# Empirical Modeling of the Theoretical and Substantive Implications of Globalization and Strategic Fiscal-Policy Interdependence

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**ABSTRACT:** Does international economic integration constrain the ability of national governments to redistribute income, risk, and opportunity through tax and expenditure policies? In answering this and related questions, scholars have overlooked the degree and manner to/in which fiscal policies correlate spatially as important evidence of globalization's influence on policymaking. This is surprising given that the formal-theoretical models most relevant to this aspect of globalization show clearly that policy in one country will be influenced by the policies of its "neighbors." Globalization, insofar as it generates externalities across political jurisdictions, entails strategic policy interdependence. Empirical models that ignore this interdependence are seriously misspecified and subject to omitted variable bias. One way to model strategic policy interdependence is with spatial lags. We use a reanalysis of Swank and Steinmo's study of OECD tax reform to illustrate "best practice" when it comes to estimating models with spatial lags and presenting the results.

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**ABSTRACT:** Does international economic integration constrain the ability of national governments to redistribute income, risk, and opportunity through tax and expenditure policies? In answering this and related questions, scholars have overlooked the degree and manner to/in which fiscal policies correlate spatially as important evidence of globalization's influence on policymaking. This is surprising given that the formal-theoretical models most relevant to this aspect of globalization show clearly that policy in one country will be influenced by the policies of its "neighbors." Globalization, insofar as it generates externalities across political jurisdictions, entails strategic policy interdependence. Empirical models that ignore this interdependence are seriously misspecified and subject to omitted variable bias. One way to model strategic policy interdependence is with spatial lags. We use a reanalysis of Swank and Steinmo's study of OECD tax reform to illustrate "best practice" when it comes to estimating models with spatial lags and presenting the results.

## *I. Introduction*

This paper studies globalization (i.e., international economic integration) and fiscal policy, emphasizing the theoretically implied strategic dependence and the resultant spatial interdependence of fiscal policies. Our contribution is threefold. With respect to research design, we call for tighter integration between formal theoretical and empirical approaches to the study of globalization and policy autonomy and show how spatial lag models can achieve this. Methodologically, we show how to estimate regression models with spatial lags consistently and how to calculate and present the spatial (and spatio-temporal) effects these estimates imply. Substantively, our results suggest that economic globalization, particularly the multinationalization of production, constrains the fiscal policy autonomy of national governments, at least in capital-tax policy, rendering income, risk, and opportunity redistribution more difficult for them.

Many academic and casual observers argue that the dramatic post-1972 rise in global capital mobility and the steady postwar rise in trade integration sharpen capital's threat against domestic governments to flee "excessive and inefficient" taxation and public policies. This, the standard view holds, forces welfare- and tax-state retrenchment and tax-burden shifts from more-mobile capital (especially financial) toward less-mobile labor (especially skilled-manual).

Several important studies of the comparative and international political economy of tax and welfare policies over this era have recently challenged such claims on at least four distinct bases. Garrett (1998) argues that certain combinations of left government with social-welfare, active-labor-market, coordinated-bargaining, and related policies can be as or more efficient than neoliberal state-minimalism and conservative government and, therefore, that capital will not flee such efficient combinations. Boix (1998) argues that public (human and physical) capital-investment strategies comprise an alternative to neoliberal minimalism that is sufficiently efficient economically to retain and possibly attract capital and politically effective enough to maintain left electoral-competitiveness. Hall and Soskice (2001) argue that complex national networks of political-economic institutions confer *comparative* advantages in differing productive activities, which, as Mosher and Franzese (2002) elaborate, implies that, *if international tax-competition remains sufficiently muted*, capital mobility and trade integration would spur institutional and policy specialization, which, in this context, means cross-national welfare/tax-state variation or divergence rather than convergence or global retrenchment. Swank (2002) argues that the institutional structure of the polity and of the welfare/tax system itself create room to maneuver and shape domestic-policy responses to capital (and trade) integration.

The debate over globalization and fiscal policy is due, in large part, to disagreements about how to measure globalization and draw sound causal inferences from the data (Brune and Garrett 2005). In particular, we emphasize, scholars have overlooked the degree and manner to/in which taxation and expenditure variables correlate spatially (i.e., across countries) as crucial evidence of globalization's influence on policy. This is surprising given that the formal theoretical models most relevant to this particular globalization debate—spillover models and resource flow models (see Brueckner 2003 for a survey)—show clearly that policy in one country will be influenced by the policies of its "neighbors." Globalization, to the extent that it generates externalities across political jurisdictions, leads to strategic policy interdependence. Thus, the best current theory suggests regression models that ignore the strategic policy interdependence driven by globalization are seriously misspecified and subject to omitted variable bias.

We organize the paper as follows. The next section (*Section II*) reviews the debate over globalization and fiscal policy autonomy. *Section III* formally demonstrates that globalization implies strategic policy interdependence, clarifies the nature of that interdependence, and suggests how to model this interdependence empirically using spatial lags. *Section IV* discusses how to estimate and present the results from such "spatio-temporally dynamic" models empirically. *Section V* offers an empirical illustration using a reanalysis of Swank and Steinmo's (2002) well-known study of OECD tax-policy reform. *Section VI* concludes.

## *II. Globalization and Fiscal Policy Competition*

In theory, strong inter-jurisdictional competition undermines the tax-policy autonomy of individual tax authorities, inducing tax rates to converge, especially those levied upon more-mobile assets. Such inter-jurisdictional competition intensifies as capital becomes more liquid and mobile across borders. Indeed, many scholars of domestic or international fiscal-competition (*e.g.*, Zodrow and Mieszkowski 1986; Wilson 1986, 1999; Wildasin 1989; Oates 2001) expect such intense inter-jurisdiction competition to engender a virtually unmitigated race to some (*ill-defined*: see below) bottom. As a central exemplar, most scholarly and casual observers see the striking post-1970s rise in international capital-mobility and steady postwar increase in trade integration as forcing welfare- and tax-state retrenchment and shifting tax-burden incidence from relatively mobile (*e.g.*, capital, especially financial capital) toward more immobile (e.g. labor, especially the less-flexibly-specialized).[1] Growing capital-market integration and asset mobility across jurisdictions enhances such pressures, the argument holds, by sharpening capital's threat against domestic governments to flee "excessive and inefficient" welfare and tax systems.

Several notable recent studies of the comparative and international political economy of policy change over this period challenge these claims. Quinn (1997), Swank (1998, 2002), Swank and Steinmo (2002), Garrett and Mitchell (2001), and others do not find that growing international economic integration has constrained governments' fiscal policies much or at all. The theoretical explanation for such results, occasionally implicit, seems to be that other cross-national differences also importantly affect investment-location decisions, affording governments some room to maneuver. Hines (1999:308), e.g., found commercial, regulatory, and other policies, and labor-market institutions, intermediate-supply availability, and final-market proximity, among other factors, to be critical in corporate investment-location decisions. Moreover, other factors than capital mobility affect governments' tax policies. For example, Swank (2002: see pp. 252-6 esp.) argues that corporate and capital tax-rates depend on funding requirements of programmatic outlays, macroeconomic factors like inflation and economic growth, and partisan politics. Controlling for such factors, he finds little relationship of taxation to capital mobility. A nearly-universal finding in this research is that internal political and economic determinants of fiscal policy are as important if not more important that external, globalization-related factors. We return to this controversy in our reanalysis below.

On closer analysis, these recent challenges to simplistic *globalization-induces-welfare/tax-*

[1] Unskilled labor is usually relatively mobile within (national) jurisdictions but highly immobile across jurisdictions, especially those borders delineating strongly differentiated ethnic, linguistic, religious, and cultural societies. Some types of skilled labor are highly specialized into specific productive activities, which may limit intra- and inter-jurisdictional mobility; other types, some *human capitalists*, *e.g.*, may be relatively mobile across jurisdictions.

*state-retrenchment* views have at least four distinct bases. Garrett (1998) argues that certain combinations of left government and social-welfare, active-labor-market, and related policies with coordinated-bargaining can be as or more efficient than neoliberal state-minimalism and conservative government. Therefore, he argues, capital will not flee such efficient combinations. Boix (1998) argues that public human- and physical-capital investment-strategies comprise an alternative to neoliberal minimalism that is sufficiently efficient economically to retain capital, and perhaps even attract it, and politically effective enough to sustain electoral competitiveness for the left. Hall, Soskice, and colleagues (2001) argue that complex national networks of political-economic institutions confer *comparative* advantages in differing productive activities, which, as Mosher and Franzese (2002) elaborate, implies capital mobility and trade integration could (*if international tax-competition remains sufficiently muted*: see below) spur institutional and policy specialization, which would imply persistent welfare/tax-system variation or even divergence rather than convergence or global retrenchment. These three views fundamentally question whether globalization actually creates economic pressures to retreat from welfare/tax-state commitments (or at least whether all aspects of globalization do so, so strongly: see below).

Swank's (2002) argument that the institutional structures of the polity and of the welfare system itself shape the domestic policy-response to integration represents a fourth basis for challenge. His view does not fundamentally challenge claims of the exclusively superior macroeconomic efficiency of neoliberal minimalism but, rather, stresses the primacy of domestic political conditions—the policymaking access, cohesion and organization, and relative power of contending pro- and anti-welfare/tax interests—in determining the direction and magnitude of welfare/tax-policy reactions to economic integration. Specifically, he argues and finds that inclusive electoral institutions, social-corporatist interest-representation and policymaking, centralized political authority, and universal welfare systems relatively favor the political access and potency of pro-welfare/public-policy interests and bolster supportive social norms in the domestic political struggle over the policy response to integration. The opposite conditions favor anti-tax/welfare interests and norms in this struggle. Capital mobility and globalization therefore induce increased welfare/tax-state largesse in previously generous states and retrenchment in tight ones: *i.e.*, divergence not convergence. Swank's approach is, thus, the most directly and thoroughly political of these critiques. It is also perhaps the most thoroughly explored empirically, offering comparative-historical statistical and qualitative analyses of six alternative versions of the *globalization-induces-retrenchment* thesis: a simple version (a regression including one of five capital-openness measures), and five others he terms the *run-to-the-bottom* (capital openness times lagged welfare-policy), *convergence* (capital openness times the gap from own to cross-country mean welfare-policy), *nonlinear* (capital openness and its square), *trade-and-capital-openness* (their product), *capital-openness-times-fiscal-stress* (deficits times capital openness), and *capital-flight* (net foreign direct investment) versions. He finds little support for any globalization-induces-retrenchment argument, and, indeed, some indications that capital mobility tends on average to enhance welfare effort (perhaps supporting those stressing its effect in increasing popular demand for social insurance against global risks).[2]

Basinger and Hallerberg (2004), in a sense, take the implied next step of Swank's central point. Swank stresses the domestic political and political-economic institutions and structures of interest that shape governments' policy responses to economic integration. It then follows, however, as Basinger and Hallerberg (2004:261) summarize, that "[if] countries with higher political costs are less likely themselves to enact reforms, [then this] also reduces competing countries' incentives to reform regardless of their own political costs." That is, the magnitude of

[2] Franzese (2003) offers a more-complete review of Swank (2002).

the tax-competition pressures that economic integration places upon one government's fiscal policies depends upon the policy choices of its competitors, which is precisely the strategic interdependence that we emphasize here as well.

Such critiques underscore that the *bottom* toward which globalization and capital mobility may push tax-competing states may not be that of neoliberal minimalism. Insofar as alternative economic advantages allow some states to retain higher tax rates, or insofar as restraining political conditions prevent some from reaching neoliberal minimum, the competitive pressures on all states diminish, more so, of course, the more economically integrated and important are those states whose domestic political-economic conditions allow such maneuvering room or raise such constraints. Furthermore, if, as Mosher and Franzese (2002) suggest, national economic-policy differences contribute to *comparative* advantages—which, if they do, they do regardless of their *absolute* efficiency—then both trade and global *fixed-capital* integration would actually enhance economic pressures toward specialization, *i.e.*, divergence, and not convergence. From this view, international *liquid-capital* mobility alone, through the tax-competition it engenders, produces whatever "races" may occur. In this case, interestingly, such competitive races would occur regardless and independent of the efficiency of the tax systems in question or of the public policies they support. Furthermore, as both Hays (2003) and Basinger and Hallerberg (2004) stress, the race need not be to the *bottom*; rather, the competitiveness and the destination of the race depend on the constellation of domestic political-economic conditions present in, and the economic integration of, the international system. Conversely, as Mosher and Franzese (2002) stress, zero offers no inherent *bottom* to such tax-cut races as may occur. In the competition for liquid portfolio-capital specifically, governments always have incentives to cut taxes further, perhaps deep into subsidy; only their abilities to tax other less liquid and/or mobile assets and to borrow limit (in internationally interdependent manner, as just noted) those races.

Thus, international tax and fiscal policy competition arguments, in any of their conventional forms and throughout each of these critiques, imply cross-national (i.e., spatial) interdependence in fiscal policymaking. Whatever pressures upon domestic policymaking may derive from rising capital mobility, their nature and magnitude will depend on the constellation of tax (and broader economic) systems with which the domestic economy competes. We explore this interdependence more formally in the next section.

### *III. Race-to-the-Bottom Dynamics and Policy Free Riding*

In theory, race-to-the-bottom (RTB) dynamics occur when policies are strategic complements across jurisdictions—that is, when policy changes adopted in one jurisdiction create incentives for other jurisdictions to adopt similar changes. The RTB argument has been applied *inter alia* to capital taxation, environment regulations, and labor standards. Cuts in taxes and the elimination of regulations and standards in one jurisdiction increase the costs to others of maintaining high taxes, regulations, and standards, inducing the affected jurisdictions to follow suit in their own policies. By contrast, free riding occurs when policies are strategic substitutes—that is, when policy changes in one jurisdiction create incentives for governments in others to adopt change in the opposite direction. For example, an increase in defense expenditures in one country might lower the marginal security benefit from defense spending in its military allies, creating an incentive for them to free ride (see Redoano, 2003).

More formally and generally, consider a two-country world (*i*,*j*), each with homogenous populations and domestic welfare (i.e., net political-economic benefits/utilities to policymakers) that, due to externalities, are a function of government policy in both countries:

$$W^i \equiv W^i(p_i, p_j) \quad ; \quad W^j \equiv W^j(p_j, p_i) \qquad (1)$$

When the government in country $i$ chooses its policy, $p_i$, to maximize its own social welfare, this affects the optimal policy-choice in country $j$, and *vice versa*. We can express such *strategic interdependence* between countries $i$ and $j$ with a pair of *best-response functions*, giving optimal policies of $i$, $p_i^*$, as a function of the policy chosen in $j$, and *vice versa*:

$$p_i^* \equiv \text{Argmax}_{p_i} W^i(p_i, p_j) \equiv R(p_j) \quad ; \quad p_j^* \equiv \text{Argmax}_{p_j} W^j(p_j, p_i) \equiv R(p_j) \qquad (2)$$

Explicitly, country $i$'s optimum policy is obtained by maximizing $W^i(p_i, p_j)$ with respect to $p_i$, taking $p_j$ as given (fixed); i.e., setting the first derivative of the welfare function with respect to $p_i$ equal to zero and solving for $p_i^*$ as a function of $p_j$ (and then verifying that the second derivative is negative). Equation (2) expresses the result as the best-response function $p_i^* = R(p_j)$. The slopes of these best-response functions, the signs of which determine whether RTB or free-riding dynamics will occur, depend on the following ratios of second cross-partial derivatives:

$$\frac{\partial p_i^*}{\partial p_j} = -W^i{}_{p_i p_j} / W^i{}_{p_i p_i} \quad ; \quad \frac{\partial p_j^*}{\partial p_i} = -W^j{}_{p_j p_i} / W^j{}_{p_j p_j} \qquad (3)$$

If the government is utility maximizing, the second order condition guarantees the denominator in (3) is negative. Therefore, the slopes will depend directly on the signs of the second cross-partial derivatives (i.e., the numerator). If $W^{i,j}_{p_i p_j} > 0$, i.e., if policies are strategic complements, we see from (3) that policy reaction-functions will slope upward. If $W^{i,j}_{p_i p_j} < 0$, policies are strategic substitutes, and the reaction functions slope downward. If the second cross-partial derivative is zero, strategic interdependence does not materialize and the best-response functions are flat (Brueckner, 2003). Notice that *positive* externalities induce strategic-*substitute* policy-interdependence and *negative* externalities induce strategic-*complement* policy-interdependence (and lack of externalities yields policy-independence). Globalization, in this context, creates strategic policy interdependence by increasing the size of cross-border (negative) externalities (i.e., the negative cross-partial derivatives), which steepens the (positively sloped) reaction functions. Figure 1 illustrates a pair of such upward-sloping best-response functions graphically.

**<Figure 1 About Here>**

Despite the connection between globalization and strategic interdependence in fiscal policymaking, very few empirical studies incorporate this interdependence into their analyses. We discuss how to do this with spatial lags in the next section.

### *IV. Estimating and Presenting Empirical Spatial and Spatio-temporal Effects*

Most of the empirical research that examines globalization and fiscal policy competition analyzes panel or time-series-cross-sectional (TSCS) data (i.e., observations on units over time). To draw sound causal inferences in such conexts, analysts should allow for both temporal and spatial interdependence in their models. Theory tells us that the failure to model the latter form of interdependence, particularly in the fiscal-policymaking contexts, is a serious misspecification risking great omitted-variable bias. The easiest and most straightforward way to incorporate this interdependence is with a spatio-temporal lag model, which we can write in matrix notation as:

$$\mathbf{y} = \rho\mathbf{W}\mathbf{y} + \phi\mathbf{M}\mathbf{y} + \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon}\,, \qquad (4),$$

where $\mathbf{y}$, the dependent variable, is an $NT \times 1$ vector of cross sections stacked by periods (i.e., the $N$ first-period observations, then the $N$ second-period ones, and so on to the $N$ in the last period, $T$).[3] The parameter $\rho$ is the spatial autoregressive coefficient and $\mathbf{W}$ is an $NT{\times}NT$ block-diagonal spatial-weighting matrix. More specifically, we can express this $\mathbf{W}$ matrix as the Kronecker product of a $T{\times}T$ identity matrix and an $N{\times}N$ weights matrix $\left(\mathbf{I}_T \otimes \mathbf{W}_N\right)$, with elements $w_{ij}$ of

[3] With some work, nonrectangular panels and/or missing data are manageable, but we assume rectangularity and completeness for simplicity of exposition.

$\mathbf{W}_N$ reflecting the relative degree of connection from unit *j* to *i*. $\mathbf{Wy}$ is thus the spatial lag; i.e., for each observation $y_{it}$, $\mathbf{Wy}$ gives a weighted sum of the $y_{jt}$, with weights, $w_{ij}$, given by the relative connectivity from *j* to *i*. Notice how $\mathbf{Wy}$ thus directly and straightforwardly reflects the dependence of each unit *i*'s policy dependence on unit *j*'s policy, exactly as in the formal model and theoretical arguments reviewed above. The parameter $\phi$ is the temporal autoregressive coefficient, and $\mathbf{M}$ is an $NT{\times}NT$ matrix with ones on the minor diagonal, i.e., at coordinates $(N{+}1{,}1)$, $(N{+}2,2)$, …, $(NT, NT\text{-}N)$, and zeros elsewhere, so $\mathbf{My}$ is the (first-order) temporal lag. The matrix $\mathbf{X}$ contains $NT{\times}k$ observations on $k$ independent variables, and $\boldsymbol{\beta}$ is a $k{\times}1$ vector of coefficients on them. The final term in (4), $\boldsymbol{\varepsilon}$, is an $NT{\times}1$ vector of disturbances, assumed to be independent and identically distributed.[4]

A. *Maximum Likelihood Estimation*

The conditional likelihood function for the spatio-temporal-lag model, which assumes the first observation non-stochastic, is a straightforward extension of the standard spatial-lag likelihood function, which, in turn, adds only one mathematically and conceptually small complication (albeit a computationally intense one) to the likelihood function for the standard linear-normal model. To see this, start by rewriting the spatial-lag model with the stochastic component on the left:

$$\mathbf{y} = \rho\mathbf{Wy} + \mathbf{XB} + \boldsymbol{\varepsilon} \Rightarrow \boldsymbol{\varepsilon} = \left(\mathbf{I} - \rho\mathbf{W}\right)\mathbf{y} - \mathbf{XB} \equiv \mathbf{Ay} - \mathbf{XB} \quad (5).$$

Assuming *i.i.d.* normality, the likelihood function for $\boldsymbol{\varepsilon}$ is then the typical linear one:

$$L(\boldsymbol{\varepsilon}) = \left(\frac{1}{\sigma^2 2\pi}\right)^{\frac{NT}{2}} \exp\left(-\frac{\boldsymbol{\varepsilon}'\boldsymbol{\varepsilon}}{2\sigma^2}\right) \quad (6),$$

which, in this case, will produce a likelihood in terms of $\mathbf{y}$ as follows:

[4] Alternative distributions of $\boldsymbol{\varepsilon}$ are possible but add complication without illumination.

$$L(\mathbf{y}) = |\mathbf{A}|\left(\frac{1}{\sigma^2 2\pi}\right)^{\frac{NT}{2}} \exp\left(-\frac{1}{2\sigma^2}(\mathbf{Ay}-\mathbf{XB})'(\mathbf{Ay}-\mathbf{XB})\right) \quad (7).$$

This still resembles the typical linear-normal likelihood, except that the transformation from **ε** to **y** is not by the usual factor, 1, but by |**A**|=|**I**- ρ**W**|.[5] Written in ( $N\times 1$) vector notation, spatio-temporal-model conditional-likelihood is mostly conveniently separable into parts, as seen here:

$$\text{Log } f_{\mathbf{y}_t,\mathbf{y}_{t-1},\ldots,\mathbf{y}_2|\mathbf{y}_1} = -\frac{1}{2}N(T-1)\log\left(2\pi\sigma^2\right) + (T-1)\log\left|\mathbf{I}-\rho\mathbf{W}\right| - \frac{1}{2\sigma^2}\sum_{t=2}^{T}\boldsymbol{\varepsilon}_t'\boldsymbol{\varepsilon}_t \quad (8),$$

where $\boldsymbol{\varepsilon}_t = \mathbf{y}_t - \rho\mathbf{W}_N\mathbf{y}_t - \phi\mathbf{I}_N\mathbf{y}_{t-1} - \mathbf{X}_t\boldsymbol{\beta}$ .

We note that the unconditional (exact) likelihood function, retaining the first time-period observations as non-predetermined, is more complicated (Elhorst 2001, 2003, 2005).[6]

$$\begin{aligned}\text{Log } f_{\mathbf{y}_t,\ldots,\mathbf{y}_1} = & -\frac{1}{2}NT\log\left(2\pi\sigma^2\right) + \frac{1}{2}\sum_{i=1}^{N}\log\left((1-\rho\omega_i)^2 - \phi^2\right) + (T-1)\sum_{i=1}^{N}\log(1-\rho\omega_i) \\ & -\frac{1}{2\sigma^2}\sum_{t=2}^{T}\varepsilon_t'\varepsilon_t - \frac{1}{2\sigma^2}\varepsilon_1'\left((\mathbf{B}-\mathbf{A})'\right)^{-1}\left(\mathbf{B}'\mathbf{B}-\mathbf{B}'\mathbf{A}\mathbf{B}^{-1}\left(\mathbf{B}'\mathbf{A}\mathbf{B}^{-1}\right)'\right)^{-1}(\mathbf{B}-\mathbf{A})^{-1}\varepsilon_1\end{aligned} \quad (9)$$

where $\boldsymbol{\varepsilon}_1 = \mathbf{y}_1 - \rho\mathbf{W}_N\mathbf{y}_1 - \phi\mathbf{I}_N\mathbf{y}_1 - \mathbf{X}_1\boldsymbol{\beta}$ . When $T$ is small, the first observation contributes greatly to the overall likelihood, and the unconditional likelihood should be used to estimate the model. In other cases, the more compact conditional likelihood is acceptable for estimation purposes.

One easy way to ease or even erase the simultaneity problem with S-OLS is to lag temporally the spatial lag (Beck et al. 2005; Swank 2006). To the extent that this makes the spatial lag pre-determined—that is, to the extent spatial interdependence does not have instantaneous effect, where *instantaneous* here means within an observation period, given the model—the S-OLS bias

[5] This difference does complicate estimation somewhat. Two strategies that simplify the problem are using an eigenvalue approximation for the determinant (Ord 1975) and maximizing a concentrated likelihood function (Anselin 1988). We discuss both of these procedures, and estimation more generally, elsewhere (e.g., Reference Omitted).

[6] Note that the same condition that complicates ML estimation of the spatio-temporal lag model, namely the first set of observations is stochastic, also invalidates the use of OLS to estimate a model with a temporally lagged spatial lag. (Reference Omitted: Appendix A presents this likelihood.) Hence, asymptotically, this consideration offers no econometric reason to prefer S-OLS over S-ML estimation of spatio-temporal-lag models or the converse.

disappears. In other words, provided that the spatial-interdependence process does not have effect within an observational period, and, of course, that the spatial and temporal dynamics are adequately correctly modeled to prevent that problem arising via measurement/specification error, OLS with a temporally lagged spatial-lag on the RHS is a simple and effective estimation strategy. However, even in this best-case scenario, *OLS with time-lagged spatial-lags only provides unbiased estimates if the first observation is non-stochastic* (i.e., if initial conditions are fixed across repeated samples). Elhorst (2001:128) shows that the likelihood function for the spatio-temporal lag model retains the offending Jacobian even in this case if the first observation is stochastic (Reference Omitted). On the other hand, testing for either or both of remaining temporal or spatial correlation in residuals given the time-lagged spatio-temporal-lag model is possible and highly advisable. Standard Lagrange-multiplier tests for remaining temporal correlation in regression residuals remain valid. (See Reference Omitted for an introduction to several tests for/measures of spatial correlation, some of which retain validity when applied to estimated residuals from models containing spatial and temporal lags.)

In (reference suppressed), we explain that model specifications that omit spatial lags assume zero interdependence by construction and show (analytically and in simulations) that this induces omitted-variable bias that inflates estimates of the effects of non-spatial model-components. Note that, in the present substantive context, this means that most extant studies of globalization, having neglected spatial lags, will have overestimated the effects of domestic and exogenous-external conditions while effectively preventing any globalization-induced interdependence from manifesting empirically. Conversely, we also show that standard regression estimates of models with spatial lags suffer simultaneity biases, which have become more common recently among researchers interested in interdependence, and which our analyses show to have vastly improved upon previous non-spatial estimation strategies, will nonetheless tend to inflate interdependence-strength estimates at the expense of domestic and exogenous-external explanators. We also show that the spatial-ML approach just described effectively redresses the simultaneity issues.

Finally, the issue of stationarity arises in more-complicated fashion in spatio-temporal dynamic models than in purely temporally dynamic ones. Nonetheless, the conditions and issues arising in the former are reminiscent although not identical to those arising in the latter. Defining $\mathbf{A}=\phi\mathbf{I}$, $\mathbf{B}=\mathbf{I}-\rho\mathbf{W}$, and $\omega$ as a characteristic root of $\mathbf{W}$, the spatio-temporal process generating the data is covariance stationary if

$$\left|\mathbf{AB}^{-1}\right|<1 \qquad (10),$$

or, equivalently, if

$$\begin{cases} |\phi|<1-\rho\omega_{\max}, \text{ if } \rho\geq 0 \\ |\phi|<1-\rho\omega_{\min}, \text{ if } \rho<0 \end{cases} \qquad (11).$$

For example, in the case of positive temporal dependence and positive, uniform spatial dependence ($\rho>0$ and $w_{ij}=1/(N-1)\ \forall\ i\neq j$), stationarity requires simply that $\phi+\rho<1$. In fact, the maximum characteristic root is +1 for any row-standardized **W**.

B. *Calculating and Presenting Spatio-Temporal Effects*

Calculation, interpretation, and presentation of effects in empirical models with spatio-temporal interdependence, as in any model beyond the strictly linear-additive (in variables and parameters, explicitly and implicitly[7]), involve more than simply considering coefficient

[7] For example, the familiar (a) linear-interaction models are explicitly nonlinear in variables although linear-additive in parameters; (b) logit/probit class of models are explicitly nonlinear in both variables and parameters; and (c) temporally dynamic models of all sorts are implicitly nonlinear in parameters and sometimes in variables too (via the presence of terms like $\rho\beta X_{t-s}$ implicitly in the right-hand-side lag terms). Spatial-lag models are likewise implicitly nonlinear-additive. In any of these cases, i.e., in all models beyond those with only and strictly linear-additively separable right-hand-side terms, like the introductory textbook linear-regression model, *coefficients* and *effects* are very different things.

estimates. *Coefficients* do <u>not</u> generally equate to *effects* beyond that simplest strictly linear-additive world. In empirical models containing spatio-temporal dynamics, as in those with only temporal dynamics, for example, coefficients on explanatory variables give only the pre-dynamic impetuses to the outcome variable from changes in those variables. The coefficients represent only the (often inherently unobservable) pre-interdependence impetus to outcomes associated with each RHS variable.

This section discusses the calculation of spatio-temporal multipliers, which allow expression of the effects of counterfactual shocks of various kinds to some unit(s) on itself (themselves) and other units over time, accounting both the temporal and spatial dynamics. These multipliers also allow expression of the long-run, steady-state, or equilibrium impact of permanent such shocks. In this section, we also apply the delta-method to derive analytically the asymptotic approximate standard errors for these response-path and long-run effect estimates.[8]

Calculating the cumulative, steady-state spatio-temporal effects is most convenient working with the spatio-temporal-lag model in (Nx1) vector form:

$$\mathbf{y}_t = \rho\mathbf{W}\mathbf{y}_t + \phi\mathbf{y}_{t-1} + \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t \qquad (12).$$

To find the long-run, steady-state, equilibrium (cumulative) level of $\mathbf{y}$, simply set $\mathbf{y}_{t-1}$ equal to $\mathbf{y}_t$ in (12) and solve. This gives the steady-state effect, assuming stationarity and that exogenous RHS terms, $\mathbf{X}$ and $\boldsymbol{\varepsilon}$, remain permanently fixed to their hypothetical/counterfactual levels:[9]

[8] For an excellent fuller discussion of spatial multipliers, see Anselin (2003). We use the terms long-run, steady-state, and equilibrium effects interchangeably. More precisely, the steady-state of a dynamic process is a hypothetical equilibrium that obtains in the long-run after the implied transitory dynamics have been realized.

[9] The counterfactual addressed here is usually the steady-state effect of *permanent* shocks; since, given stationarity, the long-run steady-state effect of a temporary shock is zero.

$$\begin{aligned}
\mathbf{y}_t &= \rho\mathbf{W}\mathbf{y}_t + \phi\mathbf{y}_t + \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t \\
&= \left(\rho\mathbf{W} + \phi\mathbf{I}\right)\mathbf{y}_t + \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t \\
&= \left[\mathbf{I}_{\mathrm{N}} - \rho\mathbf{W} - \phi\mathbf{I}_{\mathrm{N}}\right]^{-1}\left(\mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right) \\
&= \begin{bmatrix}
1-\phi & -\rho w_{1,2} & \cdots & \cdots & -\rho w_{1,\mathrm{N}} \\
-\rho w_{2,1} & 1-\phi & & & \vdots \\
\vdots & & \ddots & & \vdots \\
\vdots & & & 1-\phi & -\rho w_{(\mathrm{N}-1),\mathrm{N}} \\
-\rho w_{\mathrm{N},1} & \cdots & \cdots & -\rho w_{\mathrm{N},(\mathrm{N}-1)} & 1-\phi
\end{bmatrix}^{-1}\left(\mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right) \\
&\equiv \mathbf{S}\left(\mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right)
\end{aligned} \qquad (13).$$

Conceptually, it is useful to decompose $\varepsilon_t = \eta + \gamma_t$, such that $\eta$ is fixed and $\gamma_t$ is stochastic. In our framework, a shock to $\varepsilon$ is best understood as a permanent change in $\eta$. To offer standard-error estimates for these steady-state estimates, one could use the delta method. I.e., give a first-order Taylor-series linear-approximation to nonlinear (13) around the estimated parameter-values and determine the asymptotic variance of that linear approximation. To find the key elements needed for this, begin by denoting the $i^{\text{th}}$ column of $\mathbf{S}$ as $\mathbf{s}_i$ and its estimate as $\hat{\mathbf{s}}_i$. The steady-state spatio-temporal effects of a one-unit increase in $\varepsilon_t$ in country $i$ are $\mathbf{s}_i$ giving delta-method standard-errors of

$$\widehat{\mathbf{V}\left(\hat{\mathbf{s}}_i\right)} = \left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\boldsymbol{\theta}}}\right]\widehat{\mathbf{V}\left(\hat{\boldsymbol{\theta}}\right)}\left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\boldsymbol{\theta}}}\right]' \qquad (14)$$

where $\hat{\boldsymbol{\theta}} \equiv \left[\hat{\rho} \quad \hat{\phi}\right]'$, $\left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\boldsymbol{\theta}}}\right] \equiv \left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\rho}} \quad \frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\phi}}\right]$, and the vectors $\left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\rho}}\right]$ and $\left[\frac{\partial\hat{\mathbf{s}}_i}{\partial\hat{\phi}}\right]$ are the $i^{\text{th}}$ columns of $\hat{\mathbf{S}}\mathbf{W}\hat{\mathbf{S}}$ and $\hat{\mathbf{S}}\hat{\mathbf{S}}$ respectively.

The steady-state spatio-temporal effects of a one-unit increase in explanatory variable $k$ in country $i$ are $\mathbf{s}_i\beta_k$ giving delta-method standard-errors of

$$\widehat{\mathbf{V}\left(\hat{\mathbf{s}}_i\hat{\beta}_k\right)} = \left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\boldsymbol{\theta}}}\right]\widehat{\mathbf{V}\left(\hat{\boldsymbol{\theta}}\right)}\left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\boldsymbol{\theta}}}\right]' \qquad (15),$$

where $\hat{\boldsymbol{\theta}} \equiv \left[\hat{\rho} \quad \hat{\phi} \quad \hat{\beta}_k\right]'$, $\left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\boldsymbol{\theta}}}\right] \equiv \left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\rho}} \quad \frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\phi}} \quad \hat{\mathbf{s}}_i\right]$, and the vectors $\left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\rho}}\right]$ and $\left[\frac{\partial \hat{\mathbf{s}}_i\hat{\beta}_k}{\partial \hat{\phi}}\right]$ are the $i^{\text{th}}$ columns of $\hat{\beta}_k\hat{\mathbf{S}}\mathbf{W}\hat{\mathbf{S}}$ and $\hat{\beta}_k\hat{\mathbf{S}}\hat{\mathbf{S}}$ respectively.

The spatio-temporal response path of the $N\times 1$ vector of unit outcomes, $\mathbf{y}_t$, to the exogenous RHS terms, $\mathbf{X}$ and $\boldsymbol{\varepsilon}$, could also emerge by rearranging (12) to isolate $\mathbf{y}_t$ on the LHS:

$$\begin{aligned}\mathbf{y}_t &= \left[\mathbf{I}_N - \rho\mathbf{W}_N\right]^{-1}\left\{\phi\mathbf{y}_{t-1} + \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right\} \\ &= \mathbf{S}\left\{\phi\mathbf{y}_{t-1} + \mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right\}\end{aligned} \qquad (16).$$

This formula gives the response-paths of all unit(s) $\{i\}$ to hypothetical shocks to $\mathbf{X}$ or $\boldsymbol{\varepsilon}$ in any unit(s) $\{j\}$, including a shock in $\{i\}$ itself/themselves, just by setting $\left(\mathbf{X}_t\boldsymbol{\beta} + \boldsymbol{\varepsilon}_t\right)$ to one in the row(s) corresponding to $\{j\}$. This formulation may be especially convenient for plotting estimated response paths in a spreadsheet, for example. To calculate marginal spatio-temporal effects (non-cumulative) or plot the over-time path of the effect of a permanent one-unit change in an explanatory variable (cumulative), and their standard errors, working with the entire $NT$ x $NT$ matrix is easier. Simply redefine $\mathbf{S}$ in the (13) as $\mathbf{S} \equiv \left[\mathbf{I}_{\text{NT}} - \rho\mathbf{W} - \phi\mathbf{M}\right]^{-1}$ and follow the steps outlined above. We calculate these effects for the presentation of our empirical reanalysis below, for example.

### *V. Internal vs. External Determinants of Fiscal Policy: A Reanalysis of Swank & Steinmo*

In this section, we reanalyze the tax regressions in Swank and Steinmo (2002), taking the potential for strategic policy interdependence across countries into account. Swank and Steinmo (2002) stress the importance of domestic factors—particularly budgetary dynamics, the level of public sector debt, and macroeconomic performance—in their well-known empirical study of tax-policy reform in OECD countries. They also find some external factors, specifically a country's capital account and trade openness, are important determinants of tax reform. However, all of the models assume independent national responses to changing political-economic variables, whether internal or external; i.e., spatial lags are omitted.

A few of their findings are counterintuitive—for example, that increased capital mobility and trade put downward pressure on marginal statutory corporate tax rates but not on effective capital tax rates and that increased capital mobility leads to lower effective tax rates on labor. They argue this is because statutory rate reductions are combined with the elimination of specific investment incentives leaving effective tax burdens unaffected. The finding that increased capital mobility leads to lower effective tax rates on labor income is explained by arguing that labor taxes raise the nonwage costs of employment, cutting into profits. Swank and Steinmo recognize their data are spatially interdependent in that they report panel corrected standard errors (PCSE), as has become standard advised practice for TSCS data, but this default PCSE strategy treats dependence as a "nuisance" rather than as additional evidence of the importance of external factors in determining tax policy. In discussing their results, Swank and Steinmo (2002, 650) write, "[they] are consistent with the argument that while internationalization has influenced the shift in the content of tax policy, the combined effect of statutory tax rate cuts and base-broadening reductions in investment incentives has left the effective tax burden on capital largely unchanged." The "spatial nuisance" approach abets such conclusions because it encourages one to ignore the spatial dependence in one's data except to make standard error corrections for their coefficient estimates. The spatial dependence is "out of sight, and out of mind."

Recently, Swank (2006) greatly advanced the research agenda, focusing squarely on several potentially important sources of "spatial" interdependence in the tax data: competition for foreign direct investment, policy learning, and social emulation. He estimates spatio-temporal lag models with several different kinds of spatial weights matrices. The first gives equal weights to (i.e., averages) all of the $j \neq i$ countries in the sample. The second weights countries by the strength of their competitive relationship. Competition for capital is measured by total dyadic trade flows, FDI flows, and the correlation between the direct investment portfolios. The final weights matrix gives positive weights to countries in the same "family of nations" and no weight to countries outside of the "family". Swank finds that policymakers are not influenced by these variables. Instead he finds support for a fourth spatial-lag structure in which US capital-tax-policy changes influenced capital tax policy reforms in other countries, with this effect being conditional on a country's degree of economic integration with the US, its domestic politics, and its production regime.

This new research clearly represents a significant advancement, although some further refinement occur to us, particularly with respect to the use of spatial lags. First, Swank ignores the role of geographic space, which we believe plays an important role in competition for FDI through "third country" effects. Second, Swank uses a temporally lagged spatial lag, which may be appropriate econometrically given his choice of estimator (Beck et al. 2006) but does raise some concerns (reference suppressed). That is, temporally lagged spatial lags may not suffer the endogeneity that subjects OLS estimates to simultaneity bias, but this benefit will not obtain and one will also likely to underestimate the extent of spatial interdependence if interdependence incurs within an observational period, which strikes us as very likely in capital-tax competition. Models with contemporaneous interdependence can be estimated by instrumental-variables or maximum-likelihood strategies. Implementing the latter as described above and using a binary-contiguity spatial-lag as described below, we find strong evidence of contemporaneous (within period) spatial interdependence in capital tax policy based on geographic proximity. We show how to present these spatio-temporal effects.

We focus on the capital- and labor-tax-rate results reported in Swank and Steinmo's Table 2 (Appendix, pp. 653-4).[10] Their sample covers 13 countries over the period 1981-1995 giving a total of 195 observations. We add a spatial lag to the right-hand-side of their first-order temporal lag model, making our specification equivalent to equation (4) above. We calculated our spatial lag, $\mathbf{Wy}$, using a standardized *binary contiguity-weights matrix* which begins by coding $w_{ij}$=1 for countries $i$ and $j$ that share a border and $w_{ij}$=0 for countries that do not border. As exceptions, we code France, Belgium, and the Netherlands as contiguous with Britain. Each of the thirteen countries and their geographic neighbors are listed in Table 1. Then, we *row-standardize* (as commonly done in spatial-econometrics) the resulting matrix by dividing each cell in a row by that row's sum. This gives $\mathbf{Wy}$ as the unweighted average of $\mathbf{y}$ in "neighboring" (so-defined) countries.

**<Tables 1 About Here>**

We chose to use a binary contiguity-weights matrix because a number of recent papers have concluded that geographic location is important for determining which countries compete for capital (Blonigen et al. 2004, Guerin 2006, Abreu and Melendez 2006). The main reason is that multinational enterprises (MNEs) use host countries as "export platforms" to nearby markets. A good example of this is Ireland where are large percentage of the foreign direct investment is used to produce goods that are then exported to the European continent. The implication is that Ireland and Britain compete not only for each other's capital but also for the capital of third

[10] These regressions include fixed unit and period effects, which, in our reanalysis, prove necessary to meet the stationarity requirements discussed above.

countries. American MNEs may see Ireland and Britain as substitutable production bases for export to the nearby Benelux, French, and German markets. Portugal and Spain may compete in the same way. Canada attracts FDI from firms intending to service the American market, and therefore, because of its proximity to the States, competes with the US for foreign capital from third countries in a way that Germany, for example, does not. Note that this competition differs from the kind Swank has in mind, which is almost exclusively bilateral in nature. This kind of FDI also makes a contemporaneous spatial lag more appropriate than a temporally lagged spatial lag. If two countries are competing for FDI from a third, they will be aware of any planned policy changes by their competitor and try to match the timing of reform. Countries that are slow to change will lose capital.

Table 2 presents the original results along with the estimates from our reanalysis. We include two sets of estimates for each tax rate, one for a model that includes both fixed unit and period (i.e., country and year) effects and one for a model that includes fixed unit effects only. In short, we come to different conclusions about the importance of international factors for capital taxes. In each model, the coefficient estimate on the spatial lag is statistically significant. When a spatial lag is included on the right hand-side of their regression model we see this conclusion about the effects of international, external factors is likely incorrect. Changes in effective capital tax rates in one country have statistically significant consequences for effective capital tax rates in other countries. Moreover, some of the coefficients on the domestic variables that were statistically significant are not significant in the spatio-temporal lag model—most notably, the elderly population and Christian Democratic government variables. In both instances the size of the coefficient estimate shrinks, suggesting that these domestic variables are clustered spatially.

**<Tables 2 About Here>**

For those of us interested in globalization, spatial interdependence across observational units is more than a mere statistical nuisance; it is the very substance of our study. Research that ignores this interdependence will be biased toward finding internal-domestic and exogenous-external factors are more important than international-interdependence in determining political, economic, and policy outcomes. Thus, the empirical deck will be stacked against globalization-related hypotheses. Swank and Steinmo's capital-tax-rate estimates are a clear example.

The labor-tax-rate estimates provide a stark contrast. In neither case does the coefficient on the spatial lag achieve statistical significance at conventional levels. Not surprisingly, our estimates, particularly for the model that includes both fixed unit and period effects, are almost identical to Swank and Steinmo's. There is no evidence of strategic policy interdependence when it comes to labor taxes so the original estimates are unbiased. This result is consistent with our argument about globalization as the source of strategic policy interdependence. The international mobility of capital means that capital tax policy changes have externalities that spill across national borders, and these spillovers, in turn, cause the spatial interdependence we observe in capital tax rates. Since workers are not as mobile as capital, we would expect to find far less evidence of strategic policy interdependence in labor taxes.[11]

In Table 3, we present estimates of the spatial effects from counterfactual shocks to structural unemployment in eleven of our sample countries.[12] The cells in this table report the effect of a one-unit increase in the column country's level of structural unemployment on the row country's capital tax rate. The first number is the estimated short-run effect (direct effect plus spatial feedback), which is calculated using equation (16); for example, the immediate spatio-temporal

[11] That strategic policy-interdependence does not manifest in labor tax-rates provides no direct evidence about how any capital-tax-revenue losses associated with heightened global competition for capital are being met with labor or other tax increases, spending cuts, deficits, or some combination. It shows only that domestic labor-tax responses to these and other developments are not significantly dependent on "neighbor's" labor tax-rates.

[12] Two countries in our sample—Australia and Japan—have no *neighbors* and therefore no spatial effects to report.

effect of a one-unit increase in German structural employment is $\mathbf{s}_6\beta_5$, where $\mathbf{s}_6$ is the sixth column of $\mathbf{S}$ (Germany's column in the spatial weights matrix) as it is defined in equation (16) and $\beta_5$ is the fifth row of the column vector $\boldsymbol{\beta}$ (structural unemployment is $X_5$ in the regression; The second number is the standard error of this estimate (equation (15); *i=6, k=5* ); and the final number is the estimated long-run steady-state effect. Using Germany as our example again, we estimate that a one-unit increase in German structural unemployment, if it persists, will lead to a 7-point reduction in Germany's capital tax rate in the long-run, which, in turn, will cause France to lower its capital tax rate by almost 1.4 percentage points. These effects are calculated using equation (13), again with *i=6, k=5*.

**<Table 3 About Here>**

Figures 2 and 3 present temporal response paths to this counterfactual shock to German structural unemployment. Both are calculated using the $i^{th}$ column of $\mathbf{S} \equiv \left[\mathbf{I}_{\mathrm{NT}} - \rho\mathbf{W} - \phi\mathbf{M}\right]^{-1}$ multiplied by $\beta_k$. The spatial effects are stacked by periods. In other words, the first *N* rows of column *i* give the the time *t* spatial effects of a shock to country *i* on the other countries in the sample and itself. The next *N* rows give the time *t+1* effects, etc. (In the case of German structural employment, *i=6* and *k=5*.) Figure 2 gives the over-time marginal response in the German capital tax rate, including all spatial feedback effects, with standard-error bands reflecting a 90% confidence interval. The cumulative effect after 15 periods is -6.523, which is just over 90% of the long-run steady-state effect. Figure 3 plots the marginal first-order spatial effects from a one-unit increase in German structural unemployment on French capital-tax rates. An increase in German structural unemployment leads to a decrease in German capital tax rates, and this, in turn, produces a decrease in French capital tax rates. Roughly 68% of the steady state effect (-.943/-1.395) is felt in the first 15 periods after the shock.

## *VI. Conclusion*

Does international economic integration (i.e., globalization) constrain the ability of national governments to redistribute income, risk, and opportunity through tax and expenditure policies? In this paper, we have shown that, in overlooking the degree and manner to/in which fiscal policies correlate spatially (i.e., across countries), previous attempts to answer this and related questions empirically have missed important evidence of globalization's appreciable influence on domestic policymaking. We have shown formally and generally how positive and negative cross-jurisdictional externalities of policies respectively induce negative and positive strategic interdependence of domestic policies. Globalization and the implied heightened competition for capital therefore clearly imply that capital-tax policies in one country will be influenced by those of its "neighbors." Previous regression models that ignored the policy interdependence that globalization implies were therefore seriously misspecified and likely subject to omitted variable bias which inflated their estimates of domestic and exogenous-external factors' impacts while effectively preventing any empirical manifestation of globalization effects via interdependence. We showed how to model such strategic policy interdependence with spatial lags, discussed some crucial issues in the specification and estimation of such models related to drawing valid empirical inferences from their estimates, and offered some suggestions on effective presentation of the spatio-temporal dynamic effect-estimates yielded by these models. We then reanalyzed Swank and Steinmo's very solid and influential study of OECD tax-reform to illustrate these "best practices" in specifying, estimating, and presenting the sort of spatial-lag models that reflect more accurately the substance and theory of globalization and interdependence. In that re-analysis, we discover that capital-tax-rate policies are indeed highly interdependent, and so that previous estimates do indeed seem to have been misleading in the ways our analysis would suggest. Labor being far less mobile across jurisdictions, we also found, intuitively, far less sign of any significant strategic policy-interdependence in labor tax-rates and concomitantly no such appreciable biases in previously reported results on that policy dimension.

## REFERENCES


Abreau, M. and J. Melendez. 2006. "Spatial Determinants of Foreign Direct Investment." Paper Presented at the Fourth Annual Conference of the Euro-Latin Study Network on Integration and Trade (ELSNIT) An initiative of the Inter-American Development Bank Paris, France, October 20-21, 2006

Anselin, L. 1988. Spatial Econometrics: Methods and Models (Boston: Kluwer Academic).

Anselin, L. 2003. "Spatial Externalities, Spatial Multipliers, and Spatial Econometrics." International Regional Science Review 26(2):153-66.Bartels, L. (1991). Instrumental and 'Quasi-Instrumental' Variables. American Journal of Political Science, 35(3):777-800.

Basinger, S. and Hallerberg, M. (2004). Remodeling the Competition for Capital: How Domestic Politics Erases the Race to the Bottom. American Political Science Review, 98(2):261-76.

Beck, N., Gleditsch, K.S., Beardsley, K. 2006. "Space Is More than Geography: Using Spatial Econometrics in the Study of Political Economy," International Studies Quarterly 50(1):27-44.

Beck, N., Katz, J. 1995. "What to do (and Not to Do) with Time Series Cross Section Data in Comparative Politics." American Political Science Review 89:634-47.

Beck, N. and Katz, J. (2004). Time-Series-Cross-Section Issues: Dynamics, 2004. Paper Presented at the 2004 Summer Meeting of the Society for Political Methodology, Palo Alto, CA.

Blonigen, Bruce A., Ronald B. Davies, Glen R. Waddell, and Helen T. Naughton. 2004. "FDI in Space: Spatial Autoregressive Relationships in Foreign Direct Investment." NBER Working Paper Series, Working Paper #10939.

Boix, C. (1998). Political Parties, Growth and Equality. New York: Cambridge University Press.

Brueckner, Jan K (2003) "Strategic Interaction Among Governments: An Overview of Empirical Studies", International Regional Science Review 26(2):175-188.

Brune, Nancy and Geoffrey Garrett. 2005. "The Globalization Rorschach Test: International Economic Integration, Inequality, and the Role of Government." Annual Review of Political Science Volume 8, June, pp. 399-423.

Cameron, D. (1978). The Expansion of the Public Sector: A Comparative Analysis. American Political Science Review, 72(4):1243-1261.

Dehejia, V. and Genschel, P. (1999). Tax Competition in the European Union. Politics and Society, 27(3):403-430.

Elhorst, J. Paul. 2001. "Dynamic Models in Space and Time." Geographical Analysis 33(2):119-140.

Elhorst, J. Paul. 2003. "Specification and Estimation of Spatial Panel Data Models." International Regional Science Review 26(3):244-268.

Elhorst, J. Paul. 2005. "Unconditional Maximum Likelihood Estimation of Linear and Log-Linear Dynamic Models for Spatial Panels." Geographical Analysis 37(1):85-106.Franzese, R. (2003). Multiple Hands on the Wheel: Empirically Modeling Partial Delegation and Shared Control of Monetary Policy in the Open and Institutionalized Economy. Political Analysis, 11(4):445-474.

Garrett, G. (1998). Partisan Politics in the Global Economy. Cambridge: Cambridge University Press.

Garrett, G. and Mitchell, D. (2001). Globalization, Government Spending and Taxation in the OECD. European Journal of Political Research, 39(2):145-177.

Genschel, P. (2001). Globalization, Tax Competition, and the Fiscal Viability of the Welfare State. MPIfG Working Paper, 01/1.
Guerin, Selen S. 2006. "The Role of Geography in Financial and Economic Integration: A Comparative Analysis of Foreign Direct Investment, Trade and Portfolio Investment Flows." *World Economy* 29(2): 189-209.
Hall, Peter, and David Soskice. 2001. Varieties of Capitalism : The Institutional Foundations of Comparative Advantage. New York: Oxford University Press.
Hays, J. (2003). Globalization and Capital Taxation in Consensus and Majoritarian Democracies. World Politics, 56(1):79-114.
Hines, J. (1999). Lessons from Behavioral Responses to International Taxation. National Tax Journal, 52(2):305-322.
Hurwicz, L. (1950). Least Squares Bias in Time Series. In T.C. Koopmans ed., Statistical Inference in Dynamic Economic Models. New York: Wiley: 365-383.
Iversen, T. and Cusack, T. (2000). "The Causes of Welfare State Expansion: Deindustrialization or Globalization? World Politics, 52(3):313-349.
Lijphart, A. (1999). Patterns of Democracy: Government Forms and. Performance in Thirty-Six Countries. New Haven: Yale University Press.
Mendoza, E., Razin, A. and Tesar, L. (1997). On the Ineffectiveness of Tax Policy in Altering Long-Run Growth: Harberger's Superneutrality Conjecture. Journal of Public Economics, 66(1):99-126.
Mosher, J. and Franzese, R. (2002) Comparative Institutional Advantage: The Scope for Divergence within European Economic Integration. European Union Politics, 3(2):177-204.
Oates, W. (2001). Fiscal Competition and European Union: Contrasting Perspectives, Regional Science and Urban Economics, 31(2-3):133-145.
Ord, Keith. 1975. "Estimation methods for models of spatial interaction," Journal of the American Statistical Association, 70:120-26.
Persson, T. and Tabellini, G. (2000). Political Economics: Explaining Economic Policy. Cambridge, MA: The MIT Press.
Pierson, P. ed. (2001). The New Politics of the Welfare State. Oxford: Oxford University Press.
Quinn, D. (1997). The Correlates of Change in International Financial Regulation. American Political Science Review, 91(3):531-552.
Redoano, Michela (2003) "Fiscal Interactions Among European Countries", Warwick Economic Research Papers No. 680.
Rodrik, D. (1997). Has Globalization Gone Too Far? Washington DC: Institute for. International Economics.
Rodrik, D. (1998). Why Do More Open Economies Have Bigger Governments? Journal of Political Economy, 106(5):997-1032.
Swank, D. (1998). Funding the Welfare State: Globalization and the Taxation of Business in. Advanced Market Economies. Political Studies, 46(4):671–692.
Swank, D. (2002). Global Capital, Political Institutions, and Policy Change in Developed Welfare States. New York: Cambridge University Press.
Swank, D. and Steinmo, S. (2002). The New Political Economy of Taxation in Advanced Capitalist Democracies. American Journal of Political Science, 46(3):477-489.
Swank, D. (2006). "Tax Policy in an Era of Internationalization: Explaining the Spread of Neoliberalism." *International Organization* 60(4):847-882.
Wildasin, D. (1989). Interjurisdictional Capital Mobility: Fiscal Externality and a Corrective

Subsidy. Journal of Urban Economics, 25(2):193-212.
Wilson, J. (1986). A Theory of Interregional Tax Competition. Journal of Urban Economics, 19(3):296–315.
Wilson, J. (1999). Theories of Tax Competition. National Tax Journal, 52(2):269–304.
Zodrow, G. and Mieszkowski, P. (1986). The New View of the Property Tax: A Reformulation. Regional Science and Urban Economics, 16(3):309-327.

**Figure 1. Best Response Functions: Strategic Complements**

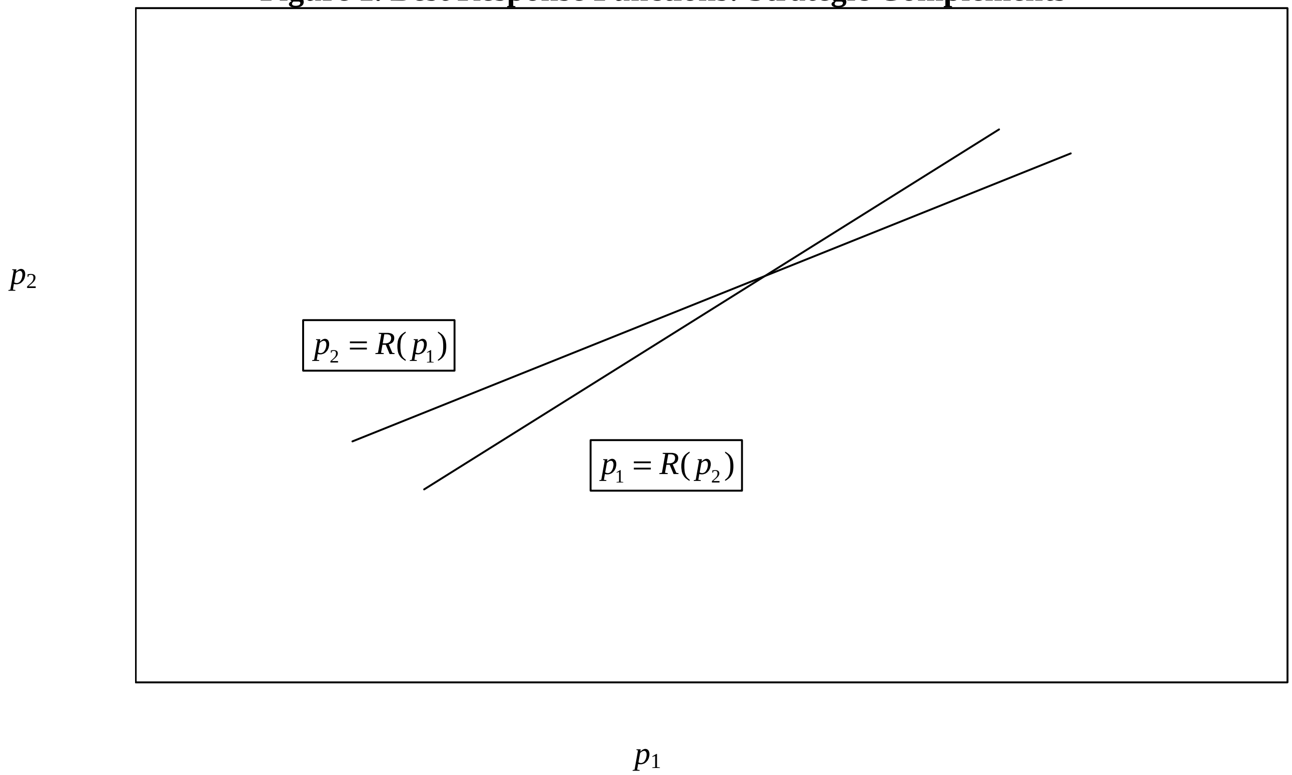

Table 1. Geographic Neighbors in the Sample

| | Neighbors |
|---|---|
| Australia | *None* |
| Belgium | France, Germany, Netherlands, UK |
| Canada | US |
| Finland | Norway, Sweden |
| France | Belgium, Germany, Italy, UK |
| Germany | Belgium, France, Netherlands |
| Italy | France |
| Japan | *None* |
| Netherlands | Belgium, Germany, UK |
| Norway | Finland, Sweden |
| Sweden | Finland, Norway |
| United Kingdom | Belgium, France, Netherlands |
| United States | Canada |

**Table 2. Reanalysis of Swank and Steinmo (2002, Appendix Table 2)**

| | Effective Tax Rate on Capital | | | Effective Tax Rate on Labor | | |
|---|---|---|---|---|---|---|
| | Swank and Steinmo | Reanalysis (1) | Reanalysis (2) | Swank and Steinmo | Reanalysis (3) | Reanalysis (4) |
| Temporal Lag | 0.809** | 0.808** | 0.864** | 0.671** | 0.66** | 0.711** |
| | | (0.05) | (0.048) | | (0.054) | (0.054) |
| Spatial Lag | | 0.104* | 0.126** | | 0.017 | 0.05 |
| | | (0.054) | (0.054) | | (0.058) | (0.055) |
| Liberalization | 1.146 | 1.235* | 0.629 | -.261** | -0.255** | -0.168* |
| | | (0.725) | (0.702) | | (0.102) | (0.091) |
| Trade | -0.018 | 0.009 | 0.005 | -0.009 | 0.001 | -0.001 |
| | | (0.064) | (0.061) | | (0.023) | (0.023) |
| Structural Unemployment | -1.147** | -1.218** | -1.033** | -0.359** | -0.38** | -0.148 |
| | | (0.306) | (0.283) | | (0.189) | (0.189) |
| Public Sector Debt | 0.089** | 0.099** | 0.046 | 0.053** | 0.056** | 0.038** |
| | | (0.036) | (0.032) | | (0.014) | (0.013) |
| Elderly Population | 1.264** | 1.011 | -0.08 | -0.018 | 0.03 | 0.171 |
| | | (0.615) | (0.481) | | (0.23) | (0.184) |
| Growth | 0.230* | 0.242 | 0.307** | -0.008 | -0.009 | 0.009 |
| | | (0.151) | (0.147) | | (0.051) | (0.051) |
| Percent Change in Profits | 0.127** | 0.136** | 0.174** | | | |
| | | (0.055) | (0.054) | | | |
| Domestic Investment | 0.066 | 0.045 | 0.059 | | | |
| | | (0.055) | (0.049) | | | |
| Inflation | | | | 0.115** | 0.115** | 0.063 |
| | | | | | (0.05) | (0.043) |
| Unemployment | | | | 0.280** | 0.296** | 0.144* |
| | | | | | (0.084) | (0.079) |
| Left Government | 0.018** | 0.018* | 0.012 | 0.008** | 0.008** | 0.007* |
| | | (0.01) | (0.01) | | (0.004) | (0.004) |
| Christian Dem. Government | 0.041** | 0.035 | 0.01 | 0.001 | 0.002 | 0.009 |
| | | (0.028) | (0.026) | | (0.011) | (0.01) |
| Fixed Effects | | | | | | |
| Country | Yes | Yes | Yes | Yes | Yes | Yes |
| Year | Yes | Yes[1] | No | Yes | Yes[1] | No |
| $R^2$ | .928 | .922 | .914 | .989 | .989 | .988 |

[1]Biannual Period Effects. Parentheses contain standard errors. **Significant at the 5% Level; *Significant at the 10% Level.

**Table 3. Short-Run and Steady-State Spatial Effects from a Shock to Structural Unemployment**

| | BEL | CAN | FIN | FRA | GER | ITA | NTH | NOR | SWE | GBR | USA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -1.222** | 0 | 0 | -0.034* | -0.034* | -0.001 | -0.034* | 0 | 0 | -0.034* | 0 |
| BEL | 0.307 | 0 | 0 | 0.021 | 0.02 | 0.001 | 0.021 | 0 | 0 | 0.02 | 0 |
| | -7.403 | 0 | 0 | -1.672 | -1.51 | -0.227 | -1.549 | 0 | 0 | -1.51 | 0 |
| | 0 | -1.231** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -0.128* |
| CAN | 0 | 0.309 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.074 |
| | 0 | -8.994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -4.876 |
| | 0 | 0 | -1.225** | 0 | 0 | 0 | 0 | -0.067* | -0.067* | 0 | 0 |
| FIN | 0 | 0 | 0.307 | 0 | 0 | 0 | 0 | 0.04 | 0.04 | 0 | 0 |
| | 0 | 0 | -7.954 | 0 | 0 | 0 | 0 | -2.958 | -2.958 | 0 | 0 |
| | -0.034* | 0 | 0 | -1.224** | -0.033* | -0.032* | -0.003 | 0 | 0 | -0.033* | 0 |
| FRA | 0.021 | 0 | 0 | 0.307 | 0.019 | 0.018 | 0.003 | 0 | 0 | 0.019 | 0 |
| | -1.672 | 0 | 0 | -7.643 | -1.395 | -1.036 | -0.731 | 0 | 0 | -1.395 | 0 |
| | -0.045* | 0 | 0 | -0.044* | -1.222** | -0.001 | -0.044* | 0 | 0 | -0.004 | 0 |
| GER | 0.027 | 0 | 0 | 0.026 | 0.306 | 0.001 | 0.026 | 0 | 0 | 0.004 | 0 |
| | -2.013 | 0 | 0 | -1.859 | -7.187 | -0.252 | -1.723 | 0 | 0 | -0.836 | 0 |
| | -0.004 | 0 | 0 | -0.127* | -0.003 | -1.221** | 0 | 0 | 0 | -0.003 | 0 |
| ITA | 0.004 | 0 | 0 | 0.073 | 0.004 | 0.306 | 0.001 | 0 | 0 | 0.004 | 0 |
| | -0.907 | 0 | 0 | -4.144 | -0.756 | -6.912 | -0.396 | 0 | 0 | -0.756 | 0 |
| | -0.045* | 0 | 0 | -0.004 | -0.044* | 0 | -1.222** | 0 | 0 | -0.044* | 0 |
| NTH | 0.028 | 0 | 0 | 0.005 | 0.026 | 0 | 0.307 | 0 | 0 | 0.026 | 0 |
| | -2.066 | 0 | 0 | -0.974 | -1.723 | -0.132 | -7.253 | 0 | 0 | -1.723 | 0 |
| | 0 | 0 | -0.067* | 0 | 0 | 0 | 0 | -1.225** | -0.067* | 0 | 0 |
| NOR | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0.307 | 0.04 | 0 | 0 |
| | 0 | 0 | -2.958 | 0 | 0 | 0 | 0 | -7.954 | -2.958 | 0 | 0 |
| | 0 | 0 | -0.067* | 0 | 0 | 0 | 0 | -0.067* | -1.225** | 0 | 0 |
| SWE | 0 | 0 | 0.04 | 0 | 0 | 0 | 0 | 0.04 | 0.307 | 0 | 0 |
| | 0 | 0 | -2.958 | 0 | 0 | 0 | 0 | -2.958 | -7.954 | 0 | 0 |
| | -0.045* | 0 | 0 | -0.044* | -0.004 | -0.001 | -0.044* | 0 | 0 | -1.222** | 0 |
| GBR | 0.027 | 0 | 0 | 0.026 | 0.004 | 0.001 | 0.026 | 0 | 0 | 0.306 | 0 |
| | -2.013 | 0 | 0 | -1.859 | -0.836 | -0.252 | -1.723 | 0 | 0 | -7.187 | 0 |
| | 0 | -0.128* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1.231** |
| USA | 0 | 0.074 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.309 |
| | 0 | -4.876 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -8.994 |

*Notes*: The elements of the table report the effect of a one-unit increase in the column country's level of structural unemployment on the row country's capital tax rate. The first number reported in each cell is the estimated short-run effect (direct effect plus spatial feedback). The second number is the standard error of this estimate. The final number is the estimated long-run steady-steady effect. Australia and Japan are omitted from the table because they have no "neighbors" in the sample. **Significant at the5% Level; *Significant at the 10% Level.

**Figure 2. Spatio-Temporal Effects on the German Capital Tax Rate from a Positive One-Unit Counterfactual Shock to Structural Unemployment in Germany (with a 90% C.I.)**

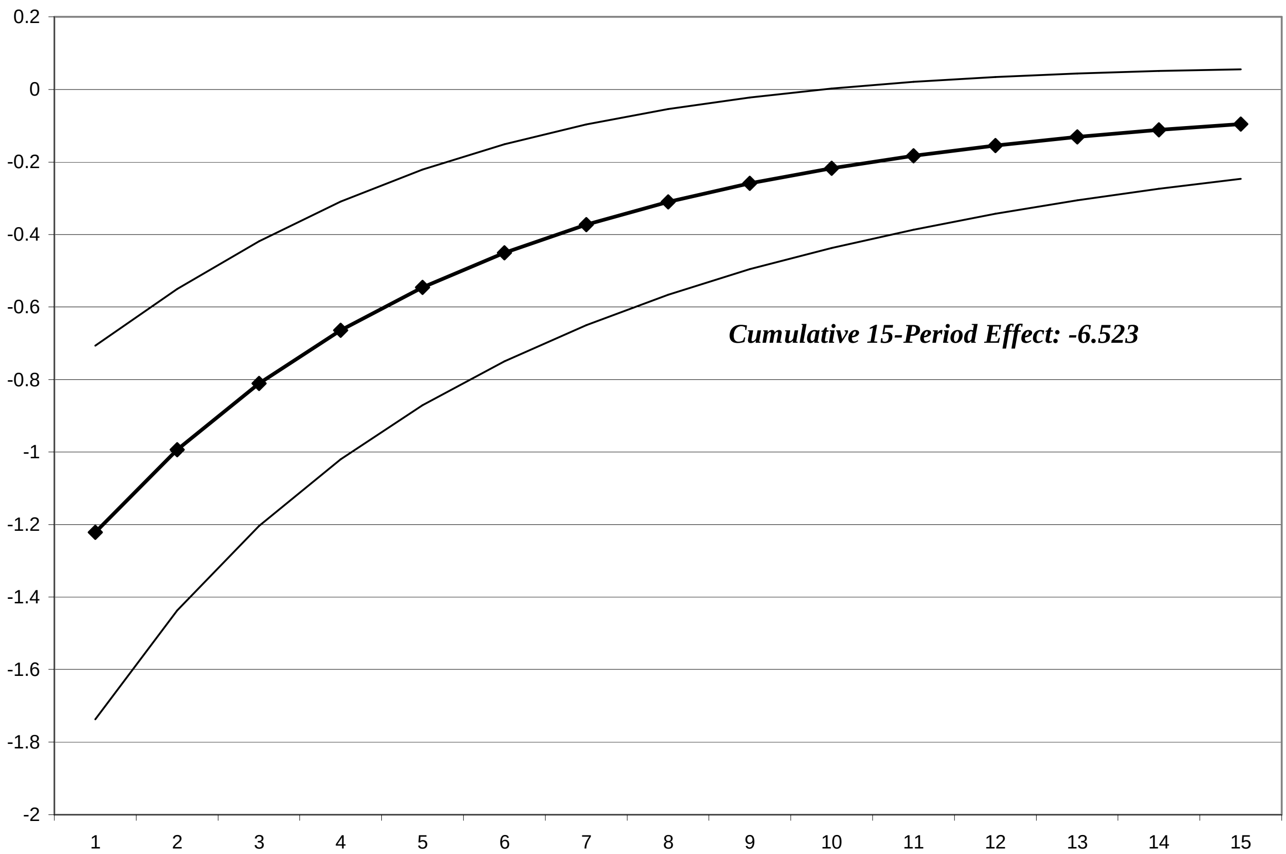

**Figure 3. Spatio-Temporal Effects on the French Capital Tax Rate from a Positive One-Unit Counterfactual Shock to Structural Unemployment in Germany (with a 90% C.I.)**