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Abstract

We study interregional competition for mobile creative capital between regions A and B. Regional authorities (RAs) in both regions use tax policy to attract the creative capital possessing members of the creative class to their region. The resulting tax revenues help RAs finance other objectives such as the provision of one or more public goods. In this setting, we accomplish five tasks. First, we explain the significance of a parameter ζ that is related to the marginal product of creative capital. Second, we compute the Nash equilibrium tax rates when each RA chooses its tax rate to maximize tax revenue. Third, we discuss how a decline in ζ affects the Nash equilibrium tax rates. Fourth, we determine the two efficient tax rates. Finally, we discuss the implications of our analysis for a policy that raises revenue by taxing creative capital.

Keywords: Competition, Creative Capital, Efficiency, Mobility, Tax Revenue

JEL Codes: R11, R50, H20

1. Introduction

1.1. Preliminaries

What is the creative class? Second, what is special about members of the creative class? Finally, should a regional authority (RA) that is interested in promoting economic growth and development in its region pay attention to the creative class? The urbanist Richard Florida was the first to provide comprehensive answers to these three questions in his well-known 2002 tome titled *The Rise of the Creative Class*. In this book (2002, p. 68), Florida explains that the *creative class* "consists of people who add economic value through their creativity." This class is made up of a variety of professionals such as attorneys, computer scientists, medical doctors, university professors, and, notably, bohemians such as artists, musicians, and sculptors. In other words, the creative class consists of a *heterogeneous* group of individuals. This means that policymakers seeking to attract creative class members to a particular region will need to account for this heterogeneity because computer scientists, for example, are likely to be more mobile than artists.[4]

What is special about the members of the creative class is that they possess *creative capital*, which is defined to be the "intrinsically human ability to create new ideas, new technologies, new business models, new cultural forms, and whole new industries that really [matter]" (Florida, 2005, p. 32). The creative capital possessing members of the creative class are salient because, *inter alia*, this group of individuals is able to produce outputs that are important for the growth and development of cities and regions.[5] Therefore, it follows that cities and regions that want to thrive

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We say this because according to the U.S. Bureau of Labor Statistics, jobs for individuals employed in "computer and mathematical occupations" are expected to grow at 9 percent in the 2020-2030 time period which is much *faster* than the 4 percent rate of job growth in 2020-2030 for those individuals employed in "arts, design, entertainment, sports, and media occupations." Go to https://www.bls.gov/ooh/about/data-for-occupations-not-covered-in-detail.htm#Arts,%20design,%20entertainment,%20sports,%20and%20media%20occupations for more details.

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See Florida *et al*. (2008) and Florida *et al*. (2012) for a more detailed corroboration of this point.

in the global arena need to do all they can to attract and retain members of the creative class because, we are led to believe, this class is the primary driver of economic growth and development.

Given the work of Houston *et al.* (2008), Oakley (2009), Batabyal and Beladi (2021), and Batabyal and Nijkamp (2021), we can now say that creative class members, in general, are mobile and hence regions seeking to attract and retain them will need to *compete* with other regions for their services. Second, Batabyal and Nijkamp (2021) tell us that RAs can use *tax* policy to perform these "attract and retain" functions. Even so, the work of Reiner (1971), Korbee *et al*. (2019) and many others informs us that RAs frequently have to work with *multiple* goals. This state of affairs raises the following question: Suppose that all the RAs in an aggregate economy use tax policy to compete for mobile creative capital. These RAs also seek to maximize the revenue from their tax on creative capital because this tax revenue can then be used to finance one or more of their multiple goals such as the provision of one or more public goods. In this setting, what are the properties of the tax rates on creative capital that arise out of the strategic competition between the different regions and, in addition, how do these tax rates compare with the efficient tax rates?

To the best of our knowledge, the above question has received *no* theoretical attention in the regional science literature. Therefore, we analyze this question in our paper. However, before we proceed to the details of the analysis itself, let us first substantiate the claim about "no theoretical attention" that we just made, by reviewing the sparse extant literature on this subject.

1.2. Literature review

Schmitz (2013) discusses how the earmarked tax revenue from Colorado's Scientific and Cultural Facilities District (SCFD) can be used to provide a somewhat stable source of funding for the arts. As she points out, the tax revenue itself can be based on sales taxes---as in the SCFD---or on other kinds of taxes. Haisch and Klopper (2015) study the extent to which taxes, in addition to the trait of tolerance and other regional amenities, influence the location decisions of members of the creative class.[6]

Buettner and Janeba (2016) analyze competition between cities for the creative class and point out that the incentive faced by cities to provide public amenities to the creative class is particularly strong when institutional restrictions prevent local governments from adjusting their tax structure. The subject of capital taxation in a creative region has been studied by Batabyal (2017). He describes the circumstances in which a policy of subsidizing investment and raising the revenue for this subsidy with lump-sum taxes, increases economic welfare.

Khan *et al*. (2019) contend that there is a clear connection between the growth of a creative economy and the enforcement of intellectual property rights. Therefore, adequate enforcement of these rights is necessary to generate tax revenues that can then be used to provide incentives to creators for their investments of labor, finance, and expertise. Finally, Batabyal and Nijkamp (2021) study the extent to which taxes are useful in attracting mobile creative capital to a region when physical capital, the second factor of production, is and is not mobile across the regions being studied.

This review of the literature yields two conclusions. First, there are a small number of studies that have looked into the connections between creative capital use and the utilization of tax policy to influence this use in one or more ways. Second and consistent with our observation in section 1.1, there are *no* studies in regional science that have *theoretically* analyzed the attributes

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In addition to these two examples, authorities in many cities such as Memphis, Tennessee, Portland, Oregon, Providence, Rhode Island, and Tampa Bay, Florida have attempted to put in place policies (including fiscal policies) to attract creative individuals to their cities. Some of the initiatives these cities have taken are described in Peck (2005). At the state level, Michigan's "Cool Cities Program" seeks to put in place economic development policies that focus on creative people. See Michigan (2003) for more details on this program. Finally, for a general discussion of how tax incentives have been used to support the arts in the United States, go to https://www.americansforthearts.org/by-program/reports-and-data/legislation-policy/naappd/issues-in-supporting-the-arts-through-tax-incentives. Accessed on 30 November 2021.

of the tax rates on creative capital that arise out of the strategic or game-theoretic competition between different regions and, in addition, how these tax rates compare with the efficient tax rates.[7]

This lacuna in the existing literature in regional science provides the basic rationale for the analysis we undertake in the present paper. It should be noted that the game-theoretic tax competition model we study in our paper is related to the sizeable literature in public economics on strategic tax competition between different tax jurisdictions. By tax competition, we mean "the interaction among [regional authorities] due to interjurisdictional mobility of the tax base" (Hindriks and Myles, 2013, p. 665). A key issue that we investigate in our paper concerns the loss of the tax base by one jurisdiction and how this fact represents a gain for the other jurisdiction. Put differently, the *mobility* of creative capital across the two jurisdictions we study (on which more below) gives rise to an externality between the two jurisdictions.

It is worth noting that the above-mentioned public economics literature has pointed to the connections between tax competition between different jurisdictions and the so-called prisoner's dilemma game from non-cooperative game theory.[8] We note that relative to extant analyses in the literature, what is different in our analysis is that the *object* of taxation is creative capital and not labor, physical capital, or some other input. Second, the factor of production in our model that is *mobile* across the two regions (tax jurisdictions) being studied is creative capital and, once again, not labor, physical capital, or some other input. Finally, the *meaning* of the so-called marginal

7 We are not assessing "differential tax forms on creative capital" in this paper. In this regard, it should be noted that we study marginal tax rate changes or, put differently, changes that can be analyzed using calculus.

8 The pioneering papers in strategic tax competition are the ones by Mintz and Tulkens (1986) and by Wildasin (1988). This early research has given rise to a number of studies that discuss the game-theoretic nature of tax competition. Of these studies, the ones that are most relevant for the analysis we undertake in our paper are those that demonstrate how tax competition between different jurisdictions can be meaningfully viewed as a prisoner's dilemma game between these same jurisdictions. For more on this point, see Janeba and Peters (1999), Cremer and Gahvari (2006), Rixen (2011), and Kalamov (2020). For a textbook discussion of this tax competition literature, see Hindriks and Myles (2013). The prisoner's dilemma game is nicely discussed in Gibbons (1992).

product of creative capital in our paper is also different from the meaning ascribed in the literature to the marginal product of either labor or physical capital.

The rest of this paper is organized as follows: Section 2.1 describes the theoretical framework. In this framework, the object of our study is an aggregate economy consisting of two regions denoted by A and B. Section 2.2 explains the significance of a parameter ζ that is related to the marginal product of creative capital. Section 2.3 computes the Nash equilibrium tax rates when the RA in each region chooses its tax rate non-cooperatively to maximize tax revenue. Section 2.4 discusses how a decline in the parameter ζ affects the Nash equilibrium tax rates. Section 2.5 determines the two efficient tax rates. Section 2.6 first discusses our results and then comments on the implications of our analysis for a policy that raises revenue by taxing creative capital. Finally, section 3 concludes and then suggests three ways in which the research delineated in this paper might be extended.

2. Analysis

2.1. The theoretical framework

Consider an aggregate economy consisting of two regions indexed by $i = A, B$. The total stock of creative capital $R > 0$ in the aggregate economy is fixed but mobile between regions A and B. It makes sense to think of the stock of creative capital as being fixed because our analysis is static in nature. How much of this fixed stock of creative capital settles in one or the other region depends on the after-tax return in each of these two regions. The creative capital that settles in region i is denoted by R_i.

Let the after-tax return to creative capital in region $i, i = A, B$, be denoted by c_{τ_i} and we have

$$c_{\tau_i} = c - \zeta R_i - \tau_i. \tag{1}$$

In equation (1) τ_i is the tax levied on creative capital in region i, c is like an interest rate and we shall refer to c as the rental rate of creative capital, and ζ is a parameter whose meaning we now explain in the following section.[9]

2.2. The meaning of ζ

Inspection of equation (1) and some knowledge of intermediate public economics---see Hindriks and Myles (2013, pp. 664-681)---together tell us that the term $c - \zeta R_i$ is the marginal product of creative capital. Alternately, we can also think of this term as the return to creative capital in the absence of a tax. Now, differentiating the term $c - \zeta R_i$ with respect to R_i gives us $d(c - \zeta R_i)/dR_i = -\zeta < 0$. Therefore, using the sign of the preceding derivative and given that $c - \zeta R_i$ is the marginal product of creative capital, the parameter ζ measures the *rate* at which this marginal product declines as more creative capital enters and settles in region i.[10]

That said, the reader should note the following three points. First, the marginal product of creative capital or $c - \zeta R_i$ is *decreasing* in the creative capital input R_i. This result is entirely consistent with modern microeconomic theory---see Hindriks and Myles (2013, p. 668)---in which it is standardly assumed that production functions are concave in their arguments, reflecting diminishing returns, and therefore the marginal product functions are decreasing in additional amounts of the relevant input. As pointed out above, if we set $\tau_i = 0$ in equation (1) then we can also interpret the marginal product $c - \zeta R_i$ as the zero or no tax return to creative capital. Since

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By rewriting equation (1) to separate out the rental rate of creative capital or c, we obtain the equation $c = c_{\tau_i} + \zeta R_i + \tau_i$. Also, remember that $R_i = R - R_j, j \neq i$. Putting these last two results together, we are able to conclude that for any given region $i, i = A, B,$ c is *not* negatively related either to R_i or to R.

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In our model, there is an *unambiguous* relationship between the parameter ζ which denotes a rate and the marginal product of creative capital $c - \zeta R_i$. This should be clear to the reader from an inspection of the preceding mathematical expression. That said, the following points now deserve some mention. First, we are *not* saying that the rate ζ and the marginal product of creative capital are one and the same; they clearly are not. Second, in the abstract, we said that the parameter ζ *is related to* the marginal product of creative capital. This sentence is obviously true and we have just demonstrated exactly how ζ is related to the marginal product of creative capital. Finally, the rate ζ may or may not be related to the marginal product in alternate models of tax competition but that is manifestly *not* the case in the model that we are working with.

this zero-tax return to creative capital is identical to the marginal product of creative capital and the marginal product of creative capital is decreasing in R_i, it follows that the no-tax return to creative capital is also decreasing in R_i. Second, inspecting equation (1), it is clear that the return to creative capital with the tax is also *decreasing* in R_i. This finding arises---see Hindriks and Myles (2013, p. 665)---because a tax on an input such as creative capital in one region typically leads this input to seek a better return in the other region. Put differently, the mobility of the creative capital input results in a loss of the tax base in the taxing region and a gain to the other region. Finally, although this is not an issue in our paper, it is possible to construct models in which there are agglomeration effects in the sense that the return to, for instance, artists, increases with the number of artists present in a particular location such as a city.

We now proceed to Section 2.3 and calculate the Nash equilibrium tax rates when the RA in each region chooses its tax rate to maximize tax revenue.

2.3. The Nash equilibrium tax rates

Given the mobility of creative capital across the two regions A and B, for there to be a locational equilibrium in our aggregate economy, the after-tax return to creative capital in these two regions must be equal. In symbols, this means that the condition

$$c - \zeta R_A - \tau_A = c - \zeta R_B - \tau_B \tag{2}$$

must hold. Simplifying equation (2) to isolate R_A on the left-hand-side (LHS), we get

$$R_A = R_B + \frac{\tau_B - \tau_A}{\zeta}. \tag{3}$$

We know that the total stock of creative capital satisfies the condition $R = R_A + R_B$. Therefore, we can use this last condition to substitute for R_B on the right-hand-side (RHS) of equation (3). This substitution gives us

$$R_A = \frac{R}{2} + \frac{\tau_B - \tau_A}{2\zeta}. \tag{4}$$

Now, the total revenue to the RA in region A from taxing the creative capital that locates in its region is given by $\tau_A R_A$. Using equation (4), this expression for the total revenue can be written as

$$\tau_A R_A = \frac{\tau_A R}{2} + \frac{\tau_A(\tau_B - \tau_A)}{2\zeta}. \tag{5}$$

The region A RA's objective is to choose the tax on creative capital τ_A to maximize the RHS of equation (5). The first-order necessary condition for a maximum to this optimization problem is[11]

$$\frac{R}{2} + \frac{\tau_B}{2\zeta} - \frac{2\tau_A}{2\zeta} = 0. \tag{6}$$

Simplifying equation (6) to isolate the RA's tax τ_A on the LHS gives us

$$\tau_A = \frac{\zeta R + \tau_B}{2}. \tag{7}$$

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The second-order sufficiency condition is satisfied.

Observe that in order to compute the Nash equilibrium tax τ_B in region B, the RA in this region solves a maximization problem that is *symmetric* to the one solved by the RA in region A. Therefore, using the symmetry of the tax rate choice problem, we obtain an expression for the relevant tax rate τ_B in region B.[12] That rate is

$$\tau_B = \frac{\zeta R + \tau_A}{2}. \tag{8}$$

Inspecting the two tax rates in equations (7) and (8), we see that these two taxes are *strategic complements*.[13] This means that the decision variables (the two taxes) of the two regions mutually reinforce each other. In other words, a higher tax rate in region A (B) results in the relocation of creative capital to region B (A), which responds by *raising* its own tax rate. More specifically, when there is a higher tax rate in region A and therefore creative capital moves to region B, the reason why the RA in region B raises its own tax rate is that by doing so, it *raises* its tax revenue and recall that in our paper, both RAs are seeking to maximize their tax revenues.

Now, solving equations (7) and (8) simultaneously, we obtain a closed-form expression for the Nash equilibrium tax rates on creative capital in regions A and B. We get

$$\tau_A = \tau_B = \tau_N = \zeta R, \tag{9}$$

where τ_N is the common, Nash equilibrium tax rate on creative capital in regions A and B. Inspecting equation (9), we see that $\zeta \uparrow \Rightarrow \tau_N \uparrow$ and $R \uparrow \Rightarrow \tau_N \uparrow$. In words, an increase in either the parameter ζ or the total stock of creative capital R requires the RA in either region A or B to raise

12 If we were to focus on an asymmetric Nash equilibrium then the method used here to derive the equilibrium taxes would need to be modified.

13 See Tirole (1988, pp. 207-208) for a textbook discussion of strategic complements and substitutes.

the Nash equilibrium tax rate it levies on the creative capital that settles in its region. We now discuss how a decline in the parameter ζ affects the two Nash equilibrium tax rates described in equation (9).

2.4. Impact of a decline in ζ on the Nash equilibrium tax rates

Recall from the discussion in section 2.2 that $c - \zeta R_i$ is the marginal product of creative capital. Inspecting equation (9), we see that as $\zeta \to 0, \tau_N \to 0$. Putting these two pieces of information together, observe that when the return to creative capital in each region is *unaffected* by the quantity of creative capital, all creative capital can move from one region to the other in response to the *slightest difference* in the two tax rates. This explains why the two Nash equilibrium tax rates are optimally equal to zero when the parameter ζ approaches zero. Our next task is to compute the two efficient tax rates.

2.5. Efficient tax rates

From the perspective of our aggregate economy consisting of regions A and B, the total stock of creative capital is fixed. Therefore, if the RAs in the two regions under study were to *cooperate* and coordinate their tax rate policies then the fixity of creative capital means that these two RAs could appropriate the full return to creative capital for their respective regions. We emphasize that the preceding finding about appropriating the entire return to creative capital depends on the fixity of the total stock of creative capital. So, as long as the two RAs levy the *same* tax rate on creative capital, half the total stock of creative capital will locate in one region and the other half in the other region, *independent* of the level of these two tax rates.

Suppose one-half of the total stock of creative capital or $R/2$ settles in each region under study. Then, our analysis thus far in this paper tells us that the *zero-tax* return to this $R/2$ amount of creative capital is given by c_{τ_B} which equals

$$c_{\tau_B} = c - \frac{\zeta R}{2}. \tag{10}$$

Now, given that the tax rates in regions A and B are identical, for this common tax rate to be efficient, it must be set equal to the zero-tax return described in equation (10). Therefore, the conclusion we come to is that the efficient and cooperative tax rate or τ_E equals

$$\tau_E = c_{\tau_B} = c - \frac{\zeta R}{2}. \tag{11}$$

We now discuss our results and then comment on the implications of our analysis for a policy that raises revenue by taxing creative capital.

2.6. Discussion

Note that as long as the RHS of equation (11) or $c - \zeta R/2$ is positive, it follows that $\tau_E > \tau_N$. In words, the (cooperative) efficient tax rate is *larger* in magnitude than the (non-cooperative) Nash equilibrium tax rate. This finding tells us that competition between regions A and B in setting the tax rates leads to an *inefficiently low* level of the tax rate on creative capital.

To understand the above result, observe that the mobility of creative capital across regions A and B creates an externality among the two regions that is *not* internalized when the RAs in these two regions set their tax rates non-cooperatively. This externality arises because a higher tax rate in one region pushes some of the available creative capital into the other region. This "push" factor has the beneficial impact of raising the other region's tax base and hence its tax revenue for any given tax rate. When the RAs in regions A and B cooperate among themselves, the externality mentioned above is effectively internalized and, as a result, the two RAs can select a mutually desirable set of tax rates.

The above line of reasoning tells us that competition for mobile creative capital leads to tax rates that are *lower* than what is efficient for regions A and B. This happens because, consistent with an observation of ours in section 1.2, the RAs of the two regions are, in essence, locked into playing a prisoner's dilemma game. This game is shown in matrix form in Table 1. The "row

Table 1 about here

player" in this Table is the RA of region A and the "column player" is the RA of region B. Both these players have two strategies. They can either set the tax rate at the cooperative or efficient level $(c - \zeta R/2)$ or at the non-cooperative Nash equilibrium level (ζR). The optimal outcome of this game is in the upper-left cell where both RAs "play" their cooperative strategies and set the tax rate at the efficient level given by equation (11). In contrast, when the two regions do not cooperate and "play" their strategies so that the tax rates are at the Nash equilibrium level given by equation (9), the suboptimal outcome shown in the lower-right cell arises. Finally, the two off-diagonal cells described by the strategies (Cooperate, Don't Cooperate) and (Don't Cooperate, Cooperate) are not of interest because the outcomes described in these two cells are not equilibrium outcomes.

The reader may want to think of the "inefficiently low Nash equilibrium tax rates" outcome that we have been describing as the result of an interaction between the two regions in our aggregate economy in which each region is attempting to undermine the other so as to attract more creative capital to its region. This undermining exerts downward pressure on the tax rates and this disadvantages regions A and B. The basic policy conclusion that emerges from this discussion is that when seeking to attract mobile creative capital, it is better to cooperate than to behave non-cooperatively. This completes our analysis of efficient regional taxes in the presence of mobile creative capital.

3. Conclusion

In this paper, we analyzed interregional competition for mobile creative capital between two regions called A and B. RAs in both regions used tax policy to attract the creative capital possessing members of the creative class to their region. The resulting tax revenue helped the two RAs fund their other goals such as the provision of public goods. In this setting, we undertook five tasks. First, we explained the importance of the parameter ζ that was related to the marginal product of creative capital. Second, we calculated the Nash equilibrium tax rates when each RA chose its tax rate non-cooperatively to maximize tax revenue. Third, we discussed how a reduction in ζ affected the Nash equilibrium tax rates. Fourth, we ascertained the two efficient tax rates. Finally, we discussed our findings and then commented on the implications of our analysis for a policy that increased revenue by taxing creative capital.

The analysis in this paper can be extended in a number of different directions. Here are three possible extensions. First, it would be interesting to analyze the interregional competition question in a finitely repeated game framework in which the creative capital possessing members of the creative class interact with RAs over multiple time periods. Second, given the heterogeneity of the creative class noted in section 1.1, it would be instructive to partition the total creative class population into different groups consisting of, for instance, engineers, medical doctors, artists, and musicians, with each group possessing a different kind of creative capital, and to then analyze the extent to which tax and subsidy policies are useful to a RA in attracting the kinds of creative capital that it is most interested in attracting to its region. Finally, following Gilbert and Oladi (2009), it would be informative to study how the results obtained in this paper are impacted by the presence of an impediment to the mobility of creative capital between regions A and B. Studies that analyze these facets of the underlying problem will provide additional insights into the attributes of policy induced interactions between RAs and creative class members.

	Region B tax rate is $c - \frac{\zeta R}{2}$ (Cooperate)	Region B cuts tax rate to ζR (Don't Cooperate)
Region A tax rate is $c - \frac{\zeta R}{2}$ (Cooperate)	A collects $c - \frac{\zeta R}{2}$ B collects $c - \frac{\zeta R}{2}$ (Optimal Outcome)	A collects nothing B collects ζR
Region A cuts tax rate to ζR (Don't Cooperate)	A collects ζR B collects nothing	A collects ζR B collects ζR (Suboptimal Outcome)

Table 1: Regional Tax Competition as a Prisoner's Dilemma Game

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