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Interregional transfer of polluting industries: a consumption responsibility perspective

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ABSTRACT

The economy and the environment are like two sides of a coin: it seems as if we cannot get both simultaneously, as the transfer of polluting industries shows such a paradox between the two sides that it promotes economic development while it may cause pollution transfer and diffusion. This paper tries to evaluate some basic issues facing interregional transfer of polluting industries in China: how to define polluting industries adequately, what benefits accrue from the transfer status and whether there are some rules governing this situation. Initially, a pollution intensity index is calculated which considers industrial waste emissions of solids, liquids, and gases to avoid the difficulty in confirming overall masses of each kind of pollution when we try to aggregate different pollution indices, we then measure the transfer of these polluting industries among the eight regions of China with the help of an input–output model and interregional input–output tables to analyse the polluting industrial transfer trends from 1997 to 2007 in China. We find that there are eight industrial sectors that can be defined as polluting industries according to the interregional input–output table with seventeen sectors, including: mining and dressing, food production and tobacco processing, garments and textile, etc. Generally, polluting industries mainly transfer from the eastern coastal areas to the western and northern inland areas that render the northwest and northeast the major polluting industries recipients. We also find that some polluting industries transfer from eastern regions to both northwest and southwest directly, instead of via midland regions in China. Anti-gradient transfer arises in some polluting industries which transfer from the midlands and southwest at a lower industrial gradient to southern coastal areas that operate under a higher industrial gradient.

1. Introduction

Industrial transfer is an important way to attain regional and industrial sustainable development concerning which, many theories and studies have been undertaken. Early researchers proposed the Flying Geese Paradigm (Akamatsu, 1961), Product Life Cycle (Vernon, 1966), Expansion of Marginal Industries (Kojima, 1978), Labour-intensive Industries Transfer (Lewis, 1978), Eclectic Theory of International Production (Dunning, 1977, 1988), and a New Economic Geography (Krugman, 1991) to explain the conditions, motivations, and modes of industrial transfer from developed countries/regions to developing countries/regions. Studies of industry transfer not only have economically theoretical significance but also deserve operational value with regards industrial structure adjustment, interregional economic integration, economic development, economic system transformation, and so on (Chen, 2002). Based on previous studies, industries transferred are always sunset, or marginal, ones which lag technologically, or are characteristically human capital intensive, extensive energy and heavy pollution emitters. Meanwhile, rapid economic growth makes decoupling even harder for energy consumptions as well as pollutant emissions (Wang and Yang, 2015; Zhang and Da, 2015; Yu and Wei, 2012). Some industries introduce pollutants during production that result in different degrees of pollution transfer and expansion during industry transfer. The "pollution haven hypothesis" provides an explanation for the international or interregional transfer of polluting industries. It considers that countries with low economic development usually implement light environmental regulations, which may lead them to become a transfer destination for polluting industries from developed countries with stringent environmental regulations. This has become an assignable but controversial problem in the present open international environment (Walter

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and Ugelow, 1979; Baumol and Oates, 1988; Low and Yeats, 1992; Copeland and Taylor, 1994; Xing and Kolstad, 2002). However, from the perspective of cleaner production, polluting industry transfer has a virtue akin to a single-cycle of rotational grazing (Dick et al., 2015).[1] After serving the local region, a polluting industry will release local environmental pressure through a proper transfer and finally finish its life cycle. And further, even for some pollutants reduction practices can result in significant environmental performance, their impacts on the improvement of economic performance are less clear (Zhang et al., 2012; Yu et al., 2014). Therefore, we cannot draw conclusions from the macro level to investigate any advantages and disadvantages accruing from polluting industry transfers, There are studies concerning the international transfer of polluting industries: researchers have investigated the motivations, modes, mechanisms, and effects associated with polluting industry transfer (Tobey, 1990; Levinson, 1992; Porter and van der Linde, 1995; Jaffe et al., 1995; Bhagwati and Hudec, 1996; Mani and Wheeler, 1997; Markusen, 1997; Xia, 1999; Zarsky, 1999; Antweiler et al., 2001; Cole and Elliott, 2003; Wang, 2004; Dean et al., 2009). As to interregional industry transfer, most relevant studies focus on qualitative research (Zhang and Liang, 2010). Regarding quantitative research, methods to measure a named industry transfer mainly investigate the relative change for a region but are rarely concerned with absolute transfer amounts among regions. To some extent, this may reflect the industrial change of one isolated region, but we cannot glean a distinct understanding of the mutual transfers associated with multi-industries within multi-regions. In other words, we cannot know the transfer amount of which industries from which regions to which others. Since the end of 20th century, China has carried out a “Western Development Drive”, a “Northeast Old Industrial Base Revitalisation”, the “Rise of Central China Plan”, and other series of strategies for regional development. One of the most important issues is to promote industry transfers from eastern regions to midland and western regions. Nevertheless, whether these policy strategies resulted in a pollution transfer should be further verified. Studies on international industry transfers can get data support from international trade and foreign investment data for certain industries; although the study of interregional industry transfers has some similar characteristics and methods to those used in international studies, the relationship between industries within regions is complex and lacks data support: accurate transfer amounts are difficult to calculate.

In this paper, we investigated the interregional transfer of polluting industries in China, while trying to make a systematic study of two key issues: which industries can be defined as polluting industries, and how to calculate the amount of interregional transfer. Generally speaking, polluting industries (as considered here) are mainly defined from economic and environmental perspectives, and for the second issue, we not only consider the direct transfer (industry transfer between two regions or direct investment from one region to another), but also consider the indirect transfer (the increase of investment or consumption in one region resulting in the increase of industrial scale of the other) (Liu et al., 2014). This idea comes from ecological footprint theory, which says that effects contingent upon the environment and arising from economic activities should be attributed to the consumption of natural products and services (Wackernagel and Rees, 1996). As for the transfer of polluting industries, the responsibility for pollutant emissions should be taken by the consumers of those polluting products (Munksgaard and Pedersen, 2001; Zhang et al., 2014). Indirect transfer or invisible transfer can reflect economic responsibility, and even reveal the hidden side of pollutant emission responsibility, the indirect part is often considered to be much more important than direct part by some scholars (Wang and Yang, 2014; Wang and Liu, 2014; Liu et al., 2015). Data from interregional I–O tables can reflect the economic structure among different regions and sectors so that we can calculate the regional direct and indirect transfer of polluting industries (Liu et al., 2011).

Other sections of this paper are arranged as follows: in Section 2 we illustrate methods to measure interregional transfer of polluting industries by I–O tables; in Section 3 we give the transfer results and short discussions on both the overall polluting industry and the detailed polluting sectors; and in Section 4, key conclusions are drawn.

2. Measuring interregional transfer of polluting industries

2.1. Literature

At present, no agreement has been reached on how to measure industry transfers: many studies just reflected the process of shifting among industries, and nevertheless, they did not embody the real meaning of industrial transfer from one region to another (Qiu et al., 2013). For the transfer of polluting industries, some researchers use the term “polluting plant locations” (Bartik, 1988; Gray, 1996; Levinson, 1996; Becker and Henderson, 2000) and focus on salient political issues such as environmental regulations that may affect plant location. To measure polluting plant (industry, business or manufacturer) location, Kahn (1994) adopted the growth rate in manufacturing employment, and Henderson (1996) adopted the stock/share-price increase and reduction in number of plants to depict this industrial change. In fact, the two methods only measured the increase and decrease of polluting industries in one region, within which no information on (industrial) flows or births and closures (Becker and Henderson, 2000) was available. Becker and Henderson (2000) created a polluting industry birth model to solve the issue of industrial flows, and they estimated econometric models of the births of plants to evaluate their hypotheses concerning the location shift between different areas. Their study was based on two types of regions with different level of environmental regulation. They adopt policy strength, instead of geographical location, as the measure when dividing regions and they still focus on the effects of external factors on industry shift not shift (transfer) itself. Fan (2004) compared several industry index changes in both time and space dimensions, including a related index of the structural differences and the change of the average concentration rate, to measure regional manufacturing industries, the spatial concentration of industry, and changes of market share therein. The index comparison was used to reflect the spatial transfer of manufacturing industries among China's Yangtze River delta regions (including Shanghai, Zhejiang Province, and Jiangsu Province) during a specific period. However, this method has some potential problems. For one thing, this method contains the hypothesis of a closed regional system in which it could not reflect the changing industry index as caused by transfer between China's Yangtze River delta region and her outer regions. In addition, this method was still a relative measure of industry shifting within an isolated region and we remained unsure as to whether the shift was caused by transfer, and moreover, we have no idea about the extent of such a transfer. Feng et al. (2010) adopted the change in proportion of regional industrial added value as a fraction of the whole country to measure industry transfers. This method is similar to that used by Fan (2004), they therefore have similar problems. Zhang and Liang (2010) selected the Herfindahl index, location

[1] Dick et al. (2015) considered that rotational grazing contributes to mitigation of environmental impacts of southern Brazilian farms, which inspires us to deem it as kind of “herd transfer”.