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Batabyal, Amitrajeet and Beladi, Hamid

Rochester Institute of Technology, University of Texas at San Antonio

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by

AMITRAJEET A. BATABYAL,[2]

and

HAMID BELADI[3]

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

[3] Department of Economics, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX 78249-0631, USA. E-mail: Hamid.Beladi@utsa.edu

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Abstract

There are *no* theoretical studies in regional science that examine which region to locate in from the standpoint of a creative class member, given that the pertinent regional authorities (RAs) are competing among themselves to attract the creative class using *subsidies*. This gap provides the motivation for our paper. This paper's contribution is that it is the *first* to theoretically study the regional location choice of creative class members when the RAs of the locations in which they might locate are using subsidies to attract them. Specifically, a knowledge good producing creative class member must decide which of two regions (A or B) to locate his plant in. This good is produced using a Cobb-Douglas function with creative and physical capital. We analyze plant location in four cases. In the benchmark case, we show that the representative creative class member ought to locate his plant in the less expensive region B. Next, we show that a small subsidy to creative capital by region A switches the plant location decision from region B to A. Finally, when both regions grant identical subsidies to creative capital, the representative creative class member is indifferent between locating in regions A and B. So, for identical subsidies to affect the plant location decision, they are better targeted to physical and not to creative capital.

Keywords: Creative Capital, Interregional Competition, Physical Capital, Subsidy,

JEL Codes: R11, R58

1. Introduction

1.1. Preliminaries

The American author and poet Maya Angelou once said that "You can't use up creativity. The more you use, the more you have." It seems fair to say that the urbanist Richard Florida would, most likely, agree with this statement. We say this because in his numerous writings about creative people and creativity---see Florida (2002, 2003, 2005, 2008, 2014)---Florida has suggested to scholars of regional economic development that cities and regions that would like to thrive in this era of globalization need to first comprehend that creativity begets creativity and then implement policies that will attract creative people who, in turn, will attract more creative people and this process will eventually, we are told, lead to the economic betterment of cities and regions.

Put differently, cities and regions need to do all they can to attract and retain members of what Florida calls the *creative class*. The creative class "consists of people who add economic value through their creativity" (Florida, 2002, p. 68). In particular, this class is composed of professionals such as engineers, medical doctors, scientists, university professors, and, notably, bohemians such as artists, musicians, and sculptors. The distinguishing feature of these people 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).

Following up on Florida's suggestions, several researchers have now explored what cities and regions might do to draw in and retain members of the creative capital possessing creative class. In this regard, recent research by Buettner and Janeba (2016), Batabyal *et al.* (2019), Batabyal and Yoo (2020a, 2020b), and Batabyal and Beladi (2021) has demonstrated that an

appropriate city authority (CA) can use local public goods (LPGs)[4] such as museums, high-quality educational institutions, theatres, and public transit to attract the creative class to its city.[5]

1.2 Literature review

1.2.1 Place-based policies

To understand the motivation for our paper, let us first briefly review the vast existing literature on place-based policies. In this review, it is understood that questions concerning the use of subsidies and the creative class are a proper subset of the set of questions addressed by this much broader literature. That said, as noted by Banerjee and Duflo (2019), economists have traditionally been skeptical of place-based policies, believing that it is generally a better idea to help people and not places. In this regard, Moretti and Kline (2014) have argued that distributing public funds into regions that are doing poorly is like throwing good money after bad. Instead, these researchers claim that "[w]hat public policy needs to do is to help people move to the places of the future" (Banerjee and Duflo, 2019, p. 85).

The above line of reasoning notwithstanding, there is increasing recognition of the following three points in the literature. First, the convergence of incomes between the poor and the wealthy regions in the United States has essentially *stalled*. Second, social problems are frequently connected to a paucity of jobs and *not* to a lack of income. Finally, there is some evidence to show that increasing the demand for labor has a noteworthy *impact* on employment in depressed regions.[6] Therefore, Austin *et al*. (2018) contend that place-based policies need to be reconsidered.

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4 See Hindriks and Myles (2013, chapter 7) for a textbook exposition of LPGs.

5 For a discussion of related matters, see Eversole (2005), Hansen and Niedomysl (2009), Richardson (2009), and Audretsch and Belitski (2013).

6 See Berry and Glaeser (2005) and Ganong and Shoag (2017) for a more detailed discussion of these and related points.

What are the key theoretical rationales for pursuing place-based policies?[7] Neumark and Simpson (2015) identify six such rationales. The first is the presence of *agglomeration economies* in which the dense population of urban regions has an independent impact on the productivity of resources. The presence of agglomeration economies implies the presence of positive externalities. This is because bringing in more people or firms into an urban region increases the productivity of other persons or firms in that region but these gains are not captured by those deciding to move to that location. As such, Moretti (2010) and Glaeser and Gottleib (2008) point out that it may make sense to subsidize in-migration or growth with the aim of bringing private returns closer to the social returns. Put differently, there may be a case for place-based policies to stimulate economic growth in a particular region.

The second rationale is the presence of *knowledge spillovers*. The basic idea here---see Jacobs (1961) and Moretti (2010)---is that when individuals possessing human capital work with each other in close proximity, this physical closeness can raise everyone's human capital and ultimately increase firm productivity because knowledge is easily shared and this, in turn, can lead to the quicker adoption of innovations. Getting closer to the subject of the present paper, the presence of knowledge spillovers can provide a rationale for local policymakers to attract skilled workers to a particular region. In this regard, Moretti (2012) points out that attracting skilled workers can, in certain circumstances, also lead to large local multipliers relative to other industries in the region under consideration.

The third rationale stems from *industry localization*. Figueiredo *et al*. (2015) explain this rationale by pointing out that the phenomenon of knowledge spillovers may have more to do with

[7] Readers interested in comprehensive discussions of the literature on place-based policies should consult Bartik (1991), Glaeser and Gottlieb (2008), and Neumark and Simpson (2015), and Austin *et al*. (2018). For a similar discussion that focuses primarily on European cities, see Ehrlich and Overman (2020).

the presence of workers in the same or in closely related industries in the locality under consideration and less to do with the presence of skilled workers as such. Neumark and Simpson (2015) point out that alternate sources of agglomeration economies may be stronger *within* industries because either thick labor markets or thick intermediate input markets that are likely to be the source of agglomeration may operate more *within* than across industries. Given the presence of such agglomeration economies, it may make sense for government policy to either establish or promote industry clusters.

The fourth rationale concerns the so-called *spatial mismatch* hypothesis. Following the work of Wilson (1987), Ihlanfeldt and Sjoquist (1998), and Gobillon *et al*. (2007), one way to understand this hypothesis is to consider the contention that the lower employment rate of disadvantaged minorities in many urban cores stems, at least in part, from there being *fewer* jobs per worker in these cores. This can happen because of what labor economists call the "exit of jobs" from these cores when the underlying industrial structure changes. The point to note is that the "fewer jobs" phenomenon can endure because of exogenous residential segregation that arises, in part, because of discrimination in housing markets. As a result, government policy may be needed to get disadvantages minorities out of an undesirable equilibrium in which they otherwise might be trapped.

The fifth rationale relates to *network effects*. Montgomery (1991) shows that in a network model, the employment of some residents increases the flow of information about jobs to other residents in the network, thereby reducing their job search costs. That said, labor market networks that are based on one's residence can *aggravate* the negative impacts of residential segregation on labor market outcomes when the network an individual belongs to is, for instance, racially stratified. In such instances, Neumark and Simpson (2015) note that place-based policies that focus

on what they call "concentrated disadvantage" can be supported because the multipliers that network impacts give rise to can augment the positive impacts of such place-based policies in, for example, regions with low employment.

The sixth and final rationale concerns *equity motivations*. The basic idea here is to use place-based policies---such as taxes or enterprise zones---to redistribute jobs and income to regions where jobs are scarce and incomes are low. Although, at the level of principle, this idea makes sense, Neumark and Simpson (2015) remind us that place-based policies may have unintended consequences because of the mobility of humans and capital. In this regard, the work of Crane and Manville (2008) tells us that it is very important to appropriately target place-based policies to the disadvantaged. Otherwise, it is certainly possible that the jobs created by one or more place-based policies may well go to non-poor residents or to migrants and, in addition, any gains in land prices may not reach the poor.

This completes our discussion of place-based policies. We now concentrate on studies that are most closely related to the contents of the present paper. In this discussion, we shall pay particular attention to four topics that are germane when considering alternate ways of attracting members of the creative class specifically to a particular region.

1.2.2. Attracting the creative class

First, consider the topic of *quality* and a particular aspect of quality, namely, the notion of *tolerance*. McGranahan and Wojan (2007) argue that in order to attract creative people to both rural and to urban regions in the United States, the basic development strategy needs to focus on doing those things that make regions high quality of life providing places. In this regard, we learn that natural amenities are important and hence regional authorities ought to pay attention to the provision of natural amenities. Clifton (2008) analyzes the location of the creative class in the U.K.

His analysis shows that the ability to attract creative class members to a region depends on its quality. In turn, quality depends on how tolerant the region is towards people of diverse ethnic and racial backgrounds and on the availability of a variety of cultural opportunities. The significance of tolerance as an attraction mechanism is disputed in the literature. The work of Ten Brink (2012) demonstrates that municipalities that are "diversity-sensitive" will have advantages over other municipalities when it comes to attracting members of the creative class. Contradicting this finding, Angelopoulos *et al*. (2015) use Australian data and note that while there is some connection between tolerance and the locational preferences of the creative class, this connection is weak and inconsistent.

Second, let us ponder the topic of *regionalism* and a specific aspect of regionalism, i.e., the availability of *broadband internet* service. In this regard, Davidson and Foster (2013) contend that creative class members increasingly move between and not just within metropolitan regions. Therefore, if authorities in such regions are to attract creative class members, then they need to pay less attention to decentralization and devolution and more to regionalism which concentrates on the point that mobile creative class members value the policy bundles that are provided by alternate metropolitan regions. Does the presence of broadband internet service in the policy bundles we just mentioned help in attracting the creative class? Conley and Whitacre (2016) conduct econometric analysis using county level data from the United States and show that the presence of broadband internet service may not help at all in attracting the creative class and may even hurt the ability of a county to attract and retain creative class members.

Third, since the topic of *LPGs* as a mechanism for attracting creative class members to a region has been fairly well researched in the literature, in addition to the studies mentioned in section 1.1, let us consider how the literature has studied the usefulness of LPGs as an attraction

mechanism. Batabyal *et al*. (2019) examine a model in which creative class members are able to move between the two cities under study. In this setting, they first describe the equilibrium distribution of the creative class in the two cities and then determine the conditions under which the provision of a LPG is efficient. Batabyal and Beladi (2021) build on this work and study a model of competition between two cities that use a LPG to interest members of the creative class. They follow Batabyal and Beladi (2018) and split the aggregate creative class population into two groups known as "artists" and "engineers." They then determine the conditions under which an equilibrium exists in their model of the use of a LPG to attract members of the creative class to the two cities.

Finally, let us reflect on the topic of *efficiency* when either a city authority (CA) or a regional authority (RA) attempts to attract the creative class to its city or region.[8] A key point here is that the use of a "representative artist and engineer" framework can lead one to concentrate on an inefficient equilibrium in a combined economy of two cities. This is the key takeaway from the research of Batabyal and Yoo (2020a). Related to this point, Batabyal and Yoo (2020b) analyze a model with two cities and observe that the provision of a LPG in either city is inefficient because the CA is able to choose *only* the optimal amount of the LPG to provide and not, in addition, the optimal number of creative class members to attract to its city.

This review of the literature about alternate ways of attracting the creative class to a particular region leads to the following noteworthy conclusion. Even though several researchers have now studied how CAs and RAs might attract members of the creative class to their cities and regions, these studies are all from the *perspective of a CA or a RA*. To the best of our knowledge,

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In the remainder of this paper, we use the term "region" broadly. Specifically, this means that "region" is the broader term and, in this view, a city is one kind of region.

there are *no* theoretical studies that have looked at the question of which region to locate in from the standpoint of a creative class member, given that the pertinent regional authorities (RAs) are competing among themselves to attract members of the creative class to their regions using *subsidies*. The absence of any theoretical research on this question leads to a gap in our knowledge and this gap provides the motivation for our paper. That said, the contribution of our paper is that it is the *first* to theoretically study the regional location choice of creative class members when the RAs of the locations in which these creative class members might locate are using subsidies to attract them.

The remainder of this paper is organized as follows. Section 2.1 delineates our stylized model of the interaction between an entrepreneurial member of the creative class who must decide which of two regions (A or B) to locate his plant in. This member uses creative and physical capital to produce a knowledge good. The creative class member's objective---on which more below---is to minimize the average cost of producing the knowledge good. We analyze the plant location question in four distinct cases. Section 2.2 discusses the first or benchmark case in which region A (B) has identical (variable) input prices. Section 2.3 focuses on the case where region A deviates from the benchmark case by subsidizing creative capital. Section 2.4 concentrates on the case in which region A departs from the benchmark case by subsidizing physical capital. Section 2.5 discusses what happens when both regions act identically in subsidizing either creative or physical capital. Section 2.6 succinctly discusses what the extant empirical evidence tells us about the factors that are important in determining the location of creative businesses and industries. Finally, section 3 concludes and then points out three ways in which the research delineated in this paper might be extended.

2. Analysis

2.1. The theoretical framework

We begin by emphasizing three points. First, the theoretical model of this section has been developed to fill a *gap* in the literature resulting from the *absence* of theoretical studies that look at which region to locate in from the standpoint of a creative class member when the relevant RAs are competing among themselves to attract the creative class using subsidies. Second, our theoretical model is focused squarely on answering the question stated above. As such, we acknowledge that this model does *not* address every aspect of the creative class in a particular region. As an example, once resident in a particular region, creative class members may give rise to negative externalities for other residents of this region by making it more difficult for them to find affordable housing or by raising rents. It is *not* our objective in this paper to focus on these issues that arise *after* the creative class has been attracted to a specific region and hence our model is unable to shed light on these issues. Finally, our model contributes to the regional science literature because it *increases* our knowledge about a previously unanswered question. In addition, this model *expands* on prior theory in the sense that it shows how a static theoretical model can shed light on how one kind of place-based policy, i.e., a subsidy, can be a useful regional economic development policy.

Now, consider an aggregate economy that is made up of two regions that we denote by A and B respectively. Actual examples of the kind of regions we have in mind include, but are not limited to, Dallas and Fort Worth in Texas, Minneapolis and Saint Paul in Minnesota, Cuttack and Bhubaneshwar in Odisha, India, and Leeds and Bradford in the United Kingdom. Both regions already have some resident creative capital possessing members of the creative class. Even so, for the reasons given in section 1, the goal of the RAs in each of these two regions is to attract

additional members of the creative class to their region. Now, to keep the subsequent analysis straightforward, we work with a *representative* creative class member from the set of all such members who have yet to determine which region they would like to live and work in.

This representative creative class member is an *entrepreneur* who manufactures a knowledge good---such as a camera or a laptop computer---using creative capital $R > 0$ and physical capital $K > 0$. Now, before proceeding further, let us understand the following three points clearly. First, as noted in Marlet and Van Woerkens (2007) and Batabyal and Beladi (2018), creative capital is a *more general* notion of capital than the schooling-based notion of human capital---that economists and regional scientists are familiar with---because creative capital not only includes individuals who are creative by virtue of their many years of schooling but also those who are innately creative despite having either no schooling or only a minimal amount of schooling. Second, human capital is a more specialized kind of labor because the focus in human capital is on the skills acquired by labor by virtue of educational attainment. Finally, because creative and physical capital are the two inputs in the production process we study, their endogenous use is optimal only when specific *equilibrium* conditions hold. In particular, for both creative and physical capital, the marginal revenue product of the input must equal its price. We demonstrate the applicability of these conditions in equations (3) and (4) below. That said, the reader should understand that it is *not* necessary to conduct any "labor market analysis" because labor is *not* a factor of production in our paper and because the use of the input that is like labor or creative capital is already subject to the optimal input use condition delineated in equation (3) below.

The output Q of this knowledge good is produced with a constant-returns-to-scale Cobb-Douglas production function given by

$$Q = F(R, K) = R^{1/2}K^{1/2}. \quad (1)$$

The fact that the exponents on the inputs R and K are equal means that both these inputs are "equally important" in producing the final knowledge good. We believe that this "equally important" assumption is reasonable in the sense that a subsidy to either creative or physical capital is *symmetric* in terms of how it affects the production of the knowledge good. As such, the impacts of the subsidies depend only on the subsidies themselves and *not* on how a subsidy affects the production of the knowledge good *asymmetrically* because one input is either more or less important than the other.

We are not the first to use a Cobb-Douglas function to model production in a region that is populated by members of the creative class. Specifically, Batabyal and Beladi (2015), Buettner and Janeba (2016), and Porter and Batabyal (2016) have all used this function in their analyses of regional economies with a noteworthy presence of the creative class. If we were willing to *dispense with* the preceding paragraph's "equally important" assumption about the two inputs R and K then it would be possible to work with a slightly more general constant-returns-to-scale Cobb-Douglas production function of the form $Q = R^{\gamma}K^{1-\gamma}, \gamma \in (0,1), \gamma \neq 1/2$, and obtain results of the sort we obtain in sections 2.3-2.5 below. Therefore, to demonstrate this point, in sections 2.2 and 2.3 below, we shall occasionally point out how our results would change when the above function is used to model production and the parameter γ is not equal to one-half.

The representative creative class member's objective is to minimize the average cost of producing the knowledge good.[9] Now, it is possible that if the RA in either region A or B is

[9] We have noted earlier in this section that we are thinking of the representative creative class member as a knowledge good *producing entrepreneur*. This means that we are emphasizing the *production* aspect of this member's activities. This emphasis on the entrepreneur's production of a knowledge good is similar to an emphasis on the behavior of a *firm* that produces a knowledge

successful in attracting a sufficient number of creative class members to its region then this success would lead to the formation of a cluster of likeminded creative class members, all of whom produce either the same or very similar knowledge goods. The existence of such a cluster could, *over time*, give rise to agglomeration economies in the pertinent region.[10] That said, two points are worth noting. First, we have stated our objectives in this paper clearly in the penultimate paragraph of section 1.2.2 and analyzing clusters and potential agglomeration economies is *not* one of them. Second, our position is that a meaningful analysis of clusters and potential agglomeration economies *cannot* be undertaken with a static model of the sort we use in this paper. Instead, such an analysis would need to be dynamic and such a dynamic analysis is *beyond* the scope of this paper.[11]

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good. Since it is standard---see Hirshleifer *et al*. (2005)---to think of the objective of a firm in terms of either the maximization of profit or the minimization of cost, we have decided to focus on the latter or cost minimization objective. We could have chosen to focus on the minimization of total cost but we have, instead, chosen to focus on the minimization of average cost. This is because a focus on average cost allows us to make inferences about the location decision of our entrepreneurial creative class member that is based *solely* on the prices of the two inputs---creative and physical capital---and *not* also on the amount of the knowledge good that is produced. To see this clearly, observe the total and average cost expressions in equations (8) and (9) below. Finally, we note that it is common practice to teach students of microeconomics---see, for example, Hirshleifer *et al.* (2005)---that it makes sense for a firm facing a U-shaped average cost curve to operate on the lowest or *minimal* point of this curve.

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It is possible that in contrast to our modeling approach in which the representative creative class member focuses on finding the "low-cost" location, this individual actually cares more about locating in a region that has a concentration of similar businesses so as to take advantage of agglomeration economies. Although, at the level of principle, it is certainly possible to state and analyze a more complex optimization problem in which the objective is to locate in a region with a concentration of related businesses, we are unaware of any theoretical studies in regional science that have adopted such a modeling approach. In fact, to the best of our knowledge, theoretical studies in regional science that have analyzed optimization problems involving creative businesses and industries---see, for example, Batabyal and Beladi (2015, 2018, 2021), Batabyal *et al*. (2019), and Batabyal and Yoo (2020a)---have typically concentrated on some version of either profit maximization or cost minimization. That said, there is an empirical literature that has attempted to determine the extent to which agglomeration economies are salient in the context of creative businesses and industries. The consensus in this literature seems to be that such economies are sometimes salient and that their salience depends on the manner in which the agglomeration economies are specified, the nature of the available data, and the econometric methodology that is used to study them. See You and Bie (2017), Coll-Matrinez (2019), and Tao *et al*. (2019) for additional details on this empirical literature.

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It is possible that the production of "creative goods" is subject to increasing returns to scale. That said, the following two points are worth emphasizing. First, as noted in the body of this paragraph, we have stated our objectives in this paper clearly and analyzing the impacts of increasing returns to scale is *not* one of them. Therefore, we omit a discussion of this topic in our paper. Second, working with a more general Cobb-Douglas production function that allows for the possibility of increasing returns to scale would, almost certainly, lead to *uninterpretable* results. One of the strengths of the modeling approach we employ in this paper is that it leads to clean and interpretable results.

With this theoretical framework out of the way, we are now in a position to analyze which region the representative creative class member ought to locate in when region A (B) has identical (variable) prices for the two necessary inputs R and K.

2.2. The benchmark case

Our first task now is to derive the cost function confronting the representative creative class member. To this end and for the moment, let $p_R > 0$ and $p_K > 0$ denote the prices of creative and physical capital, independent of the region in which production of the knowledge good is taking place. We shall shortly work with region-specific prices in which case both these prices will be denoted by p_{Ri} and p_{Ki} where $i = A, B$. The representative creative class member solves

$$min_{\{R,K\}}\, p_R R + p_K K \tag{2}$$

subject to the production function constraint given in equation (1). This optimization problem tells us that the representative creative class member is seeking to *minimize* the cost of manufacturing the knowledge good whose production is given by the function described in equation (1). Let λ denote the Lagrange multiplier for the relevant Lagrangian function. Then, differentiating this Lagrangian function with respect to the inputs R and K, the first-order necessary conditions for a minimum are[12]

$$p_R - \frac{\lambda}{2}\left(\frac{R^{\frac{1}{2}}K^{\frac{1}{2}}}{R}\right) = 0 \tag{3}$$

[12] The second-order sufficiency conditions are satisfied.

and

$$p_K - \frac{\lambda}{2}\left(\frac{R^{\frac{1}{2}}K^{\frac{1}{2}}}{K}\right) = 0. \tag{4}$$

These two first-order necessary conditions tell us that the marginal revenue product from the use of the two inputs creative and physical capital must be set equal to their prices. Dividing equation (3) by (4), we get

$$\frac{p_R}{p_K} = \frac{K}{R}. \tag{5}$$

Manipulating the production function constraint in equation (1), we see that

$$Q = R\left(\frac{p_R}{p_K}\right)^{1/2}. \tag{6}$$

Using the above results, we are now in a position to express the cost function $C(Q)$ confronting the representative creative class member. We get

$$C(Q) = p_R R + p_K K = p_R\left\{\frac{p_K}{p_R}\right\}K + p_K Q\left\{\frac{p_R}{p_K}\right\}^{1/2}. \tag{7}$$

The right-hand-side (RHS) of equation (7) can be simplified further. After this simplification, the cost function we seek can be written compactly as

$$C(Q) = 2p_R^{1/2}p_K^{1/2}Q. \tag{8}$$

Equation (8) tells us that this cost function depends on the two input prices (p_R, p_K) and the output of the knowledge good (Q). Instead of working with equation (1), if we were to work with the production function $Q = R^{\gamma}K^{1-\gamma}$ then the cost function in equation (8) would need to be replaced with $C(Q) = 2p_R^{\gamma}p_K^{1-\gamma}$. Comparing this last expression with the corresponding expression in equation (8) shows exactly how this last expression is a slightly more general description of the cost function that is obtained by eschewing the "equally important" assumption about the two inputs R and K.

We now use equation (8) to ascertain the average cost function by dividing $C(Q)$ by Q. This gives us

$$AC = \frac{C(Q)}{Q} = 2p_R^{1/2}p_K^{1/2}. \tag{9}$$

As with the derivation of the cost function $C(Q)$, if we were to work with the production function $Q = R^{\gamma}K^{1-\gamma}$ then the relevant average cost function would be $AC = 2p_R^{\gamma}p_K^{1-\gamma}$. Once again, comparing this last expression for the average cost function with the related expression in equation (9) shows the slight difference between the $\gamma = 1/2$ or "equally important" inputs case and the $\gamma \neq 1/2$ but $\gamma \in (0, 1)$ case.

Having derived the average cost function, we are now in a position to resolve the representative creative class member's plant location choice question. To this end, suppose that the prices of creative and physical capital in region A are identical and constant. In symbols, we

have $p_{RA} = p_{KA} = \alpha > 1$.[13] In contrast, the same two prices in region B are variable and we account for this by positing that $p_{RB} = \alpha + 1$ and $p_{KB} = \alpha - 1$. This constant α is important in our analysis because it is the benchmark or *reference* point against which all other subsidy induced deviations in input prices are measured in the ensuing analysis. Also, since the subsidy induced input price changes we analyze are *incremental* in nature, it is convenient---and we believe intuitive---to model these *marginal* prices changes using the notation $\alpha \pm 1$. This way of modeling the benchmark input prices and the subsequent changes in these prices is clearly *more general* than beginning with the supposition that, for instance, $p_{RA} = p_{KA} = 7, p_{RB} = 8,$ and $p_{KB} = 6$. That said, as in the case of the production function, it is possible to model the marginal price changes in a slightly less intuitive but more general manner by replacing the intuitive $\alpha \pm 1$ notation with, for instance, $\alpha \pm k$ notation where $k \geq 1$.

Now, using the $\alpha \pm 1$ notation to study changes in input prices, the average cost of producing the knowledge good in region A is

$$AC_A = 2p_{RA}^{1/2}p_{KA}^{1/2} = 2\alpha^{1/2}\alpha^{1/2} = 2\alpha. \tag{10}$$

Similarly, the average cost of producing the knowledge good in region B is

$$AC_B = 2p_{RB}^{1/2}p_{KB}^{1/2} = 2(\alpha + 1)^{1/2}(\alpha - 1)^{1/2} = 2(\alpha^2 - 1)^{1/2}. \tag{11}$$

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13 This section is titled "the *benchmark* case." As such, to clearly see how the representative creative class member's plant location decision changes as a function of input *price changes*, caused by the grant of subsidies, it is helpful to begin the analysis with a *common* set of prices. In addition, recall from equation (1) that both factors of production are "equally important" in the production process and that is why both exponents *equal* ½. These two points together explain why we assume a *common, benchmark* set of prices $p_{RA} = p_{KA} = \alpha$. Finally, these benchmark prices are constant because the model we work with in this paper is *static*.

Comparing the RHSs of equations (10) and (11), we see that because the benchmark price $\alpha > 1$, we have

$$2\alpha > 2(\alpha^2 - 1)^{1/2} \Rightarrow AC_A > AC_B. \quad (12)$$

Since the average cost of producing the knowledge good in region A is higher than the corresponding cost in region B, the representative creative class member should live and work in the less costly region B.[14] Consistent with an example given in section 2.1, if region A is Minneapolis and region B is Saint Paul then the representative creative class member ought to live and work in Saint Paul. Let us now analyze the case where region A deviates from the benchmark case studied in this section by subsidizing creative capital.

2.3. Region A subsidizes creative capital

Suppose region A encourages the use of creative capital by providing a subsidy of \$1 when this input is used. Then, the price of creative capital changes from $p_{RA} = \alpha$ to $p_{RA} = \alpha - 1$. The three other input prices in the aggregate economy remain unchanged from what they were in the benchmark case studied in section 2.2. Taking into account the subsidized price of creative capital, we get

$$AC_A = 2(\alpha - 1)^{1/2}\alpha^{1/2} = 2(\alpha^2 - \alpha)^{1/2}. \quad (13)$$

[14] This result would also hold if we were to replace the $\alpha \pm 1$ notation with the $\alpha \pm k, k \geq 1$ notation.

We now compare the RHSs of equations (13) and (11). Because the benchmark price $\alpha > 1$, we see that

$$2(\alpha^2 - \alpha)^{1/2} < 2(\alpha^2 - 1)^{1/2} \Rightarrow AC_A < AC_B. \quad (14)$$

Equation (14) tells us that a small subsidy to creative capital *switches* the representative creative class member's optimal plant location decision from region B to region A.[15] Since we are assuming that there are no moving costs associated with a move from region B to A,[16] the representative creative class member ought to make the move from region B to A. Next, we analyze the case in which region A departs from the benchmark case by subsidizing the use of physical capital.

2.4. Region A subsidizes physical capital

As in section 2.3, assume that region A grants a subsidy of \$1 when physical capital is used by the representative creative class member. Then, the incremental cost of using physical capital in this region falls to $p_{KA} = \alpha - 1$ from $p_{KA} = \alpha$. All other input prices in the aggregate economy stay unchanged. As a result of this price decline, the average cost of producing the knowledge good in region A is

$$AC_A = 2\alpha^{1/2}(\alpha - 1)^{1/2} = 2(\alpha^2 - \alpha)^{1/2}. \quad (15)$$

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If we were to replace the production function in equation (1) with $Q = R^{\gamma}K^{1-\gamma}$ and the $\alpha \pm 1$ notation with the $\alpha \pm k, k \geq 1$ notation then this result may or may not hold. That is because the result about where to locate would now depend on the *interaction* between the actual values of the triple (α, γ, k) and on the *difference* between the values of α and k. In this regard, when $\alpha = 2$ and $k = 1$, it can be shown that $AC_A > AC_B$ for $\gamma \leq 0.38$. Finally, we reiterate that we have chosen to focus on the $\gamma = 1/2$ case for the reasons given in section 2.1.

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This would be a reasonable assumption if the move is from, say, Saint Paul to Minneapolis or, for that matter, from Bhubaneshwar to Cuttack in Odisha, India.

Inspecting the RHSs of equations (15) and (13) we see the average cost expressions in both these cases are identical. Therefore, the answer to the plant location choice question is the same as that discussed in section 2.3. Specifically, our representative creative class member ought to move his plant from region B to A. Our analysis in this and the preceding section tells us that even small subsidies granted by RAs can provide the right monetary incentive for the purpose of drawing in creative class members into a particular region. Our next task in this paper is to analyze the outcome when regions A and B act *identically* in subsidizing either creative or physical capital.

2.5. Regions A and B use identical policies

As in section 2.3 for region A, suppose that region B offers a \$1 subsidy to each unit of creative capital that is used to produce the pertinent knowledge good. Then, the price of creative capital falls from $p_{RB} = \alpha + 1$ to $p_{RB} = \alpha$. The average cost of producing the knowledge good in region B now is

$$AC_B = 2\alpha^{1/2}(\alpha - 1)^{1/2} = 2(\alpha^2 - \alpha)^{1/2}. \qquad (16)$$

Comparing the RHSs of equations (16) and (13) we see that with the small subsidy to creative capital in region B, the average cost of producing the knowledge good is the same as the subsidized average cost in region A. Therefore in this case involving *identical subsidies* to creative capital, the representative creative class member is i*ndifferent* between locating and living in regions A and B.

Now, as in section 2.4 for region A, if region B provides a \$1 subsidy for the use of physical capital, then the price of physical capital drops to $p_{KB} = \alpha - 2$ from $p_{KB} = \alpha - 1$. The average cost of producing the knowledge good in region B now becomes

$$AC_B = 2(\alpha + 1)^{1/2}(\alpha - 2)^{1/2} = 2(\alpha^2 - \alpha - 2)^{1/2}. \quad (17)$$

Comparing the RHSs of equations (17) and (15), we see that

$$2(\alpha^2 - \alpha)^{1/2} > 2(\alpha^2 - \alpha - 2)^{1/2} \Rightarrow AC_A > AC_B. \quad (18)$$

In other words, the small subsidy for the use of physical capital leads to a lower average cost than the small subsidy for the use of creative capital. Therefore, in this case involving *identical subsidies* to physical capital, the representative creative class member will be induced to *relocate* to region B.

Let us summarize this discussion of identical policies with the following three points. First, if the RAs of the two regions wish to attract the representative creative class member to their region then they both have an incentive to provide *subsidies*. Second, the subsidy to be offered is better targeted to physical capital in region B. Finally, as demonstrated in sections 2.3 and 2.4, in region A, the RA's subsidy to either creative or physical capital has the *same* impact. We now briefly discuss what the available empirical evidence tells us about the factors that are salient in determining the location of creative businesses and industries.

2.6. Empirical perspectives on the location of creative industries

A key point of ours in this paper is that subsidies offered by appropriate RAs have an impact on the plant location decision made by the representative creative class member. There is empirical support for this point. For instance, as noted by Peck (2005), within the context of the so-called "Cool Cities Program" in Michigan, Detroit Jefferson East Business Association determined that it would be a good for the state to subsidize the location of desirable business

clients. Similarly, the Southwest Detroit Business Association sought subsidies from the state to become, *inter alia*, a magnet for cultural tourism.

Moving on to Lithuania, Martinaityte and Kregzdaite (2015) point out that in addition to other factors, government subsidies are important in influencing the location of the "creative sector" in this country. In the case of Wales, Thomas (2016) notes that the "creative industries" are one of the fastest growing sectors of the Welsh economy. This has happened not only because of ministerial interventions but also because of the grant of subsidies by the government. Finally, Rosenzweig *et al*. (2018) contend that RAs as disparate as the Nashville Music Council in Tennessee and Canada's Music Incubator---an entrepreneur program for artists---have granted subsidies to attract musicians and artists to their desired locations.

More generally, in addition to subsidies, researchers have pointed to other salient factors that are germane in determining the location of creative businesses and industries. Murphy *et al*. (2015) focus on the media and computer games sector in Dublin, Ireland, and divide the factors they believe are salient in determining location decisions in this sector into "hard" and "soft" factors. They contend that although "soft" factors of the sort promoted by Richard Florida are important in some situations, in general, "hard" factors have a greater impact on location decisions in this creative sector in Dublin. Sanchez Serra (2016) studies the location decisions of firms in creative industries in Spain. He argues that although specific "creative externalities" sometimes matter, for the most part, external economies related to "localization" and "urbanization" have a key bearing on the underlying location decisions of firms.

Moeller (2018) concentrates on Berlin, Germany, and points out that the location decisions of creative firms depends greatly on the location of creative employees and that such employees tend to locate in "amenity rich" urban places. Finally, Mendez-Ortega and Arauzo-Carod (2020)

analyze the location decisions of firms in the software and video game (SVE) industry in Barcelona, Lyon, and Hamburg. Their results show that the urban cores of these three cities have a significant impact on the location decisions of creative firms even though other factors such as the "core-periphery distribution" of the SVE industry are also relevant. This completes our discussion of the response of creative class members to regions competing to attract them with subsidies.

3. Conclusions

In this paper, we studied the decision problem faced by a knowledge good producing representative member of the creative class who needed to decide which of two regions (A or B) to locate his plant in. The knowledge good was manufactured with a constant-returns-to-scale Cobb-Douglas production function. Creative and physical capital were the only two inputs. The cost of using creative and physical capital varied in the two regions. The representative creative class member's objective was to minimize the average cost of producing the knowledge good. We analyzed the plant location decision in four cases. In the first or benchmark case, region A (B) had identical (variable) input prices. In the second case, region A deviated from the benchmark case by subsidizing creative capital. In the third case, region A departed from the benchmark case by subsidizing physical capital. In the final case, we studied what happened when both regions acted identically in subsidizing either creative or physical capital.

The model we used in this paper to analyze how subsidies affect a RA's ability to attract members of the creative class to a particular region does have limitations. Specifically, this model is unable to address potential negative effects that may occur *after* a sufficient number of creative class members have settled in a given region of interest. In this regard, McCann (2007), Zimmerman (2008), and others have argued that the creative class has made housing unaffordable

and increased rents in North American cities and that, more generally, this class has exacerbated social and economic inequalities in these cities. Clearly, these are salient issues that our static model is unable to address. That said, we note that to analyze these issues meaningfully, it would be necessary---as we suggest below---to work with an intertemporal model that can explicitly account for phenomena that occur over time.

The analysis in this paper can be extended in a number of different directions. Here are three potential extensions. First, it would be interesting to analyze the interaction between competing RAs and creative class members in a dynamic setting in which both parties are able to renegotiate the terms governing the location of a creative class member in a particular region. Second, it would be informative to model how the subsidies offered by the regions under study are financed and to then study the impact that the method of financing has on a RA's ability to attract creative class members to its region. Finally, one could also study a scenario in which RAs institute policies that are designed to provide information to and hence educate creative class members who have been successfully attracted to their regions. Studies that analyze these aspects of the underlying problem will provide additional insights into the nature of the static and the dynamic interactions between creative class members and regional authorities.

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