Networks as Channels of Policy Diffusion: Explaining Worldwide Changes in Capital Taxation, 1998–2006

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This paper studies policy changes in capital taxation by focusing on policy interdependence induced by network dynamics at the international level. The empirical findings indicate that the competition mechanism induced by network position similarity in the network of portfolio investment and that of exports causes policy diffusion in corporate taxation; the socialization mechanism (policy learning and emulation) induced by network position proximity in the IGO networks also drives policy changes, and the evidence is much stronger in the IGO networks that facilitate policy learning than in those that facilitate emulation. The paper also discusses explicitly empirical challenges to incorporate network characteristics into connectivity matrices in spatial lag models often used to study policy diffusion. It suggests that students of policy diffusion should discuss as explicitly as possible the assumptions and procedures to construct connectivity matrices and present results from alternative specifications: our conclusion on the strength of policy diffusion is often sensitive to the choice of connectivity matrices.

Competition in capital taxation often refers to the phenomenon where international competition for mobile capital induces national governments to lower capital tax rates in order to make domestic markets more attractive than those of neighbor or competitor countries. The change in tax policy in one country creates a negative externality for competitor states, which make similar policy moves to stay competitive. Tax competition at the international level, therefore, creates competitive races in taxation on capital among countries. Tax competition often has great repercussions far beyond tax policy itself: if lower taxation results in a reduction in government revenue, policymakers could be forced to cut domestic spending, increase budget deficits, or shift the tax burden to less mobile factors of production such as labor.² Given its importance, economists and political scientists have been studying tax competition for decades.

The first generation economic model on tax competition predicts dramatic decrease in taxation on capital (to approach zero tax rate) as the competitive downward spiral among countries reaches its equilibrium (Wilson 1986; Zodrow and Mieszkowski 1986). However, these models are often based on unrealistic

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² For studies on shifting tax burden from capital to labor, see, for example, Wibbels and Arce (2003).

assumptions such as perfect capital mobility, a single tax base and instrument, and equal-size economies. This “zero capital tax rate” prediction often contradicts the empirical evidence; for example, there is no significant decrease in corporate tax rates, especially for effective rates, in the OECD countries (Swank and Steinmo 2002; Basinger and Hallerberg 2004). Political scientists pay more attention to real-world constraints that prevent policymakers from adopting optimal capital tax rates from textbook economic models. Recent empirical studies have discovered various domestic factors that play important roles in the process of policymaking on capital taxation. These studies reveal that domestic macroeconomic conditions, government budgetary constraints/rigidities, and fairness norms on tax equality make governments (not necessarily unwillingly) keep taxing capital at levels much higher than the prediction from economic models (Troeger 2008; Plümper, Troeger, and Winner 2009). Moreover, domestic political institutions, such as the number of veto players, the nature of partisan politics, the strength of the labor union and corporatist decision making, and characteristics of the electoral system (for example, consensus vs. majoritarian), all prevent a sharp decrease in capital taxation (Hallerberg and Basinger 1998; Garrett and Mitchell 2001; Hall and Soskice 2001; Hays 2003; Basinger and Hallerberg 2004).³

A fair reading of the literature suggests that a moderate version of the tax competition model might better capture the reality, that is, the downward pressure in taxation on capital from international competition does exist and it engages countries in strategic policymaking, but this is mediated by domestic conditions. The competition-induced strategic interaction aspect of the moderate tax competition model is demonstrated by findings from numerous recent studies showing that one country’s level of capital tax rates is often associated with its neighboring and/or competitor countries’ (Hays 2003; Basinger and Hallerberg 2004; Devereux, Lockwood, and Redoano 2005; Swank 2006; Troeger 2008; Plümper et al. 2009). These studies indicate that the ultimate level of capital tax rates, as one type of government policy, is a function of both conditions at the domestic level and strategic interactions at the international level.

In this paper, we conceptualize worldwide changes in capital taxation as a process of policy diffusion that is driven by network dynamics at the international level. We focus on the aspect of policy interdependence at the international level to explain changes in capital taxation after controlling for important domestic variables. Indeed, statutory tax rate cuts accompanied by base-broadening measures (often considered an important component of the neo-liberal economic orthodoxy) first occurred in the United States since the country’s 1986 market-conforming tax reform. Since then, many OECD countries have made similar moves in their capital taxation policies (Swank 2006). From the perspective of policy diffusion, competitive races on statutory rates in capital taxation can be considered a consequence of competitive diffusion of this neo-liberal capital tax policy.⁴ The competition mechanism of policy diffusion captures the nature of strategic interactions among countries. It emphasizes the role of peer competitive pressure and it moves beyond strategic interactions among neighboring countries, often defined by proximity in geography, to competitors in the global markets defined by their positions in networks of international markets such as trade, foreign direct investment (FDI), and foreign portfolio investment. The competition mechanism of policy diffusion suggests that one country’s policy outcomes are more influenced by its key competitors, that is, countries competing for the same pool of capital and the same export markets (Guler, Guillen,

³ For a great review on the literature of tax competition, see Troeger (2008).

⁴ Race to the “bottom” is often the prediction from the tax competition model, but scholars have proposed other final “destination” of the competitive races, such as a race to the middle, according to Hays (2003).

and MacPherson 2002; Simmons and Elkins 2004; Elkins, Guzman, and Simmons 2006; Lee and Strang 2006). In this paper, we follow this line of policy diffusion research and use network concepts to provide a better specification and measurement of the competition mechanism in a broader set of global economic networks. To elaborate, our network perspective sees competitive pressure emanating mainly from policy outcomes of key competitor countries that are defined by position similarities in the networks of international markets. The level of tax competition between any two countries is expected to be proportional to the level of competitive pressure between them, which is ultimately a positive function of how similar/substitutable they are in the networks of trade and investment (Burt 1976, 1992). In other words, position similarity in global markets causes competitive pressure which in turn induces policy diffusion. We move beyond existing literature's focus on policy interdependence induced by contiguity in geography. We explicitly study new channels of tax competition by considering the networks of foreign portfolio investments, foreign direct investments (FDI), and trade.

The literature on capital taxation has often focused on the competitive aspect. However, the policy diffusion literature suggests that competition is not the only way through which one country's policy might affect that of others (Dolowitz and Marsh 2000; Elkins and Simmons 2005; Holzinger and Knill 2005; Levi-Faur 2005; Meseguer 2005; Braun and Gilardi 2006; Franzese and Hays 2008). In addition to the competition mechanism, policy learning and emulation can also induce policy diffusion. Different from recent literature's conceptualization of policy learning and emulation as learning from past experience and successful stories and imitating from culturally and politically similar countries (Simmons, Dobbin, and Garrett 2006), we emphasize the network aspect of these two aspects of a socialization mechanism among states, that is, policy learning and emulation are more likely to occur among countries that are "close" to each other in networks. Being close has different meanings. Physically, it means that two countries are close in geography, such as sharing borders or within a certain distance; culturally, it might refer to countries speaking the same language and/or sharing the same religion. In the network context, closeness denotes having high levels of bilateral interactions, such as trade, foreign direct investments, and common ties to international organizations. Policy learning is often based on shared information that travels through cognitive shortcuts bridging connected actors. A range of formal and informal connections between actors smooth the exchange of information between actors (Granovetter 1985; Uzzi 1996; DiMaggio and Louch 1998). Policy emulation, on the other hand, considers the affective dimension of the relational governance, and relies on trust, empathy, and sympathy among countries. Countries emulate the behavior of their self-identified peers, even when they often cannot ascertain that doing so will in fact be in their best interests (Simmons et al. 2006). High levels of interactions in networks are expected to strengthen this sense of affinity, and therefore facilitate policy emulation. Policy learning and policy emulation can be considered two facets of a socialization process where actors that have close interactions with each other tend to adopt similar policies.

Competition, policy learning, and policy emulation are all mechanisms of policy interdependence where one country's decision affects that of others. Spatial statistical models are able to accommodate different forms of interdependence among observations and test whether policy diffuses through these media of policy interdependence. In this paper, we use spatial models to study corporate taxation, with "space" defined by more than geography to include different network effects—cultural ties, capital flows, trade, and connections of intergovernmental organizations (IGO). In the rest of the paper, we first discuss mechanisms of policy diffusion with an emphasis on how countries' network position

characteristics drive policy changes in corporate taxation. Second, we describe changes in top corporate tax (statutory) rates in a panel of 133 countries from 1998 to 2006. Finally, we test whether network characteristics affect capital taxation by using a spatial lag model, with space defined by various forms of network-induced interdependence. The empirical findings reveal the dynamics of corporate tax policy diffusion in a broad set of countries (we include both OECD and non-OECD countries): the competition mechanism induced by network position similarity in the network of portfolio investment and that of exports causes policy diffusion in corporate taxation; the socialization mechanism (policy learning and emulation) induced by network position proximity in the IGO networks also drives policy changes, and the evidence is much stronger in the IGO networks that facilitate policy learning than in those that facilitate emulation. We discuss the empirical challenges to specify the connectivity matrix in spatial lag models and some of the empirical solutions at the same time.

Connecting Network Positions and Mechanisms of Policy Diffusion

Recent studies in international relations have discovered the logic of externalities of national economic policymaking (Simmons and Elkins 2004; Gleditsch and Ward 2006; Simmons et al. 2006; Franzese and Hays 2008). According to Simmons and Elkins (2004), one country's policy decision alters the costs and benefits of the policy for others, either materially through direct economic competition, or ideationally through the subjective pressures of prevailing global norms. From this perspective, the behavior of each country is defined or influenced by a subset of countries that it is most closely related to. In the rest of this section, we discuss mechanisms of policy diffusion and link these mechanisms to network position characteristics that ultimately drive policy interdependence and diffusion in the context of globalization. We focus on network position similarity and network position proximity as two key network position characteristics in this paper.⁵

Position Similarity, Competitive Races, and Policy Diffusion

Competition is one of the key mechanisms that drives the diffusion of norms, rules, and organizational practices (DiMaggio and Powell 1983; Burt 1987). It refers to policy interdependence stemming from peer pressures between countries competing with each other, for example, for the same export markets and the same sources of finance (Simmons et al. 2006). Simmons and Elkins (2004), when discussing the globalization of liberalization, argue that governments' liberalization policies will be influenced by the policies of their most important foreign economic competitors. Berry and Baybeck (2005) also attribute the diffusion of policy across American states to interstate competition. From the perspective of network analysis, the competition mechanism points to a key aspect of network position characteristics, that is, network position similarity, and one can argue that it is the similarity in network positions that ultimately drives the competition mechanism of policy diffusion. Indeed, when competing in the international market, countries targeting the same sources of foreign investment and the same overseas markets are facing a collective action problem as they all

⁵ Network position centrality is another important network position characteristic that deserves a close scrutiny in the study of policy diffusion. Network position centrality is closely related to the mechanism of coercion in the diffusion literature (Henisz, Zelnier, and Guillén 2005; Simmons et al. 2006), because the policy externality from a country that occupies a central position in the network often has much stronger effect on other countries than that from a peripheral country. One recent application of network position centrality in international relations is Ward (2006).

want to be competitive—actually more competitive than their major competitors. A country often has strong incentives to adopt efficiency-mandated economic policies and institutions to gain advantages over its competitors. Other countries respond by going even further in that direction.

These competitor countries are connected in similar and/or same ways to the same external markets and sources of finance; therefore they occupy similar or even equivalent positions in the networks.⁶ Similarity in network positions often causes competition among peers in the same network since they are *substitutable*; competition among substitutable peers often induces them to engage in similar moves that result in similarity in nodal characteristics (Burt 1992). We borrow these insights and speculate that similarity or even equivalence in network positions causes competition, which in turn results in competitive races in corporate tax rates. More specifically, we expect:

Hypothesis 1: *Similarity in network positions induces strategic competitive races in corporate taxation by peer competitive pressure.*

This hypothesis contends that network position determines behavior, and countries embedded in international markets are no exception. Indeed, one of the central concepts in social network analysis, and in structural theory in general, is the notion of position. There are two different approaches to network analysis: one is a positional approach focusing on structural correspondence, and the other a relational approach emphasizing proximity (Borgatti and Everett 1992). The positional approach corresponds to Hypothesis 1 and focuses on network position similarity. (The other approach, that is, the relational approach, nicely corresponds to the second hypothesis we will discuss next in this section.) In the positional approach, to define the network position of a node is to characterize the way it is connected to the rest of the network (Burt 1976; Friedkin 1984). In the context of international political economy, two countries might be far away from each other geographically, with little direct economic contact with each other, but the fact that they are connected to the rest of the world market in a similar fashion, such as exporting the same goods to the same overseas markets and receiving foreign investment from the same sender countries, puts them in a similar network position which makes them substitutable from the perspective of buyers and investors.

We choose structural equivalence to capture position similarity in networks because it provides the most rigorous test for the hypothesis of peer competitive pressure—structure equivalence, by its definition, is the most strict form of similarity in network positions. In the context of binary relationship networks, Burt (1976) defines a set of structurally equivalent nodes as a set of nodes connected by the same relations to exactly the same people. The actor's position in the network is only determined by to whom she is connected. Two actors may be said to be structurally equivalent if they have the same pattern of ties with other actors. In other words, they are substitutable. As Hanneman and Riddle (2005:199) put it, "Actors that are structurally equivalent are in identical 'positions' in the structure of the diagram. Whatever opportunities and constraints operate on one member of a class are also present for the others. The nodes in a structural equivalence class are, in a sense, in the same position with regard to all other actors." However, it is rare to observe exact structural equivalence in large networks of binary relationships, and even harder to find it in valued networks where the tie is a measurement of the strength of a

⁶ While we recognize that both actor (agency) and position (structure) are important for policy outcomes, we focus on the latter in this study as it is one primary determinant of opportunity and constraint for real-world actors (Podolny, Stuart, and Hannan 1996).

relationship. Therefore, one is often more interested in examining the degree of structural equivalence.⁷

Position Proximity, Socialization, and Policy Diffusion

In addition to network position similarity that underpins the competition mechanism of policy diffusion, network position proximity might also give rise to policy diffusion, because it facilitates policy learning and emulation (Elkins and Simmons 2005; Simmons et al. 2006). Actors that locate close to each other often enjoy a higher chance of interaction. Interaction in turn facilitates learning and emulation that induce the diffusion of ideas and practices. As Tobler's first rule of geography puts it: "everything is related to everything else, but near things are more related to each other." When we consider how "close" countries are in the context of economic interactions, one often needs to go beyond proximity in physical distance (Beck, Gleditsch, and Beardsley 2006). Proximity in a typical network in the global economy can be conceptualized as a positive function of the magnitude of interactions between two countries in the network. For example, in the network of trade, the sheer volume of goods exchanged between two countries is often considered an indicator of how close they are in the network. A high volume of bilateral trade indicates a "close" relationship between two countries and, potentially, a high level of policy learning and emulation.

Hypothesis 2: *The closer the two countries are in networks, the more "similar" they are in terms of domestic economic policies, because proximity facilitates policy learning and emulation and therefore policy diffusion.*

The rationale behind this hypothesis has to do with the micro-processes of the socialization mechanism among states at the international level. The assumption here is that most states in the world do not invent economic policies all on their own.⁸ Rather, they engage in a socialization process with other states in which they learn from each other and they may also emulate the behavior of self-identified peers. Policy learning and emulation are two key aspects of the socialization process and both point to the important role of information in the process of economic policymaking.

Policymakers need information about the nature and consequences of certain policy and those for its alternatives before they can make a decision. They have to be persuaded that this is the best policy among the alternatives they know to achieve some overarching goal. Persuasion has to do with cognition and active assessment of the content of a particular policy.⁹ According to Johnston (2001:14), "The probability of some change in attitudes through cognition increases in an iterated, cognition-rich environment where there is lots of new information that cues linkages to other attitudes and interests." In other words, *ceteris paribus*, policymakers tend to choose a policy about which they can constantly get relevant information in order to engage in systematic and intensive evaluation of the policy. Interactions at the international level, such as trade and connections in the IGO networks, can serve as channels of information that

⁷ Pearson correlation is used as specific measurement of structural equivalence. We calculate structural equivalence separately for the networks of exports, transnational portfolio investment, and foreign direct investment. For detailed procedures and data sources for the calculation, please see the Appendix at the end of the paper.

⁸ Indeed, the literature in sociology in the past two decades includes numerous studies on institutional "borrowing" among states, such as educational forms (Ramirez and Boli 1987; Meyer, Ramirez, and Soysal 1992) and adoption of women's suffrage rights (Ramirez, Soysal, and Shanahan 1997). One insight from these studies is that most of the modern states borrowed institutions and policies from a few innovators by imitation and learning.

⁹ Persuasion "involves changing minds, opinions, and attitudes about causality and affect (identity) in the absence of overtly material or mental coercion" (Johnston 2001).

facilitate this policy learning aspect of the socialization process among states: higher volume of bilateral trade and number of shared IGO memberships push countries closer to each other in the social space of international interactions. For example, trade in goods (compared to trade in assets) often has a human aspect wherein buyers and sellers have to have constant contacts with each other, and not only learn and bring home information about the products they trade, but also information of various aspects of the partner country's economics and politics that policymakers can rely on to make informed judgement for policies that have been implemented in trading partners' countries.

Moreover, the source of information matters for its persuasiveness. Information from in-group members is often more convincing, and therefore is more likely to be considered persuasive, than that from out-group members. When there is conflicting information about a certain policy and/or when there are so many policy alternatives that it is already beyond the cognitive limits of real-world actors to look at everything, policymakers might just choose to emulate policy choices of those "in-group" members. Group membership involves the identification of peers and often implies "liking." Liking often increases with more exposure, contact, and familiarity (Johnston 2001). The self-identification process involves long-term interactions along different dimensions, not only economic, but also social and cultural, that might create a sense of affinity among countries. For example, at the international level, IGOs, especially those with social and cultural purposes, such as the African Cultural Institute and the Community of Portuguese-Speaking Countries, can help to create a sense of affinity among member states. This affective dimension based on trust, empathy, and sympathy is important for human interactions (Granovetter 1985; Uzzi 1996). In policymaking process when uncertainty is high and the decision is hard to make, policymakers are more likely to emulate the policy choice of their self-identified peers, even when they often cannot ascertain that doing so will in fact be in their best interests (Simmons et al. 2006). We suspect that the diffusion of corporate tax policy also has a social aspect, that is, diffusion caused by a socialization process among states.

Changes in Top Corporate Tax Rates in the World, 1998–2006

There are different indicators of tax policy and tax burden for capital, for example, statutory marginal rate, marginal effective rate, and average effective rate (Mendoza, Razin, and Tesar 1994). None of these indicators alone can perfectly capture the extent of tax burden on capital. The marginal effective rate has the advantage of measuring the actual tax paid, which includes the combined effects of statutory rates, deductions, and credits. However, it also has the disadvantage of clarifying different revenues according to ambiguous categories such as capital tax and labor tax (Basinger and Hallerberg 2004). As Slemrod puts it, for marginal effective tax rate, "even in its most worked-out form, the procedure relies on a set of fairly arbitrary assumptions and does not account for certain features of some countries' tax systems" (Slemrod 2004:177). Another practical disadvantage of the effective rates is that the data are only available for a handful of OECD countries. Average effective rate, often defined and measured as corporate tax collections divided by overall national income, also has similar disadvantages because it is affected by some unquantifiable aspects of a country such as "non-tax rules that govern the costs and benefits of a business operating in corporate form, and the tax rules that determine the conditions under which a corporate may be taxed as a pass-through entity" (Slemrod 2004:177).

In this paper, we choose to use the simplest measurement of tax policy, that is, the highest marginal tax rate. The highest marginal corporate tax rate is the highest rate shown on the schedule of tax rates applied to the taxable income of corporations. Top marginal corporate tax rate is a simple measure of tax policy

FIG 1. Average Level of Top Corporate Tax Rates

(Notes. For year 2001 and 2005, we only have data for one country, Croatia, from the IFS data. Therefore, we treat the average levels for these 2 years as missing values.)

that reflects the tax burden of the capital. We recognize that it is by no means a perfect measurement because almost no firm ever pays the top marginal rate. In fact, statutory rate is considered by many as an inadequate measure with respect to the incentive to invest because it overlooks the base of corporate income tax such as depreciation schedules, availability of credits for investment, and tax holidays. In other words, tax codes often fail to capture the exemptions and loopholes that capital owners can use to reduce their tax payments below the statutory rate. However, using the top tax rate has several advantages, as argued by Basinger and Hallerberg (2004:268):

First, the marginal rate is the basis for tax deductions: in most cases, it is not possible to deduct foreign taxes paid from one's home taxes beyond the level of the home marginal rate. Second, the statutory rate sets the parameters for two ways for firms to get around paying tax, transfer pricing and thin capitalization. Third, the top marginal rate plays an important signaling role about the tax burden of a country. Finally, as an OECD (2000) report points out, the marginal rates "are commonly an important factor in decision making on new investment."

Indeed, many recent studies in economics have found that policymakers and investors are both sensitive to the changes in statutory rates. For example, Devereux et al. (2005) find that there is competition in statutory rates between countries without capital control. Slemrod (2004) reveals that countries' statutory rates on corporate income tax are negatively associated with trade openness (used as a proxy for foreign competition). Desai and Dharmapala (2007) show that a 10% decrease in a foreign country's statutory corporate tax rate increases the inflow of the US portfolio investments by 21%.

Data on top marginal corporate tax rates are from the World Bank's World Development Indicators online database.¹⁰ One hundred thirty-three countries are covered by the data from 1998 to 2006. This is another advantage of using the statutory rate, since the data cover a much broader set of countries, especially developing countries that often escape the scrutiny of existing studies. Data for 2001 and 2005 are mostly missing. Figure 1 summarizes the average levels of top corporate tax rates for all countries, the OECD, and the non-OECD

¹⁰ The original data are from PricewaterhouseCoopers, Corporate Taxes: Worldwide Summaries, by permission of John Wiley and Sons, Inc.

FIG 2. Top Corporate Tax Rates in the World, 1998

(Notes. We use the following class ranges for the map: 0–15, 16–30, 31–35, 35–40, 41–45. The countries having missing data for this year are not shown in the map.)

countries. The average level of top corporate tax rates for the non-OECD countries has dropped from 29.5% to 23.9% from 1998 to 2006. The same trend has occurred among the OECD countries, but the OECD countries have on average higher rates of taxation on capital. The decrease for this group of developed countries is from 33% to 26.4%. At the global level, from 1998 to 2006, the top tax corporate tax rates have dropped by almost one fifth, from 30.4% to 24.6%.

However, there is great variation in corporate taxation across countries, both in terms of the absolute levels of the top rates and the changes that these countries have experienced during the 9-year period. For instance, in 1998, countries such as Saudi Arabia, Switzerland, and Guyana had top corporate rates higher than 40%, followed by countries such as Australia, Belgium, Czech Republic, India, Italy, Japan, Portugal, and Slovak Republic with top rates higher than 35% (see the map in Figure 2). In the same year, top corporate tax rates for Botswana, Brazil, Chile, Honduras, Hong Kong, Hungary, Iran, Liechtenstein, Kuwait, Mauritius, Panama, and Papua New Guinea were lower than 20%. This group of low corporate tax countries consisted of mostly developing countries. By 2006, more countries have joined this group of low corporate taxation: Bulgaria, Cyprus, Ireland, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Serbia, Slovak Republic, Switzerland, and Uzbekistan all dropped their top corporate tax rates to levels lower than 20%. Moreover, even for West European countries whose tax rates are on average consistently higher than the rest of the world (Figures 2 and 3), top corporate tax rates have been lowered: Portugal by 12%, Austria by 9%, Belgium, Germany, and the Netherlands by 5%, Denmark and Greece by 6%, Finland by 2%, Italy by 4%, Britain by 1%, and France by 0.3%.¹¹ There are also

¹¹ The drop in top corporate tax rates for Switzerland is from 45% to 8.5%. This is the result of the tax reform in 1998 where a flat rate of 8.5% was introduced and was made applicable to all corporations.

FIG 3. Top Corporate Tax Rates in Europe, (a) 1998 and (b) 2004

(Notes. We use the same class ranges for both maps: 0–15, 16–30, 31–35, 36–40, 41–45. Notice the significant drop in top corporate tax rates in only 6 years for some European countries such as Poland, Slovak Republic, Hungary, Belgium, Switzerland, Portugal, and Ireland. Countries having missing data for this year are not shown in the map.)

countries that have not changed their tax rates during the 9-year period, such as Norway, Spain, and Sweden. Luxembourg even increased its top rate from 20% to 22.88% between 2004 and 2006. Figure 3(a) and (b) capture the changes in top corporate tax rates in Europe between 1998 and 2004. The whole of Europe gets much “lighter” on corporate tax in only 6 years.

Modeling Policy Diffusion in Corporate Taxation

Recent research on policy diffusion and interdependence often replies on some type of spatial model. There are different types of spatial models, such as spatial error model, geographically weighted regression model, and spatial lag model (Anselin 1988; Fotherington, Brunsdon, and Charlton 2002). The spatial lag model (or “spatial autoregressive model” by Beck et al. 2006) is often considered conceptually more appropriate for the study of policy diffusion, because the dependent variable for a unit is better conceptualized as being affected by the values of dependent variable in nearby units, that is, policy choice made by country i is affected by policy choices of its nearby countries, rather than by some unmeasured factors.¹² Therefore, we choose to use a typical spatial lag model:

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \rho\mathbf{W}\mathbf{y} + \varepsilon \quad (1)$$

where $\mathbf{y}$ is the dependent variable: for cross-section data, $\mathbf{y}$ is an $N \times 1$ vector of observations, N is the number of countries. For cross-section times-series data, $\mathbf{y}$ is an $NT \times 1$ vector of observations, T is the number of time periods.¹³ $\mathbf{X}\boldsymbol{\beta}$ is the linear domestic covariates. We choose a battery of variables often seen in analysis of tax policies. First, we include trade openness (total trade as a percentage of GDP). This is the most commonly used indicator to capture a country’s overall economic integration. An international financial openness index is also included. We use the Chinn-Ito Financial Openness Index, which is a more recent source of capital openness measurement that covers most of the countries until 2004.¹⁴ We also consider variables that capture domestic economic performance and pressures. Higher unemployment rates are expected to put upward pressure on spending and to be associated with lower tax rates to stimulate the economy. High GDP growth is expected to be associated with high levels of spending and low capital and labor taxation due to the “stickiness” in budgets. Higher dependency ratios, measured as the proportion of the population that are older than 65 or younger than 15, are also expected to push governments to higher levels of spending and taxation. High inflation rates might also have adverse effects on governments’ budgets and taxation. We also include fixed country and year effects. Notice that fixed year effects are important because in the analysis of spatial interdependence, we need to control the effect of common external shocks such as the oil crisis (Plümper and Neumayer 2010). Moreover, country fixed effects are used to allow for cross-sectional heterogeneity. Note that the majority of studies on tax taxation policies in political science focus on the OECD countries, and the time period covered by these studies seldom extends

¹² The spatial error model implies that the only way that observations are interdependent is through unmeasured variables that are correlated, and geographically weighted regression assumes varying coefficients across space.

¹³ We follow standard notations for scalars (italic, for example, w), vectors (bold lower-case, for example, $\mathbf{w}$), and matrices (bold upper-case, for example, $\mathbf{W}$) in this paper.

¹⁴ This index is constructed based on IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (Chinn and Ito 2006). This measurement augments Quinn’s capital openness measurement (Quinn and Inlcan 1997) by including information on whether the country in question has entered into international agreements with international organizations such as the OECD and the EU. See http://web.pdx.edu/~ito/Chinn-Ito_website.htm for detailed description.

beyond 1998 (Hallerberg and Basinger 1998; Swank and Steinmo 2002; Basinger and Hallerberg 2004; Swank 2006). We use a different data set that includes 133 countries covering the period from 1998 to 2006. Therefore, this paper extends the scope of previous research, both spatially and temporally.¹⁵

However, what interests us the most in Equation 1 is the estimation of ρ —the spatial coefficient that captures the overall strength of policy interdependence. In Equation 1, the connectivity matrix, $\mathbf{W}$, is a $N \times N$ matrix in cross-sectional context, with a typical element w_{ij} capturing relative connectivity or influence from unit j to i . In the cross-sectional-time-series context, the connectivity matrix ($\mathbf{W}$) becomes a $NT \times NT$ matrix with T (number of years) $N \times N$ submatrices along the block-diagonal. For geography and common language and cultural ties which are time-invariant, the T submatrices along the block-diagonal of the (super-) connectivity matrix are the same for all years. However, the submatrices defined by countries' network positions usually vary from one year to another. In the rest of the paper, we also refer to the submatrices defined by geography, common language, and network position characteristics generally as a connectivity matrix $\mathbf{W}$. Indeed, during the following discussion on the specification issues in connectivity matrix, we mean the $N \times N$ connectivity matrix for a given year for a simpler presentation. $\mathbf{W}\mathbf{y}$, then, is the spatial lag: for each observation in $\mathbf{y}$, $\mathbf{W}\mathbf{y}$ gives a weighted average of other observations in a given year, with each weight specified by w_{ij} . We row-standardize all the connectivity matrices used in this study.

The problem with estimating a spatial lag model as in the form of Equation 1 is that the dependent variable shows up at both sides of the equation at the same time and this causes the simultaneity bias if the model is estimated by ordinary least squares (OLS) (Anselin 1988; Beck et al. 2006; Franzese and Hays 2007a, 2008). One simple (though not perfect) strategy to get around this simultaneity bias problem, as suggested by Beck et al. (2006), is to lag the spatial lag, $\mathbf{W}\mathbf{y}$, by 1 year and use OLS to estimate the model. Then the original spatial lag model (Equation 1) can be modified and the top corporate tax rate for a country i in year t can be modeled as:

$$y_{i,t} = \mathbf{x}'_{i,t}\beta + \phi y_{i,t-1} + \rho \mathbf{w}_i \mathbf{y}_{t-1} + \varepsilon_{i,t} \quad (2)$$

Notice that we also add the time-lagged dependent variable $\phi y_{i,t-1}$ to capture dependency in time. Temporarily lagging the spatial lags and estimating the spatial lag model by simple OLS can only be a sound solution to the simultaneity bias if the errors, $\varepsilon_{i,t}$ in Equation 2, are serially independent (Franzese and Hays 2007a, 2008). Including a temporally lagged dependent variable often helps to eliminate serial correlation in the errors, but there is no guarantee. Therefore, using a Lagrange Multiplier test, we test the existence of serial correlation in error terms after estimating Equation 2 by OLS.¹⁶ Also notice that the spatial lag becomes $\rho \mathbf{w}_i \mathbf{y}_{t-1}$ ($\mathbf{w}_i$ is the i th row of the connectivity matrix $\mathbf{W}$).¹⁷ The assumption here is that whatever happened in countries that are closely connected to country i , it takes a time lag to affect the policy outcome in country i . This is by

¹⁵ But this extension does not come at no cost. A much more recent time period and a broader coverage to include non-OECD countries cause problem in collecting data for variables describing various aspects of domestic politics, such as cabinet portfolios and partisan composition of the government. Indeed, data on institutions such as veto players or political constraints (Henisz 2002; Beck, Clarke, Groff, Keefer, and Walsh 2007), covering both developed and developing countries, do exist. But these institutional variable change slowly over time, which creates problems for country fixed-effect models. Time-invariant or slow-moving variables are either perfectly or highly collinear with fixed unit-specific effects, and thus their coefficients are either not identified or are difficult to estimate with any precision. Therefore, I chose to focus on network diffusion variables in the current manuscript and leave the analysis of the institutional variables to future research.

¹⁶ We use the `bgtest()` command of the `lmtest` package in *R*.

¹⁷ If the $\mathbf{W}$ are time-variant, $\mathbf{w}_i$ requires subscript $t-1$ as well.

no means a perfect solution for the simultaneity bias, but a strategy commonly applied in the study of policy diffusion, because it provides a more convenient and flexible (and unbiased if initial conditions are non-stochastic) estimation for spatial effects with space here broadly defined (Guler et al. 2002; Elkins et al. 2006; Lee and Strang 2006; Swank 2006). However, before we proceed, we have to acknowledge that this is a very strong assumption as it basically says that interdependence does not have instantaneous effects (instantaneous here means within an observation period).¹⁸

Connectivity in Geography and Common Language

Given the importance of geographic proximity in shaping economic interactions between states, we first consider a spatial lag to capture the interdependence induced by contiguity in geography.¹⁹ The connectivity matrix $\mathbf{W}^{\text{geography}}$ is defined in such a way that the weights $w_{i,j}$ and $w_{j,i}$ are equal to 1 as long as the two countries i and j are considered as geographically “connected.” $\mathbf{W}^{\text{geography}}$ is further row-standardized to ensure that the total weights $w_{i,1}, w_{i,2}, \dots, w_{i,n}$ sum to one. In other words, after multiplication, the spatial lag for country i is a weighted average of the top corporate tax rates of its neighboring countries. There are different ways to define connectivity in geography. Strict contiguity, that is, sharing borders, is not often used in the context of international political economy, because many states become “neighborless” if this standard is applied. More often, some thresholds such as within certain distance between borders are applied. However, there is really no theoretical priors to set up the threshold, as Ward and Gleditsch (2007:73) put it, the choice of the distance threshold “... is often based on convenience or common approaches thought to be state-of-the-art.” We use the minimum distance data by Gleditsch and Ward (2001). This data set applies the basic principle of measuring the shortest distance between the two closest physical locations for pairs of independent polities. It records the shortest distance, in kilometers, between points *on the outer boundaries* for two polities, regardless of whether the states are separated by land or sea. We consider different thresholds of distance based on Gleditsch and Ward’s minimum distance data: this data set provides the shortest distance between states as long as the two states are within 950 km between the closest points on their outer boundaries.

We also consider potential policy interdependence induced by cultural similarity. We focus on whether two countries share a common language. Data on countries’ primary language(s) are obtained from the CIA Factbook (CIA 2004). If two countries i and j share a common language, the weights $w_{i,j}$ and $w_{j,i}$ in the cultural connectivity matrix $\mathbf{W}^{\text{language}}$ are both equal to 1. This connectivity matrix is also row-standardized. Table 1 summarizes the findings for three temporally lagged spatial lag models: the first model has a spatial lag defined by contiguity in geography using the minimum distance data (Gleditsch and Ward 2001) and

¹⁸ Moreover, even in the best situation where this assumption holds, as Franzese and Hays (2007b) have pointed out, this OLS with time-lagged spatial lags model only provides unbiased estimates if the first time point observations are non-stochastic, that is, they are fixed across repeated samples. In this case, spatial maximum likelihood approach performs better, as it does not assume a temporally lagged spatial lag, and address the simultaneity bias head on (Elhorst 2001; Franzese and Hays 2008). For a comparison of estimation results from a temporarily lagged spatial OLS (used in this paper) to those from a maximum likelihood estimation of a “contemporaneous” spatial lag model (Spatial ML), please see the online Appendix entitled “Spatial OLS vs. Spatial ML: time-lagged vs. contemporaneous policy interdependence” on the author’s homepage. Similar exercises have also been done in Gilardi and Wasserfallen (2009).

¹⁹ Geographic proximity often appears important in spatial analyses because many mechanisms of interdependencies correlate with proximity or contiguity in geography (Franzese and Hays 2006). Therefore, we include a spatial lag defined by geographic proximity for all model specifications in the following sections. However, the spatial lags defined by network characteristics are the focus of the analysis.

TABLE 1. Temporally Lagged Spatial Lag Model: Geography (Minimum Distance) and Common Language, 1999–2006

	Geography			Common Language			Geography & Common Language		
	Estimate	SE	Pr(> t)	Estimate	SE	Pr(> t)	Estimate	SE	Pr(> t)
Constant	-59.87	19.50	0.00	-53.80	19.51	0.01	-60.04	19.62	0.00
Time lag at year $t-1$	0.31	0.05	0.00	0.30	0.05	0.00	0.31	0.05	0.00
Inflation rate	-0.01	0.03	0.69	-0.00	0.03	0.99	-0.01	0.03	0.69
GDP growth	-0.17	0.10	0.11	-0.14	0.10	0.17	-0.17	0.10	0.11
Unemployment rate	-0.11	0.17	0.51	-0.09	0.17	0.62	-0.11	0.17	0.51
Age dependency	2.20	0.50	0.00	2.14	0.50	0.00	2.20	0.50	0.00
GDP per capita	-0.28	0.12	0.02	-0.27	0.12	0.02	-0.28	0.12	0.02
Capital market openness	-0.62	0.47	0.19	-0.70	0.48	0.14	-0.62	0.47	0.19
Trade openness	0.03	0.03	0.44	0.02	0.03	0.55	0.03	0.03	0.45
$\rho_{\text{geography}}$	0.20	0.10	0.04				0.20	0.10	0.04
ρ_{language}				0.03	0.08	0.75	0.01	0.08	0.92
Number of observations			336			336			336
Residual SE			3.63			3.66			3.64
Adjusted R^2			0.77			0.77			0.77

(Notes. SE, standard error; within 950 km is used as the threshold to define connectivities; fixed country and year effects are estimated but not reported in the table.)

applying “within 950 km between the closest points on outer boundaries” as the threshold for contiguity; the second model has a spatial lag defined by common language; and the third with both spatial lags.

The findings indicate that the among the domestic variables, age dependency and GDP per capita (in thousands of US dollars) have clear impacts on a country’s top corporate tax rate. The finding of age dependency is intuitive since a higher level of taxation is often required to support more people that do not work. Moreover, the magnitude of the effect of age dependence on top corporate tax rates is large. If the age dependency of a country increases by one unit, that is, the percentage of population that are older than 65 or younger than 15 increases by one point, we expected to see an increase in top marginal corporate tax rates for more than 2%. Also notice that the level of GDP per capita has a negative effect on top corporate tax rates. Richer countries offer less tax burden to firms operating on their soil. A unit increase in GDP per capita, that is, an increase of \$1,000, is associated with less than 0.3% decrease in tax rates. Finally, neither of the commonly used globalization variables, that is, a country’s capital market openness and trade openness, have a clear effect on the choice of corporate taxation policies.²⁰

With regard to the policy interdependence among countries that are close enough in geography (recall that we define neighbors in geography as those within 950 km between the closest points on their outer boundaries), findings from Table 1 reveal a positive and significant spatial coefficient $\rho_{\text{geography}}$. The estimate of this spatial coefficient of contiguity in geography is 0.20, meaning if the average top corporate tax rates of country i ’s neighboring countries in the previous year ($t-1$) decreases by one point, one is expected to see country i ’s

²⁰ The model also includes fixed country and fixed year effects. None of the year effects is significant, revealing a lack of temporal heterogeneity for the years included in the analysis. But almost half of the country fixed effects are important, revealing cross-country heterogeneity which might, hopefully, capture some of the domestic politics variables that we have not been able to include in the model.

FIG 4. Changes in 90% Confidence Interval of Estimated Spatial Coefficient for Policy Interdependence Induced by Proximity in Geography

(Notes. The x -axis is the changing thresholds: from a distance of zero (sharing borders), to 100 km, and to 950 km. The y -axis represents the estimated spatial coefficient. The dark dots represent the mean coefficients estimated across different threshold values, while the vertical gray lines are the 90% confidence interval of the estimated spatial coefficient, $\rho_{\text{geography}}$.)

policy response in the current year (t) to be a cut in its top corporate tax rate of 0.20 points.²¹ The threshold that we have applied (within 950 km between the closest points on outer boundaries) is a very broad one to define neighbors in geography. One can always try other thresholds such as within 500 km, 100 km, or even contiguity in a strict sense (sharing border). Figure 4 displays 90% confidence intervals for the spatial coefficient, $\rho_{\text{geography}}$, estimated from the same model as in Table 1, by using different thresholds to determine connectivity in geography. Notice that when the threshold is 0, that is, strict contiguity or sharing borders, the confidence interval of the spatial coefficient is different from all others. Except when 400 km and 500 km are used as thresholds, 90% confidence intervals do not include zero, revealing the effect of policy interdependence induced by proximity in geography.²² In sum, we find evidence of worldwide tax policy interdependence among countries that are located close to one another in geography. At the same time, we find little evidence of policy interdependence (ρ_{language}) among countries that share a common language (Table 1).

²¹ We also check the stationarity issue in the spatial-temporal context. Since we row-standardize the $\mathbf{W}$, stationarity requires that the sum of ϕ and ρ is smaller than 1 (Franzese and Hays 2007b). Table 1 shows that the coefficient for the time lag is about 0.3 and the coefficient for the spatial lag is about 0.2.

²² Another way to define connectivity is to use some measurement of the inverse distance between states, that is, a smooth pattern of distance decay without a cut-off point (Anselin 1986). We use another data set for the inverse distance approach—distance between capital cities where the distance is calculated using the Haversine formula with data on latitude and longitude of capital cities taken from the *world.cities* database maintained as part of the *maps* package in the R statistical programming package. Empirical findings from a spatial lag model using an inverse distance (between capital cities) connectivity matrix suggests that the spatial coefficient (positive but with a mean around .72 and standard deviation of .48) is not as significant as in Table 1, indicating that inverse distance between capital cities might not be a *sensitive* way to capture the strength of policy interdependence in capital tax induced by proximity in geography. One reason for this might be that the distance between capital cities often cannot take into account the effects of country size. For example, Canada and the United States share a border and will be coded as contiguous when using minimum distance data set (because the minimum distance is zero). However, the distance between capital cities of Canada and the United States is substantially larger than zero (3,586 km) because of the size of the two countries.

Networks of International Markets: Competition for Capital and Export Market

There is no reason to limit the study of policy interdependence to geography and common languages that are both time-invariant (Beck et al. 2006). The competition in international markets, as with that for exports and investments, also induces policy interdependence, especially among countries that aim at the same export markets and sources of finance. Tax competition is closely linked to the flows of capital. Since capital is more likely to flow to countries with low level of tax rates, governments have incentives to lower their tax on capital, especially when key competitor countries have already done so. Recent studies suggest that tax policy is capable of affecting the volume and location of foreign direct investment (FDI). Low tax rates on capital attract foreign investment, not only because income earned locally is taxed at favorable rates, but also because tax haven activities facilitate the avoidance of taxes that might otherwise have to be paid to other countries (Dharmapala and Hines 2006). Moreover, Desai and Dharmapala's study on US outflow of investment and destination country tax policies illustrates how sensitive the US investors are to the changes of foreign capital tax rates: a 10% decrease in destination country's statutory corporate tax rate increases the inflow of the US portfolio investments by 21% (Desai and Dharmapala 2007). Finally, low corporate tax rates might also give export-oriented companies an edge to compete in the global market. This might also induce competitive races among countries competing for same export markets. The intensity of competition between countries in a typical network of international markets can be captured by their level of network position similarity (Hypothesis 2).

In this section, we define "connectivity" and the level of policy interdependence between country i and j by their network position similarity in the network of trade, the network of transnational portfolio investments, and the network of foreign direct investment (FDI) respectively. Structural equivalence in these networks captures network position similarity and the intensity of competitive pressure between countries. We test policy diffusion against three connectivity matrices, $\mathbf{W}^{\text{portfolio}}$, $\mathbf{W}^{\text{FDI}}$, $\mathbf{W}^{\text{exports}}$. They are symmetric (before row-standardization) and each element of them is a structural equivalence score between two countries i and j in a relevant network in a given year. Structural equivalence is calculated as a Pearson correlation between two countries' profiles of connections in the same network and it is bounded between -1 and $+1$. Different from the binary weights (before row-standardization) in the connectivity matrices of geography and common language, the weights in $\mathbf{W}^{\text{portfolio}}$, $\mathbf{W}^{\text{FDI}}$, and $\mathbf{W}^{\text{exports}}$ can be any number between -1 and $+1$, with 1 capturing the situation where two countries share the exact profiles of connections in the network, and -1 , on the other hand, the situation where two countries share the most dissimilar connection profiles.²³

From the previous section's study on diffusion through geographic proximity, we have demonstrated the crucial importance of the ways by which one defines the connectivity matrix in a spatial lag model: if we happened to use 400 km or 500 km as the threshold to define contiguity, we would find no evidence of policy diffusion (see Figure 4). But at the same time, this choice is often arbitrary and without any guidance of theoretical prior (Anselin 2002). We face similar dilemma with the weights in the connectivity matrices defined by network similarity ($\mathbf{W}^{\text{portfolio}}$, $\mathbf{W}^{\text{FDI}}$, and $\mathbf{W}^{\text{exports}}$). The key argument of our theory is that a country is mostly affected by policy choices of a set of countries with which it competes for the same pool of foreign capital and the same export markets. It is therefore important for us to identify the set of competitor countries for country

²³ For detailed procedures and data sources for the calculation of structural equivalence, please see the Appendix at the end of the paper.

i. We use the *i*th row of the connectivity matrix to define this set of competitors, that is, the *i*th row of weights $(\{w_{i,1}, w_{i,2}, \dots, w_{i,j}, w_{i,n}\})$ reflects the influence of each of the *n*–1 other countries (*n* is the total number of countries) on country *i*. Some of these *n*–1 countries belong to the set of competitor countries of *i* while others do not. It is unlikely that the set of competitor countries for country *i* would include country *j* when *j* has little to compete with *i* in the global market — this lack of competition between *i* and *j* is reflected in the dissimilarity between their profiles of economic connections and indicated by a low structural equivalence score. For example, wealthy industrialized countries such as Switzerland are unlikely to compete with developing countries such as Vietnam and Laos thanks to their different positions in international markets.²⁴ Vietnam and Laos, therefore, would not be included in the set of competitor countries for Switzerland, that is, the weights $w_{\text{Switzerland}, \text{Vietnam}}$ and $w_{\text{Switzerland}, \text{Laos}}$ are likely to be zero.²⁵

The empirical difficulty for us is to find some general rule to define the set of competitor countries for a given country *i*. In the following, we discuss two approaches and use them to define connectivity matrices for our empirical tests on competition-induced policy diffusion in the networks of portfolio investment, FDI, and exports. However, we do not claim that we find the solution to provide the best way to construct connectivity matrices in the network context. Our intention is to discuss as explicitly as possible our procedures for the construction of connectivity matrices and reveal limitations associated with each approach. We think this exercise is important because it reveals the fact that every statistically significant finding on the coefficient ρ (ρ reflects the strength of policy interdependence defined by network structure in this section) that supports the claim of policy diffusion is based on some particular build-up of the connectivity matrix, and the rationale for that particular choice of the connectivity matrix is often overlooked by the existing literature on policy diffusion.²⁶

Threshold Approach

One way to define the set of competitor countries for country *i* is to choose a threshold in terms of the structural equivalence score and define competitor countries as those having a score higher or equal to the threshold value. To elaborate, this threshold approach only uses structural equivalence scores that are higher or equal to the threshold value (but does not transform them to a binary value of 1) and treat structural equivalence scores that are lower than the threshold as zero.²⁷ Since there is no theoretical prior to tell where the threshold is, zero is one natural starting point (because below zero, countries' profiles of connections in the network are negatively correlated). However, for most countries, their structural equivalence score is higher than zero. If we use zero as the threshold to identify a country *i*'s competitors, almost all the other countries qualify and the spatial lag becomes very close to a weighted average of top corporate tax rates for all other countries. For instance, for connectivity matrix defined by position similarity in the network of portfolio investment ($\mathbf{W}^{\text{portfolio}}$) in year 2005, 110 out of 120 countries have a positive structural equivalence score with Britain. If zero is chosen as the threshold, the spatial lag for Britain this year is a weighted average of top corporate tax rates among these 110 countries. In

²⁴ This is actually reflected in the negative structural equivalence scores between Switzerland and Vietnam and between Switzerland and Laos.

²⁵ We do not allow negative weights in the connectivity matrix.

²⁶ For more detailed discussion on various problem associated with the application of spatial models, see Plümer and Neumayer (2010).

²⁷ Similarly, we do not transform structural equivalence scores to 1 in the *k*-nearest neighborhood approach discussed next.

TABLE 2. Policy Interdependence Induced by Network Position Similarity in Portfolio Investment Networks

	<i>Estimate</i>	<i>SE</i>	<i>Pr(> t)</i>	<i>Estimate</i>	$\hat{\sigma}$	<i>Pr(> t)</i>
Constant	3.02	55.96	0.96	16.08	56.13	0.78
Time Lag at year $t-1$	-0.02	0.11	0.82	-0.02	0.11	0.82
Inflation rate	0.03	0.06	0.56	0.03	0.06	0.60
GDP growth	-0.04	0.13	0.75	-0.02	0.13	0.86
Unemployment rate	-0.65	0.34	0.06	-0.56	0.34	0.10
Age dependency	0.92	1.48	0.54	0.80	1.49	0.60
GDP per capita	-0.15	0.16	0.34	-0.13	0.16	0.42
Capital market openness	-0.49	0.78	0.53	-0.81	0.77	0.30
Trade openness	-0.05	0.07	0.49	-0.04	0.07	0.61
Spatial coef.: $\rho_{\text{geography}}$	0.03	0.13	0.82	0.02	0.13	0.89
Spatial coef.: $\rho_{\text{portfolio}}$	0.38	0.21	0.07			
Number of observations			183			183
Residual SE			2.51			2.54
Adjusted R^2			0.88			0.88

(Notes. SE, standard error; a structural equivalence score of 0.5 is used as the threshold to find the set of competitors for each country; fixed country and year effects are estimated but not reported in the table.)

reality, it is more likely that a country is influenced by a much smaller set of competitor countries. Jumping to the other end of the structural equivalence score, we try 0.9 as the threshold. Britain, this time, ends up having 21 competitors in 2005. However, 45 countries including major players in the global market, such as the United States, Belgium, and Germany, end up having no competitor identified. But it is more plausible that these countries do feel competitive pressure to attract more foreign capital. Even when we apply 0.8 as the cut point, the same problem still exists. The average number of competitors identified among all countries is 15 however countries such as the United States, Slovakia, and Saudi Arabia still have an empty set of competitors.

Finally, we choose 0.5 as the threshold to eventually find the set of competitors for each country. In this case, almost all the countries have a non-empty set.²⁸ And the average number of a country's close circle of competitors in the global capital market is about 30 for the period of 2001–2005 where the data on portfolio investments are available. We have fewer observations (183) than in previous spatial lag models of geography because of a shorter time period where data on portfolio investments are available. And the number of countries left in the analysis is reduced from 88 to 74. Notice that the reduction in space and time of the sample causes the final number of observations to be reduced by almost half and this reduction in itself might cause different estimate for the same model specification reported in Table 1. Therefore, in addition to a spatial lag model with space defined by position similarity in portfolio investment networks, we also run a spatial lag model of geography (using a threshold of “within 950 km between the closest points on outer boundaries”) with the same model specification as in Table 1, but only using the 183 observations left. We report findings for both models in Table 2.

The findings indicate that policy interdependence through geography, $\rho_{\text{geography}}$, does not have a clear effect on country's policy decision on tax policy, with or without policy interdependence through the network of portfolio investments for the 74 countries left and the 2002–2006 period.²⁹ Domestic variables of age dependence and GDP per capita do not have a determined effect, either. Policy

²⁸ The only exception in 2005 is Paraguay.

²⁹ The elements in the connectivity matrix are lagged by 1 year, and the data used to defined the connectivity matrix are available for 2001–2005; therefore the dependent variable is from 2002 to 2006.

interdependence through the competition mechanism in the network of portfolio investments, on the other hand, has a positive effect on country's policy choice of top corporate tax rates. In other words, any one country's policy changes in top corporate tax rates might trigger a series of responses in its key competitors defined by their positions in the network of portfolio investments. We pick one small European country, Austria in 2001 and 2002, as an example, to illustrate taxation policy interdependence induced by the competition for capital. Figure 5 demonstrates this process.

Imagine that in 2001, the unemployment rate in Austria increased by 10%. Notice this is completely for illustrative purpose and we assume that this 10% increase is an exogenous shock only felt by Austria. This is going to trigger a policy response by the Austrian government of lowering the top corporate tax rate by about 6.5% in the same year (2001): notice that the only domestic variable that matters for top corporate tax rate, according to Table 2, is unemployment rate (with a coefficient of -0.65). The drop of Austrian top corporate tax rate is going to trigger similar moves from her competitors in 2002 (we assume 1-year lag for the spatial effect to take place), and the magnitudes of these moves are determined by the spatial coefficient, $\rho_{portfolio}$ (estimated at 0.38 with a standard error of 0.21), and the structure of the connectivity matrix, $\mathbf{W}^{portfolio}$ (using 0.5 as the threshold to find competitors for models estimated in Table 2 and $\mathbf{W}^{portfolio}$ is row-standardized). According to Model 2, the vector of changes in other countries in 2002, $\Delta \mathbf{y}_{2002}$, can easily be calculated as $\rho_{portfolio} \times \mathbf{W}_{2001}^{portfolio} \times \Delta \mathbf{y}_{2001}$: $\Delta \mathbf{y}_{2001}$ is a vector capturing changes in tax rates in 2001 where all entries are zero except for Austria. Figure 5 captures the decreases in top corporate rates in Austria's competitors in 2002 calculated by $\rho_{portfolio} \times \mathbf{W}_{2001}^{portfolio} \times \Delta \mathbf{y}_{2001}$: the darker

FIG 5. Drop in Top Corporate Tax Rates in 2002 Induced by an Increase of 10% in Unemployment Rates in Austria in 2001 through Competition in the Network of Portfolio Investments (assuming 1-year lag for the competition effects to take place)

(Notes. We use a Robinson projection map of 2002 and only show the Europe part because the change in Austria affects 21 countries in the broad Europe area.)

the color, the higher the level of decrease.³⁰ Notice that the change in Austria in 2001 only affects a small group of countries in 2002 and their decreases in tax rates are much smaller than that of Austria itself: the largest decrease is expected to occur in Luxembourg with a decrease of 0.19% and the lowest decrease is in Poland with a decrease of 0.02% (both of which are mean estimates). However, this is only the short-term effect from 2001 to 2002. The decreases in tax rates in 2002 for this group of countries (induced by Austria's change in 2001) will further induce similar moves from their competitor countries in 2003 (and 2004, 2005, etc. as the long-term effect). Indeed, the induced tax rate decreases in 2003 will affect almost half of the countries in the analysis, including a feedback to Austria as well. Similarly, the changes in tax rates in 2003 can be calculated as $\rho_{portfolio} \times \mathbf{W}_{2002}^{portfolio} \times \Delta \mathbf{y}_{2002}$ in which $\Delta \mathbf{y}_{2002}$ is the vector capturing changes in tax rates in 2002 from the previous calculation by $\rho_{portfolio} \times \mathbf{W}_{2001}^{portfolio} \times \Delta \mathbf{y}_{2001}$.³¹ Moreover, the counterfactual effects above are based on the case when there is only one country that changes its tax rates. But when multiple countries do so, the aggregate effects of policy interdependence are much stronger: a spatial coefficient ($\rho_{portfolio}$) around 0.38 suggests that if the weighted average of top corporate rates among a country i 's competitors decreases by one point in the previous year ($t-1$), country i is expected to also lower its top corporate rate by almost 0.38 point in the current year (t). Again, this interpretation of policy interdependence through competition in portfolio investment is conditional upon the 0.5 threshold of structural equivalence score that we've taken to define countries' competitors in this network. When we tried other thresholds such as 0.3, 0.4, 0.6, and 0.7, the sign and magnitude of the spatial coefficient associated with competition in portfolio investment network is positive and around 0.4 (close to what we've found in Table 2), but the significance levels of the estimated spatial coefficient associated with each threshold vary.

Also notice that if we set the threshold as -1 (the lowest possible value of structural equivalence), the spatial lag calculated in this way is just a weighted average of policy outcomes for *all* other countries. This indeed is the way by which some recent diffusion studies calculate spatial lag (Guler et al. 2002; Elkins et al. 2006; Lee and Strang 2006; Swank 2006). These studies often add 1 to the correlation measure of similarity between countries to move the value range from $\{-1, 1\}$ to $\{1, 2\}$, and use the adjusted correlation measure as the weights in the connectivity matrix to calculate the spatial lag as the weighted average of all other countries' policy outcomes. We argue that this might be appropriate if we

³⁰ We only use the mean estimates of tax rate decrease to color the map in Figure 5. To further quantify the uncertainty of these counterfactual effects, we provide the 90% confidence intervals of the estimated tax rate decreases in 2002 for the group of countries affected (we show the lower bound of 90% confidence interval, the mean estimate, and the upper bound of 90% confidence interval in parentheses): Belgium (0.01, 0.09, 0.17), Croatia (0.00, 0.04, 0.08), Cyprus (0.01, 0.11, 0.20), Czech Republic (0.00, 0.03, 0.05), Denmark (0.00, 0.03, 0.07), France (0.00, 0.03, 0.06), Greece (0.01, 0.10, 0.19), Hungary (0.01, 0.08, 0.16), Ireland (0.00, 0.03, 0.06), Italy (0.01, 0.07, 0.13), Latvia (0.01, 0.14, 0.27), Lithuania (0.01, 0.14, 0.26), Luxembourg (0.02, 0.19, 0.37), The Netherlands (0.00, 0.03, 0.06), Poland (0.00, 0.02, 0.04), Portugal (0.01, 0.09, 0.16), Slovenia (0.01, 0.13, 0.26), Slovak Republic (0.01, 0.12, 0.23), Spain (0.00, 0.05, 0.10), and Turkey (0.00, 0.04, 0.08).

³¹ There are 45 countries affected in 2003, including Austria, which initiated these effects in 2001. Because of space limit, we only show the mean estimates of tax rate decreases for this group of countries (the lower and upper bounds of 90% confidence interval can be easily calculated following replication data and code in author's homepage): Albania (0.02), Argentina (0.00), Austria (0.02), Belgium (0.11), Bulgaria (0.00), Cameroon (0.01), Chile (0.00), Cote d'Ivoire (0.01), Croatia (0.08), Cyprus (0.18), Czech Republic (0.00), Denmark (0.04), Egypt (0.00), Estonia (0.02), Finland (0.03), France (0.04), Gabon (0.01), Germany (0.01), Greece (0.13), Guatemala (0.00), Hungary (0.11), Indonesia (0.00), Ireland (0.07), Italy (0.11), Jamaica (0.04), Latvia (0.20), Lithuania (0.18), Luxembourg (0.22), Malaysia (0.00), Morocco (0.01), Netherlands (0.05), New Zealand (0.00), Norway (0.03), Poland (0.04), Portugal (0.13), Romania (0.14), Russia (0.00), Slovak Republic (0.18), Slovenia (0.16), Spain (0.10), Sweden (0.03), Switzerland (0.00), Turkey (0.06), Ukraine (0.00), UK (0.00), United States (0.00), and Venezuela (0.01). We can continue the calculation of the long-term effects for 2004 and 2005. However, we choose not to further present these effects because of space limit.

only consider a small set of countries, such as the OECD countries, because they might indeed compete with each other because of their similar levels of economic development and inter-connected national economies. However, when we include all countries in the study, this might be inappropriate because countries become much more diversified and multiple groups of competitor countries arise. We did follow these recent studies and experimented with a spatial lag, defined as the weighted average of all other countries' top tax rates. We found, unsurprisingly, no evidence of policy interdependence.

K-Nearest Neighbors Approach

Another way to identify a country's competitors is to constrain the neighborhood structure to the k -nearest neighbors (Anselin 2002): we define the set of competitor countries for country i to be the top k countries that are most similar to i in the profile of portfolio investment inflows—the k highest structural equivalence scores countries with i . For the k -nearest neighbors approach, the level of structural equivalence is a relative rather than an absolute concept to define competitor countries. A structural equivalence score of 0.5 might not qualify for a country j to be considered as a competitor for Britain as Britain already has many countries having a score higher than 0.5, but it might suffice for Denmark, as it has few other countries scoring higher than 0.5. (If k is set to be $n-1$, the spatial lag calculated in this way is a weighted average of policy outcomes for all other countries.) However, one still needs to come up with a number for k and it is likely that the k varies across countries. In the current research, we assume a constant k for all countries and we will deal with country-variant k in other research.³² We try 1 to 80 for k to find estimates of the spatial coefficients, and the sensitivity of the estimation of $\rho_{\text{portfolio}}$ to the choice of k is illustrated by Figure 6.

The x -axis is the changing size of the k -nearest neighborhood from 1 to 80. The y -axis captures the estimated spatial coefficient for policy interdependence induced by competition in the network of transnational portfolio investment. The dark line in between two gray lines represents the estimated means of the spatial coefficients across different values of k , the dashed gray line on top is the upper limit of the 90% confidence interval, and the solid gray line at bottom the lower boundary of the 90% confidence intervals. One can easily tell that as k gets bigger than 20, that is, the size of the k -nearest neighbors includes more than 20 countries, the spatial effect becomes undetermined. And it is around $k = 15$ that the spatial effect is more certain to be positive as the 90% confidence intervals do not include zero. Table 3 gives detailed estimates of the spatial effect when k takes the value between 1 and 20. When k is between 13 and 16, the estimated spatial effect $\rho_{\text{portfolio}}$ is positive and able to pass the significance test with a p -value < 0.10 in a two-tail test. Moreover, the magnitude of the spatial effect is around 0.30, which is very close to the estimate when we use a threshold of 0.5 in the threshold approach (see Table 2). Finally, Figure 6 suggests that countries are only sensitive to policy changes in a relatively small number of countries that share similar network positions. The size of this small group in our sample is on average between 13 and 16 for the network of transnational portfolio investments.

Competition for FDI and Export Markets

We have been focusing on policy interdependence induced by competition in the network of transnational portfolio investments. We have found strong effects of policy interdependence through competitive pressures in this network, but this finding is sensitive to the ways that the connectivity matrix is defined. There

³² k might be a function of a country's economic size such as GDP.

FIG 6. Changes in 90% Confidence Interval of Estimated Spatial Coefficient for Policy Interdependence in Portfolio Investment Networks Depending on Different Sizes of k -nearest Neighborhoods

(Notes. The x -axis is the changing size of the k -nearest neighborhood from 1 to 80. The y -axis represents the estimated spatial coefficient. The dark line represents the mean coefficients estimated across different values of k , the dashed gray line on top is the upper limit of the 90% confidence interval, and the solid gray line at bottom illustrates the lower limit of the 90% confidence intervals across different values of k .)

TABLE 3. Estimates of Spatial Coefficients for Policy Interdependence in Portfolio Investment Networks Across Different Size of k -nearest Neighborhood, k from 1 to 20

k	$\hat{\rho}_{portfolio}$	SE	$Pr(> t)$
1	-0.02	0.03	0.56
2	0.04	0.05	0.41
3	0.08	0.06	0.25
4	0.04	0.08	0.59
5	0.15	0.09	0.09
6	0.11	0.09	0.26
7	0.13	0.10	0.19
8	0.14	0.11	0.24
9	0.19	0.11	0.10
10	0.21	0.12	0.08
11	0.21	0.14	0.14
12	0.21	0.14	0.14
13	0.28	0.15	0.07
14	0.27	0.16	0.09
15	0.33	0.17	0.05
16	0.32	0.17	0.07
17	0.28	0.17	0.11
18	0.21	0.18	0.25
19	0.23	0.19	0.22
20	0.12	0.20	0.56

are two other networks wherein the competition for capital and export markets can engage countries in tax competition, namely that of foreign direct investment and that of export. We follow the k -nearest neighborhood approach to test the strength of policy diffusion induced by competition in these two networks. The elements in the two connectivity matrices, $\mathbf{W}^{FDI}$ and $\mathbf{W}^{exports}$, are structural

TABLE 4. Policy Interdependence Induced by Network Position Similarity in FDI and Export Networks

	<i>Estimate</i>	<i>SE</i>	<i>Pr(> t)</i>	<i>Estimate</i>	<i>SE</i>	<i>Pr(> t)</i>
Constant	-88.58	24.21	0.00	-62.97	19.777	0.00
Time lag at year $t-1$	0.27	0.06	0.00	0.31	0.05	0.00
Inflation rate	-0.03	0.04	0.51	-0.01	0.03	0.75
GDP growth	-0.18	0.12	0.13	-0.17	0.10	0.11
Unemployment rate	-0.17	0.21	0.43	-0.13	0.17	0.45
Age dependency	2.95	0.62	0.00	2.06	0.50	0.00
GDP per capita	-0.28	0.18	0.12	-0.24	0.12	0.05
Capital market openness	-0.67	0.61	0.27	-0.56	0.47	0.24
Trade openness	0.01	0.05	0.75	0.03	0.03	0.43
Spatial coef.: $\rho_{\text{geography}}$	0.30	0.12	0.01	0.16	0.10	0.10
Spatial coef.: ρ_{FDI}	0.00	0.10	0.99			
Spatial coef.: ρ_{exports}				0.33	0.16	0.04
Number of observations			272			333
Residual SE			3.80			3.63
Adjusted R^2			0.76			0.77

(Notes. SE, standard error; we use the k-nearest neighborhood approach and report findings when $k = 20$ for both models; fixed country and year effects are estimated but not reported in the table.)

equivalence scores calculated as a Pearson correlation between two countries' profiles of connections in the network.

We found no evidence of a diffusion induced by competition in the network of foreign direct investments across different sizes of the k-nearest neighbors. This is somehow counter-intuitive because most of the existing literature suggests that FDI are sensitive to capital tax rates in receiving countries (see, for example, Dharmapala and Hines (2006)). Therefore, governments should have strong incentives to compete in capital tax rates, especially when their fellow FDI-competing countries have lowered the rate. What we find here is evidence that rejects the hypothesis that similarity in the FDI network induces competitive races in corporate taxation. Another explanation for this finding has to do with the data quality of bilateral FDI data. We use a combined version of the OECD and the UNCTAD data on bilateral FDI. The OECD data are of better quality but only record FDI, both stock and flow, to and from the OECD countries. This leaves the "non-OECD to non-OECD" part of the data matrix empty. The UNCTAD has data on non-OECD countries, but the quality of the data is low and the "non-OECD non-OECD" part of the data matrix is still largely empty. We simply need better data to draw a better conclusion. Policy diffusion induced by competition in the network of exports, on the other hand, is strong as long as $20 \leq k \leq 60$. We report findings, when $k = 20$, for both FDI and export networks in Table 4.³³

Networks of Global Connections: Diffusion through Socialization

We have shown that competition for portfolio investments and export markets pushes countries to engage in competitive races in corporate taxation. Two countries that compete for the same source of transnational capital and/or the same export markets might not have high levels of direct capital flows and/or trade between them. In other words, they might have a weak *direct* tie in network. However, countries that do have high levels of bilateral economic, social, and cultural interactions might also be subject to high level of policy interdependence. Here, the key causal mechanisms involve policy learning and policy emulation—we

³³ Data for FDI are available until 2002. The data on bilateral exports at sector level from Comtrade cover almost all countries until recent years.

TABLE 5. Temporally Lagged Spatial Lag Model: Bilateral Trade, 1999–2006

	Estimate	SE	$Pr(> t)$
Constant	-56.60	20.30	0.01
Time lag at year $t-1$	0.30	0.05	0.00
Inflation rate	-0.01	0.03	0.69
GDP growth	-0.17	0.10	0.10
Unemployment rate	-0.11	0.17	0.50
Age dependency	2.20	0.50	0.00
GDP per capita	-0.28	0.12	0.02
Capital market openness	-0.60	0.48	0.21
Trade openness	0.02	0.03	0.51
Spatial coef.: $\rho_{\text{geography}}$	0.21	0.10	0.03
Spatial coef.: ρ_{trade}	-0.12	0.20	0.55
Number of observations			336
Residual SE			3.64
Adjusted R^2			0.77

(Notes. SE, standard error; fixed country and year effects are estimated, but not reported in the table.)

summarize them as a socialization process where countries that are located close to each other in networks enjoy more opportunities for interactions which might induce policy learning and emulation and therefore diffusion. In trade networks, a country is considered connected to all other countries with which it trades. However, its policy choice is more dependent or influenced by its major trading partners with which the volumes of bilateral trade constitute an important proportion of its total trade. In other words, country i 's influence on country j 's policy choice is proportional to the relative importance of trade between i and j among total trade of j (with all countries). Therefore, the weight of i on j in the connectivity matrix, $w_{j,i}^{\text{trade}}$, can be defined as $\frac{\text{trade}_{j,i}}{\sum_{i=1}^n \text{trade}_{j,i}}$, where $\text{trade}_{j,i}$ is the level of bilateral trade

between country i and j and $\sum_{i=1}^n \text{trade}_{j,i}$ is the total trade j has (with all countries).

Table 5 summarizes the findings for policy interdependence induced by direct interactions in the network of trade.³⁴ Direct interactions in trade (ρ_{trade}) have no clear effect on policy interdependence with regard to capital tax.

Here, the spatial lag defined by direct trade connections includes all trading partners for a given country. However, we have shown in the previous section that a country's policy might be more likely influenced by a set of countries (rather than all countries) to which she is closely related—previous section emphasizes the identification of the group of competitor countries; here, we try to identify the most important trading partners. Therefore, we do a similar exercise, using the k -nearest neighborhood approach to narrow down the scope of countries that affect country i 's policy from all trading partners to the k most important trading partners. In other words, the spatial lag defined by direct trade connections include only the k most important trading partners for a given country i . We vary the size of k from 1 (that is, country i 's policy is only affected by its no. 1 trading partner) to 120 (close to the weighted average of all trading partners) and estimate the same model as reported in Table 5. Figure 7a summarizes the findings, from 25 regression analyses, of the spatial coefficients that capture the strength of the socialization-driven policy diffusion from the k most important trading partners. The vertical gray lines represent the 90% confidence intervals of the estimated spatial coefficients. What we found is that no

³⁴ We use the trade data from IMF's Direction of Trade Statistics and the data are updated until 2006.

matter how big the size of the k-nearest neighborhood the direct interactions in trade networks have no clear effect on policy interdependence.

After finding no evidence of policy diffusion in capital taxation induced by learning and emulation in trade networks, we turn our attention to one type of non-economic network, that is, the networks of inter-governmental organizations (IGO). We suspect that one is more likely to see higher levels of policy interdependence between countries that are more connected to each other in IGO networks. Similar to the connectivity matrix defined by trade, the weight of i on j in the connectivity matrix defined by IGO networks, $w_{j,i}^{IGO}$, can be defined as $\frac{IGO_{j,i}}{\sum_{i=1}^n IGO_{j,i}}$, where $IGO_{j,i}$ is the number of common IGO memberships shared by i and j and $\sum_{i=1}^n IGO_{j,i}$ the total bilateral common IGO ties that j has with all other countries.

FIG 7. Testing the Strength of Policy Learning and Emulation in Trade and IGO networks.

(a) The Strength of Diffusion via Socialization in Trade. (b) The Strength of Diffusion via Socialization in IGO Networks. (c) Socialization by Minimalist and Social-Cultural IGOs. (d) Socialization by Minimalist and Economic IGOs

(Notes. The x-axis is the changing size of the k-nearest neighborhood: from 1 to 120 with an interval of 5. The y-axis represents the estimated spatial coefficient that captures the strength of the socialization-driven policy diffusion. The dark dots represent the mean coefficients estimated across different threshold values, while the vertical gray lines are the 90% confidence interval of the estimated spatial coefficients.)

FIG 7. (Continued)

We also use the k -nearest neighborhood approach to test the strength of policy diffusion caused by IGO connections with different sizes of k , that is, to narrow down the scope of countries that affect country i 's policy from all other countries to the k most closely connected countries in IGO networks. We vary the size of k from 1 to 120.³⁵ Figure 7b summarizes the findings (the vertical gray lines represent the 90% confidence intervals for spatial coefficients associated with IGO connections) and we find that when the size $1 < k \leq 55$, the spatial coefficients are positive and significantly different from zero, suggesting that direct interactions in IGO networks have clear effect on policy interdependence with regard to capital tax policy.

To further differentiate policy learning from policy emulation in IGO networks, we define two additional connectivity matrices, one for IGOs with

³⁵ The model includes the same domestic variables and temporal lag, one spatial lag defined by geographic contiguity (minimal distance ≤ 950 km), and year fixed effects as in previous models estimated in Tables 1, 2, 4, and 5. We choose not to include country fixed effects because of the small number of observations (<130) and a short time period (1999 and 2000). Adding both fixed country and fixed effects based on such a short time-series cross-sectional data causes problems for unbiased estimation for the spatial coefficients; this is indeed indicated by the estimated spatial coefficient associated with the IGO spatial lag to be >1 for $k > 20$ in the k -nearest neighborhood approach.

minimalist institutional capacity and economic purposes, and the other for IGOs with minimalist institutional capacity and social and cultural purposes. Ingram, Robinson, and Busch (2005) classify IGOs by their differences in two dimensions: institutional capacity and function. In terms of institutional capacity, IGOs can be categorized as minimal, structured, and interventionist. In terms of IGO function, they can be categorized as general, political, economic, and social/cultural. Minimalist IGOs refer to those that have plenary meetings, committees, and possibly a secretariat, but without an extensive bureaucracy beyond research, planning, and information gathering. The definition suggests that minimalist IGOs have no institutional capacity to coerce and therefore forcibly affect member states' policy choices.³⁶ Therefore, if they ever matter for policy diffusion, it is more likely that they facilitate policy diffusion through "soft" ways (in contrast with more coercive roles played by strong IGOs such as the IMF and the EU), that is, policy learning and/or emulation.

But how can we differentiate learning from emulation? Minimalist IGOs with economic purposes might provides a test for the information-based policy learning mechanism because minimalist IGOs with economic functions are likely to provide relevant information about economic policies and therefore facilitate policy learning among well-connected states. IGOs with minimalist institutional capacity and social and cultural purposes, on the other hand, might provide a test for the affinity-based policy emulation mechanism: these IGOs do not provide (at least directly) information about economic policies and therefore play limited role for policy learning because of their social and cultural IGO agendas, but they do provide an arena for socialization that might create a sense of community, of trust, empathy and sympathy among member states that in turn facilitate policy emulation (Granovetter 1985).³⁷ We repeat the same exercise using the k -nearest neighborhood approach as in Figure 7b to test the strength of policy diffusion separately in the networks of minimalist IGOs with social and cultural purposes and in the networks composed of minimalist IGOs with economic purposes. Figure 7c presents the 90% confidence intervals for $\rho_{\text{IGO:social,minimal}}$ (the spatial coefficient for connectivity matrix defined by IGOs with social and cultural purposes and minimalist institutional capacities), and Figure 7d presents the 90% confidence intervals for $\rho_{\text{IGO:economic,minimal}}$ (the spatial coefficient for connectivity matrix defined by IGOs with economic purposes and minimalist institutional capacities) with different sizes of k . What we find is that $\rho_{\text{IGO:economic,minimal}}$ is always positive and significant no matter the size of k but $\rho_{\text{IGO:social,minimal}}$ is sensitive to the size of k and is only significantly different from zero when $5 \leq k \leq 25$. This seems to suggest that policy learning plays a more consistently salient role in the process of policy socialization.³⁸

³⁶ Structured IGOs, on the other hand, have stronger capacity; they contain structures of assembly, executive (non-ceremonial), and/or bureaucracy to implement policy, as well as formal procedures and rules. Interventionist IGOs contain mechanisms for mediation, arbitration, and adjudication, and/or other means to coerce state decisions (such as withholding loans or aid), as well as means of enforcement of organizational decisions and norms.

³⁷ But see Cao (2009) for the assumptions behind this approach that differentiates policy learning from emulation by looking at IGO functions and institutional capacities.

³⁸ Regarding the effects of IGO connections on tax rates, selection bias might exist. One might ask whether networks influence behavior or actors who choose to join same networks also behave similarly. Correlation between IGO connections and tax rates does not necessarily mean causal effect of the former on the latter. One way to move beyond correlation to further test causal effect is some sort of causal modeling. In Cao (2009), using a matching model (Ho, Imai, King, and Stuart 2004; Imai and van Dyk 2004), we test the causal effect of IGO connections on policy convergence in multiple dimensions of domestic economic policies, which include corporate tax rates—the dependent variable, however, is policy distance in a multidimensional policy space rather than a single policy indicator such as top tax rates. We find similar findings with regard to the effects of policy learning and emulation on policy convergence induced by IGO connections. We will conduct similar causal models for the research on corporate taxation to deal with selection bias in future analysis.

Conclusion and Discussion

The world has experienced a general trend of reduction in corporate taxation over the last 9 years (see Figure 1). However, the levels of reduction vary across space and time (see Figures 2 and 3). There are different potential determinants of a country's tax policy on capital. Tax policy might be a function of factors internal to domestic arena. It can also be a function of policy interdependence between countries. In this paper, we focus on policy interdependence induced by interstate interactions. We move beyond geographic proximity to consider capital taxation policy diffusion in a broader set of global networks, namely, common language, trade, foreign direct investment (FDI), and foreign portfolio investment. We study two key aspects of network dynamics as drivers of policy diffusion in capital taxation policies, that is, competition induced by network position similarity, and policy learning and policy emulation facilitated by network position proximity. The network version of tax competition mechanism sees the competitive pressure mainly come from a country's key competitors defined by network position similarity in international markets. We test tax competition induced by network position similarity in three networks of international markets: transnational portfolio investments, foreign direction investments (FDI), and exports. The findings show no evidence for policy interdependence caused by network position similarity in the FDI network. (However, this might be a function of the FDI data quality.) Competition in the network of transnational portfolio investments and exports, on the other hand, is shown to cause policy interdependence for top corporate tax rates.

A network socialization process, where countries that are close to each other in networks have better chances of policy learning and policy emulation, is potentially another venue through which countries make taxation policy decisions "interdependently." The proximity can be defined by contiguity in geography, shared language, and also as a positive function of the magnitude of dyadic interactions and connections within networks. We find evidence of the network socialization mechanism in the networks of IGOs and the evidence is much stronger in the IGO networks that facilitate policy learning than in the IGO networks that facilitate policy emulation. We find no evidence for this socialization process in the network of trade, nor do we find any evidence for this among countries sharing the same language. Finally, we also find that contiguity in geography, the usual focus of recent studies on policy diffusion, causes policy interdependence.³⁹

We rely on a spatial lag model for the empirical tests, with space here broadly defined to include the aforementioned global networks. We also enlarge the sample of countries to include not only developed countries, but also a large number of developing countries. We find that the estimation of the spatial coefficient is very sensitive to the ways in which one specifies the connectivity matrices in the spatial model. We have tried two approaches to specify a connectivity matrix to capture the competition mechanism in the portfolio investment network: a threshold approach and a k-nearest neighbors approach. As we have shown in the spatial models testing tax competition in the network of portfolio investments,

³⁹ We use statutory top corporate tax rates instead of effective rates. As discussed in one previous section of the paper, this dependent variable has its limitations. For example, it often fails to capture the exemptions and loopholes that capital owners can use to reduce their tax payments below the statutory rate. Statutory rate, therefore, might be considered an indicator of "signaling" behavior of nation states in the global market. In other words, countries might reduce their statutory rates to signal for a business-friendly domestic business climate, while at the same time maintain the actual tax burden by, for example, base-broadening measures. This might explain the lack of explanatory power of domestic variables in the empirical analysis. Future research with similar network diffusion models but focusing on marginal effective tax rates as well as average effective tax rates is in need to further improve our understanding of interdependent tax policy decision making among nation states.

different choices of k for k-nearest neighbors approach and different thresholds of structural equivalence scores for the threshold approach produce different connectivity matrices and different estimations for the associated spatial coefficients (see Figure 6 and Table 3). Unfortunately, there is often no theoretical prior to tell which specification is the most reasonable (Anselin 2002). Therefore, the least one can do is to discuss, as explicitly as possible, the assumptions that underpin one's choices of connectivity matrices, lay out procedures to construct these matrices, and present results from models with alternative spatial lag specifications. By doing this, one might gain more concrete information of the interdependence structures in networks in addition to a broad claim that policy interdependence matters. For instance, trials of different values of k for the k-nearest neighbors approach in this paper indicate that countries, when competing in the market of transnational portfolio investments, are more likely to be affected by policy choices of a relatively small number of competitor countries.

Appendix: Data and Method to Calculate Structural Equivalence

Portfolio Investments

The data for bilateral portfolio investment are from the IMF's Coordinated Portfolio Investment Survey (<http://www.imf.org/external/np/sta/pi/datarsl.htm>). The data cover years 2001–2005. Geographic breakdown tables of the CPIS data provide information on inflows of portfolio investments from 71 countries. We need to calculate the structural equivalence of countries in the network of financial flows, more specifically in terms of the distribution of “inflows” from these 71 “sender countries.” The first-order Pearson correlation between country i and j 's profiles of financial inflows can capture the concept of structural equivalence. We use the total bilateral portfolio investment data.

Foreign Direct Investments

Similar to the way of calculating structural equivalence for portfolio investments, structural equivalence in FDI network is calculated as Pearson correlation between country i and j 's profiles of bilateral FDI inflows. FDI data were downloaded from the UNCTAD (<http://www.unctad.org>) and the OECD (<http://www.sourceoecd.org>) databases.

Export Networks

We identified 10 broad sectors (at one-digit level of the United Nations' Standard International Trade Classification (SITC)) in international commerce: food and live animals directly for food; beverages and tobacco; crude materials, inedible, except fuels; mineral fuels, lubricants, and related materials; animal and vegetable oils, fats, and waxes; chemical and related products; manufactured goods, classified chiefly by material; machinery and transport equipment; miscellaneous manufactured articles; commodities and transactions not classified elsewhere. We calculated structural equivalence by taking the correlation between two countries' exports at both bilateral and sector level. A given country's export profile is composed of $k \times (n-1)$ elements in which $n-1$ is the number of potential export destination countries, and k is the number of trade sectors. Data for dyadic sector-level trade are from the United Nations' Commodity Trade Statistics (Comtrade) online database (<http://comtrade.un.org/db/>). This data set covers international commerce at the dyadic level since the 1960s and across different commodities to the level of five-digits SITC. Aggregating bilateral trade to the one-digit SITC level yields the ten distinct sectors that we choose to use.

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