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Development policies, transfer of pollution abatement technology and trans-boundary pollution

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ABSTRACT

In this paper, we integrate intra-region labor migration and inter-region labor migration into Harris–Todaro model in the presence of unidirectional trans-boundary pollution. We conduct a simple comparative static analysis of regional economic and environmental effects of the central government's development policies on two regions, reducing the transfer cost of inter-region labor migration and increasing the capital subsidy to the less developed region. In addition, we compare the environmental and regional economic effects of the transfer of pollution abatement technology in two regions.

1. Introduction

Current theoretical research on trans-boundary pollution are focusing on the following two aspects: first, trans-boundary pollution's impact on international trade between nations, specifically, comparative advantage, trade terms, gains from Trade and trade policy; and second, trans-boundary pollution's impact on inter-regional environmental policy and factor flow, of which the representative researches are: Hoel and Shapiro (2003),Haavio (2005) and Candel-Sanchez (2006). Hoel and Shapiro (2003) studied how the environmental policy-making of each region influenced by inter-regional households perfect mobility in the presence of trans-boundary pollution; on the basis of their work, Haavio (2005) investigated the inter-regional households imperfect mobility's influence on the environmental policy-making of each region; Sigman (2005) studied regional intergovernmental free-riding's effect on environmental policy-making and Sewage discharge level in the presence of trans-boundary pollution; Candel-Sanchez (2006) adapted the compensation principles proposed by Varian (1994) and studied the optimal allocation of trans-boundary pollution between regions.

Yet the above researches are mostly set in background of developed countries, that is, the integrated economy, thus, limit their application to the identical analysis in a dual economy. For example, despite the strong economic growth, China is suffering from worsening environmental pollution among which trans-boundary pollution is an important part. Due to China Eastern and western geographical differences, the direction of river flow and atmospheric circulation are generally from west to east, presenting a trans-boundary pollution trend from west to east. Trend from west to east is also shown in the intra-region migration flow, a result of the western backward economy and eastern coastal rapid economic development. On the other hand, in order to achieve the goal of coordinated inter-regional development, Chinese government put forward in 2000 the "scale development of the western region", which accelerated western economic growth but also exacerbated the west-to-east trans-boundary pollution issue. Therefore, current research results under existing framework are not applicable to China's trans-boundary pollution problems.

This paper is based on a dual economy, integrating both intra-region and inter-region labor immigration into Harris–Todaro model in the presence of unidirectional trans-boundary pollution. This paper will focus on governmental impletion of transportation systems and communication facilities, an effort to reduce transfer cost of intra-region labor migration (time cost, mental cost and economic cost) so as to promote labor migration, as well as the influence of governmental capital subsidy and development policy, aimed at the less developed region, on the natural environment and economy. It further compares regional and economic effects brought by the pollution abatement technology improvement in different regions. We come to the conclusion that, infrastructure construction to reduce transfer cost of intra-region labor migration has no impacts on trans-boundary pollution; the capital subsidy to the less developed region will worsen the local natural environment and increase the trans-boundary pollution. The transfer of the

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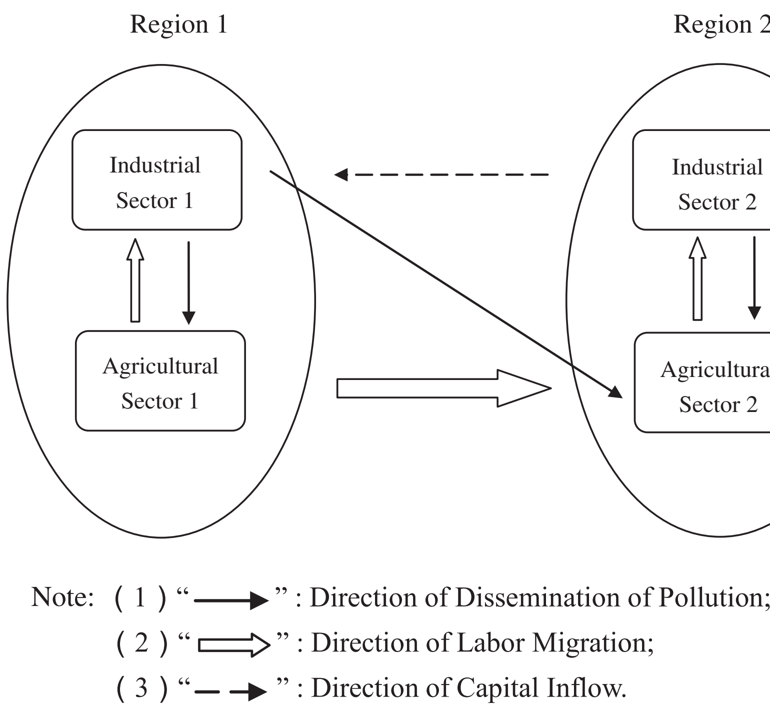

Fig. 1. Factors mobility and pollution dissemination.

pollution abatement technology is favorable to the whole environmental enhancement, etc.

The rest of this paper is organized as follows: in Section 2, we set up the theoretical model in an extended Harris–Todaro framework; in Section 3, we conducted a simple comparative static analysis of the established model; and in Section 4, we provide the concluding remarks.

2. The theoretical model

Consider a closed economy consisting of two regions: region 1 and region 2. Region 1 is the less developed region, which has two sectors, rural agricultural sector 1 and urban industrial sector 1; agricultural sector 1 utilizes the local rural labor and sector-specific capital as factors of production. The output of agricultural sector 1 also depends on the surrounding environment; that is, the better the rural environment, the more output will be produced. The local rural labors not only transfer from rural areas to urban areas in region 1, but also migrate to region 2; the wage rate of agricultural sector 1 is flexible; industrial sector 1 utilizes local rural migrants, urban labor and capital as factors of production. The wage rate is downward rigid; industrial production will generate pollution, which imposes damages upon not only the local rural environment, but also the rural environment in region 2, through agents like air or water. Region 2 is the well developed region, also with two sectors, rural agricultural sector 2 and urban industrial sector 2; agricultural sector 2 utilizes the local rural labor, rural migrants from region 1 and sector-specific capital as factors of production. The output of agricultural sector 2 depends on the surrounding environment as well. The rural labors of region 2 only transfer from rural areas to urban areas in region 2; the wage rate of agricultural sector 2 is flexible; industrial sector 2 utilizes local rural migrants, inter-region rural migrants, urban labor and capital as factors of production. The wage rate is downward rigid; industrial production will also generate pollution, which just imposes damages upon the local rural environment without any trans-boundary pollution; here we further assume that the capital could not perfectly mobile between two industrial sectors.

For the sake of promoting coordinated development of the two regions, the central government makes efforts to develop the infrastructure, such as transportation systems and communication facilities. At the same time, the central government also puts up capital to provide support for the industrial sector in the less developed region. In addition, the central government's energy saving and emission reduction policy will promote the pollution abatement technology level in different regions.

The directions of factors mobility and pollution dissemination can be illustrated by Fig. 1.

2.1. Region 1

2.1.1. Industrial sector 1

The production of industrial sector 1 is:

$$M_1 = F^{M_1}\left(L_{M_1}, K_{M_1}\right) \tag{1}$$

where M_1 is the level of output; and L_{M_1} and K_{M_1} are labor and capital inputs, respectively. The function F^{M_1} is assumed to be strictly quasi-concave and linearly homogeneous.[1] Profit maximization yields:

$$p_{M_1} F_L^{M_1} = \bar{w}_1 \tag{2}$$

where, p_{M_1} is the relative price of the industrial product in term of the agricultural product of region 1; and $\bar{w}_1$ is the institutionally fixed wage rate.

2.1.2. Agricultural sector 1

The production function of agricultural sector 1 is:

$$A_1 = g_1(E_1) F^{A_1}\left(L_{A_1}, \bar{K}_{A_1}\right) \tag{3}$$

[1] In the present paper, we assume that all the production functions share the same properties with that of the industrial sector 1. Moreover, we have $F_J^i = \partial F^i / \partial J$ and $F_{Jk}^i = \partial (F^i)^2 / \partial J \partial k$, for example, $F_L^{M_1} = \partial F^{M_1} / \partial L$ and $F_{LK}^{M_1} = \partial^2 F^{M_1} / \partial L \partial K$.