Interregional Rural/Urban Fiscal Competition: A Political-Economy General Equilibrium Approach

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Abstract

The aim of this paper is to analyze the general equilibrium welfare effects of taxation and subsidy changes in a multi-regional model that has inter-government strategic interactions. The focus is specifically on issues that arise among rural regions linked to an urban region. While, national and regional governments react to the policies of one another by implementing counter strategies to maximize their own welfare, to date, few conventional regional CGE models implement welfare theory illustrating this optimal economic decision-making by governments. This paper overcomes this limitation by analyzing a three-region GE model exhibiting maximizing behavior by both regional and federal governments. This paper extends the Groenewold, Hagger, and Madden (2000) regional political-economy general equilibrium (PEGE) model. The model is first constructed considering only regional governments. A rudimentary federal government is then introduced and several different scenarios considered; in the first case, the federal government carries out a lump-sum transfer of resources from the rural regional governments to the urban one then, it imposes lump-sum income taxes on households and uses this revenue to make transfers to the rural regional governments, and finally, the federal government imposes additional program costs on all the regional governments. The results are then used to examine the implications of federal government transfers, the resulting optimizing schemes as regional governments change their own tax rates to offset the effects on their citizens of the federal government action, and finally the effects on Rural/Urban factor transfers and competition resulting from the differing focus of federal action.*

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1 Introduction

The theory of tax competition in federal-type economies (ones in which there is tax setting autonomy at more than one level of policy-decision making) has focused primarily on the welfare consequences of horizontal externalities arising from the mobility of tax bases between lower-level jurisdictions. This approach is characterized by papers such as Wildasin (1989) and Hoyt (1991). The central conclusion of these papers is that horizontal externalities tend to leave equilibrium lower-level(state) taxes too low, since each state acts as if it were in a vacuum and ignores its impact on other states. This is the essence of Hoyt's results wherein an increase in the number of states in the model, which is to say more tax competition, causes welfare to fall. None of these models are characterized by a purposive federal government (or upper-level), hence the unambiguous nature of Hoyt's results.

More recently, attention has turned to a key feature of fiscal architecture, notably, that tax bases are coincident, occupied by both upper-level and lower-levels at the same time. This co-occupation gives rise to vertical externalities between the two levels of government. Notable contributions to this literature include Flowers (1988) and Boadway and Keen (1997), Boadway, Marchand, and Vigneault (1998) among others. These papers have generally focused on examining the effects of one states increases in tax rates and their effect on other states through the conduit of reduced federal tax base and coincident reduction in federal spending. As such the papers examine the impact of regional economies interacting with respect to each other largely through the redistributive aspect of such interaction. The political-economy general equilibrium (PEGE) model of Groenewold, Hagger, and Madden (2000), further developed in Groenewold, Hagger, and Madden (2003), examines the relative approach of an overarching federal layer and it's revenue reimbursements. This paper argues that alteration of some relative relationships within that model would allow for the examination of interregional tax and benefit competition. That exercise forms the basis for Section 4 of this paper.

Additionally, there is an important question in the field of fiscal federalism which concerns the welfare consequences of tax competition. The classic argument against it is given by Oates (1972):

> The result of tax competition may well be a tendency toward less than efficient levels of output of local services. In an attempt to keep taxes low to attract business investment, local officials may hold spending below those levels for which marginal benefits equal marginal costs, particularly for those programs that do not offer direct benefits to local business.

The question that one may examine is whether the results of tax competition that Oates cites are additionally in play, such that not only are tax rates inefficient, but also benefits. Given a world with horizontal and vertical tax externalities does tax competition what is the effect on local services? The fact that a locality may receive transfers from other localities through the federal/state transfers, may impact the relative welfare outcome. Thus the question is whether or not the presence of optimizing regional governments undermines the effectiveness of the higher government's transfers between the regions, and to what extent this might occur.

Coincident to this issue is the effect of migration on the relative outcomes of tax competition. Decisions to migrate in response to benefit differentials (see the extended discussion in Brueckner (1998)) are theoretically a deciding factor in welfare outcomes. If migration does not occur, the conventional reasoning goes, then a necessary pre-condition for 'race to the bottom' (RTB) theory does not hold and the theory cannot be valid. Recent work however, suggests that welfare benefits exert a small or even negligible effect on migration (Schram 1998). For example, Allard and Danzinger (2000) demonstrate that factors such as family, age and education exert much larger effects on decisions to move than do welfare benefits. They also find that migration is equally common from high benefit states as from low benefit states.

Such analysis may tell us something about migration, but are not tests of RTB theory. RTB theory holds not that welfare recipients move, but that regions compete. That is, the theory holds that regional spending on redistribution is lower than it would be if there were no threat of in-migration of welfare recipients or out-migration of taxpayers. For example, suppose that a simple version of RTB holds such that if region A has lower benefit than region B, all the poor will leave region A for region B. Region B would presumably cut its benefits to avoid this outcome. Would welfare induced migration actually happen? Perhaps, yet the mere threat of it is likely to lead policies towards interregional competition.

The federal government within the U. S. does not play a major interregional redistributive role, however, state governments do act as such. While State governments have control of some of the major tax bases in most states, there are many locally determined tax rates and assessments that provide some impetus for regional competition. Therefore in this paper we will cast the locality as the prime motivator of tax competition and the state as the "federal" redistributive layer.

After a brief examination of recent CGE models used to study a variety of larger regional economic issues including examining regional co-operation, a theoretical basis is provided for

regional competition a game theoretic framework for the simulations is constructed. A short summary of the construction and performance of the CGE model follows. Model simulations examining the results of the various scenarios precedes an evaluation and exploration of the limitations of the model are presented in the conclusion.

2 Recent Applications

The attempt to model fiscal federalism has led to the emergence of regional CGE models as one good approach for examining such questions. There are many examples of studies using regional and multi-regional CGE models to look at fiscal federalism issues. See for example, Jones and Whalley (1989), Dixon, Madden, and Peter (1993), Kraybill and Seung (1999), Morgan, Mutti, and Rickman (1996) and Nechyba (1996).

Morgan, Mutti, and Rickman (1996) use a nonlinear six region (Great Lakes, New England/Mideast, Plains/Rocky-Mountain, Southeast, Southwest, and the Far West), seven sector, four factor general equilibrium model of the United States to assess the viability of policies related to the long run exporting and importing of regional taxes. Particular attention is focused on interregional factor movements and their implications for changes in regional tax revenue and demand for regional public goods. To measure welfare changes, the authors propose two different criteria: welfare of the original residents residing in the region and welfare of the regional residents (including newcomers) after the tax policy change is adopted. In either case, welfare measurement is defined as an increase in consumer expenditure. Two policy changes are analyzed: the substitution of current regional business and household taxes for a non-exportable lump-sum tax (Alternative I), and the substitution of current taxes for a household tax (Alternative II), where substitutions are of equal yield. These substitutions are applied multilaterally, or simultaneously for all regions, and then unilaterally, or one region at a time.

Kraybill and Seung (1999) perform a study of the effects of a reduction in the corporate tax in Ohio. They employ a dynamic CGE structure, wherein the results from one stage are reentered as starting values for the second stage. This iterative procedure allows them to examine the effect of tax policy changes and trace out the response time of the Ohio system. Significantly aggregate welfare gains/losses are measures as the aggregate percent change over time as compared to the calibration benchmark. Their estimates of welfare changes are based primarily on the sum of the stream of the present discounted value of the change in per capita expenditures. The model

nicely illustrates capital and labor accumulation as influenced by regional policy as well.

There have been similar attempts to measure the employment gains derived from local economic development strategies; however, none to date have attempted to capture this development with contrasting models of government decision-making. Gillespie, McGregor, Swales, and Yin (2001) also attempt to evaluate the results of Regional Selective Assistance using a hybrid approach which combines the "industrial survey" and CGE techniques. Similarly, Hirte (1998) examines the welfare effects of regional income taxes in Germany using an interregional CGE model. These CGE models do capture the employment multiplier effects of the various development programs, but none attempt to evaluate the effects of transfers between levels of government and to what extent social welfare might be fully influenced by that strategy.

3 Game-Theoretic

Conventional regional CGE models generally contain little, if any, theory relating to optimal economic decision-making by governments. This imposes a clear limitation on such models for analyzing competitive federalism. An alternative modelling approach is the one developed by game-theorists who have analyzed competitive federalism in terms of a non-cooperative, strategic-form game. Examples of this approach can be found in Mintz and Tulkens (1986), Wildasin (1988), Hoyt (1993) and Laussesl and Le Breton (1998).

Strategic interaction is a key element in recent models of local government behavior. Interaction occurs because the market environment in which local policy decisions are made is affected by the actions of other local governments. Policy choices are thus interdependent and the resulting interaction must be taken into account in characterizing the public sector equilibrium.

Models with strategic interaction have found their widest use in the tax competition literature. At their most basic such models feature communities financing public spending with a tax on mobile capital, and since capital migrates to equalize after-tax returns, the allocation of capital depends on tax rates in all communities. Mintz and Tulkens (1986) and Wildasin (1988) largely started the examination of the basic premise and the resulting underprovision of public goods. Following these early papers Hoyt (1993) and Wilson (1995) add a richer menu of tax instruments and perhaps more importantly for this study, consumer mobility. Beyond these theoretical studies, Case, Rosen, and Hines (1993), Belsley and Case (1995) and Brueckner (1998) provide important empirical studies of strategic interaction among governmental units.

Within this literature, individual cities are large relative to the urban system, consumers are mobile across cities, and preferences embody a negative population externality (people prefer small to large cities). Land rent escalation derives from two sources: supply restriction and amenity creation. The first effect arises because one city's land area restriction appreciably limits the supply of urban land, driving up land rents throughout the system. In addition, the smaller population achieved by the restriction makes the city more attractive to consumers, and this amenity gain is partly capitalized in local rents.

3.1 Modeling Competition

As we are concerned about the provision of public goods as the end result of taxation it seems reasonable to consider tax competition as really a subset of welfare gaming. The advantage of considering such a categorization is that it is unlikely that localities will consistently respond symmetrically to both increases and decreases in the welfare benefits or taxes offered by other localities. Indeed, one would argue for asymmetric behavior, as welfare decreases should generate more pronounced impacts than benefit increases of similar magnitude.

An abstract framework for analyzing welfare gaming between multiple states may be set up as follows. Local governments are the decision makers in our model and will be denoted by the set $N = \{1, ..., n\}$. Each locality must select a nonnegative level of welfare (or taxes) to be levied on recipients. Strategy sets are thus characterized by $S_i \Re_+$ for each $i \in N$ and $S = \Sigma_{i \in N} S_i$ represents the space of all collective strategy profiles/outcomes. To complete the specification of the model, each locality $i \in N$ is assumed to have preferences over the outcome set S which are characterizable by a real valued utility function $u_i : S \rightarrow \Re$. These preferences are assumed to thoroughly account for the benefits as well as costs associated with various strategic outcomes. In addition to direct effects from a locality's own decision (e.g. levels of benefits and taxation) there are also indirect effects created by the choices of other localities.

Of particular interest is how the behavior of individual localities may be affected by perturbations in the behavior of others. A necessary condition for such comparative statics to be everywhere well defined is for each locality to have a single valued "best reply" correspondence. This is formally modeled by assuming that for each $i \in N$ there exists a function $b_i : S \rightarrow S_i$ such that for every $s \in S$, $u_i(b_i(s), s_{-1}) > u_i(s_i^{'}, s_{-i})$ for all $s_i^{'} \in S_i | \{b_i(s)\}$; where we let $(s_i^{'}, s_{-i})$ denote the strategy profile which agrees with $s_i^{'}$ and s_{-i} for players i and $j \neq i$ respectively. The

net result is that there exists a single unique "best" response by each locality to the actions of all others.

3.2 Explicit Regional Leadership

The preceding theoretical basis is fundamentally driven by strategic interaction due to the indirect"spillovers", be they of a benefit, or cost nature. Following Bruckener (2003), the basis of such interaction may be characterized as follows: A jurisdiction i, is not affected directly by the tax or benefit levels in other jurisdictions, z, but by the amount of a particular resource that resides within its borders, s_i. Because the distribution of this resource among jurisdictions is affected by the choices of all, jurisdiction i is indirectly affected by $z_{\rightarrow i}$, where $z_{\rightarrow i}$ is the vector of z's for other jurisdictions. In this model, jurisdiction i's objective function may be written

$$\tilde{V}(z_i, s_i\ ; X_i), \tag{1}$$

where s_i is the resource level enjoyed by i and X_i is a vector of characteristics of i, which help determine preferences. The distribution of resources depends on the entire z vector as well as on jurisdiction characteristics. Thus, the resources available to i are given by

$$s_i = H(z_i, z_{\rightarrow i}\ ; X_i). \tag{2}$$

Note that since X_i can be measured relative to the average characteristics of all jurisdictions, $X_{\rightarrow i}$ need not appear in 2.

To derive the reduced form of the resource-flow model, 2 is substituted into 1, yielding

$$\tilde{V}(z_i, H(z_i, z_{\rightarrow i}\ ; X_i)\ ; X_i) \equiv V(z_i, z_{\rightarrow i}\ ; X_i). \tag{3}$$

Maximizing 3 by choice of z_i yields a function:

$$z_i = R(z_{\rightarrow i}\ ; X_i) \tag{4}$$

The function R represents a *reaction function,* which gives jurisdiction i's best response to the choices of other jurisdictions, b_i from the previous section. Note that the position of the reaction function depends on jurisdiction i's characteristics.

The properties of this function are now more complex, with its slope depending jointly on the properties of the H and $\tilde{V}$ functions. For this study, a variant of the tax-competition model is implemented with regions producing a private good using mobile labor rather than capital. Therefore $f(k_i)$ gives the intensive from of the common production function and l_i represents the number of workers in region i. This labor plays the part of the resource s_i in the above and thus as regions levy a tax on locally employed labor,t_i, this then plays the role of the z_i. There is also a federal tax levied that is identical for each region t_f Since labor is mobile and it moves to equalize net after-tax returns, its distribution must satisfy:

$$f'(l_j) - t_j - t_f = w, \quad j = 1, \ldots, n \tag{5}$$

$$\sum_{j=1}^{n} l_j = \bar{L} \tag{6}$$

where w is the wage rate and $\bar{L}$ is the total available labor supply in the economy. These equations cast l_i and w as functions of all the tax rates, with:

$$l_i = H(t_i, t_{\to i}, t_f) \tag{7}$$

$$w = B(t) \tag{8}$$

where t represents all tax rates in the whole economy.

Tax revenue is used to provide a regional public good q_i and a federal public good qf_i, both with private characteristics. With q_i produced at unit cost, its level is then given by $t_i l_i$, or tax revenue per worker. The federal public good is used as a redistributive instrument such that:

$$qf_i + q_i = qf_{\to i} + q_{\to i} \tag{9}$$

$$t_f \bar{L} = \sum_{j=1}^{i} qf_i \tag{10}$$

Individual consumption of the private good, c_i, is equal to the wage $w(l_i)$ which depends negatively on l_i. When these equations are combined, preferences $U(c_i, q_i, qf_i; \tilde{X}_i)$ can be written

as follows:

$$
\begin{aligned}
&U[w(l_i), t_i l_i, t_f \bar{L} - t_{\rightarrow i} l_{\rightarrow i}; \tilde{X}_i] = \\
&U\{B(t)[H(t_i, t_{\rightarrow i}, t_f)], t_i H[t, t_{\rightarrow i}], t_f \bar{L} - t_{\rightarrow i} H[t, t_{\rightarrow i}]; \tilde{X}_i\} \\
&\equiv V(t_i, t_{\rightarrow i}; \tilde{X}_i)
\end{aligned} \tag{11}
$$

As can be seen the objective function this process yields a reaction function in the form of Equation 4 which depends on region i's tax rates and rates elsewhere. In choosing t_i, the region takes account of the migration of labor not only as a direct result but also due to depressing the rate of return. This is tempered however by attempts by the 'federal'level to maintain public good accessability thus the optimal tax rate value depends on the rates in the other region and the overall labor participation rate determined by the total regional and federal tax burden. With a theoretical basis now established we may proceed towards modelling the process.

4 The CGE Model

The model used in this paper is substantially based on Groenewold, Hagger, and Madden (2003). As such only a quick review of the core equations is provided. The model consists of two regions each of which contains households, firms and a regional government.

The firms produce a single good which is supplied to households for consumption or, after costless transformation, to regional government. The government supplies the transformed good to households free of charge and finances the purchase of the good by a payroll tax levied on firms located in its region.

Output is produced using a single factor, labor, which is supplied by households. Households are assumed to supply labor only to firms in the region in which they live, thus excluding the possibility that they live in one region and commute to work in the other. Inter-regional migration is allowed, however, it is assumed to occur in response to inter-regional wage differentials. The national/state supply of labor is fixed and, in equilibrium, wages clear the national labor market and are equal across regions.

Other inter-regional effects are abstracted. In particular, it is assumed that firms supply output only to the households and the government in the region in which they are located so that inter-regional trade in goods is excluded. Further, each regional government supplies the government good only to households living in its own region, thus abstracting from inter-regional

spillover effects in the provision of government goods. Finally, each firm is owned by households in the region in which it is located.

Both households and firms are optimizers - the representative household chooses its purchases of the good so as to maximize utility subject to an income constraint, with the product price and income taken as parameters, while the representative firm chooses its purchases of labor services so as to maximize profits subject to a production function constraint, with the product price and the wage rate taken as parameters. Each household has an equal share in the firms in its region and the firms distribute all profits to households.

The equation block then looks as follows:

Utility:

$$U_i = \beta_i C_i^{\gamma_i} G_i^{\delta_i} \tag{12}$$

Consumption:

$$C_i = M_i/P_i = (\pi_i + W_i)/P_i \tag{13}$$

Where M_i is nominal income per HH, π_i is nominal profit per HH, G_i is government provided HH consumption, and W_i is the nominal wage, all for region i.

Output:

$$Y_i = \left(\frac{L_i}{N_i}\right)^{\alpha_i} \qquad i = 1, 2 \quad 0 < \alpha_i < 1 \tag{14}$$

Profit:

$$\Pi_i = P_i Y_i - W_i \left(\frac{L_i}{N_i}\right)(1 + T_i) \qquad i = 1, 2 \tag{15}$$

Where Π_i is profit per firm, L_i is employment,and T_i is the government payroll tax rate, all for region i.

Regional Governments:

$$L_i GR_i = T_i W_i L_i \tag{16}$$

Which is to say that regional government output(goods) GR_i is equal to total tax revenue.

Overarching Government (Federal):

$$G_i = T_i W_i + T_f W_i \tag{17}$$

Which is really just $G_i = GR_i + GF_i$ expanded. Note that this is one of the departures of this

model from Groenewold, Hagger, and Madden (2003), where the 'federal' level only engaged in inter-regional transfers. In this model the overarching government level collects revenue from each region $T_f W_i L_I$ based on a common tax rate T_f.

Closure:

$$L_1 + L_2 = \bar{L} \tag{18}$$

$$U_1 = U_2 \tag{19}$$

$$N_i Y_i = L_i(C_i + GR_i + GF_i) \quad i = 1, 2 \tag{20}$$

$$L_i \pi_i = N_i \Pi_i \quad i = 1, 2 \tag{21}$$

Equations (13)–(22) then comprise the two-region CGE model which now may be amended with the PE aspects. While Groenewold, Hagger, and Madden (2003) assumed that the regional(local) government was maximizing the utility function of the representative household in the region, this paper takes a slightly different tact. In this paper it is assumed that the local government has self-interest and therefore when optimizing the following utility function it must consider not only the actions of the other region but also of the 'federal' level:

$$U_i = \beta_i C_i^{\gamma_i} Gr_i^{\delta_i} Gf_i^{\phi_i} \tag{22}$$

Local governments choose T_i and thereby a utility level to maximize utility from consumption and total government services while maintaining a level of services competitive with its neighbors. Thus taking the tax rate and service level of the other regional governments as given, the modelled Nash equilibrium first order condition becomes:

$$G_i^{\delta_i} \gamma_i C_i^{\gamma_i - 1} \frac{\partial W_i}{\partial T_i} + C_i^{\gamma} \delta_i G_i^{\delta_i - 1} \frac{\partial G_i}{\partial T_i} + W_i T_f \ \phi_i G f_i^{\phi_i - 1} \frac{\partial G f_i}{\partial T_f} = 0 \qquad i = 1, 2 \tag{23}$$

The model now proceeds into linearization as in Groenewold, Hagger, and Madden (2003) with representative changes in their equations (21) and (21').[1] With these changes in governmental motivation the PECGE model is better able to handle conditions of tax competition and/or differing benefit program levels.

[1] See appendix for derivation

5 Model Results

In pursuing the simulations several different scenarios will be considered; in the first case, the "federal" government carries out a lump-sum transfer of resources from the more rural localities towards the more urbanized one, the rural locality then imposes higher lump-sum income taxes on households and uses this revenue to offset transfers to the "federal" government. This scenario is then run in the reverse direction (i. e. from the urban localities to the rural) and finally, the federal government attempts to offset regional benefit changes by supplementing regional governments with their own additional programs. The results are then used to examine the implications of the overarching government transfers, the resulting optimizing schemes as regional governments change their own tax rates to offset the effects on their citizens of the "federal" government action, and finally the effects on Rural/Urban factor transfers and competition resulting from the differing focus of "federal" action.

The model altered as described above was calibrated to data for the Pennsylvania economy. An advantage derived from this lies in the fact that Pennsylvania does practice state-wide tax distribution wherein most of the tax revenue collected in the counties is sent to the state and redistributed based on a need/population basis. This allowed for the use of actual elasticities and distributional proportions in the simulations and thus better ameliorates the potential for inconsistent results. The state was separated into rural and non-rural and overlapping counties using USDA-ERS classifications, with approximately 35% of the state falling into the overlapping category, 43% rural and the remainder urban. Simulations were run using rural vs. all other counties and urban vs. all other counties.

The system was shocked in both cases with a reduction of regional tax (and therefore benefits, Gr) of 5%. This is a realistic value, as recent changes in Pennsylvania tax codes have resulted in similar reductions in many counties. Transfers from the state, the 'federal' level, then automatically apply in the model to yield the original level of public expenditure. The model was shocked as specified which yielded the results in Table 1. One may note that the reaction of the regions in the model to the differing revenue scenarios is not neutral, there are in fact decided differences. Most interesting are the relative effects on consumption, wages, total taxation, regional revenue and utility.

When examining the results, notice how, in Table 1, consumption is down in the Rural region despite the influx of 'federal' money to offset the decline in regionally provided public

Table 1: Results of Regional Benefit Shock Simulation in %Δ

Variable	Rural Region	All Others	Urban Region	All Others
c	-0.1370	0.0245	0.0341	-0.0063
l	0.5176	-0.1843	1.387	-1.219
w	0.0953	-0.4180	0.1194	0.1072
$t_i + t_f$	-4.629	1.783	-3.976	2.885
gr	-5.000	0.609	-5.000	1.058
u	-0.005	-0.005	0.003	0.003

goods/benefits. This is in stark contrast to the Urban regions which actually experience a relative gain in consumption. The factor underlying these results is the relatively greater increase in production in the urban region vs. the rural one. The relative impact of taxation changes on the urban composite good production function is greater than the rural areas.

We can see the relative effect of the Federal levels attempts to rebalance private vs. public good consumption in the regions. After the initial shock to local taxes, overall G will be too small relative to C in the shocked region, this is than offset by increased federal spending in the shocked region. This increase in federal spending does not come without cost however as spending is first reduced in the non-shocked region and then federal taxes are raised to regain the previous level of expenditure in both regions. This has the net effect of raising total taxes in the region that is not being shocked as well as in the shocked region, hence the %Δ of less than 5% in the shocked regions.

The net result of these impacts is seen when examining the utility impacts from the shocks. While the final change in utility is always small, there exist cases where it is negative. An attempt by the federal government to influence and off set changes in regional distribution of resources actually creates conditions that make residents in both regions worse off. This is despite the initial effect of enhancing or maintaining the level of welfare of the residents in the shocked region.

6 Conclusion

The essence of the modelling outcome is that the overall redistribution of labor that might be expected from a change in benefits and taxation within a region is effectively negated when an overarching federal level redistributes public goods, or benefits, in an attempt to maintain a

uniformity of access. The inter-regional migration that occurs is purely based on relative wage differentials which have to be relatively large to significantly motivate migration activities. As such the results seem to conform to that strand of the literature that suggests that migration is largely a wage and lifestyle amenities issue with little relative influence from public benefits. This has the net effect that regions are likely to be driven to compete by reducing taxes or increasing benefits beyond what they would efficiently do since the region does not bear the full burden of the policy alone, but rather has the 'federal' layer as virtual safety net, cushioning it, and its residents from the full impact of the policies.

While the model results are not inconsistent with the theoretical framework presented, there is room for improvement. A logical extension is to consider a greater degree of realism in the production functions with the incorporation of other factors of production like mobile capital and fixed land. This would allow for a richer set of potential tax instruments. While the 'federal' level obtains a majority of its revenue from wage income tax, much of the sub-federal levels rely more heavily on taxes levied on land and capital. If the model were extended in this way a more dynamic picture of the interaction between the two levels of government and their impact on the relative utility levels of the residents might be obtainable. This would also have the advantage of providing a framework for examining a wider set of tax-competition scenarios than has previously been examined in the literature. Of additional interest might be the examination of the effects of differing goals; maximizing household income vs. maximizing government revenue.

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