I really would have liked to be able to link it to empirical evidence. The ABM theoretical framework was also a very simplified version of possible diffusion processes and has much more potential than presented here. Theoretically, such ABM framework can be extended to capture more and more complexity in multiple levels with different actors and interactions. The only limitation with ABM comes from the lack of computational power. Such extensions allow for the development of complex policy analysis tools such as EUROMOD¹²⁰ where effects of micro changes in tax benefits on macro patterns is modelled in EU. However, such applications of ABM require specific policy area focus and direct link to micro data (e.g. tax benefits), otherwise they will look more like computer games rather than applied simulations. On the other hand, one could add more complexity to how agents make decisions. Most ABM frameworks limit the actions of agents into a few independent options; however, one could put them in a more strategic and interactive environment. I propose that such extension can open the door to much more methodological flexibility. However, I still believe that the framework provided showed the capacity of ABM in dealing with complexity multilevel diffusion processes.

The second limitation of this thesis comes from my own lack of expertise in taxation and public spending as a PhD researcher in comparative politics. I used environmental spending and tax rates as examples to look at policy diffusion, however one could argue that my depth of argumentation and theoretical considerations within these specific areas is limited. I wish to acknowledge this issue and accept that while this thesis's aim was to look at diffusion in general rather than specific policy areas,

¹²⁰ <https://www.euromod.ac.uk/>

a more in depth theoretical look at domestic and international determinants of policies in such areas could have added to the quality of this research. In looking at different taxes, it's obvious that more theoretical works needs to be done on how right or left leaning governments exert their preferences or in which direction. While such theoretical extensions can add to the quality of the research, I've tried to form my arguments in a way that don't require strong underlying assumptions. In this example, my argument mainly focuses on international or domestic sensitivity of tax areas rather than in which direction left or right leaning governments react to international stimuli. However, one could certainly investigate why such domestic actors treat diffusion stimuli in certain a direction.

Third limitation of this thesis is with regards to the empirical estimation methods that I have used in the second and third papers. Spatial econometric models are empirically challenging, and estimation becomes even a more complex task when it comes to dealing with temporal lags, fixed effects and multiple networks. I have used the most suitable estimation method available in common statistical packages¹²¹, however one could still argue for the need to use more specific estimation methods. For example, in the third paper's structural equations setting one could argue that the unbiased and efficient estimator needs to be built specifically to deal the spatial correlation in the error terms between equations rather than using a general seemingly unrelated setting. One solution would be building such estimators, for example by using custom built maximum likelihood estimators; however, I wasn't able to do so within the timeframe of this research. Similarly, these methodological limitations called for some assumptions that may not strongly hold. For example, while the geographical space is rather fixed, both ideological and development spaces are dynamic. This change in the space over time means that spatial lags are actually time dependent, which is an assumption that I've relaxed and therefore estimated one ρ representing the average spatial effect.

In all three papers, I focused on the unit responsiveness and domestic factors. As I reviewed in the introductions, domestic factors can also affect the signalling side heterogeneously. Theoretically,

¹²¹ I checked both Stata and R for availability and the presented estimations are implemented with Stata

ABM can deal with heterogeneity on both sides, however empirically I couldn't find a way to control for conditionality on both sides simultaneously. This area needs more methodological work.

Overall, I propose that this thesis showed domestic factors are a significant part of in international diffusion process, ABM can be used in dealing with their diversity and can explain some macro patterns. Domestic factors such as political preferences of actors to take initiatives or become response in some policy areas needs to be modelled and can be captured by conditional responsiveness, and finally when policy makers face related policy areas the domestic political conditionality will depend on the level of international determination which could spill over between policy areas.

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7 Appendices

7 - 1 Paper/Chapter 3 Appendix

Below some results of robustness checks are provided. Table 7-1 provides the final models (4 and 5) implemented and presented. Model (6 and 7) show similar specification without control variables. Models (8 and 9) on the other hand are the same model implementation without country (unit) specific dummy variables. Table 7-2 similarly presents Models (10 to 19) where single control variables have been dropped. Table 7-3 show the estimation of final Models (6 and 7) but where 10% of data is dropped. In all the below results the conditional diffusion effect of Left-Right government tendency and the environmentally friendliness of governments keep their significance and sign while the magnitude may change slightly, showing the robustness of the results.

$y = \Delta \text{ Env Spending } \$ \text{ per. person}$	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
	$W^{geo} \times L - R$	$W^{geo} \times \text{Pro Env}$	No controls $W^{geo} \times L - R$	No controls $W^{geo} \times \text{Pro Env}$	No country dummy $W^{geo} \times L - R$	No country dummy $W^{geo} \times \text{Pro Env}$
	b/p	b/p	b/p	b/p	b/p	b/p
y_{t-1}	-0.108 (0.013)*	-0.100 (0.025)*	-0.087 (0.048)*	-0.077 (0.082)	-0.119 (0.005)**	-0.112 (0.009)**
Tot. Gov. Spend %GDP	-0.125 (0.815)	-0.207 (0.702)			0.321 (0.300)	0.167 (0.598)
Log GDP per. cap.	-1.925 (0.434)	-1.444 (0.559)			-1.623 (0.261)	-1.423 (0.331)
Unemployment	-5.196 (0.002)**	-5.247 (0.002)**			-1.970 (0.068)	-1.818 (0.095)
Unemployment Squ.	0.159 (0.011)*	0.162 (0.010)*			0.073 (0.103)	0.071 (0.116)
Growth Rate	0.171 (0.712)	0.180 (0.700)			0.643 (0.134)	0.610 (0.159)
Inflation	-0.181 (0.345)	-0.155 (0.421)			0.046 (0.782)	0.074 (0.658)
Green Party Elected	1.168 (0.851)	2.015 (0.747)	-2.148 (0.734)	-1.389 (0.827)	-0.624 (0.850)	-0.358 (0.915)
Green Taxes %GDP	8.056 (0.084)	7.060 (0.135)	-5.415 (0.067)	-5.926 (0.052)	2.302 (0.371)	2.496 (0.337)
Gov Pro. Env. Position	0.486 (0.559)	1.363 (0.128)	-0.029 (0.971)	0.785 (0.365)	0.273 (0.672)	1.031 (0.147)
$W^{geo} y_{t-1}$	2.528 (0.000)***	3.604 (0.000)***	2.406 (0.000)***	3.374 (0.000)***	2.012 (0.000)***	2.879 (0.000)***
Gov. Left-Right	-0.395 (0.017)*	-0.276 (0.092)	-0.391 (0.020)*	-0.279 (0.095)	-0.281 (0.031)*	-0.107 (0.386)
$W^{geo} y_{t-1} \times \text{Gov. Left} - \text{Right}$	0.045 (0.000)***		0.043 (0.000)***		0.045 (0.000)***	
$W^{geo} y_{t-1} \times \text{Gov. Pro. Env. Pos.}$		-0.262 (0.006)**		-0.234 (0.017)*		-0.218 (0.016)*
sigma_u						
Constant	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
sigma_e						
Constant	28.833 (0.000)***	29.042 (0.000)***	29.699 (0.000)***	29.911 (0.000)***	29.896 (0.000)***	30.164 (0.000)***
Observations	460	460	460	460	460	460

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

Table 7-1 – Results of the final model, same models without control variable and same models without country dummy

$y = \Delta \text{Env Spending } \$ \text{ per. person}$	Model (10)	Model (11)	Model (12)	Model (13)	Model (14)	Model (15)	Model (16)	Model (17)	Model (18)	Model (19)
	b/p	b/p	b/p	b/p	b/p	b/p	b/p	b/p	b/p	b/p
y_{t-1}	-0.108 (0.014)*	-0.099 (0.026)*	-0.113 (0.009)**	-0.103 (0.019)*	-0.088 (0.044)*	-0.079 (0.074)	-0.108 (0.014)*	-0.099 (0.025)*	-0.107 (0.014)*	-0.099 (0.026)*
Tot. Gov. Spend %GDP			-0.453 (0.175)	-0.453 (0.179)	-0.827 (0.080)	-0.906 (0.057)	-0.198 (0.691)	-0.283 (0.573)	-0.131 (0.807)	-0.212 (0.695)
Log GDP per. cap.	-2.375 (0.122)	-2.183 (0.157)			-1.396 (0.551)	-0.947 (0.687)	-1.680 (0.478)	-1.186 (0.619)	-1.774 (0.470)	-1.317 (0.594)
Unemployment	-5.325 (0.001)***	-5.460 (0.001)***	-5.234 (0.002)**	-5.275 (0.002)**			-5.197 (0.002)**	-5.248 (0.002)**	-5.023 (0.003)**	-5.098 (0.003)**
Unemployment Squ.	0.162 (0.009)**	0.166 (0.008)**	0.166 (0.007)**	0.167 (0.007)**			0.159 (0.011)*	0.162 (0.010)*	0.155 (0.013)*	0.158 (0.012)*
Growth Rate	0.211 (0.625)	0.246 (0.572)	0.073 (0.870)	0.107 (0.813)	0.175 (0.709)	0.184 (0.696)			0.226 (0.625)	0.227 (0.624)
Inflation	-0.181 (0.343)	-0.156 (0.418)	-0.171 (0.370)	-0.148 (0.442)	-0.103 (0.590)	-0.077 (0.690)	-0.189 (0.318)	-0.164 (0.390)		
Green Party Elected	1.264 (0.838)	2.171 (0.728)	0.876 (0.888)	1.790 (0.774)	-0.442 (0.944)	0.435 (0.945)	0.932 (0.880)	1.765 (0.777)	1.245 (0.841)	2.084 (0.739)
Green Taxes %GDP	7.990 (0.087)	6.957 (0.140)	6.704 (0.122)	6.042 (0.169)	7.694 (0.098)	6.709 (0.154)	8.340 (0.070)	7.360 (0.114)	7.090 (0.120)	6.219 (0.177)
Gov Pro. Env. Position	0.493 (0.553)	1.370 (0.126)	0.412 (0.618)	1.305 (0.143)	0.340 (0.677)	1.228 (0.165)	0.513 (0.536)	1.390 (0.119)	0.432 (0.603)	1.325 (0.139)
$W^{geo}y_{t-1}$	2.533 (0.000)***	3.607 (0.000)***	2.476 (0.000)***	3.563 (0.000)***	2.585 (0.000)***	3.688 (0.000)***	2.529 (0.000)***	3.603 (0.000)***	2.528 (0.000)***	3.617 (0.000)***
Gov. Left-Right	-0.396 (0.016)*	-0.277 (0.091)	-0.390 (0.018)*	-0.273 (0.096)	-0.421 (0.012)*	-0.300 (0.070)	-0.388 (0.018)*	-0.269 (0.099)	-0.387 (0.019)*	-0.269 (0.100)
$W^{geo}y_{t-1} \times Gov. Left - Right$	0.045 (0.000)***		0.045 (0.000)***		0.046 (0.000)***		0.045 (0.000)***		0.045 (0.000)***	
$W^{geo}y_{t-1} \times Gov. Pro. Env. Pos.$		-0.261 (0.007)**		-0.262 (0.006)**		-0.269 (0.006)**		-0.262 (0.006)**		-0.265 (0.006)**
sigma_u Constant	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
sigma_e Constant	28.835 (0.000)***	29.047 (0.000)***	28.852 (0.000)***	29.053 (0.000)***	29.146 (0.000)***	29.357 (0.000)***	28.837 (0.000)***	29.047 (0.000)***	28.861 (0.000)***	29.063 (0.000)***
Observations	460	460	460	460	460	460	460	460	460	460

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

Table 7-2 Results of the final model without control variables

$y = \Delta \text{Env Spending } \$ \text{ per. person}$	Model (20)	Model (21)	Model (22)	Model (23)
	b/p	b/p	b/p	b/p
y_{t-1}	-0.114 (0.021)*	-0.101 (0.044)*	-0.064 (0.268)	-0.041 (0.477)
Tot. Gov. Spend %GDP	-0.189 (0.762)	-0.357 (0.571)	-0.399 (0.530)	-0.575 (0.368)
Log GDP per. cap.	-3.078 (0.303)	-2.757 (0.359)	-1.974 (0.494)	-1.334 (0.645)
Unemployment	-6.461 (0.001)**	-6.263 (0.002)**	-2.981 (0.123)	-3.059 (0.116)
Unemployment Squ.	0.212 (0.003)**	0.208 (0.004)**	0.110 (0.113)	0.114 (0.102)
Growth Rate	-0.174 (0.774)	-0.158 (0.795)	0.943 (0.100)	0.895 (0.121)
Inflation	-0.210 (0.353)	-0.195 (0.393)	-0.108 (0.589)	-0.086 (0.670)
Green Party Elected	7.672 (0.353)	7.579 (0.362)	8.972 (0.276)	8.309 (0.316)
Green Taxes %GDP	14.761 (0.012)*	13.897 (0.019)*	6.953 (0.223)	5.632 (0.327)
Gov Pro. Env. Position	1.361 (0.185)	2.342 (0.030)*	0.084 (0.931)	1.288 (0.221)
$W^{geo}y_{t-1}$	2.822 (0.000)***	4.158 (0.000)***	2.798 (0.000)***	4.311 (0.000)***
Gov. Left-Right	-0.536 (0.007)**	-0.462 (0.021)*	-0.438 (0.027)*	-0.313 (0.114)
$W^{geo}y_{t-1} \times \text{Gov. Left} - \text{Right}$	0.048 (0.000)***		0.049 (0.000)***	
$W^{geo}y_{t-1} \times \text{Gov. Pro. Env. Pos.}$		-0.307 (0.004)**		-0.374 (0.001)***
sigma_u				
Constant	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)	0.000 (1.000)
sigma_e				
Constant	29.653 (0.000)***	29.855 (0.000)***	28.092 (0.000)***	28.236 (0.000)***
Observations	342	342	319	319

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

Table 7-3 – Final models on two randomly selected 90% of data

7 - 2 Paper/Chapter 4 Appendix

Table 7-4 represents the implementation of the model including VAT in the system of equations. The first version of this thesis included the VAT in the system of equations; however, one can see in the results presented below that VAT lack cross area conditionality effect mainly due to standardization throughout the Europe which forms the data of this research. Therefore, it's been dropped from the final version of this thesis. Results show that the cross-policy conditionality in PIT and CIT still exists.

Figure 7-1, Figure 7-2 and Figure 7-3 show the conditional changes of tax rates based on the spatial effects and changes in government Left-Right tendency . One can see that the conditionality is consistent with the main presented results.

Table 7-5 to Table 7-8 show the robustness results Model (6) is the last model presented in the main text and in Models (7 and 8) some control variables are dropped. Models (9 to 12) drop the country and year specific dummies, and lag from the main specification. Models (13 and 14) use the level of tax rates instead of changes in the rates as the dependent variable. In Models (15 to 18), 5% of observations are dropped to show the robustness. As the numbers of observations is not very big one can see that in some of the models below some coefficients lose significance compared to the main Model (6) however the cross-policy effect of CIT is significant in almost all the specification providing support for the main propositions of this research, and others keep their sign and relative magnitude while some lose slight significance. This shows that the results are relatively robust.

	Model (VAT1) Including VAT with no conditionality			Model (VAT2) Including VAT with conditionality		
	PITd b/p	CITd b/p	VATd b/p	PITd b/p	CITd b/p	VATd b/p
L.Top Personal Income Tax Rate %	-0.320 (0.000)***			-0.305 (0.000)***		
L.Top Corporate Income Tax Rate %		-0.378 (0.000)***			-0.365 (0.000)***	
L.Standard VAT Tax Rate %			-0.599 (0.000)***			-0.605 (0.000)***
L.Spatially Lagged PITd	0.544 (0.965)	-8.585 (0.125)	-2.976 (0.366)	3.725 (0.759)	-5.533 (0.316)	-3.140 (0.354)
L.Spatially Lagged CITd	11.999 (0.528)	33.798 (0.000)***	-11.114 (0.032)**	8.299 (0.669)	27.105 (0.005)***	-9.983 (0.073)*
L.Spatially Lagged VATd	48.005 (0.334)	15.133 (0.512)	42.951 (0.002)***	-10.254 (0.836)	3.881 (0.868)	43.340 (0.002)***
Gov. Left-Right	0.053 (0.173)	0.020 (0.212)	0.006 (0.507)	0.061 (0.242)	0.007 (0.758)	0.018 (0.229)
Central government debt % of GDP	-0.008 (0.548)	0.002 (0.797)	0.001 (0.801)	-0.007 (0.628)	0.003 (0.634)	-0.000 (0.980)
Unemployment	0.849 (0.002)***	-0.048 (0.718)	0.068 (0.360)	0.671 (0.013)**	-0.106 (0.414)	0.086 (0.264)
Unemployment Squ.	-0.022 (0.011)**	0.004 (0.361)	-0.001 (0.821)	-0.015 (0.073)*	0.006 (0.157)	-0.001 (0.722)
FDI out	-0.001 (0.859)	-0.002 (0.276)	0.000 (0.897)	-0.000 (0.946)	-0.002 (0.332)	0.000 (0.778)
FDI in	0.006 (0.623)	0.003 (0.575)	-0.004 (0.222)	-0.000 (0.995)	0.001 (0.814)	-0.004 (0.183)
Gov. Left-Right # L.Spatially Lagged PITd				-3.376 (0.002)***	-1.048 (0.051)*	0.303 (0.343)
Gov. Left-Right # L.Spatially Lagged CITd				6.041 (0.000)***	1.609 (0.031)**	0.143 (0.753)
Gov. Left-Right # L.Spatially Lagged VATd				11.116 (0.003)***	6.073 (0.001)***	-0.812 (0.453)
Constant	9.522 (0.001)***	12.945 (0.000)***	9.341 (0.000)***	10.266 (0.000)***	12.693 (0.000)***	9.386 (0.000)***
Observations	186			186		

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

Table 7-4 Summary of Model Estimations with VAT

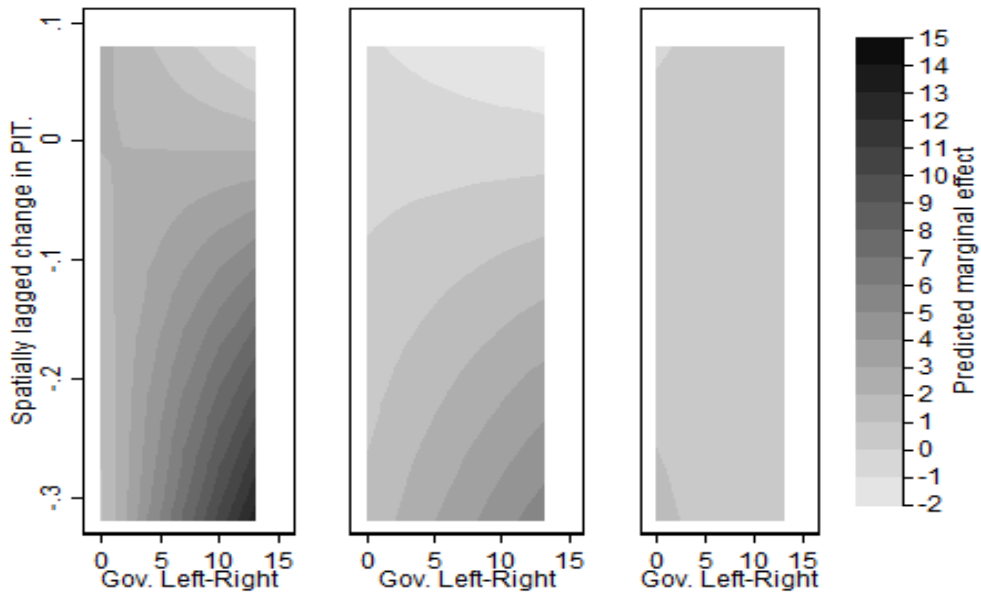


Figure 7-1 Conditional marginal effect on PIT due to spatial lag of PIT, CIT and VAT

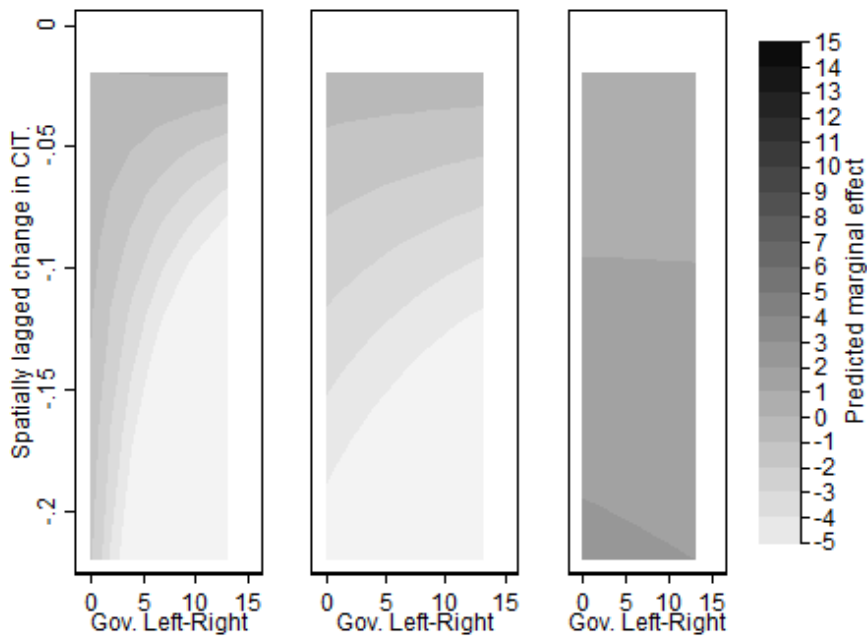


Figure 7-2 Conditional marginal effect on CIT due to spatial lag of PIT, CIT and VAT

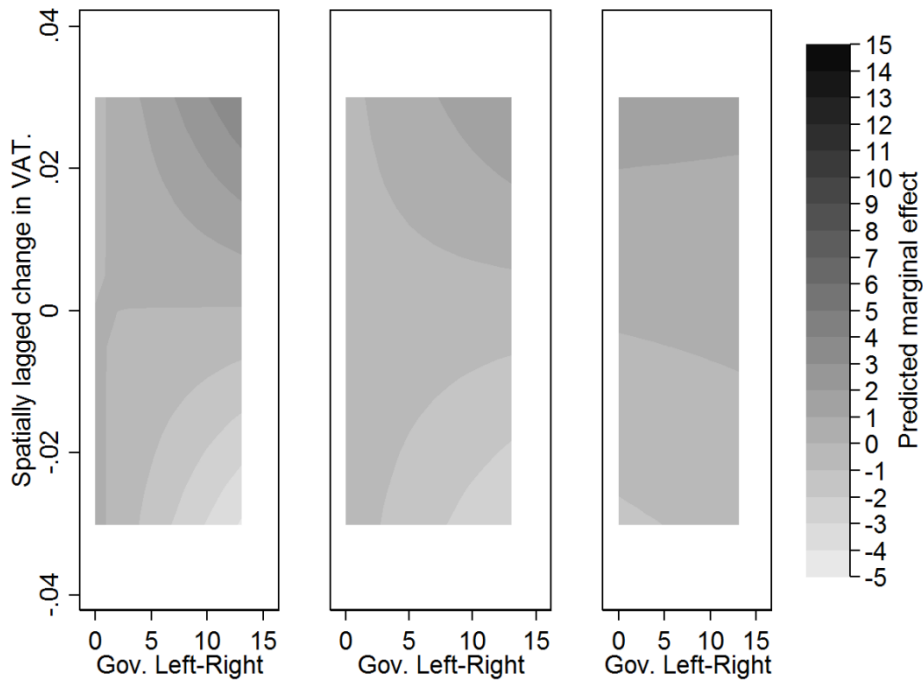


Figure 7-3 Conditional marginal effect on VAT due to spatial lag of PIT, CIT and VAT

	Model (6)		Model (7)		Model (8)	
	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p
L.Top Personal Income Tax Rate %	-0.176 (0.000)***		-0.149 (0.000)***		-0.167 (0.000)***	
L.Top Corporate Income Tax Rate %		-0.121 (0.000)***		-0.130 (0.000)***		-0.121 (0.000)***
L.Spatially Lagged PITd	18.463 (0.023)**	-18.237 (0.000)***	19.093 (0.021)**	-18.112 (0.000)***	18.825 (0.020)**	-18.508 (0.000)***
L.Spatially Lagged CITd	9.858 (0.465)	62.969 (0.000)***	9.115 (0.506)	62.024 (0.000)***	11.084 (0.408)	62.857 (0.000)***
Gov. Left-Right	0.068 (0.019)**	0.033 (0.039)**	0.061 (0.035)**	0.032 (0.042)**	0.064 (0.023)**	0.037 (0.018)**
Central government debt % of GDP	-0.010 (0.337)	0.011 (0.058)*	0.004 (0.700)		-0.011 (0.236)	0.008 (0.129)
Unemployment	0.517 (0.014)**	-0.222 (0.053)*			0.502 (0.013)**	-0.201 (0.068)*
Unemployment Squ.	-0.012 (0.075)*	0.008 (0.042)**			-0.012 (0.083)*	0.007 (0.044)**
FDI out	-0.000 (0.933)	-0.002 (0.268)	-0.002 (0.556)	-0.001 (0.646)		
FDI in	-0.000 (0.984)	0.005 (0.362)	0.005 (0.645)	0.001 (0.793)		
Gov. Left-Right # L.Spatially Lagged PITd	-0.976 (0.074)*	0.500 (0.095)*	-0.889 (0.108)	0.526 (0.083)*	-0.961 (0.077)*	0.517 (0.084)*
Gov. Left-Right # L.Spatially Lagged CITd	3.992 (0.000)***	1.561 (0.009)***	3.889 (0.000)***	1.483 (0.012)**	4.002 (0.000)***	1.654 (0.005)***
Constant	6.388 (0.003)***	6.914 (0.000)***	7.374 (0.000)***	6.642 (0.000)***	6.192 (0.003)***	6.903 (0.000)***
Observations	274		274		278	

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

Table 7-5 Estimation of final models without control variables

	Model (6)		Model (9) No country dummy		Model (10) No year dummy		Model (11) No year or country dummy		Model (12) No lag	
	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p
L.Top Personal Income Tax Rate %	-0.176 (0.000)***		-0.034 (0.035)**		-0.164 (0.000)***		-0.034 (0.034)**			
L.Top Corporate Income Tax Rate %		-0.121 (0.000)***		-0.032 (0.034)**		-0.066 (0.002)***		-0.036 (0.006)***		
L.Spatially Lagged PITd	18.463 (0.023)**	-18.237 (0.000)***	35.464 (0.000)***	-14.169 (0.000)***	19.282 (0.016)**	-18.698 (0.000)***	34.665 (0.000)***	-13.569 (0.000)***	23.662 (0.003)***	-21.957 (0.000)***
L.Spatially Lagged CITd	9.858 (0.465)	62.969 (0.000)***	-3.050 (0.774)	53.605 (0.000)***	8.152 (0.542)	71.101 (0.000)***	-3.250 (0.760)	57.005 (0.000)***	7.870 (0.566)	75.226 (0.000)***
Gov. Left-Right	0.068 (0.019)**	0.033 (0.039)**	0.038 (0.072)*	0.026 (0.043)**	0.065 (0.012)**	0.037 (0.012)**	0.034 (0.097)*	0.022 (0.076)*	0.052 (0.061)*	0.037 (0.013)**
Central government debt % of GDP	-0.010 (0.337)	0.011 (0.058)*	0.001 (0.845)	0.006 (0.024)**	-0.014 (0.155)	0.011 (0.065)*	0.003 (0.553)	0.007 (0.008)***	-0.010 (0.359)	0.014 (0.016)**
Unemployment	0.517 (0.014)**	-0.222 (0.053)*	0.011 (0.933)	-0.052 (0.461)	0.550 (0.006)***	-0.186 (0.106)	0.064 (0.615)	-0.007 (0.924)	0.340 (0.102)	-0.237 (0.036)**
Unemployment Squ.	-0.012 (0.075)*	0.008 (0.042)**	-0.000 (0.934)	0.001 (0.679)	-0.013 (0.049)**	0.007 (0.078)*	-0.002 (0.690)	-0.001 (0.862)	-0.009 (0.183)	0.009 (0.022)**
FDI out	-0.000 (0.933)	-0.002 (0.268)	-0.000 (0.820)	-0.001 (0.594)	0.001 (0.870)	-0.002 (0.259)	-0.000 (0.914)	-0.001 (0.478)	-0.000 (0.921)	-0.002 (0.235)
FDI in	-0.000 (0.984)	0.005 (0.362)	-0.000 (0.985)	-0.001 (0.871)	-0.002 (0.862)	0.003 (0.630)	-0.001 (0.872)	-0.001 (0.820)	-0.003 (0.750)	0.004 (0.497)
Gov. Left-Right # L.Spatially Lagged PITd	-0.976 (0.074)*	0.500 (0.095)*	-0.511 (0.268)	1.006 (0.000)***	-1.005 (0.065)*	0.417 (0.180)	-0.488 (0.293)	0.896 (0.002)***	-0.706 (0.144)	0.720 (0.006)***
Gov. Left-Right # L.Spatially Lagged CITd	3.992 (0.000)***	1.561 (0.009)***	3.428 (0.001)***	0.789 (0.184)	3.847 (0.000)***	1.680 (0.005)***	3.278 (0.001)***	0.787 (0.192)	4.527 (0.000)***	1.837 (0.002)***
Constant	6.388 (0.003)***	6.914 (0.000)***	1.891 (0.161)	2.090 (0.005)***	5.397 (0.003)***	4.001 (0.000)***	1.081 (0.313)	1.155 (0.032)**	-0.111 (0.942)	2.939 (0.000)***
Observations	274		274		274		274		283	

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

Table 7-6 Estimation of final models without unit and time dummies

	Model (13)		Model (14)	
	Level of Tax Rates		Level of Tax Rates with No Country or Year Dummy	
	b/p	b/p	b/p	b/p
L.Top Personal Income Tax Rate %				
L.Top Corporate Income Tax Rate %				
L.Spatially Lagged PIT0	0.884 (0.671)	-4.880 (0.001)***	23.070 (0.000)***	-6.911 (0.000)***
L.Spatially Lagged CIT0	-1.090 (0.725)	8.137 (0.000)***	-25.195 (0.000)***	16.219 (0.000)***
Gov. Left-Right	0.201 (0.001)***	0.089 (0.051)*	-0.118 (0.298)	-0.080 (0.296)
Central government debt % of GDP	0.008 (0.651)	-0.013 (0.285)	0.087 (0.000)***	0.034 (0.001)***
Unemployment	0.725 (0.028)**	-0.115 (0.632)	-1.143 (0.006)***	-0.822 (0.003)***
Unemployment Squ.	-0.009 (0.426)	0.001 (0.895)	0.049 (0.003)***	0.025 (0.025)**
FDI out	0.001 (0.873)	-0.000 (0.909)	0.009 (0.127)	0.002 (0.712)
FDI in	0.014 (0.383)	0.008 (0.486)	0.021 (0.447)	0.034 (0.073)*
Gov. Left-Right # L.Spatially Lagged PIT0	-0.641 (0.000)***	-0.358 (0.000)***	-0.259 (0.152)	-0.063 (0.604)
Gov. Left-Right # L.Spatially Lagged CIT0	0.878 (0.000)***	0.441 (0.001)***	0.599 (0.033)**	0.115 (0.545)
Constant	38.673 (0.000)***	35.999 (0.000)***	37.171 (0.000)***	32.567 (0.000)***
Observations	283		283	

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

Table 7-7 Estimation of level dependent variables (tax rates) instead of changes

	Model (15)		Model (16)		Model (17)		Model (18)	
	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p	PITd b/p	CITd b/p
L.Top Personal Income Tax Rate %	-0.178 (0.000)***		-0.156 (0.000)***		-0.209 (0.000)***		-0.156 (0.000)***	
L.Top Corporate Income Tax Rate %		-0.103 (0.000)***		-0.114 (0.000)***		-0.136 (0.000)***		-0.128 (0.000)***
L.Spatially Lagged PITd	12.072 (0.157)	-16.409 (0.000)***	18.888 (0.023)**	-23.141 (0.000)***	18.419 (0.025)**	-20.221 (0.000)***	20.927 (0.009)***	-19.408 (0.000)***
L.Spatially Lagged CITd	20.393 (0.156)	60.979 (0.000)***	3.144 (0.824)	71.890 (0.000)***	4.479 (0.747)	64.232 (0.000)***	-5.080 (0.711)	69.680 (0.000)***
Gov. Left-Right	0.091 (0.008)***	0.010 (0.547)	0.079 (0.010)***	0.014 (0.375)	0.086 (0.005)***	0.047 (0.007)***	0.050 (0.081)*	0.034 (0.043)**
Central government debt % of GDP	-0.002 (0.835)	0.003 (0.585)	-0.008 (0.476)	0.009 (0.141)	-0.022 (0.056)*	0.011 (0.099)*	-0.004 (0.710)	0.017 (0.009)***
Unemployment	0.272 (0.246)	0.059 (0.610)	0.261 (0.249)	-0.195 (0.099)*	0.639 (0.003)***	-0.255 (0.033)**	0.426 (0.052)*	-0.263 (0.033)**
Unemployment Squ.	-0.003 (0.700)	-0.004 (0.344)	-0.005 (0.503)	0.006 (0.114)	-0.014 (0.040)**	0.009 (0.025)**	-0.010 (0.176)	0.009 (0.021)**
FDI out	-0.002 (0.658)	-0.001 (0.648)	-0.000 (0.895)	-0.001 (0.527)	0.000 (0.970)	-0.002 (0.396)	-0.004 (0.373)	-0.006 (0.024)**
FDI in	0.003 (0.776)	0.002 (0.739)	0.001 (0.957)	0.006 (0.281)	-0.010 (0.319)	0.004 (0.541)	0.001 (0.934)	0.006 (0.329)
Gov. Left-Right # L.Spatially Lagged PITd	-0.712 (0.216)	0.011 (0.970)	-0.980 (0.081)*	0.598 (0.043)**	-1.171 (0.030)**	0.459 (0.132)	-0.863 (0.108)	0.600 (0.049)**
Gov. Left-Right # L.Spatially Lagged CITd	4.039 (0.000)***	1.959 (0.001)***	4.714 (0.000)***	0.919 (0.157)	4.727 (0.000)***	2.061 (0.001)***	2.848 (0.009)***	1.414 (0.023)**
Constant	7.578 (0.001)***	5.641 (0.000)***	6.503 (0.002)***	7.147 (0.000)***	7.015 (0.001)***	7.238 (0.000)***	5.234 (0.014)**	7.408 (0.000)***
Observations	255		261		250		248	

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

Table 7-8 Estimation of model on random 95% of data

