International Trade, Spillovers and Regional Income Disparity

Jiansuo PEI*, Jan OOSTERHAVEN† and Erik DIETZENBACHER†

** School of International Trade and Economics, University of International Business and Economics, 10 Huixin Dongjie, Beijing 100029, China. Email: jiansuo.pei@gmail.com*

† Faculty of Economics and Business, University of Groningen, PO Box 800, NL-9700 AV, the Netherlands.

Abstract: To explain China's regional income disparity, heterogeneous production functions for different regions have been introduced recently. This study extends this contribution by developing a multi-regional model, based on China's 2002 updated interregional input-output table. It is found that interregional trade and regional income disparities are partly explained by a region's position in the global supply chain. Typically, the South Coast and East Coast regions locate in the top tier of the hierarchy while the Central, Northwest and Southwest regions represent the lower end. Moreover, it is shown by a scenario analysis that regional disparity will persist, but may be alleviated in the short run by *Regional Development Programs*.

Keywords: regional convergence; interregional input-output model; global supply chain; China

JEL classifications: R15; C67; F14; O18

1. Introduction

China's tremendous economic growth has been exceptional in the world economy, with a record of roughly 10% *real* average annual growth rate in terms of gross domestic product (GDP) for over three decades. In 2010, China surpassed Japan and became the second largest economy. On the other hand, growth has been unequal among regions in China. In 2010, for instance, regional GDP ranges from 50.7 billion Renminbi (RMB for short) in Tibet to 4.6 trillion RMB in Guangdong Province (over 90 times as large). Measured by GDP per capita, the differences are also huge; in 2010 it amounted to 13.2 thousand RMB in Guizhou Province and 74.5 thousand RMB in Shanghai (5.6 times as large). Given its vast area and huge population, the interregional equity issue has been a major concern to China's central government. In fact, to tackle the potential consequences of regional disparity, China started the "*Western Development Program*" in 1999 and has launched several regional development programs thereafter, such as the "*Rise of Central China Program*" in 2009.

Not only politically, but also scientifically the regional disparity problem has received much attention. In particular, several studies investigated whether or not convergence occurs among regions, which is closely related to studies on economic growth (see recent overviews by MAGRINI, 2004; ISLAM, 2003). This line of research is rooted in neoclassical growth theory (SOLOW, 1956; SWAN, 1956). There are two main types of methodologies adopted: namely the "regression technique" that employs cross-sectional growth regressions to see whether regional disparity is narrowing, i.e. whether regions are converging, or not (see BARRO and SALA-I-MARTIN, 1991, 1992, 2004; MANKIW *et al.*, 1992, for early contributions); and the "distributional approach" that uses the so-called *Markov transition matrix* to "capture the dynamics and to reveal the changes in the shape of the distribution" (see QUAH 1996a, 1996b; SAKAMOTO and ISLAM, 2008). But as indicated in MAGRINI (2004), the underlying assumptions of the theory are confined to a closed economy, which is clearly not appropriate for interdependent economies, in

particular not for regions within one country, say China. Previous research, however, addresses the question whether or not convergence was and/or is expected among China's distinct regions/provinces by means of the techniques discussed above (see also, JIAN *et al.*, 1996; RAISER, 1996; ZHANG, 2001, among others).

Obviously, studies of convergence and of disparity represent two sides of the same coin. Specifically, convergence would naturally result if the determinants causing disparity diminished; and *vice versa*. We focus on the disparity problem: what are the causes for the disparity? Will they persist or change? It is argued that the causes for the disparity are comparative advantages that determine regional economic structures, and thus also interregional interdependency. This viewpoint is supported by a recent study by JIA and GAN (2010), who argue that disparity may be caused by heterogeneous production functions present in different regions. Further, they state that region-specific industry compositions are likely to be the determinants of disparity. Thus the investigation of regional economic structures is of particular importance.

In theory, exports play an important role for economic growth and aggregate industry productivity (FEDER, 1982; FRANKEL and ROMER, 1999; MELITZ, 2003), and likely contribute to the regional disparity (SUN and PARIKH, 2001; ZHANG, 2001; MAGRINI, 2004; SAKAMOTO and ISLAM, 2008). Intuitively, one may expect that the inland regions will serve the coastal regions with natural resource and raw materials, while the coastal regions serve the foreign consumers with final products by exports. Therefore, the interregional interdependency that forms regional trade hierarchies in the global supply chain may result in regional disparity. And regions that locate higher in the hierarchy may be found to have higher per capita incomes.

Building on previous studies, we investigate the regional disparity problem from the perspective of comparative advantage and thus from regional positions in the global supply chain. To verify the relevance of this explanation of regional disparities, we use the interregional IO (IRIO) model (as developed by ISARD, 1951; see also, OOSTERHAVEN, 1981; MILLER and BLAIR, 2009), because it is the only model that is able to study interregional interindustry

interdependencies, i.e. to distinguish intra-regional effects from interregional spillovers at the level of individual industries (see ZHANG and ZHAO, 2005 for a Chinese study). Thus, this study serves to complement the gap discussed in Sakamoto and Islam (2008), i.e. neither the "regression method" nor the "distribution technique" is able to explicitly capture the interregional spillovers, which are non-trivial in an interregional context.

Firstly, we disentangle the complex total of intra-regional effects and interregional spillovers by means of an additive decomposition methodology (OOSTERHAVEN, 1981; MILLER and BLAIR, 2009). Second, we perform a scenario analysis in the light of China's regional development programs. It appears that the regional position in global supply chains can partly explain interregional trade, which in turn partly explains the regional disparity.

The most related studies adopting a comparable methodology to investigate China's regional disparity are HE and DUCHIN (2009) and YANG and LAHR (2008). In HE and DUCHIN (2009), the focus is on infrastructure differences and regional comparative advantages. They project scenarios for 2010 and 2020 to provide an indication of the benefits that would be generated by means of facilitating infrastructure. But their dataset is for three mega-regions of China.[1] This aggregate level, as noticed in previous studies (SAKAMOTO and ISLAM, 2008; MAGRINI, 2004 for example), unfortunately prevents to study significant differences in economic structures (to a relatively large extent). Hence, more disaggregated data are called for.

YANG and LAHR (2008) view the disparity problem from the perspective of productivity. Labor productivity, defined as value added per worker, is decomposed into five partial effects (see OOSTERHAVEN and BROERSMA, 2007, for a comparable Dutch study). In this way, they answer the interregional disparity problem from the perspective of different sectoral structures and different productivity growth patterns. But due to data constraints they are forced to use a

[1] There are several different methods to group different provinces into different numbers of regions. For instance, the JETRO-IDE and State Information Centre of China based their work on the eight-region delimitation (the same as this study), while the Development Research Centre of the State Council uses another seven-region classification. As there is no official definition of regions, the delimitation is problem-driven, i.e. depends on the research question. However, generally speaking, the more detail is preferred.

ten-industry framework, which is relatively aggregate. A more disaggregated industry classification serves as a better starting point to highlight the importance of region-specific economic structures.

In addition to using a much more comprehensive dataset, our data are updated to the most recent year available. Moreover, our approach combines and integrates the three dimensions discussed above. First, region-specific industry compositions are paid special attention to, which extends the argument made in JIA and GAN (2010). Second, and more important, spatial interactions (i.e. interregional interdependencies) are taken into full account. Third, the role of regional trade hierarchies in global supply chains is shown empirically.

The rest of this paper is structured as follows. In section 2, a traditional convergence analysis in relation with the industrial structure of regions, viewed in isolation, is presented. In section 3, data issues and methodology of the input-output analysis of interregional interdependency are presented. In Section 4, the additional insights gained in this way are compared to the outcomes of section 2, while a scenario analysis explores the interregional impacts of a reduced foreign export of China's coastal regions and increasing investments in China's western regions in Section 5. The last section concludes by illustrating further insights that an interregional approach add for policy purposes and discusses.

2. Descriptive analysis of regions in isolation

First the analysis based on traditional convergence literature will be presented, and then the industrial structure of regions and its relation to GDP per capita is discussed.

2.1. Convergence or divergence?

To set the stage, Table 1 summarizes stylized facts about the regional disparity problem in China.[2] From 1995 to 2010, an inverted U-shaped distribution is found for thirty-one provinces. Measured by the *mean/median* ratio, which shows the skewness of distribution, a peak is found for 2002. The other indices (i. e. *s.d./mean*, *max./min.*, and σ), all indicating the spread around the mean, show a later maximum for 2002-2004. The regional development policies may have an impact on the reduction of the disparity after these peaks. The *Western Development Program* was launched in 1999, the *Northeast Revitalization Program* in 2003, and the *Bohai-Rim-Region Program* in 2004. These programmes, however, take time before they take effect. Hence, disparity is expected to decline some time later. In fact, both σ and σ* were decreasing after 2006. This, of course, does not prove, but suggests a relationship.

Table 1 about here

2.2. Regions viewed in isolation

The typical explanation of the above analysed regional disparity in per capita GDP's looks at differences in sectoral labour productivities combined with differences in regional sectoral structure. Table 2 shows by means of the row with regional specialization coefficients (RSC, see HOEN and OOSTERHAVEN, 2006) that the latter differences are moderate in China, as that index runs from 8.5% for the central region (CR) to 25.9% for the Northern Municipalities region (NM), whereas it could run from 0%, indicating a region with the national sector structure, to 100%, indicating a region that is entirely unique. However, these moderate structural differences are

[2] The so-called σ-convergence is used to demonstrate the dispersion of the GDP per capita among China's thirty-one provinces (see ZHANG, 2001). It is defined as the standard deviation of the logarithm of GDP per capita among the 31 provinces, i.e. as $\sigma_t = \sqrt{\sum_{i=1}^{r} (\log(gpc_{it}) - \rho_t)^2 / r}$, where gpc_{it} = GDP per capita level of province *i* for year *t*, and ρ_t = national average of the logarithm of GDP per capita for year *t*. In the same fashion, the σ* is calculated for the aggregate eight regions further used in this paper.

quite important, as labour productivity, in the last column of Table 2, varies greatly between the industries, running from only 4,510 RMB per worker in the large traditional agricultural sector (13.7% of total value added), to 76,930 RMB in the much smaller capital intensive modern public utility sector 14 (3.6% of national total value added).

Table 2 about here

The matrix with sectoral Location Quotients (LQs) in Table 2 shows which regions have a revealed comparative advantage (see HOEN and OOSTERHAVEN, 2006) in what industries. The most specialized NM region has such an advantage in producing electronic products (sector 12 with an LQ of 1.7) and all kind of services (the large sector 17 with an LQ of 1.8). These are both industries with a relatively high labour productivity, while agriculture with its very low labour productivity is almost absent in NM, as its LQ is only 0.2. The dominance of agriculture in the SW, NW and Central Region (with LQs of 1.6, 1.3 and 1.4), on the other hand, obviously, contributes to their relative low per capita GDP's.

In contrast, the EC and the SC found revealed comparative advantage in producing electronic products (sector 12, with LQs of 1.6 and 2.3, respectively). This coincides with their relatively high per capita incomes. Besides, it is found that the economic structure is persistent or even strengthened along time, as witnessed in the NC, the CR, and the SW regions, the LQs of agriculture in these regions became even more pronounced from 1997 to 2002. This change is associated with heterogeneous productivity progress, from 23% increase (agriculture) to 346% growth (metal products, sector 9) from 1997 to 2002.[3]

Moreover, when regions are viewed in isolation, along with differences in sectoral structure, other factors are traditionally put forward to explain regional differences in per capita incomes,

[3] The changes over time are measured in constant prices of 2002, and are based on the primary data (*i.e.* 1997 IRIO Table), calculated using *China Statistics Yearbook*. Detailed results are not shown, but available upon request.

such as internal and external economies of scale and density (see e.g. BROERSMA & OOSTERHAVEN, 2009). Regional difference in population density, given in the one but last row of Table 2, may serve as a proxy for such factors. Thus, the high concentrations found in the NM and the EC (with 864 and 648 inhabitants per square kilometres), may play a role in explaining the relatively high per capita incomes.

2.3. Preliminary conclusion: add interregional interdependencies

Clearly, the above findings support the conclusion drawn from JIA and GAN (2010). However, the role of trade and through which the interregional interactions are realised have not been touched thus far. To tackle this issue, interregional input-output analysis is needed to analyze whether regions have different positions in worldwide supply chains. Our hypothesis is that this is the case, and that this partly explains GDP per capita differences. So the next section will account for the interregional interdependencies.

3. Methodology development

In this section, first the construction and updating of China's interregional input-output table to the most recent year available is proceeded. Then, the IRIO model is developed. The IRIO model is preferred, because it (i) preserves as much as possible of the information about region-specific comparative advantage, which determines its own economic structures or the industry compositions, as discussed in last section; (ii) adds information about interregional transactions;