Interregional Competition for Mobile Creative Capital With and Without Physical Capital Mobility

Batabyal, Amitrajeet and Nijkamp, Peter

Rochester Institute of Technology, Open University, Heerlen

29 December 2020

Interregional Competition for Mobile Creative Capital With and Without Physical Capital Mobility[1]

by

AMITRAJEET A. BATABYAL[2]

and

PETER NIJKAMP[3]

[1] For their helpful comments on two previous versions of this paper, we thank the Editor-in-Chief Alan Murray and two anonymous reviewers. In addition, Batabyal acknowledges financial support from the Gosnell endowment at RIT. Peter Nijkamp acknowledges grant PN-III-P4-ID-PCCF-2016-0166 from the Ministry of Research and Innovation (Romania), project ReGrowEU.The usual disclaimer applies.

[2] Department of Economics, Rochester Institute of Technology, 92 Lomb Memorial Drive, Rochester, NY 14623-5604, USA. E-mail: aabgsh@rit.edu

[3] Alexandru Ioan Cuza University, Iasi, Romania, A. Mickiewicz University, Poznan, Poland, and Open University, Heerlen, The Netherlands. E-mail: pnijkamp@hotmail.com

Interregional Competition for Mobile Creative Capital With and Without Physical Capital Mobility

Abstract

A lacuna in the extant literature and our desire to contribute to the theoretical literature on how tax/subsidy policies can be used by regions to attract the creative class together provide the motivation for this paper. The paper's basic contribution is that it is the *first* to *theoretically* analyze competition between two regions (1 and 2) for *mobile* creative capital, the key attribute possessed by the creative class. Both regions produce a final good using creative and physical capital. In the first case, physical capital is immobile and only region 2 uses tax policy to attract the mobile creative capital. We compute the equilibrium returns to creative and physical capital, we specify a key condition for creative capital in the aggregate economy, and we show which of three tax policies gives region 2 the highest income. In the second case, creative *and* physical capital are mobile and both regions pursue tax policies to attract mobile creative capital. Once again, we compute the equilibrium returns to creative and physical capital and then describe the optimal taxes for the two regions given that they wish to maximize regional income.

Keywords: Competition, Creative Capital, Physical Capital, Regional Income, Tax

JEL Codes: R11, R50, H20

1. Introduction

1.1. Definitions

It is fair to say that researchers interested in studying regional economic growth and development are now very familiar with two concepts that were first introduced by Richard Florida in his well-known 2002 book titled *The Rise of the Creative Class*. The first concept is that of the *creative class* and the second concept is that of *creative capital*. According to Florida (2002, p. 68), the creative class "consists of people who add economic value through their creativity." This class is made up of specialists such as engineers, lawyers, medical doctors, scientists, university professors, and, notably, bohemians such as artists, musicians, and sculptors. What exactly about these specialists is relevant for regional economic growth and development? As Florida (2002, 2005) explains, what is germane is that these specialists 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).

In subsequent work, Florida has emphasized the point that in his view of regional economic development, the creative capital possessing creative class is significant because this group possesses certain attributes and is therefore able to give rise to outputs that are important for the growth and development of cities and regions.[4] Hence, cities and regions that want to prosper in the global arena need to do all they can to attract members of the creative class because this class is, *inter alia*, the principal driver of regional economic growth.

The question of how tax/subsidy policies might be used by a region to compete for mobile creative capital has received *no* theoretical attention in the literature. Hence, we study this question in the present paper. However, before we proceed to the details of the analysis, let us first

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

substantiate the claim about "no theoretical attention" that we just made, by reviewing the extant literature.

1.2. Literature review

The functioning of what might be called "creative regions" has been studied by several researchers. In this regard, a creative region is one that utilizes creative capital in a way that promotes the economic well-being of the region. Usman and Batabyal (2014) study the effects of learning by doing in a creative region that uses creative and physical capital to produce a final good for consumption. They show that the economy of the creative region converges to a balanced growth path (BGP) in which the growth rates of physical capital, technology, and output of the final good are identical. 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.

Focusing on Istanbul, Falcioglu and Kurtaglu (2016) point out that "soft factors" such as cultural diversity and social opportunities influence the residential and work choices of the mobile members of the creative class. Batabyal and Beladi (2016) concentrate on India and study the creative capital accumulation decision faced by workers who are interested in becoming members of the creative class. Batabyal and Nijkmap (2016) point out that under plausible conditions, income inequality is a likely consequence in a creative region that uses creative capital to produce a final consumption good.

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. Ostbye *et al.* (2018) use data

from Finland, Norway, and Sweden and chronicle the mobility of the creative class. They contend that there is a clear connection between what they call creative class jobs and individuals with high educational attainment. Vossen *et al.* (2019) use data and analyze the migratory behavior of the creative class within Germany. On the basis of this study, these researchers make policy recommendations for supporting what they call creative industries in Germany.

Let us now focus briefly on what cities and regions might do to attract members of the creative class. In this regard, Boyle (2006) notes that in order to comprehend why Scottish expatriates are attracted to and hence willing to live and work in Dublin, we must first understand the complex ways in which developmental states interact with skill flows and what he calls "cosmopolitan cultural agendas." Hansen and Niedomysl (2009) use Swedish data and argue that there is not a whole lot that regions can do to attract the creative class because members of this class move only slightly more than others and when they do move, they do so primarily for jobs rather than a particular place. Concentrating on Vancouver's biotechnology sector, Richardson (2009) contends that the availability of spousal work visas, professional employment options, and "traditional livability attributes" are most salient in attracting the creative class to Vancouver.

Angelopoulos *et al*. (2015) point out that in Australia, tolerant---but not necessarily diverse---places are likely to be successful in attracting the creative class. Conley and Whitacre (2016) point out that it is commonly thought that a lack of access to broadband prevents rural America from attracting the creative class. Even so, empirical analysis demonstrates that making broadband easily available is not a viable economic development strategy[5] in the sense that it may actually reduce the number of creative class members who are willing to reside and work in rural

[5] There is now a fairly sizeable literature that studies the nexuses between the creative class and economic development strategies. *Inter alia*, this literature has focused on topics such as the importance of small versus big projects and the importance of having a "people climate" and not just a conventional business climate. For more on this literature, see Currid-Halkett and Stolarick (2013), Florida (2014), Berry and Portney (2016), and the many references cited in these three papers.

America.

This review of the literature yields four conclusions. First, several studies have analyzed creative regions in which the production of one or more final goods is undertaken using creative and physical capital as inputs. Second, other studies have documented the fact that the mobility of creative capital explains in part why regions need to compete with each other to attract this kind of capital. Third, studies that have looked into what cities and regions might do to attract members of the creative class are primarily *empirical* in nature. Finally, and consistent with our observation in section 1.1, there are *no* studies that have *theoretically* analyzed how fiscal (tax/subsidy) policies might be used by a region to compete for mobile creative capital with other regions when physical capital may or may not be mobile across the regions being studied. This is the main *gap* in our knowledge that the present paper seeks to fill.

This lacuna in the existing literature and our desire to contribute to the formal literature on how taxes and subsidies can be used by regions to attract the creative class together provide the motivation for conducting the analysis in this paper. The basic contribution of this paper lies in the fact that, to the best of our knowledge, this is the *first* paper to analyze competition between two regions for *mobile* creative capital which is the key attribute possessed by members of the creative class. The main theoretical advance that our model makes is to show how (i) a parsimonious construct in which the relevant agents in the model optimize their objectives and (ii) numerical analysis can jointly shed valuable light on the research question mentioned in the beginning of this paragraph.[6]

Section 2 describes the theoretical framework. In this framework, the object of our study

[6] The basis for developing and analyzing our theoretical model is the gap that we have just alluded to in the preceding paragraph. We believe that our model and the associated analysis are expanding on prior theory because, as we have already noted, this model is the *first* to shed theoretical light on the question of how tax/subsidy policies might be used by a region to compete for *mobile* creative capital with other regions when physical capital may or may not be mobile across the regions being analyzed.

is an aggregate economy consisting of two regions denoted by 1 and 2. Section 3 focuses on the case in which physical capital is *immobile* between the two regions and *only* region 2 uses tax policy to attract the mobile creative capital. This section computes the equilibrium returns to creative and physical capital, specifies a key condition for creative capital in the aggregate economy, and then shows which of three tax policies gives region 2 the highest level of income. The reader should note that the focus in section 3 is *exclusively* on how income in the taxing region 2 is affected by the use of three different taxes. In this section, we are *not* interested in studying how the non-taxing region 1 is impacted by region 2's taxes. This is why our subsequent results in section 3 concentrate on region 2 specifically. In contrast, section 4 concentrates on the case in which creative *and* physical capital are mobile between regions 1 and 2 and *both* regions pursue tax policies to attract the mobile creative capital. As in section 3, this section computes the equilibrium returns to creative and physical capital, then delineates a ratio condition for creative to physical capital in the two regions that must hold, and then describes the optimal taxes for the two regions given that they both wish to maximize regional income. Finally, section 5 concludes and then suggests three ways in which the research described in this paper might be extended.[7]

2. The Theoretical Framework

Consider an aggregate economy consisting of two regions indexed by $i = 1, 2$. The stock of creative capital R in the aggregate economy is fixed but mobile between regions 1 and 2. The creative capital in region i is denoted by R_i. The fixed and---in this section---immobile stock of physical capital in the ith region is denoted by K_i. The two regions produce a very similar final

[7] We emphasize that our goal in this paper is to contribute to the theoretical and *not to the empirical* literature on the use of tax/subsidy policies by regions to attract the creative class. Also, since we do not state any formal propositions, the question of "testing" propositions with data does not arise. That said, in the remainder of this paper, we frequently conduct numerical analyses to illustrate the working of our theoretical model. Finally, we do point to connections between our theoretical results and relevant empirical findings in the literature. For instance, see footnote 11.

good whose outputs are denoted by Q_1 and Q_2 and this good acts as the numeraire. The production function in region i is Cobb-Douglas in nature and it is given by

$$Q_i = R_i^{1-\alpha} K_i^{\alpha}, i = 1,2, \quad (1)$$

and the parameter $\alpha \in (0,1)$.[8]

Both regions would like to attract the mobile creative capital to their region for the reasons delineated in section 1.1. To this end, in section 3 below, an appropriate authority in region 2 (RA) imposes a tax τ on each unit of creative capital. The returns to physical capital in the two regions are given by r_1 and r_2 and the returns to creative capital are denoted by c_1 and c_2. Market clearing determines the equilibrium values of the returns (r_1, r_2), (c_1, c_2) and the outputs (Q_1, Q_2).

With this description of the theoretical framework out of the way, our next task is to study the case in which physical capital is immobile and then derive expressions for the returns to physical and creative capital in the two regions or r_i and c_i for $i = 1, 2$.

3. Immobile Physical Capital

3.1. Returns to physical and creative capital

Since creative capital is mobile between the two regions in our aggregate economy, the return to creative capital must be equalized across the two regions. In other words, we must have $c_1 = c_2 = c$. The profit in the ith region from the production of the single final good is

$$\pi_i = R_i^{1-\alpha} K_i^{\alpha} - r_i K_i - c R_i - \tau_i R_i, \quad (2)$$

and it is understood that $\tau_1 = 0$ and that $\tau_2 = \tau$. The first-order necessary conditions for a

[8] We are certainly not setting a precedent by using the Cobb-Douglas production function. The Cobb-Douglas production function has been used widely in the regional science literature to model and study aspects of the creative class and creative regions. Examples of such studies include Batabyal and Beladi (2015, 2018), Porter and Batabyal (2016), and Batabyal and Nijkamp (2019). In this regard, note that Buttener and Janeba (2016) and Batabyal and Nijkamp (2019) both use constant returns to scale production functions to conduct their analyses of the creative class. Finally, we posit that the immobility of the physical capital stock is an "imperfection" in the short run and hence the analysis in section 3 below can be viewed as a short-run analysis. In contrast, in the long-run, all factors of production are mobile and the mobility of both creative and physical capital is analyzed in section 4 below, and this analysis can be viewed as a long-run analysis.

maximum are[9]

$$\frac{\partial \pi_i}{\partial R_i} = (1-\alpha)R_i^{-\alpha}K_i^{\alpha} - c - \tau_i = 0 \tag{3}$$

and

$$\frac{\partial \pi_i}{\partial K_i} = \alpha R_i^{1-\alpha}K_i^{\alpha-1} - r_i = 0. \tag{4}$$

Now, simplifying equation (4),[10] we get an expression for the profit-maximizing return to physical capital that we seek. That expression is

$$r_i = \alpha R_i^{1-\alpha}K_i^{\alpha-1} = \frac{\alpha R_i^{1-\alpha}K_i^{\alpha}}{K_i} = \alpha\left(\frac{K_i}{R_i}\right)^{\alpha-1}, i = 1,2. \tag{5}$$

Inspecting equation (5), we see that this profit-maximizing return r_i is a positive (negative) function of the creative (physical) capital input R_i (K_i).

Now, simplifying equation (3), we get

$$c + \tau_i = (1-\alpha)R_i^{-\alpha}K_i^{\alpha} = \frac{(1-\alpha)R_i^{1-\alpha}K_i^{\alpha}}{R_i}, i = 1,2. \tag{6}$$

9

The second-order sufficiency conditions are satisfied.

10

Equation (4) shows the correct first-order necessary condition with respect to the physical capital input K_i. That said, using (the endogenous) output Q_i, equation (4) can also be written as $r_i = \alpha K_i^{-1}Q_i$. Note that the input K_i is fixed and immobile in the analysis undertaken in this section. Finally, we point out that there is *no production* of physical capital in our model. Instead, physical capital is an input that is used---with creative capital---to produce output in the two regions under study.

Manipulating equation (6), we obtain expressions for the profit-maximizing return to creative capital or c and for the sum of this return and the tax which, the reader will recall, is levied only by region 2. These two expressions are

$$c = \frac{(1-\alpha)R_1^{1-\alpha}K_1^{\alpha}}{R_1} = (1-\alpha)\left(\frac{K_1}{R_1}\right)^{\alpha} \tag{7}$$

and

$$c + \tau = \frac{(1-\alpha)R_2^{1-\alpha}K_2^{\alpha}}{R_2} = (1-\alpha)\left(\frac{K_2}{R_2}\right)^{\alpha}. \tag{8}$$

Inspecting equation (7) we observe that the profit-maximizing return c is an increasing (decreasing) function of the physical (creative) capital input K_1 (R_1). Our next task is to derive an important condition for the total amount of creative capital R in the aggregate economy under study.

3.2. Condition for total creative capital

We begin by dividing equation (5) by equation (6). This gives us

$$\frac{r_i}{c+\tau_i} = \left(\frac{\alpha}{1-\alpha}\right)\frac{R_i}{K_i}. \tag{9}$$

Manipulating equation (9) to isolate the ratio R_i/K_i, we get

$$\frac{R_i}{K_i} = \left(\frac{1-\alpha}{c+\tau_i}\right)\frac{r_i}{\alpha} = \left(\frac{1-\alpha}{c+\tau_i}\right)\left(\frac{R_i}{K_i}\right)^{1-\alpha}. \tag{10}$$

Rearranging the terms in equation (10), we infer that

$$\left(\frac{R_i}{K_i}\right)^{\alpha} = \frac{1-\alpha}{c+\tau_i} \Rightarrow \frac{R_i}{K_i} = \left(\frac{1-\alpha}{c+\tau_i}\right)^{1/\alpha}. \quad (11)$$

We are now in a position to derive the condition for the total amount of creative capital R that we seek. In this regard, note that $R = R_1 + R_2$. Therefore, using equation (11) and the preceding equation for R, we get

$$R = R_1 + R_2 = K_1\left(\frac{1-\alpha}{c}\right)^{1/\alpha} + K_2\left(\frac{1-\alpha}{c+\tau}\right)^{1/\alpha}. \quad (12)$$

Equation (12) tells us that the total stock of the mobile creative capital in our aggregate economy or R can be expressed as a weighted linear combination of the physical capital in the two regions or K_1 and K_2 and the weights are given by the two parenthetical ratio expressions. We are now in a position to analyze the impact that three different tax policies implemented by the RA in region 2 have on income in this region when this region competes with region 1 to attract mobile creative capital.

3.3. Optimal tax policy

3.3.1. Zero tax

We begin by studying the benchmark case in which region 2 levies *no* tax on the units of creative capital in this region. Clearly, this means that $\tau = 0$. To make further progress, it will be necessary to impose additional structure on the aggregate economy of two regions that we are studying. As such, we make three assumptions. First, we suppose that the creative capital in region

i is proportional to this region's stock of physical capital. Second, we assume that the production function parameter $\alpha = 1/2$. This means that creative capital and physical capital are "equally significant" in the production of the final consumption good in regions 1 and 2.[11] Finally, we assume that and the stocks of physical capital in the two regions can be described by the numerical amounts $K_1 = 100$ and $K_2 = 200$. This last assumption means that region 2 is better endowed with physical capital than is region 1.[12]

Let $\bar{R}_i$ denote how much creative capital there is in region i. Given that this amount is proportional to the ith region's stock of physical capital, we must have $\bar{R}_i = \zeta K_i$ for some constant $\zeta > 0$. To keep the subsequent analysis straightforward, we assume that the constant of proportionality $\zeta = 1$ which tells us that $\bar{R}_i = K_i$. We can now write an expression for income in the ith region. That expression is

$$I_i = r_i K_i + c\bar{R}_i + \tau R_i = (r_i + c)K_i + \tau R_i. \tag{13}$$

Now, using equation (12) and the numerical values specified in the preceding paragraph, we get

$$300 = 100\left(\frac{1}{2c}\right)^2 + 200\left\{\frac{1}{2(c+\tau)}\right\}^2. \tag{14}$$

11

A central aim of ours in this third section is to study the effects of tax/subsidy policies on the taxing/subsidizing region. Both regions in our model are creative in the sense that they both possess creative capital. As we show later in this section, relative to the zero tax case, creative capital flows out of (into) region 2 when this region taxes (subsidizes) creative capital. That said, the reader should note that we are *not* making any assumptions about one region being more or less creative than the other region and therefore there is *no* "self-selection" issue of any sort that needs to be addressed.

12

It is important to point out that these numerical assumptions are made to illustrate the working of our theoretical model. Without such assumptions, it is impossible to meaningfully interpret the working of the theoretical model. That said, the reader should understand that this kind of numerical analysis is general in the sense that we can obtain *concrete results for many different numerical values* of the model's parameters and variables as long as the numerical values themselves are chosen sensibly. We picked $\alpha = 1/2$ because, *faute de mieux*, this value gives equal importance to the two inputs and hence does not "stack the deck" in our analysis in favor of either creative or physical capital. That said, we reiterate that the results we obtain depend on the assumptions we make. In particular, the outcomes that we report in section 3.3 about the effects of the three kinds of taxes do depend on our choice of $\alpha = 1/2$. Finally, we get $R_1 + R_2 = 300$ because this is the simplest way to study the scenario in which (by assumption) each region's creative capital is *proportional* to this region's stock of physical capital. Put differently, we obtain $R_1 + R_2 = 300$ because the *constant of proportionality is assumed to equal unity*. In this regard, if we alter the numerical value of the constant of proportionality then our results will be impacted by this alteration.

When the RA in region 2 levies no tax and hence $\tau = 0$, we can use this value of the tax in equation (14) and solve for the return to creative capital or c. This gives us $c = 0.5$. Since the value of c is equalized across regions 1 and 2 because of the mobility of creative capital, using equation (6), we get

$$(1-\alpha)\left(\frac{K_1}{R_1}\right)^{\alpha} = (1-\alpha)\left(\frac{K_2}{R_2}\right)^{\alpha} \Rightarrow \frac{K_1}{R_1} = \frac{K_2}{R_2} \qquad (15)$$

Equation (15) and the discussion thus far tell us that $R_1 = 100$ and that $R_2 = 200$. Second, equation (5) tells us that $r_2 = 0.5$. Therefore, using this last value of r_2 and equation (13), we infer that[13]

$$I_2 = (r_2 + c)K_2 + \tau R_2 = (0.5 + 0.5)200 = 200. \qquad (16)$$

Equation (16) tells us that when regions 1 and 2 compete with each other for footloose creative capital in the presence of physical capital immobility and when the RA in region 2 levies *no* tax on the creative capital in its region, the resulting total income in region 2 is 200 units. Can the RA in region 2 improve upon this state of affairs by levying a positive tax on the creative capital in its region? We now proceed to answer this question.

3.3.2. Positive tax

We model the impact of a positive tax by setting $\tau = 0.15$ and we continue to follow the methodology used in section 3.3.1. Let us substitute $\tau = 0.15$ in equation (14) and then solve for the return to creative capital or c. After several steps, we get $c = 0.41643$. Now, we know that c must be equalized across regions 1 and 2. Using this fact and equation (6), we deduce that

[13] As noted, equation (15) implies that $K_1/R_1 = K_2/R_2$. In words, the ratio of physical to mobile creative capital is the same in the two regions under study.

$$\frac{(1-\alpha)R_1^{1-\alpha}K_1^{\alpha}}{R_1} = \frac{(1-\alpha)R_2^{1-\alpha}K_2^{\alpha}}{R_2} - \tau. \quad (17)$$

Substituting $R_1 = 300 - R_2$ and $K_1 = 100, K_2 = 200, \alpha = 0.5$, and $\tau = 0.15$ in equation (17) gives us

$$0.5\left(\frac{100}{300-R_2}\right)^{0.5} = 0.5\left(\frac{200}{R_2}\right)^{0.5} - 0.15. \quad (18)$$

Solving equation (18) for R_2 and then using $R_1 = 300 - R_2$ gives us R_1=144.16 and $R_2 = 155.84$. Second, using $\alpha = 0.5, R_2 = 155.84$, and $K_2 = 200$ in equation (5), we get $r_2 = 0.4414$. Finally, using these numerical values that we have just determined in equation (13) gives us the value for regional income that we seek. That value is

$$I_2 = (r_2 + c)K_2 + \tau R_2 = (0.4414 + 0.41643)200 + (0.15)155.84 = 194.94. \quad (19)$$

Comparing the right-hand-sides (RHSs) of equations (16) and (19), we see that income in region 2 with a positive tax is *lower* than the corresponding income with a zero tax. So, if the objective of the RA in region 2 is to attract more of the mobile creative capital to its region then taxing this creative capital is a losing proposition. How does this result change if, instead of taxing creative capital, the RA in region 2 subsidizes it? We now answer this question.

3.3.3. Negative tax

To be symmetric with our analysis of the positive tax in section 3.3.2, we now set the value of the subsidy[14] or negative tax at $\tau = -0.15$. Using this value of the subsidy in equation (14) and

[14] Buettner and Janeba (2016) discuss how subsidies to public theatres by local governments can help attract the creative class in Germany. See Rhule (2017) for a more general discussion of the use of subsidies to attract the creative class.

then solving for the return to creative capital gives us $c = 0.6128$. As in section 3.3.2, because creative capital is mobile across regions 1 and 2, the value of c must be equalized across these two regions. So, using equation (6) and then employing a procedure identical to that employed in section 3.3.2, we reckon that the condition

$$0.5\left(\frac{100}{300-R_2}\right)^{0.5} = 0.5\left(\frac{200}{R_2}\right)^{0.5} + 0.15 \qquad (20)$$

must hold.

Solving equation (20) for R_2 and then using $R_1 = 300 - R_2$ gives us $R_1 = 66.57$ and $R_2 = 233.43$. Next, using $\alpha = 0.5, R_2 = 233.43$, and $K_2 = 200$ in equation (5), we get $r_2 = 0.5402$. Finally, using these numerical values that we have just ascertained in equation (13) gives us the value of regional income that we are looking for. That value is

$$I_2 = (r_2 + c)K_2 + \tau R_2 = (0.5402 + 0.6128)200 - (0.15)233.43 = 195.59. \qquad (21)$$

We are now in a position to compare the impacts of the three different tax policies pursued by the RA of region 2 to attract creative capital to its region. To do so, let us look at the RHSs of equations (16), (19, and (21). The incomes in region 2 with a zero, a positive, and a negative tax or subsidy are 200, 194.94, and 195.59 respectively. First, observe that there is *no* monotonic relationship between the tax levied by the RA in region 2 and its income. In other words, it is not the case that as the tax increases from $\tau = -0.15$ to $\tau = 0.15$, income in region 2 also increases monotonically. Second, the tax policy that gives rise to the highest income in region 2 is the *zero* tax which is, in effect, a policy of fiscal non-intervention by the RA in region 2. Finally, between the two interventionist tax policies, relative to the positive tax, the negative tax or subsidy generates higher income for region 2.

When region 2 levies a tax of $\tau = 0$, we have seen that R_2=200. So, if we think of this non-interventionist case as a benchmark case, then, intuitively, when region 2 levies a positive tax, we expect $R_2 < 200$. Similarly, when region 2 implements a negative tax or a subsidy, we expect $R_2 > 200$. The results we obtain conform well with this intuitive line of reasoning because our analysis shows that when $\tau = 0.15$, we get $R_2 = 155.84 < 200$ and when $\tau = -0.15$, we obtain $R_2 = 233.43 > 200$. The magnitudes of the decrease and the increase in R_2 are not identical because we are working with a non-linear model.

Why might the RA in region 2 want to tax mobile creative capital? One reason could be to simply generate tax revenue when other taxes are either unavailable or difficult to implement. A second reason could be the existence of institutional constraints that make it infeasible to tax profits directly. We do not claim that taxing mobile capital is the most efficient way to raise tax revenue but the generation of tax revenue does provide an explicit rationale. That said, by studying negative, zero, and positive taxes, we have covered the three logical possibilities for taxes. It is important to comprehend that the analysis we undertake in this paper is *partial equilibrium* in nature. This explains why we have not accounted for the revenue that would fund the negative tax or subsidy that we have studied in this section. That said, our first rationale for taxing mobile creative capital provides one possible way to fund the subsidy.

As we have shown, without resorting to numerical assumptions, it is very difficult to come up with interpretable results in our partial equilibrium framework. A general equilibrium analysis is beyond the scope of this paper. In addition, it is certainly not obvious that this kind of analysis will yield interpretable results without many additional simplifying assumptions. So, to conclude this discussion, if a RA's objective is to compete for mobile creative capital effectively then it is clearly better to subsidize than to tax. We now analyze the case where creative *and* physical capital

are mobile between regions 1 and 2 and *both* regions pursue tax policies to attract mobile creative capital.

4. Mobile Physical Capital

4.1. Returns to physical and creative capital

When physical capital, like creative capital, is mobile across regions 1 and 2, the return to this kind of capital must also be equalized. This means that we must have $r_1 = r_2 = r$. Using this last condition, we can modify equation (5). This modification tells us that the common return to physical capital or r satisfies

$$r = \alpha R_i^{1-\alpha} K_i^{\alpha-1} = \frac{\alpha R_i^{1-\alpha} K_i^{\alpha}}{K_i}, i = 1,2. \tag{22}$$

Similarly, the mobility of creative capital between regions 1 and 2 and the fact that both regions now tax creative capital tell us that equation (6) must also be adjusted. This adjustment gives us

$$c + \tau_1 = \frac{(1-\alpha) R_1^{1-\alpha} K_1^{\alpha}}{R_1} \tag{23}$$

and

$$c + \tau_2 = \frac{(1-\alpha) R_2^{1-\alpha} K_2^{\alpha}}{R_2}. \tag{24}$$

With these expressions for the returns to physical and creative capital out of the way, our

next task is to demonstrate that an implication of equation (22) is that there is a particular mathematical relationship that the creative to physical capital proportions in regions 1 and 2 must satisfy.

4.2. Ratio relationship

Simplifying equation (22), we see that

$$r = \frac{\alpha R_1^{1-\alpha} K_1^{\alpha}}{K_1} = \alpha \left(\frac{R_1}{K_1}\right)^{1-\alpha} = \alpha \left(\frac{R_2}{K_2}\right)^{1-\alpha} = \frac{\alpha R_2^{1-\alpha} K_2^{\alpha}}{K_2} \Rightarrow \frac{R_1}{K_1} = \frac{R_2}{K_2}. \quad (25)$$

Looking at the RHS of equation (25) carefully, the reader may be wondering how the shown equality between the creative to physical capital ratios in regions 1 and 2 can be consistent with what we have derived in equations (23) and (24).

In this regard, some thought ought to convince the reader that the condition $R_1/K_1 = R_2/K_2$ is consistent with equations (23) and (24) *only* when the two taxes are equal or when $\tau_1 = \tau_2$. This is because the relationships shown in equations (22)-(24) correspond to interior solutions for the allocation of creative and physical capital in regions 1 and 2. Because creative and physical capital are now both mobile between the two regions under study and there is no tax on physical capital, a higher tax on creative capital in one region will lead to all creative capital moving to the other region and this move will be followed by a movement of physical capital. So, the *only* way in which we can have an interior equilibrium in which there are positive amounts of the two inputs (R_i, K_i) and output Q_i is when the two regional taxes on creative capital (τ_1, τ_2) are equal. Our last task in this paper is to describe the optimal taxes of regions 1 and 2 given that they want to maximize regional income.

4.3. Optimal taxes

The logic of our discussion in the preceding paragraph tells us that if one region (say region i) levies a positive tax $\tau_i > 0$ on creative capital then the optimal tax for the other region (say region j) will be to set its tax at level $\tau_j = \tau_i - \varepsilon$ for some $\varepsilon > 0$. The mobile creative and physical capital will then move to this lower taxing region. The obvious consequence of this line of reasoning is that the only equilibrium in which there is competitive tax setting must have taxes at the lowest possible level or $\tau_1 = \tau_2$=0. The reader should note that these zero taxes are also the efficient tax rates in regions 1 and 2. This completes our discussion of interregional competition for mobile creative capital with and without physical capital mobility.

5. Conclusions

In this paper, we analyzed competition between regions 1 and 2 for *mobile* creative capital, the key attribute possessed by members of the creative class. Both regions produced a final good using creative and physical capital. We focused on two cases. In the first case, physical capital was immobile between the two regions and only region 2 used tax policy to attract the mobile creative capital. We calculated the equilibrium returns to creative and physical capital, we specified a key condition for creative capital in the aggregate economy, and then we showed which of three tax policies gave region 2 the highest level of income. In the second case, creative *and* physical capital were mobile between regions 1 and 2 and both regions pursued tax policies to attract mobile creative capital. Once again, we calculated the equilibrium returns to creative and physical capital and then delineated the optimal taxes for the two regions given that they wished to maximize regional income.

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 dynamic setting in which RAs and creative capital possessing members of the creative class interact with each other over multiple time periods. Second, it would also be instructive to partition the creative class population into different groups, with each group possessing a different kind of creative capital, and to then analyze the extent to which non-tax policy instruments such as local public goods and what Kourtit and Nijkmap (2019) call "heritage assets" can be used to successfully attract footloose creative capital. Finally, we have not explicitly modeled the geographical distance between the two regions in our aggregate economy. As such, our model and the results we have obtained are best viewed as being representative of regions that are proximate to each other. That said, if the two regions are far apart then, when evaluating the impact of a particular tax or subsidy policy, it would make sense to explicitly account for the cost of moving from, say, region 2 to region 1. In addition, it would also be useful to recognize that the magnitude of the "push" and the "pull" of R_2 that arises when region 2 taxes and subsidizes creative capital will be attenuated because of the physical distance between the two regions. As such, it would be useful to ascertain the extent to which the results obtained in this paper hold when the geographical distance between the two regions is explicitly modeled. Studies that analyze these aspects of the underlying problem will provide additional insights into the nature of policy induced interactions between RAs and creative class members.

References

Angelopoulos, S., Boymal, J., de Silva, A., and Potts, J. 2015. Does residential diversity attract workers in creative occupations? *Australasian Journal of Regional Studies*, 21, 202-231.

Batabyal, A.A. 2017. On capital taxation and economic growth and welfare in a creative region, in H. Shibusawa, K. Sakurai, T. Mizunoya, and S. Uchida, (Eds.), *Socioeconomic Environmental Policies and Evaluations in Regional Science*, 147-159. Springer Nature, Singapore.

Batabyal, A.A., and Beladi, H. 2015. The importance of creative capital for economic growth in the presence of learning by doing, *Regional Science Policy and Practice*, 7, 187-197.

Batabyal, A.A., and Beladi, H. 2016. Creative capital accumulation and the advancement of India's creative economy, *Environment and Planning C*, 34, 356-363.

Batabyal, A.A., and Beladi, H. 2018. Artists, engineers, and aspects of economic growth in a creative region, *Economic Modelling*, 71, 214-219.

Batabyal, A.A., and Nijkamp, P. 2016. Creative capital in production, inefficiency, and inequality: A theoretical analysis, *International Review of Economics and Finance*, 45, 553-558.

Batabyal, A.A., and Nijkamp, P. 2019. Creative capital, information and communication technologies, and economic growth in smart cities, *Economics of Innovation and New Technology*, 28, 142-155.

Berry, J.M., and Portney, K.E. 2016. A creative class theory of city sustainability policies, *Unpublished Manuscript*, Tufts University, Medford, MA.

Boyle, M. 2006. Culture in the rise of tiger economies: Scottish expatriates in Dublin and the 'creative class' thesis, *International Journal of Urban and Regional Research*, 30, 403-426.

Buettner, T., and Janeba, E. 2016. City competition for the creative class, *Journal of Cultural Economics*, 40, 413-451.

Conley, K.L., and Whitacre, B.E. 2016. Does broadband matter for rural entrepreneurs and creative class employees? *Review of Regional Studies*, 46, 171-190.

Currid-Halkett, E., and Stolarick, K. 2013. Baptism by fire: Did the creative class generate economic growth during the crisis? *Cambridge Journal of Regions, Economy, and Society*, 6, 55-69.

Falcioglu, P., and Kurtoglu, A.L. 2016. Life and work place choices of the creative class in cities: The case of Istanbul, *Research Journal of Business and Management*, 3, 42-58.

Florida, R. 2002. *The Rise of the Creative Class*. New York, NY: Basic Books.

Florida, R. 2005. *The Flight of the Creative Class*. New York, NY: Harper Business.

Florida, R. 2014. The creative class and economic development, *Economic Development Quarterly*, 28, 196-205.

Florida, R., Mellander, C., and Stolarick, K. 2008. Inside the black box of regional development--human capital, the creative class, and tolerance, *Journal of Economic Geography*, 8, 615-649.

Florida, R., Mellander, C., Ross, A., and Stolarick, K. 2012. Cities, skills, and wages, *Journal of Economic Geography*, 12, 355-377.

Hansen, H.K., and Niedomysl, T. 2009. Migration of the creative class: Evidence from Sweden, *Journal of Economic Geography*, 9, 191-206.

Kourtit, K., and Nijkamp, P. 2019. Creative actors and historical-cultural assets in urban regions, *Regional Studies*, 53, 977-990.

Ostbye, S., Moilanen, M., Tervo, H., and Westerlund, O. 2018. The creative class: Do jobs follow

people or do people follow jobs? *Regional Studies*, 52, 745-755.

Porter, A., and Batabyal, A.A. 2016. Physical capital mobility, the educational and quality aspects of creative capital, and output production, *Regional Science Policy and Practice*, 8, 167-175.

Rhule, J. 2017. Richard Florida, the creative class, and gentrification. Project: Human City, https://medium.com/project-human-city/richard-florida-the-creative-class-and gentrification-527912a71583. Accessed on 29 December 2020.

Richardson, K.E. 2009. What lures and retains the international creative-class family? A case study of the family unit found in Vancouver's biotechnology sector, *Comparative Technology Transfer and Society*, 7, 323-345.

Usman, U., and Batabyal, A.A. 2014. Goods production, learning by doing, and growth in a region with creative and physical capital, *International Review of Economics and Finance*, 33, 92-99.

Vossen, D., Sternberg, R., and Alfken, C. 2019. Internal migration of the 'creative class' in Germany, *Regional Studies*, 53, 1359-1370.