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Creative Capital in Production, Inefficiency, and Inequality: A Theoretical Analysis[1]

by

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Abstract

We analyze inefficiency and inequality associated with the use of creative capital to produce a final good in a regional economy. Specifically, we first study a case in which the individual creative capital units are perfect substitutes in the production of the final good. We show that the equilibrium outcome is inefficient and that there is too little application of effort. Second, we define an indicator of inequality and show that an increase in inequality enhances efficiency and that it is, in principle, possible to achieve complete efficiency. Third, we focus on the case where the individual creative capital units are perfect complements and show that the equilibrium outcome is, once again, inefficient with too little effort application. Finally, we contend that our theoretical results provide a possible rationale for the observed income inequality in cities and regions in which the activities of the creative class constitute a large part of all economic activities.

JEL Codes: R11, D20, D63

Keywords: Creative Capital, Inefficiency, Inequality, Perfect Complements, Perfect Substitutes

1. Introduction

1.1. Overview of the issues and the literature

An outcome of the academic and the popular writings of the urbanist Richard Florida,[4] is that both regional scientists and urban economists are now very familiar with the twin notions of the *creative class* and *creative capital*. In his prominent tome titled *The Rise of the Creative Class*, Florida (2002, p. 68) explains that the creative class "consists of people who add economic value through their creativity." This class is made up of professionals such as doctors, lawyers, scientists, engineers, university professors, and, notably, bohemians such as artists, musicians, and sculptors. From the standpoint of urban and more generally regional economic growth and development, these people are significant because they possess creative capital which is 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).

As pointed out by Florida on several occasions, the creative class is important because this group gives rise to ideas, information, and technology, outputs that are important for the growth and development of cities and regions. Hence, in this era of globalization, cities and regions that want to be successful need to do all they can to draw in members of this creative class because this class is the principal driver of economic growth.

Is there any difference between the well known concept of human capital and Florida's newer notion of creative capital? To answer this question, first observe that in empirical work, the notion of human capital is generally measured with education or with education based indicators. Even so, Marlet and Van Woerkens (2007) have rightly pointed out that the accumulation of creative

[4] See Florida (2002, 2005) and Florida *et al.* (2008).

capital does *not* always depend on the acquisition of formal education. Put differently, while the creative capital accumulated by some members of Florida's creative class (doctors, engineers, university professors) does depend on the completion of many years of formal education, the same is not always true of other members of this creative class (artists, painters, poets). Individuals in this latter group may be innately creative and hence possess creative capital despite having very little or no formal education.

As such, we agree with Marlet and Van Woerkens (2007) and contend that there is little or no difference between the notions of human and creative capital when the accumulation of this creative capital depends on the completion of many years of formal education. In contrast, there can be a lot of difference between the notions of human and creative capital when the accumulation of this creative capital does not have to depend on the completion of formal education. Because creative capital is of two types it is a *more* general concept than the notion of human capital.[5]

Critiquing the notions of the creative class and creative cities, Peck (2005) claims that the use of creative strategies in creative cities has done little to ameliorate problems stemming from the existence of what he calls socio-spatial *inequality*. Donegan and Lowe (2008, p. 46) have forcefully put forth the view that creative class theory has a "dark side" to it because cities that have a larger creative talent pool are also likely to have greater *income inequality*. This point has also been emphasized by Reese and Sands (2008). The findings of these three studies notwithstanding, Arribas-Bel *et al.* (2015) point out that social and ethnic diversity may act as an "attraction force" for visitors seeking to enjoy the vibrancy of inner city areas in a metropolis like Amsterdam.

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[5] This observation is in agreement with Michalko's (2001) conceptualization of creativity as the ability to view problems, situations, and challenges in novel ways and to explore original and less traveled pathways in response to the above mentioned challenges. See Pratt (2008) and Balducci (2011) for more on these ideas.

Lorenz (2011) looks at regional education and training systems in the context of what he calls creative forms of work organization. He points out that *inequalities* in access to high quality work environments can be reduced only with the employment of lifelong learning policies. Leslie and Catungal (2012) contend that the pursuit of ideas stemming from Richard Florida's creative class theory by many municipal governments has not only deepened class inequality but that specific features of what they call the "creative city" have resulted in the maintenance and even the exacerbation of class, gender, and racial *inequalities*.

Siemiatycki (2013) focuses on Oshawa, Ontario and points out that policies designed to attract creative class workers to this "lagging region" have resulted in some achievements but they have also given rise to growing concerns about poverty, homelessness, and *inequality*. Finally, Liu and Xie (2013) use data for 1998, 2000, 2005, and 2008 and show that provinces in China with a larger creative economy also tend to have a higher level of *wage inequality* between workers in the creative and other sectors of the economy.

Two points are now worth emphasizing. First, a central claim made by the papers discussed in the preceding three paragraphs—and indeed by many other studies—is that there is a *connection* between income inequality in particular and inequality more generally and cities and regions in which the activities of the creative class constitute a large part of all economic activities. Second, even though many observers have commented on the nexus between income inequality and cities and regions in which the activities of the creative class are a large proportion of all economic activities, to the best of our knowledge, *no one* has provided a microeconomic rationale for the existence of income inequality in the types of cities and regions that we have just mentioned.

1.2. Contributions of our paper

Given this lacuna in the literature, in our paper, we focus on a stylized production process in a region that uses creative capital—provided by members of the resident creative class—to produce a final good. Of particular interest to us are the twin notions of *inefficiency* and *inequality* associated with the use of creative capital in this production process. In this regard, we first analyze a case in which the individual creative capital units are perfect substitutes in the production of the final good. We show that the equilibrium outcome is *inefficient* and that there is too *little* application of effort by the individual creative capital units. Second, we define an indicator of inequality and show that increasing inequality in the output shares received by the various creative capital units *enhances* efficiency and that it is possible to achieve complete efficiency in the allocation of the various creative capital units. Third, we concentrate on the case where the individual creative capital units are perfect complements and show that the equilibrium outcome is, once again, *inefficient* with too *little* effort application by the individual creative capital units. Finally, consistent with the discussion in the last paragraph of section 1.1, we contend that our theoretical results provide a possible rationale for the observed income inequality in cities and regions in which the activities of the creative class make up a large part of all economic activities.

The remainder of this paper is organized as follows. Section 2 delineates our theoretical framework in detail. Section 3 discusses inefficiency in input allocation for the case in which the various creative capital units are perfect substitutes in the production of the final good. Section 4 first defines an indicator of inequality and then shows that increasing inequality in the output shares received by the individual creative capital units raises efficiency in input allocation and that full efficiency is an attainable goal as far as the allocation of the various creative capital units is

concerned. Section 5 first conducts an exercise similar to that conducted in section 3 except that the individual creative capital units are now assumed to be perfect complements. Next, this section notes that our theoretical results in sections 3 through 5 provide a possible rationale for the observed income inequality in cities and regions in which the activities of the creative class are a large fraction of all economic activities. Section 6 concludes and then discusses two ways in which the research described in this paper might be extended.

2. The Theoretical Framework

Our model is adapted from Ray *et al.* (2007). Consider a stylized production process in a regional economy that is creative in the sense of Richard Florida. This production process uses $n \in \mathbb{N}$ units of creative capital to produce a final good. The price of this final good is normalized to unity and the output Q of this good is given by the production function

$$Q = G(\vec{a}) = G(a_1, a_2, \ldots, a_n), \tag{1}$$

where $\vec{a} = (a_1, a_2, \ldots, a_n)$ is a nonnegative vector denoting the effort *applied* by the n creative capital units (inputs). We assume that the production function $G(\cdot)$ is strictly increasing, strictly concave, and that it satisfies the so called Inada conditions. In symbols, we have $G'(\cdot) > 0$, $G''(\cdot) < 0$, $G'(\vec{0}) = \infty$, and $G'(\infty) = 0$. Consistent with Florida's description of creative capital and the creative class given in section 1.1, we assume that the n creative capital units are heterogeneous.

We suppose that the output of the final good is distributed to the n creative capital units in accordance with a fixed sharing rule described by the sharing vector

$$\vec{\sigma} = (\sigma_1, \sigma_2, \ldots, \sigma_n) \tag{2}$$

which is arranged in *increasing* order and we have $\sigma_1+...+\sigma_i+...+\sigma_n=1$. The payoff function or the return $R(\cdot,\cdot)$ to the ith creative capital unit is given by

$$R_i(a_i,\ \vec{a}_{-i})=\sigma_i G(a_i,\ \vec{a}_{-i})-a_i, \tag{3}$$

where $\vec{a}_{-i}$ is a vector denoting the effort applications of all the creative capital units excluding the ith creative capital unit. Finally, to conclude our discussion of the theoretical framework, note that the efficient vector of effort applications by the n creative capital units is the one that maximizes what we call the "regional surplus" from the production of the final good. This regional surplus or RS is given by

$$RS\equiv G(\vec{a})-\Sigma_{i=1}^{n}a_i. \tag{4}$$

Our next task is to analyze the connection between inefficiency and the equilibrium effort applications of the individual creative capital units in the case where these units are perfect substitutes in the production of the final good.

3. The Perfect Substitutes Case

To motivate this case, consider a scenario in which the final good is a new good that an aspiring entrepreneur would like to produce. The ability of this entrepreneur to produce the final good in question depends on his ability to secure adequate start-up funding from venture capitalists who we shall think of as creative capital possessing units. If we think of the effort application of each creative capital unit as the amount of money contributed by this unit, then it is clear that the ability of our entrepreneur to produce the new good or, equivalently, secure the requisite amount of funding, depends on the *sum* of the money contributed by the individual creative capital units. Therefore, the individual creative capital units in this case are *perfect substitutes* in the production

of the entrepreneur's new good. More generally, the perfect substitutes assumption is relevant in all cases where the production of a final good is the result of financial lobbying by the individual factors of production. This is because the effectiveness of this kind of lobbying generally depends on the *sum* of the monetary contributions made by the individual factors of production.

In symbols, the case of perfect substitutes means that the output of the final good is given by $Q=G(\Sigma_{i=1}^{n} a_i)$. Now, let us formally analyze the interaction or the game between the n creative capital units. Given the effort applications $\vec{a}_{-i}$ of the $n-1$ other creative capital units, the ith creative capital unit chooses effort application a_i to maximize his return and mathematically this can be expressed as

$$a_i^* = argmax_{\{a_i\}} \sigma_i G(a_i + \Sigma_{\forall j \neq i} a_j) - a_i. \quad (5)$$

An equilibrium in this interaction is a vector of effort applications $\vec{a}^*$ with the property that for the ith creative capital unit, the effort application is a_i^* given the optimal effort applications of all the other creative capital units given by $\vec{a}_{-i}^*$. Recall that the vector of output shares is given by $\vec{\sigma}=(\sigma_1,\sigma_2,...,\sigma_n)$ where we have $\sigma_1<...<\sigma_i<...<\sigma_n$.

The objective of each of the n creative capital units is to maximize its return function given in equation (3) with $G(a_i, \vec{a}_{-i})$ replaced with $G(\Sigma_{i=1}^{n} a_i)$. Therefore, the first order necessary condition for an interior maximum for the ith creative capital unit is

$$\sigma_i G'(\Sigma_{\forall j} a_j) - 1 = 0. \quad (6)$$

Now note that because of the arrangement of the output shares or the σ_i specified in the preceding paragraph, the left-hand-side (LHS) of equation (6) is *increasing* in these output shares. This tells us that of all the creative capital units, *only* unit n with the highest output share σ_n will apply positive effort in the equilibrium under study.

The remaining creative capital units with output share $\sigma_i<\sigma_n$ will apply *zero* effort in equilibrium because $\sigma_i G'(\Sigma_{\forall j} a_j)<\sigma_n G'(\Sigma_{\forall j} a_j)=1.$ This means that in the equilibrium under study, the optimal effort applications of all the creative capital units except the nth creative capital unit equal zero. In addition, the optimal effort application of the nth creative capital unit is the solution to the equation

$$\sigma_n G'(a_n^*)=1. \tag{7}$$

Let us now focus on the allocative efficiency of the n creative capital units. In this regard, note that in contrast to what actually occurs in the equilibrium of the above described interaction between the n creative capital units, the *efficient* effort application levels by these same units can be obtained by maximizing the regional surplus or the RS function given in equation (4). Therefore, the problem of interest now is to solve

$$\max_{\{a_j\}} G(\Sigma_{j=1}^n a_j)-\Sigma_{j=1}^n a_j. \tag{8}$$

The first order necessary condition for efficient effort application is

$$G'(\Sigma_{j=1}^n a_j)=1. \tag{9}$$

Comparing the efficient effort applications with the equilibrium effort applications—see

equations (6), (7), and (9)—and recalling the facts that $\sigma_n<1$ and $G''(\cdot)<0$, we see that there is *too little* effort application in the equilibrium and hence this equilibrium is *inefficient*. Put differently, final good production in our regional economy with perfectly substitutable creative capital units and with a fixed output sharing rule will result in an inefficient equilibrium with suboptimal effort applications. Our next task in this paper is to define an indicator of inequality and to then analyze the relationship between this indicator, the output shares (the $\sigma_i's$) received by the various creative capital units, and allocative efficiency in the production process that we have been studying in this third section.

4. An Indicator of Inequality

Let us define the indicator of inequality to be the highest output share σ_n such that $(1/n)\leq\sigma_n\leq 1$. From our analysis in section 3 we know that the equilibrium effort application level a_n^* satisfies the condition $\sigma_n G'(a_n^*)=1$ given in equation (7). Inspecting this condition, we obtain two results. First, we see that the LHS of this condition is increasing in our indicator of inequality σ_n. Second, we observe that the LHS of this condition converges to the efficient effort application level given in equation (9) when σ_n approaches unity. Note that this second result arises because in the limit as σ_n approaches unity, we get $G'(a_n^*)=1$ and $a_n^*=\Sigma_{\forall j}a_j^*$.

The discussion in the previous paragraph shows that as the inequality in the receipt of the output shares by the individual creative capital units *increases*, i.e., as $\sigma_n\rightarrow 1$, allocative efficiency

is *enhanced*. In particular, when inequality in the receipt of the output shares is *maximal* $(\sigma_n=1)$, the effort applications of the individual creative capital units are *completely* efficient and this results in the maximization of the regional surplus described in equation (4). In other words, there is a clear *tradeoff* between inequality and inefficiency. As the sharing of the output of the final good becomes more unequal, the lesser is the inefficiency—and the greater is the efficiency—of the effort applications of the individual creative capital units. We now proceed to study the case that is the polar opposite of the case studied in section 3. In other words, we study the connection between inefficiency and the equilibrium effort applications of the individual creative capital units when these units are perfect complements in the production of the final good.

5. The Perfect Complements Case

To motivate this case, consider a scenario in which the final good is a smart phone such as the iPhone. In order to produce a smart phone, a producer needs various inputs such as computer chips, batteries, circuits, etc. in very *specific* proportions. If we think of the provision of these different inputs as the result of the effort applications by individual creative capital units, then it makes sense to think of the effort allocations of these different creative capital units as being almost *perfect complements*.

As a second example, consider the production of musical instruments such as horns or ammunition casings, both of which are made with brass. In order to produce such goods, the producer first needs copper and zinc in a *specific* proportion and then he needs skilled personnel to create and work on the brass alloy in a *particular* manner. As in the example in the preceding paragraph, if we think of the provision of these different inputs as the result of effort applications by individual creative capital units then it is reasonable to think of the contributions of these units

as being almost perfectly complementary in nature.

In symbols, the case of perfect complements means that the output of the final good is given by $Q=G(\min_{\forall i}\{a_i\})$ and the production function $G(\cdot)$ has the monotonicity and curvature properties specified in section 2. In words, the production function $G(\cdot)$ is a strictly increasing and strictly concave function of the smallest effort application a_i in the effort application vector $\vec{a}=(a_1,...a_i,...,a_n)$.

The equilibrium effort application of the ith creative capital unit can be mathematically expressed as

$$a_i^* = argmax_{\{a_i\}} \sigma_i G(\min_{\forall i}\{a_i\}) - a_i. \tag{10}$$

Note that in this perfect complements case, the output Q of the final good is generated by the *smallest* effort application from a creative capital unit. In addition, the equilibrium effort applications of the various creative capital units are *increasing* in the output shares, i.e., the $\sigma_i's$.

Finally, recall from the discussion in section 2 that the elements of the output shares vector $\vec{\sigma}$ are arranged in *increasing* order.

The three points mentioned in the preceding paragraph together tell us that the smallest effort application is made by the creative capital unit with the *smallest* output share. Clearly, this is the first or $i=1$ creative capital unit. Knowing this, we infer that the first order necessary condition that describes the optimal effort application by this first creative capital unit is given by

$$\sigma_1 G'(a_1)=1 \tag{11}$$

and it is understood that $0<\sigma_1\leq(1/n)$.

The effort applications that maximize the regional surplus RS are given by solving

$$\max_{\{a_j\}} G(\min_{\forall j}\{a_j\})-\Sigma_{j=1}^{n}a_j. \tag{12}$$

Note that only the *smallest* effort application now contributes positively to the production of output Q. Therefore, some thought and the discussion in Ray *et al.* (2007, p. 923) tell us that allocative efficiency now requires *equal* effort applications from the various creative capital units. In symbols, we have $a_i=a^e$ for all $i=1,...,n$ and the superscript e denotes equal. The first order necessary condition describing the efficient level of effort application is

$$G'(a^e)=n. \tag{13}$$

Comparing the equilibrium and the efficiency conditions given in equations (11) and (13), we see that

$$\sigma_1 G'(a_1)=(1/n)G'(a^e)=1. \tag{14}$$

Equation (14) tells us that for $0<\sigma_1\leq(1/n)$, we have $a_1<a^e$. In other words, just as in the perfect substitutes case studied in section 3, there is *too little* effort application by the various creative capital units in the equilibrium under study and therefore this equilibrium is, once again, *inefficient*. This means that the production of the final good in our regional economy with perfectly complementary creative capital units and with a fixed output sharing rule will result in an inefficient equilibrium with suboptimal effort applications.

What about the connection between inefficiency and inequality in this perfect complements case? Equation (14) provides us with the answer to this question. In this regard, inspection of

equation (14) tells us that as we elevate the lowest output share σ_1, we *reduce* inequality among the various creative capital units and this reduction *enhances* the equilibrium effort application. In particular, as the output share σ_1 approaches full equality or zero inequality, i.e., the ratio $1/n$, the equilibrium effort application converges to the fully efficient level of effort application.

Comparing the results in the preceding paragraph with those obtained for the perfect substitutes case in sections 3 and 4 we see that there is a similarity but also a key difference. The similarity is that in both cases, the equilibrium effort applications are inefficient with too little effort applied. The difference concerns the nature of the relationship between the notions of inefficiency and inequality. In the perfect substitutes case, there is a *tradeoff* between inequality and inefficiency. Specifically, as the sharing of the output of the final good becomes more unequal, the lesser is the inefficiency—and the greater is the efficiency—of the effort applications of the individual creative capital units. In contrast, in the perfect complements case, there is *no* tradeoff between inequality and inefficiency. In particular, as we reduce inequality by raising the value of the lowest output share σ_1, there is less inefficiency in the effort applications of the various creative capital units.

Finally, our analysis shows that in a stylized production process in a regional economy that involves the use of creative capital, if we omit a single boundary value for the output share $(\sigma_1=1/n)$, then some degree of inequality and inefficiency is *always present*. In fact, in the perfect substitutes case, even when we take the boundary value $(\sigma_n=1)$ into account, there is a very high degree of inequality in the output shares.

Now, in cities and regions in which the activities of the creative class constitute a large part of all economic activities, we can expect to see a large number of final goods being produced by

members of the creative class who possess and supply creative capital. Therefore, our concluding point in this paper is that if we generalize our theoretical findings about a single production process to a city or regional economy with multiple such production processes, then we see that it is certainly possible for widespread inefficiency and inequality to exist simultaneously. In fact, in such economies, it is even possible for very high inequality to coexist with full efficiency in production. These points, we believe, provide a potential rationale for the *observed* income inequality in cities and regions in which the activities of the creative class are a large proportion of all economic activities.

6. Conclusions

In this paper, we theoretically analyzed inefficiency and inequality associated with the use of creative capital to produce a final good. Specifically, we first studied a case in which the individual creative capital units were perfect substitutes in the production of the final good. We showed that the equilibrium outcome was inefficient and that there was too little application of effort. Second, we defined an indicator of inequality and showed that increasing inequality enhanced efficiency and that it was possible to achieve complete efficiency. Third, we focused on the case where the individual creative capital units were perfect complements and showed that the equilibrium outcome was, once again, inefficient with too little effort application. Finally, we pointed out that our theoretical results provided a possible rationale for the observed income inequality in cities and regions with a noteworthy presence of the creative class.

The analysis in this paper can be extended in a number of different directions. In what follows, we suggest two possible extensions. First, it would be useful to generalize the analysis in this paper by studying the intermediate cases in which the substitutability and the complementarity

between the individual creative capital units is imperfect. Second, instead of treating the output sharing rule as exogenous, it would also be instructive to study the design of sharing rules in a dynamic context with certain desirable properties such as the property of being renegotiation-proof. Studies that analyze these aspects of the underlying problem will provide additional insights into the nexuses between creative capital using production processes and the notions of inefficiency and inequality.

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