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by

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Abstract

We analyze a stylized model of competition between two cities that use a local public good (LPG) to attract members of the creative class. The creative class consists of *artists* and *engineers* and we study the behavior of a *representative* artist and an engineer. The level of the LPG in each city is determined by majority voting of the two representative creative class members. If both representative members choose to live in the same city then the LPG provision is the average of the preferred quantities of the two members. In this setting, we perform three tasks. First, we ascertain the preferred quantity of the LPG for the representative artist and the engineer. Second, assuming that the representative artist and the engineer accurately predict the outcome of living in a particular city, we describe a scenario in which there is *no* equilibrium in our model. Finally, we show that if the representative artist and the engineer treat the LPG provision levels in each city as *exogenous* then an equilibrium does *exist* in the model.

Keywords: Artist, Creative Class, Engineer, Equilibrium, Local Public Good

JEL Codes: R11, H40

1. Introduction

Regional scientists and urban economists are both very familiar with two notions that have been introduced into the literature by the urbanist Richard Florida. The first is the notion of the *creative class* and the second is the notion of *creative capital*. The creative class, according to Florida (2002, p. 68), is composed of "people who add economic value through their creativity." This class is made up of specialists such as doctors, engineers, lawyers, scientists, university professors, and, markedly, bohemians such as artists, musicians, and sculptors. What distinguishes members of the creative class from other people---who are not members of the creative class---is the fact that they possess creative capital which is postulated 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).

From the standpoint of the economic development of cities and regions, what is special about the creative capital possessing members of the creative class? In his copious writings on this question, Florida (2002, 2003, 2008, 2014), Florida *et al.* (2017), and some of Florida's supporters such as Stolarick *et al.* (2011) and Lobo *et al.* (2014) have argued that city and regional planners ought to focus seriously on the activities of the creative class because the collection of people making up this class gives rise to ideas, information, and technology, outputs that are salient for the growth and development of cities and regions. Put differently, cities and regions that want to flourish in this age of globalization need to do all they can to draw in and then hold on to members of this creative class who are, for all intents and purposes, the primary drivers of economic growth and development.

One question that economists---see Glaeser (2005)---have raised when pondering the concept of creative capital is the following: What is the difference between the well-known and time-honored notion of human capital and Florida's newer concept of creative capital? The recent work of Batabyal and Beladi (2016, 2018) and that of Batabyal *et al.* (2019) is pertinent in answering this important question. These researchers have helpfully explained that there is little or no difference between the notions of human and creative capital when the accretion of this creative capital is contingent on the successful completion of many years of formal education. In contrast, there can be a lot of difference between the concepts of human and creative capital when creative capital is either present naturally or when it is based on the accretion of business and professional experiences but *not* on the successful completion of a formal education.

The discussion in the preceding paragraph tells us that creative capital is of two types. Therefore, as pointed out by Porter and Batabyal (2016), it is a *more general* concept than the mainly formal instruction based notion of human capital. Batabyal and Beladi (2018) and Batabyal *et al.* (2019) refer to members of the creative class who have creative capital either naturally or mostly by collecting business and professional experiences as *artists* and to those whose acquisition of creative capital is the outcome of many years of formal instruction as *engineers*. This bipartite classification---also see Marlet and van Woerkens (2007)---implies that the aggregate creative class in either a city or more generally a region is the *sum* of the artists and the engineers in this city or region. We shall make use of this two-part classification of the creative class in the ensuing analysis in this chapter.

We now concentrate on cities specifically in the remainder of this chapter. In this context, suppose one accepts Florida's (2002) basic point that cities that would like to flourish economically need to draw in and then hold on to members of the creative class. The obvious next question is: "How are cities to do this?" Florida (2002, 2008), Buettner and Janeba (2016), and Batabyal *et al.* (2019) have responded to this question by explaining that local public goods (LPGs) such as cultural amenities, quality schools, and public transit are a key means by which cities can efficaciously carry out the dual "draw in" and "hold on to" functions.[4]

The idea mentioned at the end of the preceding paragraph about the usefulness of LPGs is now recognized by researchers. Even so, we would like to emphasize the following two points. First, to the best of our knowledge, Batabyal *et al.* (2019) is the only paper to have conducted a theoretical analysis of the effect that the provision of LPGs by two cities has on their ability to draw in and hold on to members of the creative class.[5] However, to conduct their analysis and obtain concrete results, these researchers work with a model with (i) *linear* functional forms, and (ii) *actual numbers* for many of the model variables. Therefore, the results obtained by these researchers in their paper are specific and we know relatively little about the existence of an equilibrium in theoretical models in which two cities use LPGs to compete with each other to draw in and hold on to members of the creative class. Second and given this lacuna in the literature, our goal in this chapter is to provide the *first* analysis of some of the circumstances that determine when an equilibrium does and does not exist in models of LPG use by two cities to attract and retain members of the creative class.

The remainder of this chapter is organized as follows. Section 2 describes our stylized model of an aggregate economy that consists of two cities. We use this model to analyze competition between the two cities when each city uses a LPG to draw in members of the creative class. As pointed out previously, the creative class consists of artists and engineers and we concentrate on the behavior of a *representative* artist and a *representative* engineer. The amount

4 See Hansen and Niedomysl (2009), Richardson (2009), and Audretsch and Belitski (2013) for a discussion of related issues.

5 For theoretical studies of other questions about the creative class, the reader should consult Batabyal (2017a, 2017b), Batabyal and Beladi (2016), Batabyal and Nijkamp (2016), Batabyal and Yoo (2018), and Usman and Batabyal (2014). That said, we stress that there is *no* overlap between the topics we study in this chapter and the questions analyzed in these cited journal articles.

of the LPG that is provided in each city is determined by majority voting of the two representative creative class members. If both representative members choose to live in the same city then the LPG provision is the average of the preferred quantities of these two members. Section 3 ascertains the preferred quantity of the LPG for the representative artist and the engineer. Assuming that the representative artist and the engineer accurately predict the outcome of living in a particular city, section 4 describes a scenario in which there is no equilibrium in the model under study. Section 5 demonstrates that if the representative artist and the engineer treat the LPG provision levels in each city as *exogenous* or given then an equilibrium does exist in the model. Finally, section 6 concludes and then suggests four ways in which the research delineated in this chapter might be extended.

2. The Theoretical Framework

Consider an aggregate economy that consists of two cities denoted by the superscript $i = 1, 2$. Real world examples from the United States of the kind of cities we have in mind are (i) Rochester and Syracuse in the state of New York, (ii) Minneapolis and Saint Paul in the state of Minnesota, and (iii) Dallas and Fort Worth in the state of Texas. Our analysis focuses on the creative class, i.e., on the sum of the artists and the engineers, in the two cities. Rather than model the entire creative class in a city, for expositional ease, in the remainder of this chapter, we shall focus on the behavior of a representative artist and a representative engineer. The superscript $k = a, e$ denotes these two representative creative class members. Specifically, "a" denotes the representative artist and "e" denotes the representative engineer. The utilities or payoffs representing the preferences of the representative artist and the engineer are given by the quasi-linear functions[6]

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See Hindriks and Myles (2013, pp. 555-558) for a textbook exposition of such functions.

$$U^k = 1 - T^i + \beta^k \log(L^i), k = a, e, \quad (1)$$

where U^k denotes the kth representative member's utility, T^i denotes the tax levied by city i $(= 1, 2)$ to pay for the LPG L^i provided in this city, β^k is a representative member specific parameter, and we assume that the inequality $\beta^e > \beta^a > 0$ holds. In words, this assumption means that relative to artists, engineers place a higher value on the LPG on offer in each of the two cities.[7]

The amount of the LPG provided in each city is determined by majority voting of the two representative creative class members (artist and the engineer). If a particular city happens to draw in both representative creative class members, then we suppose that the supply of the LPG in this city is given by the *average* of the preferred quantities of the two representative members. With this description of our aggregate economy of two cities out of the way, our next task is to ascertain the preferred quantity of the LPG for the representative artist and the engineer.

3. Preferred Levels of the LPG

Suppose that there are n^i residents in city i. Then the tax T^i levied by city i when representative member k selects LPG level L^k is given by L^k/n^i. In symbols, we have $T^i = L^k/n^i$. Substituting this expression for the tax in equation (1), the kth representative member's utility function can be written as

$$U^k = 1 - \frac{L^k}{n^i} + \beta^k \log\left(\frac{L^k}{n^i}\right). \quad (2)$$

As pointed out by Hindriks and Myles (2013, pp. 208-209), a LPG is typically *not* a pure public good because exclusion is frequently possible. One kind of exclusion arises from the fact that in

[7] There is a precedent for this assumption in the extant literature. See Batabyal *et al.* (2019) for additional details.

order to enjoy a LPG, an individual must be resident in a particular geographical area. In addition, a resident individual who refuses to pay local taxes that fund the provision of a LPG can also be excluded from enjoying the benefits of the relevant LPG. What this means in our case is that the last term in the utility function on the right-hand-side (RHS) of equation (2) is appropriately written as $\log\left(L^k/n^i\right)$ and not as $\log(L^k)$.

To determine the preferred value of L^k, we solve

$$max_{L^k}\left[1-\frac{L^k}{n^i}+\beta^k log\left(\frac{L^k}{n^i}\right)\right]. \qquad (3)$$

The first-order necessary condition for an optimum is

$$\frac{\beta^k}{L^k}-\frac{1}{n^i}=0, \qquad (4)$$

which tells us that the preferred level of the LPG that we seek is given by[8]

$$L^k=\beta^k n^i. \qquad (5)$$

Inspecting equation (5), it is easy to confirm that if either the parameter β^k or the number of residents in city i or n^i increases then the kth representative member's preferred level of the LPG also *increases*. Now suppose that the representative artist and the engineer accurately predict the outcome of living in a particular city. Given this supposition, our next task is to delineate a situation in which there is no equilibrium in the model under study.

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It is straightforward to verify that the second-order sufficiency condition in this maximization problem is satisfied.

4. Non-Existence of an Equilibrium

Some thought ought to convince the reader that only two types of equilibria are possible in the model that we are studying. In the first or "type I" equilibrium, the representative artist and the engineer choose to reside in *separate* cities and in the second or "type II" equilibrium, the representative artist and the engineer both choose to reside in the *same* city. Now recall from the discussion in section 2 that the level of the LPG provided in each city is determined by majority voting of the representative artist and the engineer.

Therefore, accounting for this voting and the possibility that either the representative artist or the engineer may, in principle, want to move to the other city, the utilities obtained by the two agents in our model in the first or type I equilibrium are given in Table 1. To interpret the payoffs

[Table 1 about here]

specified in the bottom four cells of Table 1, consider the *second row* first. In this row, the U^a payoff under the "Stay in city" column describes the utility obtained by the representative artist when he or she chooses to reside in one city and the representative engineer decides to reside in the other city. Now recall that $T^i = L^k/n^i$ and that $L^k = \beta^k n^i$. Substituting the second of these two equations into the first gives $T^i = (\beta^k n^i)/n^i = \beta^k$. This explains why the tax term T^i can be written as β^k in the equation for U^a. Similarly, the U^a payoff under the "Move from city" column delineates the utility obtained by the representative artist when he or she and the representative engineer both choose to reside in the *same* city. In this case, because both representative members live in the same city, the supply of the LPG is the *mean* of the two preferred quantities. This explains why the tax term in the expression for U^a is given by $(\beta^a + \beta^e)/2$. Finally, observe that since $L^k = \beta^k n^i$, we obtain $L^a = 2\beta^a$ and $L^e = 2\beta^e$. Therefore, $(L^a + L^e)/2 = \{2(\beta^a + \beta^e)\}/2 = \beta^a + \beta^e$. This last result explains why the concluding term in the expression for U^a is $\beta^a \log(\beta^a + \beta^e)$ and not $\beta^a \log\{(\beta^a + \beta^e)/2\}$. A similar interpretation applies to the two payoffs in the *third row* of Table 1 except that these payoffs now refer to the representative engineer.

Moving on to the second or type II equilibrium, the four possible utilities accruing to the representative artist and to the engineer are shown in Table 2. To interpret these payoffs, let us,

[Table 2 about here]

once again, focus first on the *second row* of this Table. In this row, the U^a payoff under the "Stay in city" column describes the utility obtained by the representative artist when he or she and the representative engineer both choose to live in one city. Similarly, the U^a payoff under the "Move from city" column delineates the utility obtained by the representative artist when he or she decides to live in one city and, as a result, the representative engineer ends up living in the other city. A similar interpretation applies to the two payoffs in the *third row* of Table 2 except that these payoffs now refer to the representative engineer.

After observing the eight payoffs accruing to the representative artist and the engineer in Tables 1 and 2 and the structure of our model, we deduce that an equilibrium will *not* exist if at least one representative creative class member (artist or engineer) wishes to *move* in the two possible types of equilibria. That said, let us concentrate on the type I equilibrium for the time being. With regard to this kind of equilibrium, observe that it is *not* possible to satisfy the inequalities

$$1 - \beta^a + \beta^a \log(\beta^a) < 1 - \frac{\beta^a + \beta^e}{2} + \beta^a \log(\beta^a + \beta^e) \tag{6}$$

and

$$1-\frac{\beta^a+\beta^e}{2}+\beta^e\log(\beta^a+\beta^e)<1-\beta^e+\beta^e\log(\beta^e) \tag{7}$$

simultaneously. Why not? To answer this question, observe that if the inequalities in (6) and (7) hold simultaneously then an implication of (7) is that the inequality

$$\frac{\beta^e-\beta^a}{2}<\beta^e\{\log(\beta^e)-\log(\beta^a+\beta^e)\} \tag{8}$$

is satisfied. However, since $\beta^e>\beta^a>0$, some thought and the properties of the logarithm function together tell us that the left-hand-side (LHS) of (8) is positive but the RHS is negative. Therefore, the inequality in (8) clearly cannot hold which, in turn, means that the inequality in (7) also *cannot* hold.

The above finding informs us that the direction of the inequality sign in (7) needs to be flipped. Once this is done, the implication of the flipped inequality is that the utility from moving exceeds the utility from staying and therefore the representative engineer ought to *move* to the other city and live jointly with the representative artist. The inequality in (6) tells us that the utility from staying in a city for the representative artist (the LHS) is *less* than the utility from moving to the other city in which the representative engineer is resident (the RHS). Therefore, the representative artist also ought to *move* and live jointly with the representative engineer. Putting these two results together, we see that both representative creative class members would like to move from the posited equilibrium. Therefore, we *cannot* have a type I equilibrium in the model under study.

Having discussed the type I equilibrium, let us now focus on the type II equilibrium. In this case, consider the inequalities given by

$$1-\beta^{a}+\beta^{a}\log(\beta^{a})>1-\frac{\beta^{a}+\beta^{e}}{2}+\beta^{a}\log(\beta^{a}+\beta^{e}), \tag{9}$$

and

$$1-\frac{\beta^{a}+\beta^{e}}{2}+\beta^{e}\log(\beta^{a}+\beta^{e})>1-\beta^{e}+\beta^{e}\log(\beta^{e}). \tag{10}$$

Straightforward algebra reveals that the inequality in (10) always holds. Manipulating the individual terms in the inequality in (9) gives us the following parametric condition

$$\frac{\beta^{e}}{\beta^{a}}>1+2log\left(1+\frac{\beta^{e}}{\beta^{a}}\right). \tag{11}$$

When the parametric condition in (11) is satisfied, the inequality in (9) holds for sure. In addition, since the inequality in (10) always holds, we can say that both the inequalities given in (9) and (10) hold when the above parametric condition is satisfied. From this discussion, we can deduce that when the parametric condition in (11) is satisfied, the representative artist will want to move away from a type I equilibrium (see (6), (9), and the payoffs in Tables 1 and 2) and the representative engineer will want to move away from a type II equilibrium (see (7), (10), and the payoffs in Tables 1 and 2). On the basis of this deduction we conclude that when the parametric condition given in (11) is satisfied, there is *no* equilibrium in the model under study. We now proceed to our final task in this chapter. This involves showing that if the representative artist and the engineer treat the LPG provision levels in each city as *exogenous* or given then an equilibrium does exist in our model.

5. Existence of an Equilibrium

In this case, the representative artist and the engineer both take the provision levels of the LPG or L^k in each of the two cities as exogenous or given and *not* as something that either one of them can influence with their own actions. In this situation, the utilities obtained by the representative artist and the engineer will change and no longer be given by the payoffs specified in Tables 1 and 2. In particular, to analyze the type I equilibrium, the analog of Table 1 is now

[Table 3 about here]

given by Table 3.

Comparing Tables 1 and 3, we see that the payoffs to the representative artist (U^a) and to the representative engineer (U^e) in the "Stay in city" column are unchanged in Tables 1 and 3. However, because the LPG provision levels are now treated as exogenous by the two representative creative class members, relative to Table 1, the payoffs (U^a) and (U^e) in the "Move from city" column in Table 3 do change.

Similarly, in the type II equilibrium, we observe that the payoffs to the representative artist (U^a) and to the representative engineer (U^e) in the "Stay in city" column are unchanged in both Tables 2 and 4. Even so, for the same reason as the one mentioned in the preceding paragraph,

[Table 4 about here]

relative to Table 2, the utilities (U^a) and (U^e) in the "Move from city" column in Table 4 are different. In this regard, note that the specification $U^a = U^e = -\infty$ for the two utilities in this column makes sense because we are assuming that if there are *no* representative creative class members residing in a particular city then the level of the LPG provided in this city is zero.

Now, inspecting the payoffs in Table 4, it is straightforward to verify that *both* representative creative class members will want to stay in the city in a type II equilibrium and not move. However, the same cannot be said about a type I equilibrium. Inspecting the four payoffs in Table 3, we see that we cannot make a definitive statement about whether a type I equilibrium will exist. This is because at least one representative creative class member may want to move from the city in a type I equilibrium. So, we have just demonstrated that in contrast to the situation examined in section 4, a type II equilibrium *will* always exist when the representative artist and the engineer take the provision levels of the LPG or L^k in each of the two cities as exogenous or given. This concludes our analysis of the existence of an equilibrium in models of LPG use by cities to draw in the creative class.

6. Conclusions

In this chapter, we examined a stylized model of competition between two cities that used a LPG to draw in members of the creative class. The creative class consisted of artists and engineers and we analyzed the behavior of a *representative* artist and an engineer. The amount of the LPG provided in each city was determined by majority voting of the two representative creative class members. If both representative members chose to live in the same city then the LPG provided was the average of the preferred quantities of the two members. In this setting, we performed three tasks. First, we ascertained the preferred quantity of the LPG for the representative artist and the engineer. Second, assuming that the representative artist and the engineer accurately predicted the outcome of living in a specific city, we described a scenario in which there was no equilibrium in our model. Finally, we demonstrated that if the representative artist and the engineer treated the LPG provision levels in each city as exogenous then a type II equilibrium existed in the model.

The analysis conducted in this chapter can be extended in a number of different directions. In what follows, we suggest four possible extensions. First, instead of using quasi-linear utility functions to describe the payoffs obtained by the two representative creative class members, it would be useful to study the equilibrium existence question with general utility functions that are both increasing and concave in their arguments. Second, since the decision about which city to live in is typically made on more than one occasion in a creative class member's lifetime, it would be useful to analyze a multi-period game between representative creative class members and an apposite city authority where it is possible to change a member's residence decision at different points in time. Third, it would be useful to explore the extent to which cities benefit by drawing in and retaining diverse sets of people within the creative class as opposed to specific subsets such as artists or engineers only. Finally, it would be helpful to study the equilibrium existence question of this chapter in a setting in which city authorities are able to draw in and hold on to members of the creative class with an expanded set of policies that includes LPGs as one particular policy. Studies that analyze these aspects of the underlying problem will provide additional insights into the range of circumstances in which equilibria exist in models of interactions between creative class members and city authorities.

Stay in city	Move from city
$U^a = 1 - \beta^a + \beta^a \log(\beta^a)$	$U^a = 1 - \frac{\beta^a + \beta^e}{2} + \beta^a \log(\beta^a + \beta^e)$
$U^e = 1 - \beta^e + \beta^e \log(\beta^e)$	$U^e = 1 - \frac{\beta^a + \beta^e}{2} + \beta^e \log(\beta^a + \beta^e)$

Table 1: Utilities from staying in and moving from a city in the type I equilibrium

Stay in city	Move from city
$U^a = 1 - \frac{\beta^a + \beta^e}{2} + \beta^a \log(\beta^a + \beta^e)$	$U^a = 1 - \beta^a + \beta^a \log(\beta^a)$
$U^e = 1 - \frac{\beta^a + \beta^e}{2} + \beta^e \log(\beta^a + \beta^e)$	$U^e = 1 - \beta^e + \beta^e \log(\beta^e)$

Table 2: Utilities from staying in and moving from a city in the type II equilibrium

Stay in city (Exogenous LPG provision)	Move from city (Exogenous LPG provision)
$U^a = 1 - \beta^a + \beta^a \log(\beta^a)$	$U^a = 1 - \beta^e + \beta^a \log(\beta^e)$
$U^e = 1 - \beta^e + \beta^e \log(\beta^e)$	$U^e = 1 - \beta^a + \beta^e \log(\beta^a)$

Table 3: Utilities from staying in and moving from a city in the type I equilibrium

Stay in city (Exogenous LPG provision)	Move from city (Exogenous LPG provision)
$U^a = 1 - \frac{\beta^a + \beta^e}{2} + \beta^a \log(\beta^a + \beta^e)$	$U^a = -\infty$
$U^e = 1 - \frac{\beta^a + \beta^e}{2} + \beta^e \log(\beta^a + \beta^e)$	$U^e = -\infty$

Table 4: Utilities from staying in and moving from a city in the type II equilibrium

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