A consideration of the “no-black-hole” condition

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Abstract. The purpose of this paper is to investigate the economic interpretation of the “no-black-hole” condition (NBHC) described in the Chapt. 4 of the book by Fujita, Krugman and Venables (1999), under the context of a more general model. The main findings are as follows. First, there is the case in which the NBHC does not hold even though the real wage falls at the symmetric equilibrium. Secondly, the NBHC in the more general model requires both a reduction in profits in response to an increase in the number of firms and a fall in the real wage rate in response to an increase in labor at the symmetric equilibrium. Thirdly, we show that NBHCs obtained in some analyses are special cases of our model. Moreover, we show that the NBHC includes the stability condition for the short-run equilibrium. Therefore the NBHC is not affected by relative speed of labor movement and entry/exit of firms.

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1. Introduction

Since early 1990’s, various analyses called “new economic geography” to investigate the relation between trade costs and industry location. They introduce economies of scale and transportation costs and show that the core-periphery structure emerges catastrophically. Krugman (1991), Krugman and Venables (1995), Fujita et al. (1999) and Puga (1999) show a number of equilibria and their stabilities vary dramatically for some values of parameters. Although Krugman, Krugman and Venables, and Puga obtain the conditions for the critical values to exist, there is no consideration for the economic meaning of the conditions. However in the Chapt. 4 of their book, Fujita et al. expound that this condition guarantees the avoidance of the “black-hole-location” theory in which “the forces working toward agglomeration always prevail” and call it a “no-black-hole” condition (NBHC hereafter.) They explain that a condition which assures a fall in the real wage rate in response to an increase in labor at the symmetric equilibrium is the NBHC.

The purpose of this paper is to show the interpretation of the NBHC by Fujita et al. does not account for the NBHC in a more general model and to consider its NBHC. Moreover, the differences among the NBHCs in the three
models, that is the model of Puga, the model in the Chapt. 5 and the Chapt. 14 of Fujita et al. and of Krugman and Venables, are related to the differences among their assumptions on intermediate goods, labor movements and relative speed of market adjustments. To consider these problems, we develop a model based on Krugman and Venables. This model has the same basic assumptions as those in the Puga model except for the relative speed of labor migration and the entry/exit of firms. Also, the models of Fujita et al. are special cases of this model.

This paper has the following structure. Part 2 presents a monopolistically competitive model. Part 3 obtains the NBHC in this model. We show that the economic implication of the NBHC by Fujita et al. does not avoid “black-hole-location theory” and investigate the economic implications of the NBHC in our model. Part 4 discusses the NBHC in an international model briefly, and Part 5 summarizes the conclusion.

2. Model

The fundamental framework in this paper is a monopolistically competitive model, which assumes two regions and two sectors. One sector is a perfectly competitive agricultural sector and the other is an imperfectly competitive industrial sector. Let us assume that a homogenous agricultural product is produced by one unit of labor and traded without transportation costs. Assuming agricultural product as the numeraire, a wage in this sector is equal to one.

The industrial sector is monopolistically competitive and produces differentiated goods. Trade of industrial goods incurs “ice-berg” real trade costs: $\tau$ units of the differentiated good must be shipped to receive one unit in the other region. Firms use composite inputs to produce output. Production of each variety requires $\alpha$ units of the input as a fixed input and $\beta$ units as a marginal input. The composite input is produced by a Cobb-Douglas technology with labor and the intermediate goods $M_i$ which share is $\mu$. Let $w_i$ be the wage rate of the industrial sector in region $i (=1,2)$ and $G_i$ be the price of $M_i$. The cost function of a firm producing quantity $x$ of variety $k$ in region $i$, $x_i(k)$, is

$$C_i(k) = G_i^\mu (w_i)^{1-\mu}[x + \beta x_i(k)].$$  \hspace{1cm} (1)

Let $\sigma$ be an elasticity of technological substitution across varieties and $N$ be the total number of varieties. $M_i$ is produced by a CES technology with available industrial goods:

$$M_i = \left[ \int_0^N m(k)^{1-\sigma} \, dk \right]^{1/(1-\sigma)}, \quad \sigma > 1,$$ \hspace{1cm} (2)

where $m(k)$ is the quantity of variety $k$ used in the intermediate production. Denoting the user price of variety $k$ in region $i$ by $q_i(k)$, the price of intermediate goods, $G_i$, is

$$G_i \equiv \left[ \int_0^N q_i(k)^{1-\sigma} \, dk \right]^{1/(1-\sigma)}.$$ \hspace{1cm} (3)