Analysis of Industrial Transfer Mechanism Based on Environmental Regulation

Wen-Bin Peng, Yin-Hua Tian, Guo-Cheng Xiang & Chang-E Kuang
Faculty of Business School, Hunan University of Science and Technology, China
E-mail:vpengwenbin@163.com

Received: November 17, 2011 Accepted: November 28, 2011 Published: February 1, 2012
doi:10.5539/ibr.v5n2p173 URL: http://dx.doi.org/10.5539/ibr.v5n2p173

Abstract

Based on outcomes of existing researches, This paper discussed capital mobility in condition of monopolistic competition and transaction costs which be decided by cost of environmental regulation, also analyzed new economic geography model of industrial transfer. After derivation and analysis of model, we find that in short term, industrial transfer of different regions is related to transaction costs due to environmental regulations, which means lower transaction costs and higher trade freedom can promote industrial transfer; While in long term, equilibrium point of industrial transfer changes with change of different initial endowment of capital and labor of two regions.

Keywords: Environmental regulation, Capital gains, Iceberg transaction costs, Industrial transfer

1. Introduction

Industrial transfer refers to phenomena that enterprises transfer some or all of their productions from original regions to other regions which have different economic development levels, resulting in this status that spatial distribution of enterprises transfer from developed regions to developing ones. Although this concept itself can not show causes and more features of industrial transfer between different regions, it directly reflects this meaning of shift and distribution of economic activities, therefore it is inseparable of new economic geography research.

New economic geography researches on spatial distribution of economic activity, which refers to various countries or different regions within a country or city. Viewing existing literatures, many foreign scholars have studied importance of space factors in economic analysis, especially model of increasing returns under monopolistic competition proposed by Dixit and Stiglitz (1977), which made a new breakthrough on research of Spatial Economics. This model builds consumer preference function under assumptions that market structure is monopolistic competition, trying to answer basic questions of welfare economics from perspective of economies of scale, namely, whether market can produce socially optimal types and quantity of goods. On this basis, Paul Krugman (1991) constructed a model that contains only two regions. This model includes two types of products: agricultural product and manufactured goods. The former is produced by agricultural sector which is perfect competed, has constant returns to scale and produces only a single agricultural product; the latter is produced by industrial sector which is monopolistic competed, has increasing returns to scale and produces a wide variety of industrial products. After analyzing model, we found that economies between two regions will eventually form framework of industrialized area as core and agricultural area as periphery, then we proposed a "core-periphery" model. Based on this, researches on spatial distribution of economic activities from perspective of new economic geography are widely concerned , such as, Duranton and Overman (2005) improved research on regional economy with closely accurate enterprise geographic data under assumption that regional distribution of enterprises is continuous and not affected by regional marginal limit. Li and Long (2005)discussed relationship between capital element, technology transfer and business gathering by improving Dixit-Stiglitz monopolistic competition model, then discovered that different factors which affects business gathering is decided by different capital return, and technology transfer is one factor of business gathering. By means of theoretical perspective of new economic geography, Zhang etc.(2006)considered that upgrading industrial structure in a country should first enforce industrial transfer within country, then achieve inter-regional collaboration upgrading of industrial structure through layout of industrial structure in different regions. Gao(2007) made an analysis of spatial concentration and dynamics of economic activities by using method of mainstream economics, a found that factors such as opening and development gap between regions, contributed to occurrence of industrial transfer and formation of industrial clusters. Wu and Zeng(2007) constructed a circle economic structure formed by industrial transfer from perspective of specialization, and considered that structure was conducive to upgrading of China's regional industrial structure. Xie ect.(2010)examined variation of China's 19 industries locational Gini coefficient before and after accession to WTO, by the way of using new economic geography theory of industrial clustering, and found that changes in China's regional economic differences had a trend of slowing down.

Above literatures analyzed clustering and upgrading of industrial structure from perspective of new economic geography, but lack of deep research on phenomenon of industrial transfer which is in connection with formation of industrial clusters, and can optimize industrial structure. On basis of existing researches, this paper studied mechanism of industrial transfer through improving Dixit-Stiglitz’s model, and tried to analysis various factors which have impact on China's industrial transfer, its purpose is coordinate development of Chinese regional economic.

2. Establishment of Model

According to new economic geography theory, assuming that there are two regions, N and S, which have two industries A and B respectively, and two regions are symmetrical in preferences, technical conditions, openness to trade, factor endowments and other aspects; Suppose industry B is perfectly competitive, constant returns to scale, and its production uses only a factor : labor force L. Industry A is monopolistically competitive, with characteristics of increasing returns to scale and environmental regulation, and so on. In addition to labor factor L, industrial production also demands another factor of production, namely capital K, and industrial production that produces a product needs one unit of capital as fixed cost. Both N and S produce and consume products of industries A and B, N has industry A with number of n, and S with n*.

Returns on capital are π and π* respectively in both regions; we also assume that capital can flow over regions, in order to pursue highest rate of return; taking impact of capital movements into account, we assume that labor and capital owners are not mobile, and capital income is consumed by owners in its location. Consumers from both regions have the same utility function. At the same time, we assume that it has no transaction costs for products from industry B, no transaction costs for products from industry A while in local transaction, but there exist "iceberg transaction costs (G)" in foreign transactions, which is determined by "melting coefficient (τ)" and "distance (d)".Here "distance" is a broad concept, on behalf of impact of environmental regulation in this paper. Expression as follows:

$$G=\tau d$$

3. Derivation of Model

Following derivation takes region N ,as an example, S in similar situation, marked by asterisk(*).

Utility function is divided into two levels: first level refers to Cobb-Douglas utility function that consumers consume both products from industries A and B; second level is utility function that consumers consume products portfolio from industry A, expressed by CES function. That is:

$$U = U(C_A, C_B) = C_A^{\mu} C_B^{1-\mu} \tag{1}$$

$$C_A = [\sum_{i=1}^{n} c_{NN}^{(\sigma-1)/\sigma} + \sum_{j=1}^{n^*} c_{NS}^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)} \quad 0<\mu<1, \rho = \frac{\sigma-1}{\sigma} < 1, \sigma>1 \tag{2}$$

Where U denotes consumer's utility, and C_A is a quantitative indicator of consumers consume products from industry A ,$C_A=(c_1,c_2,c_3,...,c_n)$. $n^{\omega}=n+n^*$ is number of total demand for products from industry A in region N, c_{NN} and c_{NS} are numbers of region N's consumer's demand for products from industry A which are produced in region N and S respectively, σ is elasticity of substitution between products of industry A, μ is share of expenditure on products from industry A in total expenditure, both σ and μ are constants.

In first stage, consumer's total budget can be broken down into budget for products form industry A and budget for products from industry B. The issue is how consumer choose C_A and C_B to maximize utility:

$$U = U(C_A, C_B) = C_A^{\mu} C_B^{1-\mu}$$

$$P_N C_A + P_S C_B = I \tag{3}$$

P_N,P_S denote price index of products portfolios from N and S,I is consumer's income level. Based on first-order conditions for total utility maximization under constraints of total expenditure, direct demand function about CA and CB is:

$$C_A = \mu I / P_N, C_B = (1-\mu) I / P_S \tag{4}$$

In second stage, it minimizes consumer's expenditure considering that consumer s consume products portfolio from industry A, that is, it maximizes consumer's subutility under constraint of $\sum_{i=1}^{n} p_{NN}c_{NN} + \sum_{j=1}^{n^*} p_{NS}c_{NS} = \mu I$ .Lagrange equation is :

$$L = [\sum_{i=1}^{n} c_{NN}^{(\sigma-1)/\sigma} + \sum_{j=1}^{n^*} c_{NS}^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)} + \lambda[\sum_{i=1}^{n} p_{NN}c_{NN} + \sum_{j=1}^{n^*} p_{NS}c_{NS} - \mu I] \tag{5}$$

Then we can get demand of N's consumers for products, which produced in region N, from industry A .

$$c_{NN} = \mu I \frac{p_{NN}^{-\sigma}}{P_N^{1-\sigma}}, I = \pi K + W_L L$$

P_{NN}, P_{NS} denote sale prices of products from industry A in region N and S respectively, which are produced in region N.P_{SS},P_{SN} are sale prices of products from industry A in region S and N respectively, which are produced in region S.I is not only total income, but also total expenditure(In case of monopolistic competition, industry's excess profits is zero when it is at equilibrium point, so I only contains factor income). $P_N^{1-\sigma}$ is price index of products from industry A in region N. Similarly, we can get c_{NS}, c_{SS} (demand of consumer S for products ,which produced in region S, from industry A), c_{SN} (demand of consumers S for products, which produced in region N, from industry A) respectively:

$$c_{NS} = \mu I \frac{p_{NS}^{-\sigma}}{P_N^{1-\sigma}}, c_{SS} = \mu I^* \frac{p_{SS}^{-\sigma}}{P_S^{1-\sigma}}, c_{SN} = \mu I^* \frac{p_{SN}^{-\sigma}}{P_S^{1-\sigma}} \tag{6}$$

If we ignore impact of price changes of some products on overall price index in formula of consumer demand, then $P_N^{1-\sigma}$ and μ are constants. We may assume that:

$$k = \mu I / P_N^{1-\sigma}, k^* = \mu I^* / P_S^{1-\sigma}$$

Then formula (6) can also be simplified as：

$$c_{NN} = kp_{NN}^{-\sigma}, c_{NS} = k^* P_{NS}^{-\sigma}, c_{SS} = kp_{SS}^{-\sigma}, c_{SN} = k^* p_{SN}^{-\sigma} \tag{7}$$

Above formulas give a description of constraint conditions, under which industry A makes price and output decision between two different regions in order to maximize profits. Consumer in regions N and S have the same utility function of products from industry B. Because we assume no transaction costs for products from industry A while in local transactions, but there exist "iceberg transaction costs (G)" in foreign transactions, then optimal outputs of industry A in regions N and S are :

$$x_N = c_{NN} + d\tau c_{SN} = kp_{NN}^{-\sigma} + d\tau k^*(p_{SN})^{-\sigma} = kp_{NN}^{-\sigma} + d\tau k^*(d\tau p_{NN})^{-\sigma} = [k + (d\tau)^{1-\sigma}k^*]p_{NN}^{-\sigma}$$

$$x_S = c_{SS} + d\tau c_{NS} = kp_{SS}^{-\sigma} + d\tau k^*(p_{NS})^{-\sigma} = kp_{SS}^{-\sigma} + d\tau k^*(\tau p_{SS})^{-\sigma} = [k + (d\tau)^{1-\sigma}k^*]p_{SS}^{-\sigma} \tag{8}$$

In front we assumed that fixed cost of every industry A in regions N and S is one unit of capital, while variable cost of per unit of output requires one unit of labor, which is free to enter and exit. Therefore, excess profit of industry is zero when it is at equilibrium status. Profit-maximizing pricing principle of industry is marginal cost-plus pricing. Because of "iceberg transaction costs" in inter-regional trade, ratio of local products in overseas trading price and local trading price is $d\tau$ .we can draw out profit function of industry A in region N：

$$p_{NN}x_N - (\pi + W_L a_m x_N)$$

π denotes return of one unit of capital, $W_L$is gains for one unit of labor. Therefore, we can work out prices of product when traded in local and foreign market under constraints of formula (8) by establishing Lagrangian Function of industry profits：

$$L = p_{NN}x_N - (\pi + W_L a_m x_N) + \lambda[x_N - kp_{NN}^{-\sigma} + d\tau k^* p_{NS}^{-\sigma}]$$

According to $p_{NS} = d\tau p_{NN}$,we can get：

$$L = p_{NN}x_N - (\pi + W_L a_m x_N) + \lambda[x_N - (k + d^{1-\sigma}\tau^{1-\sigma}k^*)p_{NN}^{-\sigma}] \tag{9}$$

we can solve：

$$p_{NN} = \frac{W_L a_m}{(1-1/\sigma)}, p_{NS} = \frac{d\tau W_L a_m}{(1-1/\sigma)} \tag{10}$$

Suppose industry A makes choice of its location according to its own capital gains from regions N or S. In case of monopolistic competition, excess profit of industries is zero, so sales revenue is equivalent to cost of production：

$$p_{NN}c_{NN} + p_{NS}c_{NS} = \pi + W_L a_m (c_{NN} + c_{NS})$$

Combined with formula (10), industry A's gains from region N can be expressed as：

$$\pi = p_{NN}x_N / \sigma = \mu p_{NN}^{1-\sigma}[IP_A^{-(1-\sigma)} + I^* d^{1-\sigma}\tau^{1-\sigma}P_B^{-(1-\sigma)}] \tag{11}$$

$P_N^{1-\sigma}$, $P_S^{1-\sigma}$ denote price indices of industries A and B in region N.

$$P_N^{1-\sigma} = \sum_{i=1}^{n} p_{NN}^{1-\sigma} + \sum_{j=1}^{n^*} p_{NS}^{1-\sigma} = np_{NN}^{1-\sigma} + n^*(d\tau p_{NN})^{1-\sigma} = n^\omega p_{NN}^{1-\sigma}[s_n + \Phi(1-s_n)] \tag{12}$$

$$P_S^{1-\sigma} = \sum_{i=1}^{n} p_{SN}^{1-\sigma} + \sum_{j=1}^{n^*} p_{SS}^{1-\sigma} = n(d\tau p_{SS})^{1-\sigma} + n^*(p_{SS})^{1-\sigma} = n^\omega p_{SS}^{1-\sigma}[s_n + \Phi(1-s_n)] \tag{13}$$

Taking formulas (12) and (13) into (11),we have：

$$\pi = p_{NN}x_N / \sigma = \frac{\mu p_{NN}^{1-\sigma}}{\sigma}[\frac{I^\omega s_I}{n^\omega p_{NN}^{1-\sigma}(s_n + \Phi(1-s_n))} + \frac{I^\omega(1-s_I)\Phi}{n^\omega p_{NN}^{1-\sigma}(\Phi s_n + (1-s_n))}]$$

$$= \frac{\mu I^\omega}{\sigma n^\omega}[\frac{s_I}{(s_n + \Phi(1-s_n))} + \Phi\frac{(1-s_I)}{(\Phi s_n + (1-s_n))}] \tag{14}$$

$\Phi = (d\tau)^{1-\sigma}$,$s_n = n/n^\omega$ denotes share of industry A in region N,$1-s_n = n^*/n^\omega$ is share of industry A in region S, $s_I = I/I^\omega$ is ratio of expenditure in region N in total expenditure, $1-s_I = I^*/I$ is ratio of expenditure in region S in total expenditure. Similarly, we can get capital gains of industry A when it chooses location in region S：

$$\pi^* = \frac{\mu I^\omega}{\sigma n^\omega}[\Phi\frac{s_I}{s_n + \Phi(1-s_n)} + \frac{1-s_I}{\Phi s_n + (1-s_n)}] \tag{15}$$

then, difference of capital gains between two region is：

$$\pi - \pi^* = b\frac{I^\omega(1-\Phi)}{K^\omega\Delta\Delta^*}[(1+\Phi)(s_I - \frac{1}{2}) - (1-\Phi)(s_n - \frac{1}{2})] \tag{16}$$

$$b = \mu/\sigma, \Delta = s_n + \Phi(1-s_n), \Delta^* = \Phi s_n + (1-s_n)$$

4. Conclusion

4.1 Short-Term Equilibrium

From formula (16), we can see that if there are no "iceberg transaction costs" between regions N and S, which means capital returns of industry in regions N and S is equal when trade is freedom. $\Phi = (d\tau)^{1-\sigma} = 1$ .Usually, $0 < \Phi = (d\tau)^{1-\sigma} < 1$. Then difference of capital gains of two regions is related to "iceberg transaction cost" ($d\tau$), industrial distribution of two regions (n, n^*), and consumer expenditures(I ,I^ω).industry will make choice of its location according to capital gains of two regions.

Under different "iceberg transaction costs", effect intensity of each factor will be different. First, when "iceberg transaction costs" is low level , which means two environmental regulation strength (d) is weak or melt coefficient (τ) is small, freedom of trade tends to be 1.

$$\lim_{\Phi\to 1}(\pi - \pi^*) = b\frac{I^\omega(1-\Phi)}{K^\omega\Delta\Delta^*}[(1+\Phi)(s_I - \frac{1}{2}) - (1-\Phi)(s_n - \frac{1}{2})] = 0$$

At this point, industries have similar returns on capital in regions N and S. Choice of industry's location is less affected by share of expenditure in income and industrial distribution of two regions. With strength of environmental regulation increases, it will have an impact on choice of industry's location in two regions which have initial endowment with symmetrical distribution, leading industry moves to area with greater capital gains.

Secondly, when "iceberg transaction cost" is at a high level, that environmental regulation strength(d) of two regions is strong or melt coefficient (τ) is large, then freedom of trade tends to be zero.

$$\lim_{\Phi\to 0}(\pi - \pi^*) = b\frac{I^\omega(1-\Phi)}{K^\omega\Delta\Delta^*}[(1+\Phi)(s_I - \frac{1}{2}) - (1-\Phi)(s_n - \frac{1}{2})] = b\frac{I^\omega(s_I - s_n)}{K^\omega s_n(1-s_n)}$$

From above formula we can conclude that shift direction of industries between two regions depends on two opposite forces. It has an positive impact on difference between profitability of capital gains if share of expenditure in income is greater than share with symmetrical distribution, which means region with larger share of expenditure has greater attractiveness of capital, resulting in industrial transfer to region with larger share of expenditure. If actual use of capital share exceeds that of symmetric distribution, it will reduce capital return in region N, and impede capital flowing to region N. Ultimate flowing direction of capital depends on sizes of two forces. We assume that each industry only uses one unit of capital and labor to product, so amount of capital equals to numbers of industries, which implies transfer of capital means industrial transfer.

4.2 Long-Term Equilibrium

In the long run, we can use equation of capital flow to represent long-run equilibrium of industry locating.

$$\frac{ds_n}{dt} = (\pi - \pi^*) s_n (1 - s_n) \tag{15}$$

From this, we can conclude that there are two possible long-run equilibriums. One is equilibrium of the same return on capital in two regions, that is $\pi = \pi^*$, Another is equilibrium of that all industry A will choose the same location to product at the same time, then $s_n = 0$ or $s_n = 1$ .We can also solve:

$$s_n = \frac{1}{2} + \frac{1+\Phi}{1-\Phi}\left(s_E - \frac{1}{2}\right) \tag{16}$$

Then we can draw out long-term equilibrium solution figure of industry A.

Insert Figure 1 here

In figure 1, this expression of curve II is:

$$s_I = \frac{E}{E^{\omega}} = (1-b)s_L + bs_k, s_L \equiv \frac{L}{L^{\omega}}, s_K \equiv \frac{K}{K^{\omega}}$$

Which is formed by equilibrium point. Curve nn is represented by formula (16) ,which is standard of capital mobility. Stable long-run equilibrium is determined by curve II and curve nn. Slope of curve nn($(1+\Phi)/(1-\Phi)$) varies with trade freedom .The greater trade freedom Φ (the smaller "iceberg transaction cost"),the greater $(1+\Phi)/(1-\Phi)$,the steeper curve nn. But no matter how trade freedom changes, curve nn is always through equilibrium point(1/2,1/2). Slope of curve nn is greater than 1, or coefficient of independent variable S_I ,which represents market share, is always greater than 1, that is, changes in local market share will result in a greater proportion of local industrial changes. Intersection of curve II and curve nn is long-run equilibrium point of industry in two regions. Point A(1/2,1/2) is its long-run equilibrium point when regions N and S have symmetrical distribution of labor endowment and capital endowment. If distribution of initial endowment is non-symmetrical, intersection of curve $I'I'$ and curve nn (point B) is its long-run equilibrium point.

Acknowledgement

The authors thank National Social Science Foundation Major Bidding Project (11&ZD043、09&ZD041), Ministry of Education Key Projects of Philosophy and Social Sciences Research

(11JZD018), National Social Science Foundation (09CJY044), National Natural Science Foundation(70973035), Natural Science Foundation of Hunan Provence (11JJ6071), Soft Science Research Project of Hunan Provence (2011ZK2018) ,Social Science Foundation of Hunan Province (11YBA127)for their support in carrying out the study.

References

An, H. (2005). The Principle of Spatial Economics. Beijing China, *Economic Science Press*.

Davis, D. R., & Weinstein, D. E. (2002). Bones, Bombs and Break Points: The Geog- raphy of Economic Activity. *American Economic Review*, l92, 1269-1289. http://dx.doi.org/10.1257/000282802762024502

Dixit, A. K., & Stiglitz, J. E. (1977). Monopolistic Competition and Optimu Product Diversity. *American Economic Review*, 6, 297-308.

Duranton, G., & Overman, H. G. (2005). Testing for Localisation Using Micro-Geographic Data. *Review of Economic Studies*, 72, 1077-1106. http://dx.doi.org/10.1111/0034-6527.00362

Gao, Y. (2007). Study of Industrial Clusters in the Context of Multi-angle of Economic Geography. *The Journal of Lanzhou Commercial College*, 2, 12-15.

Krugman, P. (1991). Increasing returns and economic geography. *Journal of Political Economy*, 99, 183-199.

http://dx.doi.org/10.1086/261763

Li, Y. Z., & Long, Z. H. (2005). Business Gathering Model Based on the Movement of Capital. *Quantitative and Technical Economics Research*, 3, 8-15.

Wu, X. B., & Zeng, Z. (2007). The Structure of Circle, Economic and Coordinated Development of Regional Economy in China. *Industry Economic Research*, 2, 47-56.

Xie, Y., & Zhong, S. Y. (2010). Bussiness Gathering and the Differences in Regional Economic Development in China-based on the Perspective of New Economic Geography. *Industrial Technology and Economy*, 5, 133-138.

Zhang, Y. B., Huang, J. L., & Zeng, Z. (2006). Cities,"Circle" of Economic and Industrial Upgrading-based on the Analysis of Theoretical Perspective of Economic Geography. *China's Industrial Economy*, 12, 45-52.

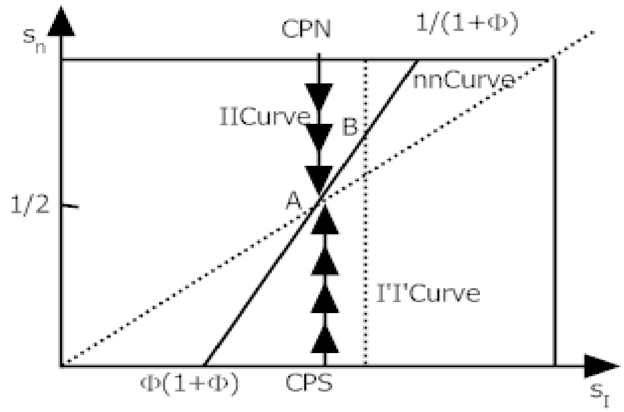

Figure 1. Long-Term Equilibrium Solution of Industry A