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Increasing Returns and Economic Geography with Solow-Uzawa, Dixit-Stiglitz, and Krugman Unified

Wei-Bin Zhang

Wei-Bin Zhang

PhD in Economics

Professor

Ritsumeikan Asia Pacific University, Jumonjibaru, Beppu-Shi, Oita-ken, 874-8577 Japan

E-mail: wbz1@apu.ac.jp

ORCID: 0000-0002-3012-304X

Abstract. The purpose of this study is to study interdependence between growth and economic geography. We build a two-regional growth model of endogenous wealth under perfect and imperfect competition by integrating the three basic models – the Solow-Uzawa growth model, the Krugman two-region model, and the Dixit-Stiglitz imperfect competition model – in economic theory. The economy in our approach is composed of three sectors – the capital goods sector as in the Solow one sector, the consumer goods sector as in the Uzawa model, and the intermediates sector as in the Dixit-Stiglitz model. The economy is composed of two regions as in the Krugman two-region model with intermediates produced in the two regions under imperfect competition. The household behavior is modelling by synthesizing Zhang's concept of disposable income and utility function and the Dixit-Stiglitz concept of composite good and utility function. We build and simulate the model. We identify existence of equilibrium. We examine effects of changes in some parameters on economic geography. We examined the effects of changes in some parameters on economic geography. For instance, we showed that as the transportation cost falls, the population is more concentrated on one region, the numbers of varieties of intermediates are reduced, the output level of each firm in the intermediate sector is increased, the household consumes more each intermediate good, and prices of all intermediate goods are reduced.

Keywords: Krugman's two-region model, Solow model, Uzawa model, Dixit-Stiglitz model, monopolistic competition, wealth accumulation

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Возрастающая отдача и экономическая география, объединение моделей Солоу – Узавы, Диксита – Стиглица и Кругмана

Вэй-Бин Чжан

Вэй-Бин Чжан

PhD in Economics

профессор

Азиатско-Тихоокеанский университет Рицумейкан, ул. Джумонджибару, 1, Префектура Оита, Беппу, Япония

E-mail: wbz1@apu.ac.jp

ORCID: 0000-0002-3012-304X

Аннотация. Целью настоящего исследования является изучение взаимозависимости между экономическим ростом и экономической географией. В рамках экономической теории мы построили для двух регионов модель эндогенного роста в условиях совершенной и несовершенной конкуренции путем интеграции трех базовых моделей: модели экономического роста Солоу – Узавы, модели Кругмана для двух регионов и модели Диксита – Стиглица с несовершенной конкуренцией. В нашем понимании экономика состоит из трех секторов – сектора средств производства, как в односекторной модели Солоу, сектора товаров широкого потребления, как в модели Узавы, и сектора промежуточных продуктов, как в модели Диксита – Стиглица. Экономика состоит из двух регионов, как в модели Кругмана, с производством промежуточных продуктов в двух регионах с несовершенной конкуренцией. Поведение домохозяйств смоделировано путем синтеза концепции Чжана о располагаемом доходе и функции полезности и концепции Диксита – Стиглица о совмещенной функции товара и полезности. Мы строим и проверяем работу модели. Мы определяем существование точки равновесия (эквиполюса). Мы изучили последствия изменений в некоторых параметрах экономической географии. Например, показано, что по мере снижения транспортных расходов население все более концентрируется в одном регионе, число разнообразных промежуточных продуктов снижается, растет объем производства каждой компании в секторе промежуточных продуктов, домохозяйства потребляют все больше каждого из промежуточных продуктов, и цены на все промежуточные продукты снижаются.

Ключевые слова: модель Кругмана для двух регионов, модель Солоу, модель Узавы, модель Диксита – Стиглица, монополистическая конкуренция, накопление богатств

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1. INTRODUCTION

In his well-known article ‘Increasing Returns and Economic Geography’ (Krugman, 1991) makes a seminal contribution to development of the so-called new economic geography. Since then, economic geography has increasingly an

important field in economics. Krugman's work provides an analytical framework to study, in a simplified and rigorous manner, the role of geography in national and global economies in determining spatial trade pattern. By his simple and rigorous model with imperfect competition, Krugman shows that interregional trade is determined not only by comparative advantage but also by increasing returns and external economies. The role of industrial agglomeration on growth of national and regional economies can be analyzed with the simple modelling strategies of the Dixit-Stiglitz utility function and monopolistic competition. He tried to explain phenomena that international trade take place between economies with roughly the same ratio of capital to labor rather than the capital-rich countries exporting capital-intensive goods and importing labor-intensive goods as predicted by the traditional H-O theory. He also shows how agglomeration economies accrue at micro levels and firms tend to locate in a single area nearer to consumer demand with large populations and minimal transport costs. Krugman was awarded the Nobel Prize for his contributions to studies of international trade and economic geography. Although the new trade theory and the new economic theory raise many important issues for regional and international development, the approaches in the literature have some significant limitations. As argued by Martin and Sunley (Martin, Sunley, 1996, p. 259), 'while an exchange of ideas between his theory and recent work in industrial geography would be mutually beneficial, both approaches are limited by their treatment of technological externalities and the legacy of orthodox neoclassical economics'. Neoclassical economics such as Walrasian general equilibrium theory and neoclassical growth theory have played the key role of development of economic theory. A new theory should treat traditional theories as special cases if traditional theories are still valid under certain conditions. The purpose of this study is to integrate Krugman's two-regional model (the core model of the new economic geography) and the Solow-Uzawa neoclassical growth model (the core model of neoclassical growth theory).

This study is concerned with the role of perfect competition and monopolistic competition on economic geography within an analytical framework within which the core models in the new economic geography and neoclassical growth theory are integrated. Our design of modelling coexistence of perfect competition and monopolistic competition in macroeconomics is based on, for instance, Krugman (Krugman, 1979; Krugman, 1980; Krugman, 1991), and Romer (Romer, 1990). We integrate a few basic models in growth theory, interregional model, and theory of monopolistic competition. Following Krugman (1991), our model consists of two regions and each region has two sectors. Region 1 has capital goods sector (like in Solow model) and intermediate goods sector and region 2 has consumer goods sector (like in the Uzawa model) and intermediate goods

sector. In modelling production and consumption of middle goods, we follow the analytical framework for monopolistic competition by Dixit and Stiglitz (1977). The Dixit-Stiglitz model plays a key role in the development of the new trade theory and new economic geography. It emphasizes the role of diversity of consumption in modelling scale economies with monopolistic competition. Monopolistic competition is applied in different studies on economic structures, economic growth, economic geography, international trade, and innovation and technological diffusion (e.g., Chamberlin, 1933; Lancaster, 1980; Waterson, 1984; Benassy, 1996; Bertolotti, Etro, 2015; Nocco et. al., 2017; Parenti et. al., 2017). Zhang (2018) contributes the literature by introducing monopolistic competition to neoclassical growth theory by applying the modelling strategy by Dixit and Stiglitz (1977). This study further generalizes Zhang's model by introducing interregional model by integrating neoclassical trade theory with endogenous capital and new economic geography. Our approach to increasing scale economies, product differentiation, transportation cost, and the pattern of trade in intermediate goods sector is based on Krugman (1991).

We base Solow's one-sector growth model to describe the capital goods sector. Solow (1956) published the seminal work for development of neoclassical growth theory (e.g., Burmeister, Dobell, 1970; Azariadis, 1993; Barro, Sala-i-Martin, 1995; Ben-David, Loewy, 2003; Zhang, 2008). One extension of the Solow one sector model is carried out by Uzawa (Uzawa, 1961) by dividing Solow's one sector into two sectors. The extension is a new approach to endogenous determination of industrial structure in a perfectly competitive economy with endogenous capital accumulation (e.g., Stiglitz, 1967; Jensen, 2003). This study is to connect the Solow-Uzawa model to a new mainstream of economic theory with monopolistic competition. As mentioned before, new economic geography fails to provide an effective modelling framework to introduce endogenous wealth accumulation. On the other hand, neoclassical growth theory is mainly concerned with wealth accumulation with perfect competition. It is obvious that wealth accumulation is an essential force of economic dynamics. The omission of wealth accumulation in new economic geography implies limited insights into understanding processes of economic development. We unify the different approaches by applying the utility function and the concept of disposable income proposed by Zhang (2005, 2008). The model in this study is an extension of Zhang's model which integrates the Solow model and the Dixit-Stiglitz model (Zhang, 2018). The rest of the paper is organized as follows. Section 2 constructs the two-region growth model by integrating the Solow-Uzawa growth model and Krugman's two region model. Section 3 analyzes properties of the model and simulates the economic equilibrium structure. Section 4 conducts comparative comparative analysis in some parameters. Section 5 concludes the study.

2. THE TWO-REGIONAL GROWTH MODEL

The three models on which this model is based are the Solow-Uzawa growth model, the Krugman two-region model, and the Dixit-Stiglitz model with product variety. These models are integrated with applying Zhang's concept of disposable income and utility function. With regards to modelling production of intermediate goods, we follow the analytical framework for monopolistic competition by Dixit and Stiglitz (1977). Monopolistic competition is characterized by many producers who produce differentiated products. Products are differentiated from each other and are not perfect substitutes. Each firm takes the prices charged by other firms as given and maximizes its profit. Each firm has some degree of market power. Market power is measured by power over the terms and conditions of demand and supply equilibrium. The supply side consists of three kinds of activities: production of capital goods, production of consumer goods, and production of differentiated intermediate goods for consumption. There are two regions. The capital goods sector is located in region 1, and the consumer goods sector is located in region 2. Each firm of intermediates can be located in either No firm in the middle goods sectors can produce a product with an attribute that is very close to any given attribute of any other product. They are assumed to act atomistically in that no firm take account of possible impacts of its decisions on any other firm.

Capital goods sector

The capital goods sector is the same as the industrial sector in the Solow model. Let $F_1(t)$, $K_1(t)$ and $\tilde{N}_1(t)$ stand for, respectively, its output, capital input and labor input. As in Solow (1956), we have the following production function:

$$F_1(t) = A_1 K_1^{\alpha_1}(t) \tilde{N}_1^{\beta_1}(t), 0 < \alpha_1, \beta_1 < 1, \alpha_1 + \beta_1 = 1, \quad (1)$$

in which A_1 , α_1 and β_1 are coefficients. Capital goods is taken as numeraire. Physical capital depreciates at a constant exponential rate δ_k . We use $w_j(t)$ and $r(t)$, to stand for, respectively, the wage rate in region j and the rate of interest. We have the profit of the capital goods good sector as follows:

$$\pi_1(t) = F_1(t) - (r(t) + \delta_k) K_1(t) - w_1(t) \tilde{N}_1(t). \quad (2)$$

Maximizing profit implies the following marginal conditions:

$$r(t) + \delta_k = \frac{\alpha_1 F_1(t)}{K_1(t)}, \quad w_1(t) = \frac{\beta_1 F_1(t)}{\tilde{N}_1(t)}. \quad (3)$$

Consumer goods sector

Let $F_2(t)$, $K_2(t)$ and $N_2(t)$ stand for, respectively, output of the consumer goods sector, capital input and labor input. We have the following production function:

$$F_2(t) = A_2 K_2^{\alpha_2}(t) \tilde{N}_2^{\beta_2}(t), \quad 0 < \alpha_2, \beta_2 < 1, \quad \alpha_2 + \beta_2 = 1, \quad (4)$$

in which A_2 , α_2 and β_2 are coefficients. Maximizing profit implies the following marginal conditions:

$$r(t) + \delta_k = \frac{\alpha_2 \tilde{p}(t) F_2(t)}{K_2(t)}, \quad w_2(t) = \frac{\beta_2 \tilde{p}(t) F_2(t)}{\tilde{N}_2(t)}. \quad (5)$$

Consumer behaviors and wealth dynamics

We apply the approach by Zhang (1993) to model behavior of households. The approach is applied to different fields of economics (Zhang, 2005). We use $\bar{k}_j(t)$ to represent per household wealth in region j . Let stand for human capital of the household. The current income of the representative household is:

$$y_j(t) = r(t) \bar{k}_j(t) + w_j(t). \quad (6)$$

The household disposable income $\hat{y}_j(t)$ is the sum of the current disposable income and the value of wealth:

$$\hat{y}_j(t) = y_j(t) + \bar{k}_j(t) = (1 + r(t)) \bar{k}_j(t) + w_j(t). \quad (7)$$

The representative household spends the total available budget on saving $s_j(t)$, and consuming consumer good $d_j(t)$ and aggregate of intermediates $c_j(t)$, $j = 1, 2$. As in Dixit and Stiglitz (1977), we introduce a composite good for household in region j as follows:

$$c_j(t) = \left(\int_0^{n_1(t)} c_j^{\bar{\theta}}(\varepsilon, t) d\varepsilon + \int_{n_1(t)}^{n(t)} c_j^{\bar{\theta}}(\varepsilon, t) d\varepsilon \right)^{1/\bar{\theta}}, \quad 1 > \bar{\theta} > 0, \quad j = 1, 2 \quad (8)$$

in which $n(t)$ is the total number (in density) of varieties produced in the two regions, $n_1(t)$ and $n_2(t) = n(t) - n_1(t)$ are respectively the numbers of varieties produced in region 1 and region 2. We have the budget constraint as follows:

$$\tilde{p}(t) d_j(t) + \int_0^{n_1(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon + \int_{n_1(t)}^{n(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon + s_j(t) = \hat{y}_j(t). \quad (9)$$

The assumption of Samuelson's iceberg form is given by a constant τ , which implies only τ of a unit of another region's variety arrives for consumption. The consumer price of an imported variety is thus given by (the price in the producer's region)/ τ . We thus have:

$$\begin{aligned} \tau p_2(\varepsilon, t) &= p_1(\varepsilon, t), \quad \varepsilon \in [0, n_1(t)], \\ \tau p_1(\varepsilon, t) &= p_2(\varepsilon, t), \quad \varepsilon \in (n_1(t), n(t)]. \end{aligned} \quad (10)$$

In our model the household decides consumption levels of goods and services and saving. We assume that utility level $U_j(t)$ is dependent on $d_j(t)$, $c_j(t)$ and $s_j(t)$ as follows:

$$U_j(t) = d_j^{\xi_0}(t) s_j^{\lambda_0}(t) c_j^{\chi_0}(t), \quad \xi_0, \lambda_0, \chi_0 > 0, \quad (11)$$

where χ_0 is the propensity to consume intermediates, ξ_0 is the propensity to consume consumer goods, and λ_0 is the propensity to save.

The problem is to maximize utility (11) subject to budget constraint (9). We apply the two-stage method to solve the optimization problem (e.g., Dixit-Stiglitz, 1977; Wang, 2012). In the first stage, we imagine that there is a price $p_j(t)$ for $c_j(t)$. The budget for the question is:

$$\tilde{p}(t) d_j(t) + p_j(t) c_j(t) + s_j(t) = \hat{y}_j(t).$$

It is straightforward to show that the optimal solution is given by:

$$\tilde{p}(t) d_j(t) = \xi \hat{y}_j(t), \quad p_j(t) c_j(t) = \chi \hat{y}_j(t), \quad s_j(t) = \lambda \hat{y}_j(t), \quad (12)$$

where

$$\xi \equiv \rho \xi_0, \quad \chi \equiv \rho \chi_0, \quad \lambda \equiv \rho \lambda_0, \quad \rho \equiv \frac{1}{\xi_0 + \chi_0 + \lambda_0}.$$

The second-stage maximization is formed as follows: maximize $c_j(t)$ by choosing $c_j(\varepsilon, t)$ subject to:

$$\int_0^{n_1(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon + \int_{n_1(t)}^{n(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon = p_j(t) c_j(t). \quad (13)$$

Introduce the following Lagrangian function:

$$\begin{aligned} \mathcal{L}_j(t) = & \left(\int_0^{n(t)} c_j^{\bar{\theta}}(\varepsilon, t) d\varepsilon \right)^{1/\bar{\theta}} \\ & + \hbar_j(t) \left\{ \chi \hat{y}_j(t) - \int_0^{n_1(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon - \int_{n_1(t)}^{n(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon \right\}, \quad (14) \end{aligned}$$

where $\hbar_j(t)$ is the Lagrangian multiplier. From (14), we get the following first-order conditions:

$$\frac{\partial \mathcal{L}_j(t)}{\partial c_j(\varepsilon, t)} = c_j^{1-\bar{\theta}-1}(t) c_j^{\bar{\theta}-1}(\varepsilon, t) - \hbar_j(t) p_j(\varepsilon, t) = 0, \quad \varepsilon \in [0, n(t)],$$

$$\frac{\partial \mathcal{L}_j(t)}{\partial \hbar_j(t)} = \chi \hat{y}_j(t) - \int_0^{n_1(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon - \int_{n_1(t)}^{n(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon = 0. \quad (15)$$

From the first equations we have

$$c_j^{\bar{\theta}-1}(t) c_j^{\bar{\theta}}(\varepsilon, t) - \hbar_j(t) p_j(\varepsilon, t) c_j(\varepsilon, t) = 0.$$

We have

$$c_j^{1-\bar{\theta}}(t) \int c_j^{\bar{\theta}}(\varepsilon, t) d\varepsilon = \hbar_j(t) \int c_j(\varepsilon, t) p_j(\varepsilon, t) d\varepsilon.$$

From the above equation, (8) and the last one in (15), we solve

$$\hbar_j(t) = \frac{c_j(t)}{\chi \hat{y}_j(t)}.$$

Hence, we have

$$c_j^{1-\bar{\theta}}(t) c_j^{\bar{\theta}-1}(\varepsilon, t) - \frac{p_j(\varepsilon, t)}{\chi \hat{y}_j(t)} = 0. \quad (16)$$

From (16), we have:

$$\frac{c_j(\varepsilon, t)}{c_j(\gamma, t)} = \left(\frac{p_j(\varepsilon, t)}{p_j(\gamma, t)} \right)^{1/(\bar{\theta}-1)} = \left(\frac{p_j(\varepsilon, t)}{p_j(\gamma, t)} \right)^{-\omega}, \quad \bar{\theta} = 1 - \frac{1}{\omega}, \quad \gamma, \varepsilon \in [0, n(t)], \quad (17)$$

where ω is the elasticity of substitution between any two varieties:

$$\frac{\left(p_j(\varepsilon, t) / p_j(\gamma, t) \right) d \left(c_j(\varepsilon, t) / c_j(\gamma, t) \right)}{\left(c_j(\varepsilon, t) / c_j(\gamma, t) \right) d \left(p_j(\varepsilon, t) / p_j(\gamma, t) \right)} = \omega.$$

From (12) and (17)

$$\chi \hat{y}_j(t) = \int_0^{n(t)} p_j(\varepsilon, t) c_j(\varepsilon, t) d\varepsilon = \frac{c_j(\gamma, t)}{p_j^{1/(\bar{\theta}-1)}(\gamma, t)} \int_0^{n(t)} p_j^{\bar{\theta}/(\bar{\theta}-1)}(\varepsilon, t) d\varepsilon.$$

Hence, we have

$$c_j(\varepsilon, t) = \chi \hat{y}_j(t) p_j^{1/(\bar{\theta}-1)}(\varepsilon, t) \left(\int_0^{n(t)} p_j^{\bar{\theta}/(\bar{\theta}-1)}(\gamma, t) d\gamma \right)^{-1}.$$

From (13), (8) and the above equation, we have:

$$p_j(t) = \frac{\chi \hat{y}_j(t)}{c_j(t)} = \left(\int_0^{n(t)} c_j^{\bar{\theta}}(\gamma, t) d\gamma \right)^{-\frac{1}{\bar{\theta}}} \chi \hat{y}_j(t) = \left(\int_0^{n(t)} p_j^{\bar{\theta}/(\bar{\theta}-1)}(\varepsilon, t) d\varepsilon \right)^{1-\frac{1}{\bar{\theta}}}. \quad (18)$$

The change in the household's wealth saving minus dissaving:

$$\dot{k}_j(t) = s_j(t) - \bar{k}_j(t). \quad (19)$$

Region's share of variety ε in the region's total value of intermediates for consumption is:

$$\varphi_j(\varepsilon, t) \equiv p_j(\varepsilon, t) c_j(\varepsilon, t) \left(\int_0^{n(t)} p_j(\gamma, t) c_j(\gamma, t) d\gamma \right)^{-1}. \quad (20)$$

Insert (18) in (20)

$$\varphi_j(\varepsilon, t) = p_j^{\bar{\theta}/(\bar{\theta}-1)}(\varepsilon, t) \bar{p}_j(t), \quad (21)$$

where

$$\bar{p}_j(t) \equiv \left(\int_0^{n(t)} p_j^{\bar{\theta}/(\bar{\theta}-1)}(\varepsilon, t) d\varepsilon \right)^{-1}.$$

Intermediate goods sector

Each firm takes the prices charged by other firms as given and maximizes its profit. Each firm has some degree of market power. Market power is measured by power over the terms and conditions of demand and supply equilibrium. Let $x_\varepsilon(t)$ stand for output level of the producer of variety ε . We have the condition that demand equals supply as follows:

$$c_1(\varepsilon, t) \bar{N}_1(t) + c_2(\varepsilon, t) \bar{N}_2(t) = x_j(\varepsilon, t), \quad (22)$$

where $c_{j\varepsilon}(t)$ is given by (18). According to the definitions, we have:

$$c_j(\varepsilon, t) \bar{N}_j(t) = \frac{\varphi_j(\varepsilon, t) \bar{y}_j(t)}{p_j(\varepsilon, t)}, \quad (23)$$

where $\bar{y}_j(t) \equiv \chi \hat{y}_j(t) \bar{N}_j(t)$.

It is assumed that all intermediate goods are produced with the same cost function. The labor force used in producing each good is linearly related to output as follows:

$$l_j(\varepsilon, t) = \alpha + \beta x_j(\varepsilon, t), \quad (24)$$

where $l_j(\varepsilon, t)$ is labor force used in producing good ε , α is a fixed cost and β is a parameter. The total labor force used by region j 's intermediate firms is the sum of labor force used by all the firms in the region $N_j(t)$:

$$N_1(t) = \int_0^{n_1(t)} l_1(\varepsilon, t) d\varepsilon, \quad N_2(t) = \int_{n_1(t)}^{n(t)} l_2(\varepsilon, t) d\varepsilon. \quad (25)$$

The producer of variety ε in region j has the following profit:

$$\pi_j(\varepsilon, t) = p_j(\varepsilon, t) x_j(\varepsilon, t) - (\alpha + \beta x_j(\varepsilon, t)) w_j(t). \quad (26)$$

The symmetry of the problem implies that all immediate firms in the same region will produce the same quantity at the same price. We thus can use the shorthand notation

$$p_{j\gamma}(t) = p_j(\varepsilon, t), \quad x_{j\gamma}(t) = x_j(\varepsilon, t), \quad j, \gamma = 1, 2,$$

where $j = \gamma$ when variety j is produced and consumed in the same region and $j \neq \gamma$ when variety j is consumed in the other region.

We have (26) as:

$$\pi_j(t) = (p_{jj}(t) - \beta w_j(t)) p_{jj}^{1/(\bar{\theta}-1)}(t) \bar{p}_{jj}(t) \left(\bar{y}_j(t) + \frac{\bar{y}_q(t)}{\tau} \right) - \alpha w_j(t) \quad (27)$$

where we use (21) and (23). The first-order condition (i. e., $\partial \pi_j / \partial p_{jj} = 0$) implies the following fixed-markup pricing rule:

$$p_{jj}(t) = \frac{\beta w_j(t)}{\bar{\theta}}. \quad (28)$$

Insert (28) in (27)

$$\pi_j(t) = \left(\frac{1}{\bar{\theta}} - 1 \right) \beta w_j(t) p_{jj}^{1/(\bar{\theta}-1)}(t) \bar{p}_{jj}(t) \left(\bar{y}_j(t) + \frac{\bar{y}_q(t)}{\tau} \right) - \alpha w_j(t). \quad (29)$$

It should be noted that we obtain (27) under the consideration that a firm's action has negligible effect on $\bar{p}_j(t)$. Under monopolistic competition, each firm's profit is differentiated from each other's profit, but firms compete and competition results in zero profit condition due to free entry. By (29) the zero-profit condition implies:

$$\left(\frac{1}{\bar{\theta}} - 1 \right) \beta p_{jj}^{1/(\bar{\theta}-1)}(t) \bar{p}_{jj}(t) \left(\bar{y}_j(t) + \frac{\bar{y}_q(t)}{\tau} \right) = \alpha. \quad (30)$$

From (18), we have

$$\begin{aligned} c_{11}(t) &= \frac{\chi \hat{y}_1(t) p_{11}^{1/(\bar{\theta}-1)}(t) \bar{p}_1(t)}{n_1(t)}, \quad c_{12}(t) = \frac{\chi \hat{y}_1(t) p_{12}^{1/(\bar{\theta}-1)}(t) \bar{p}_1(t)}{n_2(t)}, \\ c_{22}(t) &= \frac{\chi \hat{y}_2(t) p_{22}^{1/(\bar{\theta}-1)}(t) \bar{p}_2(t)}{n_2(t)}, \quad c_{21}(t) = \frac{\chi \hat{y}_2(t) p_{21}^{1/(\bar{\theta}-1)}(t) \bar{p}_2(t)}{n_1(t)}. \end{aligned} \quad (31)$$

Utility equalization between regions implies:

$$U_1(t) = U_2(t). \quad (32)$$

Equilibrium conditions for capital goods and consumer goods

As change in capital stock is equal to the output of the final good sector minus the depreciation of capital stock, we have:

$$\dot{K}(t) = F_1(t) - \delta_k K(t). \quad (33)$$

The total demand for consumer goods equals the total supply

$$d_1(t) \bar{N}_1(t) + d_2(t) \bar{N}_2(t) = F_2(t). \quad (34)$$

Labor and capital are fully employed

The labor force is fully employed

$$\tilde{N}_1(t) + \tilde{N}_2(t) + N_x(t) = \bar{N}, \quad (35)$$

where $N_x(t) = N_1(t) + N_2(t)$. Regional distribution of the population is:

$$\tilde{N}_j(t) + N_j(t) = h \bar{N}_j(t), \quad \bar{N}_1(t) + \bar{N}_2(t) = \bar{N}. \quad (36)$$

Capital is fully employed:

$$K_1(t) + K_2(t) = K(t). \quad (37)$$

National capital equaling national wealth

The value of physical capital is equal to the value of national wealth:

$$\bar{k}_1(t) \bar{N}_1(t) + \bar{k}_2(t) \bar{N}_2(t) = K(t). \quad (38)$$

We built the model. The model is based on the Solow model, the modeling framework by Dixit-Stiglitz model, and the Krugman two-region model with Zhang's concept of disposable income and utility function. We now study properties of the model.

3. THE DYNAMIC PROPERTIES OF THE MODEL

The previous section built a neoclassical growth model by integrating the Solow-Uzawa growth model, the Dixit-Stiglitz model, and Krugman's two-region model with perfect competition and monopolistic competition. The economy is characterized by the neoclassical growth mechanism with perfect competition and monopolistic competition. The following lemma gives a computational program for following the movement of the economic system. Before describing

the procedure to describe the motion of the economic system, we introduce three variables:

$$\hat{y} \equiv \frac{\hat{y}_1}{\hat{y}_2}, \quad z_j \equiv \frac{r + \delta_k}{w_j}.$$

Lemma

The following differential equation determines the motion of the economic system:

$$\begin{aligned} \dot{\hat{y}}(t) &= \Lambda_0(z_1(t), z_2(t), \hat{y}(t)), \\ \dot{z}_j(t) &= \Lambda_j(z_1(t), z_2(t), \hat{y}(t)), \quad j = 1, 2. \end{aligned} \quad (39)$$

in which Λ_0 and Λ_j are functions of $z_1(t)$, $z_2(t)$ and $\hat{y}(t)$. All the variables are functions of $z_1(t)$, $z_2(t)$ and $\hat{y}(t)$ given by the procedure: $r(t)$ and $w_1(t)$ by (A3) $\rightarrow w_2(t)$ and $\tilde{p}(t)$ by (A4) $\rightarrow \tilde{n}(t)$ by (A9) $\rightarrow \bar{n}(t)$ by (A12) $\rightarrow \bar{N}_j(t)$ by (A13) $\rightarrow n_2(t)$ by (A24) $\rightarrow \hat{y}_2(t)$ by (A25) $\rightarrow \hat{y}_1(t) = \hat{y}_2/\hat{y}(t)$ $\rightarrow n_1(t) = n_2(t)/\tilde{n}(t) \rightarrow N_j(t)$ by (A21) $\rightarrow \tilde{N}_1(t)$ by (A19) $\rightarrow K_1(t)$ by (A18) $\rightarrow K(t)$ by (A17) $\rightarrow \bar{k}_j(t)$ with (A16) $\rightarrow \tilde{N}_2(t)$ by (A15) $\rightarrow K_2(t)$ by (A14) $\rightarrow F_j(t)$ by (A2) $\rightarrow d_j(t)$ by (12) $\rightarrow s_j(t)$ by (12) $\rightarrow p_{jj}(t)$ by (28) $\rightarrow \hat{p}_j(t)$ by (A10) $\rightarrow p_j(t)$ by (A7) $\rightarrow \bar{p}_{jj}(t)$ by (A6) $\rightarrow N_x(t)$ by (36) $\rightarrow c_{jq}(t)$ by (31) $\rightarrow \pi_j(t)$ by (27) $\rightarrow x_{jj}(t)$ by (29) $\rightarrow x_{j\varepsilon}(t)$ by (22) $\rightarrow \varphi_{j\varepsilon}(t)$ by (21) $\rightarrow p_{jq}(t)$ by (10).

As the expressions are complicated, we show behavior of the system by simulation. We specify the parameters as follows:

$$\tau = 0,95; \quad N = 10; \quad \bar{\theta} = 0,6; \quad \alpha = 0,3; \quad \beta = 0,15; \quad A_1 = 1,2; \quad A_2 = 1; \\ \alpha_1 = 0,35; \quad \alpha_2 = 0,4; \quad \lambda_0 = 0,7; \quad \xi_0 = 0,2; \quad \chi_0 = 0,4; \quad h = 1; \quad \delta_k = 0,05. \quad (40)$$

The population is 10. The level of human capital is 1. We fix depreciation rate at 5 percent. The utility elasticity of intermediates for consumption is 0,4. The ice-berg parameter is 95 percent. The propensity to save is 0,7, the propensity to consume consumer goods is 0,2, and the propensity to consume intermediate goods is 0,6. The total factor productivities are respectively 1,2 and 1. Although the specified values are not based on empirical studied, we show how the economic system is affected when these parameters are varied. The simulation confirms the equilibrium point as follows:

$$\begin{aligned}
 K &= 18,82; \bar{N}_1 = 4,17; \bar{N}_2 = 5,83; n_1 = 0,786; n_2 = 0,57; F_1 = 0,941; \\
 F_2 &= 4,914; K_1 = 2,499; K_2 = 16,32; \tilde{N}_1 = 0,42; \tilde{N}_2 = 2,21; x_{11} = 26,88; \\
 x_{22} &= 37,55; l_{11} = 4,332; l_{22} = 5,932; N_1 = 3,403; N_2 = 3,382; r = 0,0818; \\
 w_1 &= 1,456; w_2 = 1,461; \tilde{p} = 1,094; p_{11} = 0,364; p_{21} = 0,383; p_{22} = 0,365; \\
 p_{12} &= 0,385; c_{11} = 2,857; c_{21} = 2,567; c_{22} = 3,9885; c_{12} = 3,432; \\
 p_1 &= 0,304; p_2 = 0,307; c_1 = 3,536; c_2 = 3,507; \hat{y}_1 = 3,487; \hat{y}_2 = 3,5; \\
 d_1 &= 0,49; d_2 = 0,492; \bar{k}_1 = 1,878; \bar{k}_2 = 1,885; U = 2,234.
 \end{aligned} \tag{41}$$

In our modelling, two regions differ in pre-fixed locations of capital and consumer goods production, which are different from the standard Krugman economic geographic model by making land endowments different. We see that two regions are different in almost all aspects. Region 2 which attracts more workers than region 1 produces less varieties than region 1. Region 2 has a slightly higher wage rate than region 2. The household in region 1 consumes less consumer goods and owns less wealth than the household in region 2. The prices of intermediate goods are lower in the region which produce them than in the other region. The consumer in the producer region consumes more the intermediate good than the consumer in the other region. The rest of the paper is mainly concerned with analyzing steady state as it is difficult to simulate motion of the system. We now examine what happen to the economic system when some parameters are shifted.

4. COMPARATIVE STATIC ANALYSIS

The previous section identified the existence of an equilibrium. This section studies how changes in parameters affect economic geography and long-term growth. We introduce a symbol to stand for the change rate of the variable in percentage due to changes in the parameter value.

4.1. The elasticity of substitution between two intermediates is increased

We now study the case that the elasticity of substitution between two intermediates is increased as follows: From the fixed-markup pricing rule (28) we see that the change implies a fall in the price of intermediates for given wage rate. We list the simulation result in (42). The change rates are compared to the variable values in (41). The national capital stock and capital employed by each region fall. The rate of interest is almost not affected. The utility level is enhanced. The price of consumer goods falls. Some people migrate from region 1 to region 2. Region 1 produces less capital goods, while region 2 supplies more consumer goods. The varieties produced in the two regions are increased, but each firm produces less and employs less labor force. The wages and wealth levels per household change slightly. The aggregate consumption levels of intermediate goods are increased, even though each type of intermediates is consumed less. The prices of intermediates are reduced.

$$\begin{aligned}
 \bar{\Delta} K &= -0,02; \bar{\Delta} r = 0; \bar{\Delta} U = 1,6; \bar{\Delta} \tilde{p} = -0,02; \\
 \begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} &= \begin{pmatrix} -0,09 \\ 0,06 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} -0,02 \\ 0,001 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} -0,02 \\ -0,02 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} &= \begin{pmatrix} -0,02 \\ 0,02 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} 2,36 \\ 6,02 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} -0,43 \\ -0,13 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} &= \begin{pmatrix} -2,93 \\ -6,11 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} -2,7 \\ -5,8 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} -3,23 \\ -3,23 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} -2,51 \\ -3,25 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} -3,26 \\ -3,26 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} -5,91 \\ -6,46 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} &= \begin{pmatrix} -3,87 \\ -3,99 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} 4,03 \\ 4,12 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,04 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} &= \begin{pmatrix} 0,02 \\ -0,02 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,04 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,04 \end{pmatrix}. \quad (42)
 \end{aligned}$$

4.2. The fixed cost of intermediates is increased

We now study what happen to the economic system when the fixed cost of intermediates is increased as follows: . We list the simulation result in (43). The national capital stock and capital employed by each region slightly fall. The rate of interest is almost not affected. The utility level is enhanced. The price of consumer goods falls. Some people migrate from region 2 to region 1. The varieties produced in the two regions are increased, but each firm produces less and employs less labor force. The capital goods sector is shrunk a little. The household in region 1's consumption level of consumer goods rises, while that in region 2. The capital goods sector is almost not affected. The wage rate in region 2 is slightly reduced, while the wage rate in region 1 is almost not affected. The wealth levels per household change slightly. The aggregate consumption levels of intermediate goods are increased. Each intermediate is consumed less. The prices of intermediates are reduced in the two regions.

$$\begin{aligned}
 \bar{\Delta} K &= -0,001; \bar{\Delta} r = 0; \bar{\Delta} U = 0,17; \bar{\Delta} \tilde{p} = -0,001; \\
 \begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} &= \begin{pmatrix} 0,072 \\ -0,05 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} -0,001 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} -0,001 \\ -0,001 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} &= \begin{pmatrix} -0,001 \\ 0,001 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} 0,58 \\ 0,7 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} 0,16 \\ -0,05 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} &= \begin{pmatrix} -1,19 \\ -1,31 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} -0,42 \\ -0,74 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} -1,19 \\ -1,2 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} -0,001 \\ -0,001 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} -1,32 \\ -1,304 \end{pmatrix};
 \end{aligned}$$

$$\begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} = \begin{pmatrix} -0,414 \\ -0,419 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} 0,416 \\ 0,419 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,001 \end{pmatrix};$$

$$\begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} = \begin{pmatrix} 0,001 \\ -0,001 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,001 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,001 \end{pmatrix}. \quad (43)$$

4.3. The transportation cost is reduced

We now examine the impact of the following reduction in transportation cost: We list the simulation result in (44). Region 2 attracts more people from region 1. The numbers of varieties are reduced in each region. The improved transportation reduces varieties of intermediate goods available in the two regions. The utility level is reduced. The output level of each firm in the intermediate sector is increased. Each firm in the intermediate sector employs more labor force. The household consumes more each intermediate good and prices of all intermediate goods are reduced. The prices of aggregated intermediate goods are increased. The aggregated consumption levels are reduced. The price of consumer goods falls. The household in region 1 consume more consumer goods, while the household in region 2 consume less consumer goods. The national capital stocks fall.

$$\begin{aligned} \bar{\Delta} K &= -0,09; \quad \bar{\Delta} r = 0; \quad \bar{\Delta} U = -0,39; \quad \bar{\Delta} \tilde{p} = -0,09; \\ \begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} &= \begin{pmatrix} -0,34 \\ 0,24 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} -0,08 \\ 0,003 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} -0,08 \\ -0,08 \end{pmatrix}; \\ \begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} &= \begin{pmatrix} -0,08 \\ 0,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} -2,6 \\ -3 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} 3,59 \\ 3,14 \end{pmatrix}; \\ \begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} &= \begin{pmatrix} 6,82 \\ 6,65 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} 6,35 \\ 6,32 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 0 \\ -2,06 \end{pmatrix}; \\ \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} 4,25 \\ 8,89 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} -0,14 \\ -2,2 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} 4,2 \\ 10,7 \end{pmatrix}; \\ \begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} &= \begin{pmatrix} 1,02 \\ 0,55 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} -1,01 \\ -0,69 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,14 \end{pmatrix}; \\ \begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} &= \begin{pmatrix} 0,09 \\ -0,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,14 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ -0,14 \end{pmatrix}. \end{aligned} \quad (44)$$

4.4. The total factor productivity of the capital goods sector is enhanced

We now study the impact of the following technological improvement in the capital goods sector: We list the simulation result in (45). The capital goods sector is expanded. The labor distribution between the sectors and regions are not affected. The national capital stocks rise. The utility level is enhanced. The price

of consumer goods is increased. The consumer in each region consumes more consumer goods. The numbers of varieties are not affected. The wages and prices of intermediate goods are enhanced.

$$\begin{aligned}
 &\bar{\Delta} K = 6,48; \bar{\Delta} r = 0; \bar{\Delta} U = 5,02; \bar{\Delta} \tilde{p} = 3,84; \\
 &\begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 2,54 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} = \begin{pmatrix} 2,54 \\ 2,54 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 6,48 \\ 6,48 \end{pmatrix}. \tag{45}
 \end{aligned}$$

4.5. The human capital is enhanced

We now study how the economic structure is affected when the human capital is enhanced as follows: We list the simulation result in (46). The capital goods and consumer goods sectors are expanded. Some people immigrate from region 1 to region 2. The utility level is enhanced. The price of consumer goods is increased. The consumer in each region consume more consume goods. The numbers of varieties if intermediate goods are reduced. The output level of each variety in each region is expanded. Each firm in the intermediate sector employ more labor forces. The national capital stock is augmented. The wage rates are slightly changed. The price of each intermediate is affected slightly. The consumption level of each intermediate is enhanced.

$$\begin{aligned}
 &\bar{\Delta} K = 10; \bar{\Delta} r = 0; \bar{\Delta} U = 13; \bar{\Delta} \tilde{p} = 0,001; \\
 &\begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} = \begin{pmatrix} -0,065 \\ 0,047 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} -0,51 \\ -0,62 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} 9,84 \\ 10,1 \end{pmatrix}; \\
 &\begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} = \begin{pmatrix} 11,18 \\ 11,31 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} 10,41 \\ 10,73 \end{pmatrix}; \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix};
 \end{aligned}$$

$$\begin{aligned}
 \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} 11,2 \\ 11,2 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} 0,001 \\ 0,001 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} 11,3 \\ 11,3 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} &= \begin{pmatrix} 0,371 \\ 0,375 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} 9,593 \\ 9,59 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0,001 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} &= \begin{pmatrix} 10 \\ 10 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 10 \\ 10 \end{pmatrix}.
 \end{aligned} \tag{46}$$

4.6. The propensity to consume intermediate goods is enhanced

We now study how the economic structure is affected when the propensity to consume intermediate goods is enhanced as follows: We list the simulation result in (47). The capital goods and consumer goods sectors are shrunk. Some people immigrate from region 2 to region 1. The utility level is reduced. The price of consumer goods is increased. The consumer in each region consume less consumer goods. The number of intermediate firms is increased in region 2 and reduced in region 1. The output level of each variety in each region is expanded. Each firm in the intermediate sector employ more labor forces. The national capital stock is reduced. The wage rates are slightly changed. The price of each intermediate is affected slightly. The consumption level of each intermediate is increased. Wealth of each household is reduced.

$$\begin{aligned}
 \bar{\Delta} K &= -3,55; \quad \bar{\Delta} r = 0; \quad \bar{\Delta} U = -0,23; \quad \bar{\Delta} \tilde{p} = 0,01; \\
 \begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} &= \begin{pmatrix} 0,76 \\ -0,54 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} -3,55 \\ -3,56 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} -3,55 \\ -3,55 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} &= \begin{pmatrix} -3,55 \\ -3,56 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} -0,31 \\ 0,23 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} 1,28 \\ 1,24 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} &= \begin{pmatrix} 1,72 \\ 1,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} 1,6 \\ 1 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} 1,68 \\ 1,69 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} 0,01 \\ 0,01 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} 1,11 \\ 1,1 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} &= \begin{pmatrix} 0,06 \\ 0,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} 1,21 \\ 1,22 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0,01 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} &= \begin{pmatrix} -3,56 \\ -3,55 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} -2,07 \\ -2,05 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} -3,55 \\ -3,54 \end{pmatrix}.
 \end{aligned} \tag{47}$$

4.7. The propensity to save is enhanced

We now study how the economic structure is affected when the propensity to save is enhanced as follows: We list the simulation result in (48). The national capital stock is increased. The consumer goods and capital goods sectors employ

more capital stocks. The capital goods and consumer goods sectors are expanded. The utility level is enhanced. The price of consumer goods falls. Each region's consumer consumes more consumer goods. Some people immigrate from region 2 to region 1. The number of intermediate firms is increased in region 2 and reduced in region 1. The output level of each variety in region is enhanced but is reduced in region 2. Each firm in region 1's intermediate sector employs more labor force, but each firm in region 2's intermediate sector employs more labor force. The wage rates are enhanced. The price of each intermediate is increased. The consumption level of each intermediate produced in region 1 is increased, while the consumption level of each intermediate produced in region 2 is reduced. Wealth of each household is reduced.

$$\begin{aligned}
 \bar{\Delta} K &= 2,04; \quad \bar{\Delta} r = -1,97; \quad \bar{\Delta} U = 2,2; \quad \bar{\Delta} \tilde{p} = -0,1; \\
 \begin{pmatrix} \bar{\Delta} \bar{N}_1 \\ \bar{\Delta} \bar{N}_2 \end{pmatrix} &= \begin{pmatrix} 0,07 \\ -0,05 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} F_1 \\ \bar{\Delta} F_2 \end{pmatrix} = \begin{pmatrix} 2,04 \\ 0,7 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} K_1 \\ \bar{\Delta} K_2 \end{pmatrix} = \begin{pmatrix} 3,3 \\ 1,84 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} \tilde{N}_1 \\ \bar{\Delta} \tilde{N}_2 \end{pmatrix} &= \begin{pmatrix} 1,36 \\ -0,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} n_1 \\ \bar{\Delta} n_2 \end{pmatrix} = \begin{pmatrix} -0,11 \\ 0,16 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} N_1 \\ \bar{\Delta} N_2 \end{pmatrix} = \begin{pmatrix} -0,07 \\ -0,05 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} x_{11} \\ \bar{\Delta} x_{22} \end{pmatrix} &= \begin{pmatrix} 0,04 \\ -0,22 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} l_{11} \\ \bar{\Delta} l_{22} \end{pmatrix} = \begin{pmatrix} 0,04 \\ -0,21 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{11} \\ \bar{\Delta} p_{21} \end{pmatrix} = \begin{pmatrix} 0,66 \\ 0,66 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} c_{11} \\ \bar{\Delta} c_{21} \end{pmatrix} &= \begin{pmatrix} 0,06 \\ 0,03 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} p_{22} \\ \bar{\Delta} p_{12} \end{pmatrix} = \begin{pmatrix} 0,66 \\ 0,66 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_{22} \\ \bar{\Delta} c_{12} \end{pmatrix} = \begin{pmatrix} -0,22 \\ -0,19 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} p_1 \\ \bar{\Delta} p_2 \end{pmatrix} &= \begin{pmatrix} 0,67 \\ 0,65 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} c_1 \\ \bar{\Delta} c_2 \end{pmatrix} = \begin{pmatrix} -0,06 \\ -0,06 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} w_1 \\ \bar{\Delta} w_2 \end{pmatrix} = \begin{pmatrix} 0,66 \\ 0,66 \end{pmatrix}; \\
 \begin{pmatrix} \bar{\Delta} d_1 \\ \bar{\Delta} d_2 \end{pmatrix} &= \begin{pmatrix} 0,7 \\ 0,7 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \hat{y}_1 \\ \bar{\Delta} \hat{y}_2 \end{pmatrix} = \begin{pmatrix} 1,38 \\ 1,37 \end{pmatrix}; \quad \begin{pmatrix} \bar{\Delta} \bar{k}_1 \\ \bar{\Delta} \bar{k}_2 \end{pmatrix} = \begin{pmatrix} 2,04 \\ 2,03 \end{pmatrix}.
 \end{aligned} \tag{48}$$

5. CONCLUDING REMARKS

This study integrated the three basic models in economic theory. They are respectively the Solow-Uzawa growth model, the Krugman two-region model, and the Dixit-Stiglitz imperfect competition model. The economy in our approach is composed of three sectors – the capital goods sector as in the Solow one sector, the consumer goods sector as in the Uzawa model, and the intermediates sector as in the Dixit-Stiglitz model. The economy is composed of two regions as in the Krugman two-region model. Rather than the fixed agricultural activities in the two regions as in the Krugman model, we assume that the capital goods sector is located in one region and the consumer goods sector in the other. As economic geography is concerned, the role of the fixed locations of the economic activities is like that

of the fixed agricultural activities in the Krugman model. Like in the Krugman model, intermediates are produced in the two regions under imperfect competition and the numbers of varieties produced in each region are determined by zero-profit conditions. Our model applies the utility function and concept of the disposable income to model the household behavior. The utility function is a synthesis of Zhang's utility function and the Dixit-Stiglitz utility function and concept of composite good. We built and then simulated the model. We showed existence of an equilibrium point. We examined the effects of changes in some parameters on economic geography. For instance, we showed that as the transportation cost falls, the population is more concentrated on one region, the numbers of varieties of intermediates are reduced, the output level of each firm in the intermediate sector is increased, the household consumes more each intermediate good, and prices of all intermediate goods are reduced. As there are a large amount of publications based on the three main models on which our model is developed, we can extend and generalize the model by introducing more refined or special features in the literature. For instance, we may make human capital endogenous variables as in the Romer model (Romer, 1990). We may also invest the profits of the intermediates sectors in R&D activities as in the Grossman- Helpman model (e.g., Grossman, Helpman, 1990). There are other possible extensions (Ethier, 1982; The Monopolistic..., 2004; Behrens, Murata, 2007; Parenti et al., 2017).

REFERENCES

- Azariadis C.* Intertemporal Macroeconomics. Oxford: Blackwell Publishing Company, 1993. 528 p.
- Barro R.J., Sala-i-Martin X.* Economic Growth. New York: McGraw-Hill, 1995. 539 p.
- Behrens K., Murata Y.* General Equilibrium Models of Monopolistic Competition: A New Approach // *Journal of Economic Theory*. 2007. Vol. 136. Issue 1. Pp. 776–787. <https://doi.org/10.1016/j.jet.2006.10.001>
- Benassy J.P.* Taste for Variety and Optimum Production Patterns in Monopolistic Competition // *Economics Letters*. 1996. Vol. 5. Issue 1. Pp. 41–47. [https://doi.org/10.1016/0165-1765\(96\)00834-8](https://doi.org/10.1016/0165-1765(96)00834-8)
- Ben-David D., Loewy M.B.* Trade and Neoclassical Growth Model // *Journal of Economic Integration*. 2003. Vol. 18. No. 1. Pp. 1–16.
- Bertoletti P., Etro F.* Monopolistic Competition When Income Matters // *The Economic Journal*. 2015. Vol. 127. Issue 603. Pp. 1217–1243. <https://doi.org/10.1111/eoj.12329>
- The Monopolistic Competition Revolution in Retrospect / Edited by S. Brakman, B.J. Heijdra. Cambridge: Cambridge University Press, 2004. 512 p.
- Burmeister E., Dobell A.R.* Mathematical Theories of Economic Growth. London: Collier Macmillan Publishers, 1970. 444 p.
- Chamberlin E.* The Theory of Monopolistic Competition. Cambridge: Harvard University Press, 1933. 213 p.
- Dixit A., Stiglitz J.E.* Monopolistic Competition and Optimum Product Diversity // *American Economic Review*. 1977. Vol. 67. Issue 3. Pp. 297–308. <https://doi.org/10.7916/D8S75S91>

- Ethier W.J.* National and International Returns to Scale in the Modern Theory of International Trade // *American Economic Review*. 1982. Vol. 72. Issue 3. Pp. 389–405.
- Grossman G.M., Helpman E.* Comparative Advantage and Long-Run Growth // *The American Economic Review*. 1990. Vol. 80. Issue 4. Pp. 796–815.
- Krugman P.R.* A Model of Innovation, Technology Transfer, and the World Distribution of Income // *Journal of Political Economy*. 1979. Vol. 87. Issue 2. Pp. 253–266. <https://doi.org/10.1086/260755>
- Krugman P.R.* Scale Economies, Product Differentiation, and the Pattern of Trade // *The American Economic Review*. 1980. Vol. 70. Issue 5. Pp. 950–959.
- Krugman P.R.* Increasing Returns and Economic Geography // *Journal of Political Economy*. 1991. Vol. 99. Issue 3. Pp. 483–499. <https://doi.org/10.3386/w3275>
- Jensen B.S.* Walrasian General Equilibrium Allocations and Dynamics in Two-Sector Growth Models // *German Economic Review*. 2003. Vol. 4. Pp. 53–87.
- Lancaster K.* Intra-Industry Trade under Perfect Monopolistic Competition // *Journal of International Economics*. 1980. Vol. 10. Issue 2. Pp. 151–175.
- Martin R., Sunley P.* Paul Krugman's Geographical Economics and Its Implications for Regional Development Tehory: A Critical Assessment // *Economic Geography*. 1996. Vol. 72. Issue 3. Pp. 259–292. <https://doi.org/10.2307/144401>
- Nocco A., Ottaviano G.L.P., Salto M.* Monopolistic Competition and Optimum Product Selection: Why and How Heterogeneity Matters // *Research in Economics*. 2017. Vol. 71. Issue 4. Pp. 704–717.
- Parenti M., Ushchev P., Thisse J.F.* Toward a Theory of Monopolistic Competition // *Journal of Economic Theory*. 2017. Vol. 167. Pp. 86–115.
- Romer P.M.* Endogenous Technological Change // *Journal of Political Economy*. 1990. Vol. 98. Issue 5. Pp. S71–S102.
- Solow R.* A Contribution to the Theory of Economic Growth // *The Quarterly Journal of Economics*. 1956. Vol. 70. Issue 1. Pp. 65–94. <https://doi.org/10.2307/1884513>
- Stiglitz J.E.* A Two-Sector Two Class Model of Economic Growth // *Review of Economic Studies*. 1967. Vol. 34. Pp. 227–238.
- Uzawa H.* On a Two-Sector Model of Economic Growth // *Review of Economic Studies*. 1961. Vol. 29. Pp. 40–47.
- Wang W.W.* Monopolistic Competition and Product Diversity: Review and Extension // *Journal of Economic Surveys*. 2012. Vol. 26. Issue 5. Pp. 879–910.
- Waterson M.* *Economic Theory of the Industry*. Cambridge: Cambridge University Press, 1984. 256 p.
- Zhang W.B.* A Woman's Labor Participation and Economic Growth – Creativity, Knowledge Utilization and Family Preference // *Economics Letters*. 1993. Vol. 42. Issue 1. Pp. 105–110. [https://doi.org/10.1016/0165-1765\(93\)90181-B](https://doi.org/10.1016/0165-1765(93)90181-B)
- Zhang W.B.* *Economic Growth Theory*. London: Ashgate, 2005. 482 p.
- Zhang W.B.* *International Trade Theory: Capital, Knowledge, Economic Structure, Money and Prices over Time and Space*. Berlin: Springer, 2008. 425 p. <https://doi.org/10.1007/978-3-540-78265-0>
- Zhang W.B.* An Integration of Solow's Growth and Dixit-Stiglitz's Monopolistic Competition Models // *SPOUDAI Journal of Economics and Business*. 2018. Vol. 64. Issue 4. Pp. 3–19.

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