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A NOTE ON "CAPITAL TAX EXPORTING IN A MODEL OF STRATEGIC TAX COMPETITION"

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ABSTRACT: *This note is intended to amend and correct Kunce (2006) originally published in the ICFAI Journal of Public Finance (currently out of print). Aims of this amending note are three-fold, (i) to bring up to date the literature review regarding the prevalence and growing importance of tax exporting in the U.S., (ii) to provide an alternate derivation of the optimal Nash equilibrium, and (iii) to correct errors in equations in the original manuscript.*
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INTRODUCTION

Developing the optimal institutional structure in the determination of tax policy remains an important yet unresolved public policy concern. Tax structures are generated within a system, both in the United States and the European Union, that involves several layers of government. Assessing the role of these various governments surfaces as paramount. There is now a large literature that addresses both taxation and local public expenditure that suggests decentralized decision making is not appropriate and results in suboptimal outcomes in public goods provision (see Wilson 2015; Mongrain and Wilson 2018 for extensive reviews). The fundamental assertion is that devolved authority will induce local governments to compete for industry and jobs by lowering taxes hence underproviding local public goods. However, a share of this literature forwards well-received exceptions to this reasoning. Kunce (2006), the focus of this note, debits the literature inventory of exceptions. The purpose of this amending note is three-fold, (i) to bring up to date the literature review regarding the prevalence and growing importance of tax exporting in the U.S., (ii) to provide an alternate derivation of the optimal Nash equilibrium, and (iii) to correct errors in equations in the original manuscript.

In a recent U.S. tax exporting analysis compiled by Prante and Navin (2016) (Prante-Navin), results suggest that up to 45 percent of overall state and local tax collections are ultimately borne by source jurisdiction non-residents. This result is markedly different than the 23 percent found in McLure (1967) and the 26 percent in Morgan et al (1996).

The difference is accounted for by what the author's and others coin the "new view" of property tax incidence. Following Zodrow and Mieszkowski (1983), the "new view" treats property taxes as distortionary where distortion effects are reflected in price differentials across local capital markets. As the analysis determines, three key factors affect the ability of jurisdictions to export taxes (a) reliance on property taxation and other taxes on capital, (b) a jurisdiction may be endowed with an abundance of extractable natural resources, and (c) tourism draws a wealth of visitors.

Reliance on property taxation at the state and sub-state level in the U.S. is pervasive. Roughly 32 percent of overall state tax revenues are sourced from property taxation making it the largest single source (Prante and Navin 2016). Moreover, 72 percent of local (sub-state) government's tax revenues are sourced from property taxation (Urban-Brookings Tax Policy Center 2017). Regions rich with exploitable natural resources generally tax the production post severing it from the ground (Kunce and Morgan 2005). The incidence of these 'severance' taxes generally falls on the producing firms as assumed by Prante-Navin. In most cases, extraction firms are owned outside the region where production occurs. Lastly, jurisdictions' with a large tourism sector can exploit non-resident taxation very efficiently. Sales, specific use, transportation and lodging taxes generally dominate fiscal structures in these regions.

Prante-Navin found that 27 states and the District of Columbia[1] are net tax exporters in the calendar year 2012. A net tax exporter is defined by taking gross tax revenues exported (per capita) less gross tax revenues imported (per capita) for a specific state.[2] The top five largest net tax exporting jurisdictions (per capita) are Alaska, North Dakota, District of Columbia, Tennessee and Hawai'i. Interestingly, Alaska's net tax exporting proficiency exceeds that of North Dakota's by a factor 2 to 1. Prante-Navin do not address excess burden costs or local public goods spillovers in their extensive examination. Paired with these year 2012 empirical findings, contributions from the new economic geography (NEG) literature have also elevated the importance of understanding mobile capital tax exporting and its welfare effects. Essentially, NEG models find that agglomeration forces may mitigate tax competition pressures through capital tax exporting (see Baldwin and Krugman 2004 for a review).[3] Previously, mobile factor tax exporting was viewed as scarcely important and received scant attention in the literature.

[1] Commuting from surrounding states (along with tourism) bolsters the District's ability to tax export.
[2] See Prante and Navin (2016) Table 4. p. 46-47.
[3] Reconciling NEG with traditional tax competition is not direct and appears tenuous (Fernandez 2005).

THE AMENDED MODEL

Suppose for simplicity that an area's economy consists of two symmetric regions (indexed by $i = 1, 2.$).[4] The region's population is fixed and each identical resident owns an equal share of a productive fixed factor L_i. Each region produces a homogeneous numeraire private good that is sold in a national market. Production requires capital inputs, K_i and κ_i, and the regional fixed factor, L_i. The fixed domestic-capital stock, $\overline{K}$, is owned in equal regional shares, θ_i, by residents.[5] The fixed capital stock, $\overline{\kappa}$, is owned entirely by agents outside the two regions modeled.[6] Absentee-capital owners are committed to invest the entirety of $\overline{\kappa}$ to the modeled economy. Attractive risk rewards, favorable tax deduction reciprocities, preferential treatment, general agglomeration forces and/or strong complementarities to other regional production inputs surface as decisive factors for this investment.

Let $f(K, \kappa, L)$ denote each jurisdiction's constant-returns-to-scale technology. Production possesses all conventional curvature properties hence all marginal products f_K, f_κ, f_L are positive and diminish f_{KK}, $f_{\kappa\kappa}$, $f_{LL} < 0$, where subscripts denote partial derivatives. Concavity requires,

$$\mathrm{A} = f_{KK} f_{\kappa\kappa} - f_{\kappa K} f_{K\kappa} > 0, \tag{1}$$

$$2 f_{KL} f_{\kappa L} f_{K\kappa} - (f_{KL})^2 f_{\kappa\kappa} - (f_{\kappa L})^2 f_{KK} + \mathrm{A} f_{LL} < 0, \tag{2}$$

where each successive leading principal minor (Hessian) determinate alternates signs. Linear homogeniety of production and Euler's theorem establishes,

$$f(K, \kappa, L) = f_K K + f_\kappa \kappa + f_L L, \tag{3}$$

while differentiating equation (3) with respect to each input yields,

$$f_{KK} K + f_{\kappa K} \kappa + f_{LK} L = 0, \tag{4}$$

[4] The presumption of symmetric regions allows us to avoid the potential inefficiencies in which Tiebout-type regions are inefficiently organized or incongruously stratified by class, information, wealth or size. Moreover, if inefficiencies arise in a symmetric setting, they are likely to be exacerbated in an asymmetric construct.

[5] Following convention, the model focuses on the allocation of a fixed stock rather than new capital formation. Additionally, from this point forward the use of subscripts will be limited, however functions are understood to be region specific.

[6] See Wildasin (1989) for a similar construct, though the implications of tax exporting are not explored. In a two region model, Mongrain and Wilson (2018) treat 'foreign capital (firms)' as the other region's domestic mobile capital.

$$f_{K\kappa}K + f_{\kappa\kappa}\kappa + f_{L\kappa}L = 0, \quad (5)$$

$$f_{KL}K + f_{\kappa L}\kappa + f_{LL}L = 0. \quad (6)$$

Additionally, Young's theorem allows us to define *all* common mixed partial derivatives as equal, for example $f_{\kappa K} = f_{K\kappa}$. Equations (4) - (6) constrain at least one mixed partial in each equation to be positive.

Both capital types are perfectly mobile within and across regions (at least in the long run) following,

$$K_1 + K_2 = \overline{K} \text{ and } \kappa_1 + \kappa_2 = \overline{\kappa}. \quad (7)$$

Regions in this strategic construct possess some level of market power over returns to mobile factors. Let r and ρ denote endogenous net returns to domestic and absentee-owned capital. Each capital type faces separate source based unit taxation. Capital types contribute to a region's technology distinctively warranting differential tax treatment that enhances a jurisdiction's welfare (Smith 1999, Kunce 2000).[7] Profit maximizing mobile factor equilibrium conditions become,

$$r = f_K - t \text{ and } \rho = f_\kappa - \tau, \quad (8)$$

denoting that the net return of capital inputs are equal to the after tax value of each marginal product. Since both types of capital are mobile, respective net returns must be equalized across regions. Equations (7) and (8) provide the necessary system of equations required to determine equilibrium values of K, κ, r and ρ as implicit functions of tax rates t and τ. The following is a summary of the relevant jurisdiction specific comparisons derived. The ratio of two differentials are interpreted as partial derivatives when holding all other variables constant.

$$\frac{\mathrm{d}K}{\mathrm{d}t} = \frac{f_{\kappa\kappa}}{2\mathrm{A}} < 0,\ \frac{\mathrm{d}K}{\mathrm{d}\tau} = \frac{-f_{K\kappa}}{2\mathrm{A}}, \quad (9)$$

$$\frac{\mathrm{d}\kappa}{\mathrm{d}t} = \frac{-f_{K\kappa}}{2\mathrm{A}},\ \frac{\mathrm{d}\kappa}{\mathrm{d}\tau} = \frac{f_{KK}}{2\mathrm{A}} < 0, \quad (10)$$

[7] Parallels are lifted from the commodity tax literature, see Mintz and Tulkens (1986). In a related vein, Mongrain and Wilson (2018) model a preferential tax system where foreign and domestic capital face different tax rates.

Equation (10) denotes the correct version of *equation (8)* found in the original manuscript.

$$\frac{\mathrm{d}r}{\mathrm{d}t} = -\frac{1}{2} < 0, \ \frac{\mathrm{d}r}{\mathrm{d}\tau} = 0, \tag{11}$$

$$\frac{\mathrm{d}\rho}{\mathrm{d}t} = 0, \ \frac{\mathrm{d}\rho}{\mathrm{d}\tau} = -\frac{1}{2} < 0. \tag{12}$$

Irrefutable signs stemming from the maximization hypothesis apply to six of the comparisons shown in equations (9) - (12), signs of the other two are ambiguous and depend on production input relationships that we will explore in more detail below.

Output from production is consumed as a composite private good, X, or supplied to the regional government to produce a Samuelsonian public good, G. The public good is financed by taxing both types of capital where,

$$G = tK + \tau\kappa. \tag{13}$$

Regional consumption is defined,

$$X = f(K, \kappa, L) - rK - \rho\kappa - G + r\theta\overline{K}, \tag{14}$$

which represents output net of returns to capital types, public good financing and adding back the region's domestic capital ownership returns. Fixed, identical residents of a region receive utility from consumption and local public goods. Regional utility takes the form, $U(X,G)$, where U_X and $U_G > 0$. In keeping with the Arrow-Debreu (Wilson 1999) separation assumption for general equilibrium constructs, residents have two distinct roles in the model. First, as consumers, they seek to maximize utility over a bundle of goods and services. Second, supplying production inputs and in return receiving income returns. More of the mobile factors enhance local production and can provide residents with higher incomes hence more consumption. However, in order to attract the mobile factors, the jurisdiction lowers taxes (effecting G) thus setting up a characteristic economic tradeoff.

Will imperfect competition among jurisdictions lead to efficiency? Since all residents in the model are fixed and identical, we can reduce the analysis to a regional focus providing a useful benchmark. Social efficiency requires the maximization of a region's utility subject to (i) utility in all other jurisdictions is equalized to a fixed level, (ii) aggregate production and consumption clear, and (iii) the mobile factor stocks are allocated entirely among regions (clear). The resulting social optimum conditions are well known (see Wilson 1999) therefore derivation discussion in this section is keep to a minimum. Ignoring any corner solutions, efficiency becomes,

$$MRS_{G,X} = \frac{U_G}{U_X} = 1 \quad \forall i, \tag{15}$$

$$f_K^i = f_K^j \text{ and } f_\kappa^i = f_\kappa^j \quad \forall i, j \quad j \neq i. \tag{16}$$

Equation (15) represents the familiar 'Samuelson condition' for the provision of public goods (Wilson 1999). This appropriate optimality condition suggests that the marginal rate of substitution ($MRS_{G,X}$) between the public good and consumption (over all regional residents) equals the marginal cost of providing an incremental increase in the public good. Given equation (14), the marginal rate of transformation in this context is one for one. Equation (16) shows the optimal clearing condition for the mobile production factors.

Regional governments play a Cournot-Nash game in tax rates. Acting as benevolent dictators, authorities in each region will choose t and τ that maximize the common utility of its residents, subject to holding tax policies in the other region as given. A region's utility maximizing conditions, in total differential form, become,

$$\mathrm{d}U = U_X \mathrm{d}X + U_G \mathrm{d}G = 0. \tag{17}$$

Changes in regional consumption are derived,

$$\mathrm{d}X = f_K \mathrm{d}K + f_\kappa \mathrm{d}\kappa + f_L \mathrm{d}L - (r\mathrm{d}K + K\mathrm{d}r) - (\rho \mathrm{d}\kappa + \kappa \mathrm{d}\rho) - \mathrm{d}G + \theta\overline{K}\mathrm{d}r,$$

or when evaluating at the symmetric equilibrium where θ = 1/2 resulting in $\theta\overline{K} = K$ and using equations (8),

$$\mathrm{d}X = [t\mathrm{d}K + \tau \mathrm{d}\kappa - \kappa \mathrm{d}\rho] - \mathrm{d}G. \tag{18}$$

Recall that L is fixed in the jurisdiction's point of view. The negative of the bracketed section of equation (18) denotes the correct version of *equation (16)* found in the original manuscript. Changes in the local public good become,

$$\mathrm{d}G = t\mathrm{d}K + K\mathrm{d}t + \tau \mathrm{d}\kappa + \kappa \mathrm{d}\tau. \tag{19}$$

Best response (reaction) functions are derived by evaluating equations (17) - (19) with respect to each choice variable where,

$$(t):\quad U_X\frac{\mathrm{d}X}{\mathrm{d}t}+U_G\frac{\mathrm{d}G}{\mathrm{d}t}=0,$$
$$\frac{\mathrm{d}X}{\mathrm{d}t}=t\frac{\mathrm{d}K}{\mathrm{d}t}+\tau\frac{\mathrm{d}\kappa}{\mathrm{d}t}-\kappa\frac{\mathrm{d}\rho}{\mathrm{d}t}-\frac{\mathrm{d}G}{\mathrm{d}t},$$

$$\frac{\mathrm{d}G}{\mathrm{d}t}=t\frac{\mathrm{d}K}{\mathrm{d}t}+K+\tau\frac{\mathrm{d}\kappa}{\mathrm{d}t}. \tag{20}$$

Combining equations (20) with suitable rearrangement yields,

$$(t):\quad \left[\frac{U_G}{U_X}-1\right]\left[t\frac{\mathrm{d}K}{\mathrm{d}t}+K+\tau\frac{\mathrm{d}\kappa}{\mathrm{d}t}\right]+t\frac{\mathrm{d}K}{\mathrm{d}t}+\tau\frac{\mathrm{d}\kappa}{\mathrm{d}t}-\kappa\frac{\mathrm{d}\rho}{\mathrm{d}t}=0. \tag{21}$$

To complete the best response function with respect to *t*, we substitute into equation (21) the relevant comparisons from equations (9) - (12) resulting in,

$$(t):\quad \left[\frac{U_G}{U_X}-1\right]\left[t\left(\frac{f_{\kappa\kappa}}{2\mathrm{A}}\right)+K-\tau\left(\frac{f_{K\kappa}}{2\mathrm{A}}\right)\right]+t\left(\frac{f_{\kappa\kappa}}{2\mathrm{A}}\right)-\tau\left(\frac{f_{K\kappa}}{2\mathrm{A}}\right)=0. \tag{22}$$

Following the same derivation procedure, the best response function for τ becomes,

$$(\tau):\quad \left[\frac{U_G}{U_X}-1\right]\left[-t\left(\frac{f_{K\kappa}}{2\mathrm{A}}\right)+\kappa+\tau\left(\frac{f_{KK}}{2\mathrm{A}}\right)\right]-t\left(\frac{f_{K\kappa}}{2\mathrm{A}}\right)+\tau\left(\frac{f_{KK}}{2\mathrm{A}}\right)+\frac{\kappa}{2}=0, \tag{23}$$

Solving equations (22) and (23) simultaneously yields the optimal tax rules *with* efficiency in public goods provision,

$$t=-\kappa f_{K\kappa}\quad\text{and}\quad\tau=-\kappa f_{\kappa\kappa}, \tag{24}$$

A mix of capital taxation is chosen with efficient public goods provision. An interior utility maximizing condition in public goods requires,

$$G=\kappa(-Kf_{K\kappa}-\kappa f_{\kappa\kappa})>0, \tag{25}$$

or when using equation (5),

$$G=\kappa(Lf_{\kappa L})>0. \tag{26}$$

An efficient interior public goods result is secured when absentee-capital productivity is enhanced by the region's fixed factor ($f_{\kappa L} > 0$). This requisite is intuitively appealing given the necessary absentee-capital investment assumptions discussed above.

DISCUSSION AND CONCLUDING REMARKS

The optimal tax rule for domestically owned capital is dependent on the region's production relationship between the two capital types, $f_{K\kappa}$. For example, if the marginal product of domestic-capital diminishes with incremental increases in absentee-capital employed (substitutes), t is positive. Conversely, a complementary relationship gives rise to domestic-capital subsidies. No relationship between capital types would yield, $t = 0$. The maximization hypothesis, concavity, production linear homogeneity and interior solution conditions generate no *firm* boundaries regarding the sign of $f_{K\kappa}$. Nevertheless, a substitute relationship between capital types would bolster concavity bounds imposed by equation (2).

Alternatively, a region's optimal absentee owned capital tax rate is unambiguously positive. Devolved efficiency is the consequence of shifting taxes to non-resident capital owners. Because the welfare of non-residents secures no weight in a region's objective function, tax exporting becomes welfare enhancing. Alternatively, tax exporting counteracts the tension created by mobile factor tax competition and allows for the efficient provision of the local Samuelsonian public good. Conversely, tax structures that restrict taxation to domestically owned mobile factors would not yield such efficient outcomes (Smith 1999; Wilson 2015). A note of interpretive caution, the feasibility of this Nash equilibrium collapses once absentee-capital commitments erode. Strong, long-run synergism between absentee-capital and a region is crucial to this optimal decentralized result.

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