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On research and development in a model of Schumpeterian economic growth in a creative region☆

Amitrajeet A. Batabyal [a], Seung Jick Yoo [b,*]

[a] Department of Economics, Rochester Institute of Technology, 92 Lomb Memorial Drive, Rochester, NY 14623-5604, USA
[b] Graduate School of International Service, Sookmyung Women's University, 100 Cheongpa-ro 47-gil, Yongsan-gu, Seoul, Republic of Korea

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ABSTRACT

We analyze the nature of research and development (R&D) that leads to Schumpeterian economic growth in a region that is creative in the sense of Richard Florida. The engine of economic growth in our creative region is process innovations that lead to *quality* improvements in the machines that are used to produce a final consumption good. We accomplish two main tasks. First, we show that in the so called balanced growth path (BGP) equilibrium, growth is unbalanced because R&D takes place *only* on the machine line with the highest quality. Second, we show how a policymaker can alter the basic model so that the resulting equilibrium has balanced growth in the sense that there is R&D across *all* the different machine lines.

1. Introduction

1.1. Aim and rationale

The urbanist Richard Florida has now successfully popularized the twin concepts of the *creative class* and *creative capital* to economists and to regional scientists.[1] In this regard, Florida (2002, p. 68) helpfully explains that the creative class "consists of people who add economic value through their creativity." This class is composed of professionals such as doctors, lawyers, scientists, engineers, university professors, and, notably, bohemians such as artists, musicians, and sculptors. From the perspective of 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, 2005a, p. 32).

As noted by Florida on numerous occasions, the creative class deserves to be studied in detail 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 and retain members of the creative class because this class is the primary driver of economic growth.

The above discussion raises the following question: how is the notion of creative capital different from the concept of human capital? To answer this question, first observe that in empirical work, the concept of human capital is typically measured with education or with education based indicators. Even so, Marlet and Van Woerkens (2007) have rightly pointed out that the accumulation of creative capital does *not* have to be dependent on the acquisition of a formal education. What this means is that even though 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 necessarily true of other members of this creative class (artists, painters, poets). People in this latter group may be innately creative and thus possess raw creative capital despite having very little or no formal education.

Given this situation, Marlet and Van Woerkens (2007) are surely right when they say that there is little or no difference between the concepts of human and creative capital when the accumulation of this

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* Corresponding author.
E-mail addresses: aabgsh@rit.edu (A.A. Batabyal), sjyoo@sookmyung.ac.kr (S.J. Yoo).

[1] See Florida (2002, 2005a, 2005b) and Florida et al. (2008).

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creative capital is a function of the completion of many years of conventional education. In contrast, there can be a lot of difference between the concepts of human and creative capital when the accumulation of this creative capital does not have to be a function of the completion of a conventional education. Because creative capital is of two types, it is a *more* general concept than the notion of human capital.

Let us now emphasize three points. First, the work of Eversole (2005), Baumol (2010), Batabyal and Nijkamp (2013), and Siemiatycki (2013) tells us that in regions where the creative class is a dominant part of the overall workforce, there is a definite link between *innovations*, the creative class, and regional economic growth and development. Second, innovative activities and processes are essentially *competitive* in nature and that this competitive aspect is related to the insight of Joseph Schumpeter who contended that growth processes are marked by *creative destruction* in which "economic growth is driven, at least in part, by new firms replacing incumbents and new machines and products replacing old ones" (Acemoglu, 2009, p. 458). Finally, the preceding two points notwithstanding, there are *no* theoretical studies of research and development (R&D) that leads to Schumpeterian economic growth in a region that is creative in the sense of Richard Florida. Hence, in this paper, we provide the *first* theoretical analysis of the ways in which R&D affects Schumpeterian economic growth in a region that is creative *a la* Richard Florida. Now, before we discuss the specifics of our paper, let us first briefly survey the related literature on R&D and Schumpeterian economic growth.

1.2. Review of the literature

In a prescient paper, Leahy and McKee (1972) noted that change in generic regional economies can be appropriately understood by adopting a "Schumpeterian view" of the underlying economy. In spite of the appearance of this statement more than four decades ago, economists and regional scientists have begun to utilize the ideas of Schumpeter to look at the nexus between innovation and economic growth in generic regions only since the early 1980s. Therefore, there is now a fairly sizeable empirical and case study based literature that has analyzed different aspects of Schumpeterian economic growth in generic regional economies.

In his survey article on R&D in creative regions, Malecki (1987) points out that regions that expect to become major areas of what he calls spin-off and creativity are likely to be constrained by the joint preferences of R&D workers, venture capital investors, and high-tech employers. Hodgkinson (1999) concentrates on Illawara, Australia and shows that what she calls "creative milieu factors" are salient determinants of R&D in Illawara. Malecki (2007) notes that although sophisticated policies are now in place to attract creative workers who comprise the core of the knowledge economy, it is important for policy makers to comprehend the nature of place competition and the critical role that knowledge plays in the strategies of the most competitive places.

Dewick et al. (2006) model creative destruction and its impacts on industrial structure in the European Union, the United States, and China. They show that as a result of the development and the diffusion of future biotechnologies and nanotechnologies, some industries grow, others decline, and some new ones emerge. Quatraro (2009) maintains that Schumpeter's views about innovation and business cycles can be used to comprehend the diffusion of innovation capabilities in various Italian regions. Aghion et al. (2009) point out that there is empirical support for the idea that more intense competition enhances innovation among what they call "frontier" firms but that this kind of intense competition may actually discourage innovation in "non-frontier" firms. Focusing on major high-tech industries in the United States, Bieri (2010) finds considerable support for some of Richard Florida's ideas in his empirical study. Specifically, he shows that the mix of creativity and diversity as proxied by his "Florida measure" is a key driver of the location choices of new high-tech firms.

Concentrating on 2645 counties in the United States, Hodges and Ostbye (2010) find support for a Schumpeterian growth model because, in their empirical model, bigger firms are needed to carry out effective R&D which then leads to higher economic growth in the localities being studied. Carillo and Papagni (2014) utilize a Schumpeterian growth model and make the point that the incentive structure confronting an economy's science sector greatly influences both the development of science and the economy itself. Finally, Batabyal and Beladi (2014) use a theoretical model to first derive the equilibrium level of creative capital that is allocated to the R&D sector in a creative region and then show how this level is affected by changes in the parameters of the model.

There are only three theoretical studies that are loosely connected to the basic issue we study—see Section 1.1—in this paper. Batabyal and Nijkamp (2012) have analyzed a one-sector, discrete-time, Schumpeterian model of growth in a general region and have shown that the region being studied experiences bursts of unemployment followed by periods of full employment. Batabyal and Nijkamp (2014) have used a Schumpeterian growth model to study the circumstances in which there is either too much or too little innovation first in a generic region and then when this region is part of an aggregate economy of $N \geq 2$ regions. Batabyal and Beladi (2016) have analyzed the effects of probabilistic innovations on Schumpeterian economic growth in a creative region. This last paper also studies whether there is too much or too little innovation in a particular creative region. In contrast to these three papers, we focus on the nature of R&D *per se* and the Schumpeterian economic growth that the conduct of R&D gives rise to in a creative region. There is no overlap between the questions analyzed by the above three papers and the question we study in the present paper.

The remainder of this paper is organized as follows. Section 2 describes our theoretical model of a creative region that is adapted from Aghion and Howitt (1992) and Acemoglu (2009, pp. 459–472). The engine of economic growth in our creative region is *process* innovations that lead to *quality* improvements in the inputs or machines that are used to produce a final consumption good. Section 3 describes the balanced growth path (BGP) equilibrium and then shows that in this equilibrium, R&D takes place only on the machine line with the *highest* quality. Section 4 shows how our model can be altered by a policymaker so that the resulting equilibrium has R&D across all the different machine lines. Finally, Section 5 concludes and then offers two suggestions for extending the research delineated in this paper.

2. The theoretical framework

2.1. Preliminaries

Consider an infinite horizon, stylized region that is creative in the sense of Richard Florida. The representative creative class household in this region displays constant relative risk aversion (CRRA) and its CRRA utility function is denoted by $\int_0^\infty \exp(-\rho t)[\{C(t)^{1-\theta} - 1\}/(1-\theta)]dt, \theta \neq 1$, where $C(t)$ is consumption at time t, $\rho > 0$ is the constant time discount rate, and $\theta \geq 0$ is the constant coefficient of relative risk aversion.[2] Following Aghion and Howitt (1992, p. 327), in what follows, we suppose that the representative creative class household is risk-neutral and hence this means that $\theta = 0$.

At any time t, the creative region under study possesses *creative capital* which we denote by $R(t)$. The total available creative capital at any time t or $R(t)$ either produces the final consumption good ($R_F(t)$) or is involved in R&D ($R_D(t)$). There is no growth in the stock of creative capital over time and hence we can write $R(t) = R, \forall t$. This creative capital R is supplied inelastically. The market for creative capital in our region is competitive and it clears. Hence, the market clearing condition $R_F(t) + R_D(t) = R$ holds.

[2] See Acemoglu (2009, pp. 308–309) for additional details on the properties of the CRRA utility function.