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The effects of probabilistic innovations on Schumpeterian economic growth in a creative region☆

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ABSTRACT

We analyze the impact that stochastically occurring innovations have on Schumpeterian economic growth in a region that is creative in the sense of Richard Florida. Our analysis leads to four findings. First, we delineate the so called balanced growth path (BGP) equilibrium and then compute the BGP growth rate in our creative region. Second, we discuss why the lower limit of the support of the random variable that describes the outcome of innovation quality improvements, takes the value that it does. Third, we solve the social planner's problem and derive the Pareto optimal growth rate in our creative region. Finally, we compare the BGP and the Pareto optimal growth rates, we discuss when there is either too much or too little innovation, and we conclude by commenting on the implications of our findings for future research on Schumpeterian economic growth in creative regions.

1. Introduction

1.1. Objective and rationale

A result of the academic writings and the popular musings of the urbanist Richard Florida[1] is that economists and regional scientists are now very familiar with the two related notions of the *creative class* and *creative capital*. 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 standpoint of regional economic growth and development, these people are important 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 a number of occasions, the creative class is noteworthy because this group gives rise to ideas, information, and technology, outputs that are important for the growth and development of cities and regions. Therefore, in this era of globalization, cities and regions that want to be successful need to do all they can to attract and retain members of the creative class because this class is the principal driver of economic growth.

How is the concept of creative capital different from the more familiar and traditional notion of human capital? To answer this question, first note that in empirical work, the notion of human capital is generally measured with education or with education based indicators. This notwithstanding, Marlet and Van Woerkens (2007) have rightly noted that the accumulation of creative capital does *not* have to be a function of the acquisition of formal education. What this means is that although the creative capital accumulated by some members of Florida's creative class (doctors, engineers, university professors) is a function of 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 raw creative capital despite having very little or no formal education.

Given this state of affairs, we agree with Marlet and Van Woerkens (2007) and assert 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. Since creative capital is of two types, it is a *more* general concept than the more traditional notion of human capital.

With this explanatory background in place, let us now emphasize three points. First, Eversole (2005), Siemiatycki (2013), and others have noted that in regions where the creative class is a dominant part of the overall workforce, there is a definite link between *innovations* and the activities of the members of this creative class. In this regard, Fischer and Nijkamp (2009), Baumol (2010), and Batabyal and Nijkamp (2013) have stressed that innovation is an important driver of regional economic growth and development.

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

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Second, the existing literature has recognized that innovative activities and processes are fundamentally *competitive* in nature and that this competitive aspect is closely related to the critical insight of Joseph Schumpeter who argued that growth processes are characterized 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, the reader should understand that there are *no* theoretical studies of Schumpeterian economic growth in a region that is creative in the sense of Richard Florida. Therefore, in this paper, we provide the *first* theoretical analysis of the effects that probabilistic or stochastic innovations have on Schumpeterian economic growth in a region that is creative *a la* Richard Florida. Now, before we proceed to the specifics of our paper, we first briefly survey the related literature on Schumpeterian economic growth.

1.2. Review of the literature

Without concentrating on creative regions per se, Leahy and McKee (1972) stated but did not model the idea that change in regional economies can be appropriately understood by adopting a "Schumpeterian view" of the regional economy. In spite of the appearance of this statement more than four decades ago, economists and regional scientists have begun to use the ideas of Schumpeter to investigate the nexus between innovation and economic growth in *generic* regions only since the early 1980s. As such, there is now a fairly substantial empirical and case study based literature that has analyzed several different aspects of Schumpeterian economic growth in generic regional economies.

At the regional level, Van Wissen and Huisman (2002) show that large growth differentials are likely to be observed between what they call "core," "ring," and "peripheral" regions. Lodde (2008) demonstrates that there is qualified support for the Schumpeterian hypothesis in selected regions in Italy. Crespi and Pianta (2008) concentrate on six nations in Europe and point out that the ideas of Schumpeter are useful in comprehending the variety of innovation and what they call "innovation–performance relationships" in the six countries under study.

Quatraro (2009) contends 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 innovative firms, Akcigit and Kerr (2010) and Haltiwanger et al. (2010) point out that firm size and age are positively correlated and that in innovative industries, small firms exit the industry more often and hence the surviving firms tend to grow relatively rapidly.

Concentrating on 2,645 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. Saunoris and Payne (2011) use United States data from 1960 to 2007 and demonstrate that long run increases in R&D expenditures are necessary to offset lower R&D productivity due to the presence of product proliferation. Shen (2014) shows that the impact of wealth inequality on Schumpeterian economic growth arises through the supply of human capital as well as the demand for higher quality goods. Finally, 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.

There are only two theoretical studies that are loosely connected to the basic question 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 that is not necessarily creative. They show that the region being studied experiences bursts of unemployment followed by periods of full employment. There is no overlap between the question studied in this paper and our present paper. More recently, Batabyal and Nijkmap (2014) have used a Schumpeterian growth model to study a question similar to the one we study here. However, there are three key differences between this paper and our present paper. Specifically, Batabyal and Nijkamp (2014) focus on generic regions, innovations reduce the marginal cost of producing machines or intermediate goods, and the impact of the innovations is deterministic. In contrast, our paper focuses on a *creative* region, innovations improve the *quality* of existing machines, and the effect of innovations is *probabilistic*.

The remainder of this paper is arranged as follows. Recall that our basic goal here is to analyze the effects of probabilistic innovations on Schumpeterian economic growth in a creative region. To this end, Section 2 describes our theoretical model of a creative region that is adapted from Aghion and Howitt (1992) and Acemoglu (2009, pp. 459–472). Section 3 describes the so called balanced growth path (BGP) equilibrium and then computes the BGP growth rate in our creative region. Section 4 discusses why the lower limit of the support of the random variable that describes the effect of innovation quality improvements, takes the value that it does. Section 5 solves the social planner's problem and then derives the Pareto optimal growth rate in our creative region. Section 6 compares the BGP and the Pareto optimal growth rates and then discusses when there is either too much or too little innovation in our creative region. Finally, Section 7 concludes and then offers three suggestions for extending the research described here.

2. The theoretical framework

2.1. Preliminaries

Consider an infinite horizon, stylized region that is creative in the sense of Richard Florida. This creative region is made up of J distinct spatial units which we index with the superscript j where $j = 1, 2, \ldots, J$. The representative creative class household in our 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 in time t, $\rho > 0$ is the constant time discount rate, and $\theta \geq 0$ is the constant coefficient of relative risk aversion.[2]

The creative region under study possesses *creative capital* in each of its J distinct spatial units. The creative capital in the *jth* spatial unit at time t is denoted by $R^j(t)$. Clearly, the total stock of creative capital in our region at any time t is given by $R(t) = \sum_{j=1}^{J} R^j(t)$. There is no growth in the stock of creative capital $R(t)$ and this $R(t)$ is supplied inelastically. The aggregate resource or budget constraint in our region at time t is given by

$$C(t) + X(t) + I(t) \leq O(t), \tag{1}$$

where $C(t)$ is consumption, $X(t)$ is total spending on machines, $I(t)$ is total spending on R&D, and $O(t)$ is the output of the competitively produced single final good for consumption that we shall think of as a knowledge good such as a smartphone or a desktop computer. The price of this final good is normalized to unity at all points in time and hence $O(t)$ denotes both the output and the value of the final good. In addition, note that the machines we have just referred to can also be thought of as inputs or as intermediate goods. The aggregate or total expenditure on R&D in our creative region or $I(t)$ is the sum of the R&D expenditures incurred by each one of the J distinct spatial units in the region under study. In symbols, this means that $I(t) = \sum_{j=1}^{J} I^j(t)$.

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