International Trade, Spillovers and Regional Income Disparity

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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; (iii) serves as a tool to investigate the spillovers among regions, which is beyond the ability of other competing methods;[4] Moreover, industry level scenario analysis is perfectly possible in an IRIO framework. Last, the total effects are broken down into a direct, indirect and spillover effects.

[4] For instance, as discussed in SAKAMOTO and ISLAM (2008), neither "regression method" nor "distribution technique" is able to explicitly capture the interregional spillover effects.

3.1. Construction and updating of China's interregional input-output table

The primary source data are China's interregional input-output tables (IRIOTs) constructed by the State Information Centre of China in collaboration with IDE in Japan.[5] The resulting IRIOT includes 17 sectors, covering 8 regions for 1997 (see Appendix A and B for the delimitation of the regions and sectors).

Figure 1 about here

Figure 1 defines the data of China´s 1997 IRIOT. $\mathbf{x}$, $\mathbf{v}$, $\mathbf{m}$ and $\mathbf{e}$ denote the 17*1 vectors of, respectively, total output/input, value added, imports from *rest of the world* (ROW) and exports to ROW. Superscripts *r* and *s* indicate region-specific values, with *rs* indicating a flow for region *r* to region *s*. $\tilde{\mathbf{Z}}^{rr}$ indicates a 17*17 local intermediate deliveries matrix (including foreign imports), and $\mathbf{Z}^{rs}$ a 17*17 interregional intermediate deliveries matrix. $\tilde{\mathbf{F}}^{rr}$ gives a 17*5 matrix of regional final demand (including foreign imports), with rural household consumption, urban household consumption, government consumption, gross fixed capital formation and changes in inventories. $\mathbf{F}^{rs}$ is a 17*5 matrix of interregional final deliveries from region *s* to region *r*. The region-specific total final demands per category are given by the 1*5 vectors $\mathbf{f}^{r}$, while the scalars *e*, *m* and *v* indicate total foreign exports, total foreign imports and total value added (i.e. Chinese GDP), respectively.

To derive a useable IRIOT, first, foreign imports need to be separated from local deliveries (both for intermediate demands and final uses). Given the limited data availability, the proportional method is used for this purpose (see LAHR, 2001 for an evaluation). This method proportionally divides total foreign imports per product along all regional domestic intermediate

[5] The multi-regional IO (MRIO) table is used in their terminology. In fact, the interregional matrices are full matrices, in which sense the term interregional IO table (IRIO) is more appropriate by definition thus used in this study.

and final uses. Define $\mathbf{t}^r$ by $t_i^r = m_i^r / (\tilde{z}_{i\bullet}^{rr} + \tilde{f}_{i\bullet}^{rr})$, where $\bullet$ indicates a summation over the superscript at hand. Then, the self-sufficiency ratios equal to one minus these import ratios $(\mathbf{i} - \mathbf{t}^r)$, while the local deliveries, net of foreign imports, consequently, equal $\mathbf{Z}^{rr} = (\mathbf{I} - \hat{\mathbf{t}}^r)\tilde{\mathbf{Z}}^{rr}$ and $\mathbf{F}^{rr} = (\mathbf{I} - \hat{\mathbf{t}}^r)\tilde{\mathbf{F}}^{rr}$.[6] And the resulting true IRIOT accounting framework is shown in Figure 2.

Figure 2 about here

Next, the thus constructed IRIOT for 1997 is updated to 2002, which is the most recent year available. Briefly speaking, the available data of 2002 are thirty provincial IO tables (Tibet does not have an IO table, given its GDP takes a share of less than 0.2% of national total income in 2002, it is proxied by the remaining SW structure and its values added per industry are scaled up proportionally) and one national benchmark IO table. Still we face a reconciliation issue. Taking into account that the 2002 national IO table is a benchmark table, we assume that its totals are more reliable than the totals of the 2002 regional data, and thus used as constraints (OOSTERHAVEN et al., 1986). To summarize, the available data are (see Figure 2 for reference): value added per region ($\mathbf{v}^r$); total output/input per region ($\mathbf{x}^r$); the column total of intermediate inputs, given by $\mathbf{u}^r = \mathbf{x}^r - \mathbf{v}^r$; total domestic final uses per region per category ($\mathbf{f}_q^r$); national import (m) and national export (e); national intermediates ($[z_{ij}^{nat.}]$) and national final use ($[f_{iq}^{nat.}]$).

Given that both negative and positive values are present in the data, in particular for the *changes in inventories* and the *discrepancy*, the generalised RAS (GRAS) method (JUNIUS and

[6] To be precise, the so-called *processing with customer's materials* (PCM) should be deducted both from export and import a priori, because the interdependence or roundabout effects do not hold for PCM production. Consequently, the import ratio would be adjusted downward accordingly. However, as such detailed data are not available; one needs to interpret the results with caution, especially at industry level. See PEI *et al.* (2011) for a detailed discussion on treatment of PCM in a national setting.

OOSTERHAVEN, 2003) is used. Finally, the GRAS program incorporated with national constraints is run for the updating.[7] Next, the updated IRIOT for 2002 is ready to be used.

3.2. Interregional spillovers and the generation of value added

Under an ideal IRIO framework, $\mathbf{A}^{rr}$ is defined as pure intra-regional input coefficient matrix, its element is computed by employing $a_{ij}^{rr} = z_{ij}^{rr} / x_j^r$; $\mathbf{A}^{rs}$ is an interregional coefficients matrix, from region *r* to *s* (*r*≠*s*), its elements are similarly calculated by using $a_{ij}^{rs} = z_{ij}^{rs} / x_j^s$. They are building blocs of **A** matrix, given below:

$$\underset{(nr\times nr)}{\mathbf{A}} = \begin{pmatrix} \mathbf{A}^{11} & \mathbf{A}^{12} & \cdots & \mathbf{A}^{1R} \\ \mathbf{A}^{21} & \mathbf{A}^{22} & \cdots & \mathbf{A}^{2R} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{A}^{R1} & \mathbf{A}^{R2} & \cdots & \mathbf{A}^{RR} \end{pmatrix}, \quad \underset{(nr\times 1)}{\mathbf{x}} = \begin{pmatrix} \mathbf{x}^1 \\ \mathbf{x}^2 \\ \vdots \\ \mathbf{x}^R \end{pmatrix}, \quad \underset{(nr\times 1)}{\mathbf{y}} = \begin{pmatrix} \mathbf{F}^{11} + \cdots + \mathbf{F}^{1R} \\ \mathbf{F}^{21} + \cdots + \mathbf{F}^{2R} \\ \vdots \\ \mathbf{F}^{R1} + \cdots + \mathbf{F}^{RR} \end{pmatrix} \mathbf{i} + \begin{pmatrix} \mathbf{e}^1 \\ \mathbf{e}^2 \\ \vdots \\ \mathbf{e}^R \end{pmatrix}$$

The dimensions of each matrix are given in parenthesis by lower-case letters. The *n* refers to number of industries, *r* gives how many regions are studied. **i** is a vector with *one*s of appropriate length.

Here, the fundamental input-output equation will serve as the starting point,

$$\mathbf{x} = \mathbf{Z} + \mathbf{y} = \mathbf{A}\mathbf{x} + \mathbf{y} \tag{1}$$

Solving formula (1) for **x**, we have

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{2}$$

To recap, in this study, $\mathbf{A}^{rr}$ is a 17*17 intra-regional input coefficient matrix; $\mathbf{A}^{rs}$ is a 17*17 interregional coefficients matrix, from region *r* to *s*. Further, denote $\mathbf{F}^{rC} = \sum_{s(s\neq r)} \mathbf{F}^{rs}$ a

[7] Detailed discussion of the updating procedure and formulas is omitted from the main text but available upon request.

17*5 matrix of final demand of *rest of China* served by region *r*. Define $\mathbf{y}^r = \mathbf{F}^{rr}\mathbf{i} + \mathbf{F}^{rC}\mathbf{i} + \mathbf{e}^r$. Moreover, **c** is introduced as the value added coefficient, with its typical element $c_j = v_j / x_j$. Hence, the value added accounting equation can be derived from the fundamental input-output formula,

$$\mathbf{v} = \hat{\mathbf{c}}\mathbf{x} = \hat{\mathbf{c}}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{3}$$

Where $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief-inverse and a hat indicates the diagonalization.

Total value added by sector and by region can be decomposed in two ways, namely, according to (i) the type of final demand that causes it and (ii) the directness of the causal relation with this final demand. First, define $\mathbf{v}_e^r$ as the value added that is generated by foreign export for a given region *r*:

$$\mathbf{v}_e^r = \hat{\mathbf{c}}^r\mathbf{L}^{rr}\mathbf{e}^r + \hat{\mathbf{c}}^r\sum\nolimits_{s(s\neq r)}\mathbf{L}^{rs}\mathbf{e}^s \tag{4}$$

In the same fashion, the value added that is due to intra-regional deliveries to regional final demand and interregional exports of final goods within China ($\mathbf{V}_f^r$) is obtained.

Second, (4) can be decomposed into the following effects (see OOSTERHAVEN, 1981; MILLER and BLAIR, 2009):

$$\mathbf{v}_e^r = \hat{\mathbf{c}}^r\mathbf{e}^r \text{ (within region direct effects)} \tag{5.1}$$

$$+\ \hat{\mathbf{c}}^r(\mathbf{L}^{rr} - \mathbf{I})\mathbf{e}^r \text{ (within region indirect effects)} \tag{5.2}$$

$$+\ \hat{\mathbf{c}}^r\sum\nolimits_{s(s\neq r)}\mathbf{L}^{rs}\mathbf{e}^s \text{ (interregional spillover effects)} \tag{5.3}$$

Similarly, the decompositions of value added for within-regional trade and interregional trade by category can be derived. In formula,

$$\mathbf{V}_f^r = \hat{\mathbf{c}}^r \mathbf{F}^{rr} \text{ (within region direct effects)} \tag{6.1}$$

$$+ \hat{\mathbf{c}}^r (\mathbf{L}^{rr} - \mathbf{I})\mathbf{F}^{rr} \text{ (within region indirect effects)} \tag{6.2}$$

$$+ \hat{\mathbf{c}}^r (\mathbf{L}^{rr} \sum\nolimits_{s(s\neq r)} \mathbf{F}^{rs} + \sum\nolimits_{s(s\neq r)} \mathbf{L}^{rs} (\mathbf{F}^{ss} + \mathbf{F}^{sC})) \text{ (interregional spillover effects of regional final demand of other regions)} \tag{6.3}$$

Adding (5) and (6), and rewriting the sum shows that $\mathbf{v}^r = \mathbf{V}_f^r \mathbf{i} + \mathbf{v}_e^r$ for each of the eight regions.[8] In this way we are able to attribute value added to direct and indirect intra-regional impacts, and interregional spillover of these two types of final demand.

Moreover, from a global supply chains point of view, if one region is more close to the final consumers, then this very region's position in the global supply chain will be higher in the supply chain hierarchy. In contrast, those regions that are more close to the natural resource and raw materials will locate lower in the hierarchy of the global supply chain. By so doing, implications on regional disparity issue can be inferred. What's more, the results can also be used to check the impact of regional development programs by an additional exercise of scenario analysis.

4. Empirical results when interregional interdependencies are considered

Compared with Section 2, where regions are viewed in isolation, additional insights are provided in this section. In this regard, three types of empirical results will be presented. First, as an economy with more than 1.3 billion people, production for domestic consumers serves as the

[8] In fact, the own region indirect effects can be further decomposed into two effects, namely *intra-regional effect without feedbacks* and *interregional feedbacks* (see OOSTERHAVEN, 1981; ZHANG and ZHAO, 2005; MILLER and BLAIR, 2009). The feedback effects, however, are relatively small (though relevant theoretically), which is why they are not studied separately.

dominant part of the whole production, which is discussed next. Several observations stimulate us to have a closer look at the production for foreign export next, both in aggregate and at industry level, which are discussed in subsequent sections.

4.1. *Interregional interdependencies: value added due to domestic final uses*

Table 3 gives the most aggregated results using the 2002 IRIOT, where row two and three show the regional value added that is generated by production for regional domestic final use, both absolute and as a percentage of total regional value added. At first sight, roughly four groups of regions may be distinguished: South Coast, with 61% of value added generated by production for regional final use; East Coast and Northern Municipalities with about 70%; followed by Northeast and North Coast with roughly 87%; and finally the rest with more than 91% (see Appendix A for the definition of regions, and Figure 3 below for their location).

Table 3 about here

For each region as a whole, the own region's domestic final demand plays dominant role (see the rows with the subtotal in Table 3). Of the direct effects, the urban household consumption demand (UHC) accounts for the most, ranging from 11.6% (for NC) to 19.5% (for SC) of total value added generated by domestic final demand. Of the indirect effects, the gross fixed capital formation (GFK) leads the list, contributing about 15.2% (for NW) to 21.3% (for SW) for the total value added considered in Table 3.[9] Obviously, GFK requires more specialized products than UHC, which therefore tend to be imported from the *rest of China* more frequently.

[9] One exception is for the SC, where the indirect effect of GFK only contributes 9.8% (less than those of UHC with 10.5%) of total value added generation by production for domestic final use. This region stands out in that investment contributes the least share to value added impacts among all regions concerned. This could be an indicator for the development level, which means SC relies more on consumption rather than investment (like most of the developed economies).

In contrast, the spillovers are relatively small in magnitude (see *subtotal* in bottom panel in Table 3, which ranges from 12.7% for the NE to 26.3% for the EC). The implication is clear: considering only the demand effects, the stimulation by means of direct investment in certain region, that very region would be the one to gain most in terms of value added.

Note that the three least developed regions (see Table 3) share a value added generation pattern that is quite similar, *i.e.* more than 91% of total value added can be attributed to production for domestic final use. Moreover, when we take a closer look, investment expenditures accounts for roughly 31% of value added generation in SW region (i.e. 9.6%+21.3%). Given that the spillover effects play relatively limited role (i.e. 18.6%), it is safe to argue that the promotion of investment in this region may be effective (as confirmed by HE and DUCHIN, 2009), which is what the *Western Development Program* aims at.

As far as interregional spillover effects are concerned (bottom panel in Table 3), the EC region receives no less than 26% of its value added via spillovers from domestic final demand in rest of China. Within the 26% spillovers from other regions, over 7% is generated by final use in CR and another 5% originates from the NC. These results give clear picture about the interregional interdependences and interactions.

However, a word of caution is needed. The above analysis only allows establishing the short run demand effects of investment programmes in these three regions will be captured by those regions. The actual composition of the investment programmes, however, should also consider the longer run supply effects, such that the interregional and international competitiveness of the regions at hand also increases.

4.2. Interregional interdependencies: value added due to foreign exports

Generally speaking, the ability to export abroad indicates relatively high productivity and thus high per capita income (see MELITZ, 2003), due to the competition on foreign markets, the technologically advanced products demanded there, the technology transferred with foreign

investments and so forth; and conversely. Hence, it is needed to carefully inspect the regional value added generation by production of foreign export and its implication for disparity.

Table 4 presents the most aggregated estimates of foreign export-led value added generation: column two and three give the total value added generated by production for exports, both in absolute and in percentage terms (note that the setup of Table 4 is transposed compared to Table 3). Columns four and five, respectively, illustrate the direct effect and indirect effect, followed by the spillover effects. Looking at the spillovers, the foreign exports from EC and SC benefit the regions NC, CR, NW and SW indirectly to a considerable extent. In percentages, the exports of EC and SC contribute to over one quarter (for region NC) to roughly half (for region CR) of the total value added generated by exports production.[10]

Table 4 about here

Regarding supply chains in the global economy, EC and SC are mainly coastal provinces that have natural locational advantages. The reason why the disparity did not show in pre-reform period was mainly due to the fact that the comparative advantages in those regions were largely suppressed. They only started to take effect when the Chinese economy opened up exploit them (ZHANG, 2001). Moreover, preferential policies for the coastal zones reinforced that advantage and even stimulated it.[11]

Imagine the global supply chain as a hierarchy. The closer a region is to the consumers in the ROW the higher its position in this hierarchy; while regions that provide raw material or natural resources take up lower positions in the global supply chain. Viewed in this way, the regional

[10] For instance, the SC and EC took, respectively 67% and 19% of total processing trade in 2002. It would be more desirable to split the sub-table of the SC to a processing part and the rest. Due to data constraint, one has to stick to the best data available. On the other hand, the share of processing trade to the total export (import) was about 17% (19%) in 2002 for the peculiar SC, which assures that the results are qualitatively valid (with certain quantitative bias).
[11] This phenomenon is well documented in new economic geography literature; see FUJITA *et al.* (1999).

trade hierarchy can be traced by using the absolute spillovers values, since they indicate the actual direct and indirect strengths of the supply chain. Given spillovers are two-way; the net spillover is defined as the sum of each region's outflow spillover effect minus inflow one (see Table 5).

Table 5 about here

Two regions are outstanding, namely the EC and the SC. Partly due to their locational advantage, the rest of China saw positive net spillovers of 139 billion RMB from the SC and 74 billion RMB from the EC. Conversely, the CR benefits mainly from region SC and EC, running a 96 billion RMB negative spillover effect. Thus, it is evident that, within China, SC and EC are at the top the global supply chains in absolute terms, *i.e.* the overall performance of China's export solely depends on the export performance of SC and EC (see Figure 3).

Figure 3 about here

In addition, there are four relatively independent exporting regions which, according to this definition, locate relatively high in the hierarchy too. For SC, about 95% of value added from export production is locally attributable; for EC it is 89%, for NM 88% and for NE 80%. Furthermore, the correlation between absolute value of value added generated by local foreign export and that of the share to total value added by all foreign export is 0.85; while the correlation for summation of net spillovers (in absolute values) and that of in percentages is as high as 0.92. This phenomenon, namely specialization or agglomeration, is well documented and discussed in new economic geography literature (see FUJITA *et al.*, 1999). To substantiate previous findings, the relationship between the locations in global supply chains of different regions and regional income differences is explored at the industry level next.

4.3. Interregional interdependencies at the industry level

In order to further detect the spatial industrial links among regions via foreign export, the five most important industries (on the basis of relative importance in value added generation by foreign export production) in each of the eight regions are further investigated.[12] Table 6 is organized in the same fashion as Table 4.

Table 6 about here

Regional trade hierarchies are even more pronounced for the most important industries than at the aggregate level in Table 4. In particular, SC and EC are engines for exports in all cases. Notably, *mining* (industry 2) and *chemical* (industry 7) in all regions are sensitive to spillovers from exports of SC and EC. Take industry 2 (*mining* products) export, for example. Because of their location in the global supply chain, the short-run export effects of SC and EC may contribute to 32.7% of all export-led value added generation in NE, 47.7% in NC, and even two-thirds in CR, NW and SW, in industry 2. Hence, a stronger supply chains in major export industries are found. This, in part, explains the regional disparity.

It is worth noting that, at the industry level region NM shows somewhat different nature than this general observation. It does not depends much upon EC and SC, especially for its dominant exporting industries (*service* (industry 17), *trade and transport* (industry 16), and *electronic product* (industry 12)). This result fits well with what is concluded from Table 2 in case of the location quotients for value added. Region NM is outstanding also because of its unique political status (being the capital city) and independent exports.

To summarize, major exporting industries in most regions depend heavily on the performance of EC and SC. In other words, the exports from regions EC and SC may also be viewed as the

[12] The regional trade hierarchy details are not included at industry level due to space constraints, but are available upon request. In fact, they are very much like Figure 3.

indirect exports of other regions, and thus to some extent they are also the result of interregional trade. Naturally, one may ask what would happen if the exports from region SC or EC decreased for, say one trillion RMB due to whatever reasons, for instance the global financial crisis? Would this change widen or narrow the regional disparity?

5. Scenario analysis for investment and export

In view of the global financial crisis and the regional development programs launched in China in recent years, two types of scenarios are investigated in this section. First, it is assumed that exports decrease with one trillion RMB (maintaining the 2002 export structure) in both EC and SC, due to the lack of external demand from ROW. Second, in line with the *Rise of Central China Program* and the *Western Development Program* initiated in respectively 2009 and 1999, it is assumed one trillion RMB investment is invested in CR, NW or SW (with the 2002 *gross fixed capital formation* composition). Again, the impacts are investigated based on short-run demand-driven rather than long-run supply. The value added impacts of these five scenarios are given in Table 7 (note that it is organized differently from previous tables).

Table 7 about here

The total value added changes have been decomposed into within-region changes (direct effect and indirect effect), and interregional effects that are passed on to other regions due to the shock in the region at hand. Table 7 shows both the aggregate results and those of the five major industries (on the basis of the size of the impact). A common feature of all five scenarios is that about four-fifth of the changes are confined to the own region (see the upper panel of Table 7, column three plus column four over column two).

From the aggregate results, one may infer that the investment in NW would generate most value added in China as a whole (*i.e.* 1208 billion RMB), whereas its within-region impact of 883

that is 73% of the total (the smallest in percentage). Since roughly 88 billion and 59 billion would pass on to CR and NC, respectively. However, the investment made to SW would generate 856 billion within-region benefit (84% of the total, the highest in percentage), in which case relatively limited benefit would be passed on to other regions. For the case of a decrease of exports in EC and SC, CR would be hit sharply, with a value added decrease of 67 billion and 62 billion, respectively. This reveals the relatively heavy dependence of CR to exports of EC and SC regions, echoing preceding arguments about the regional trade hierarchy.

To summarize the aggregate results, despite the dominant within-region effect, about one-fifth of total income change due to export contracting would pass on to other regions, in particular CR and NC. Second, for the investment scenarios the NW is outstanding in that 27% of the benefit would generate spillovers on other regions. Continued with the above analysis, in the lower panel of Table 7, five industries are selected for each scenario (according to the size of their impact).

For the export shocks, the values added of five industries *trade and transport* (industry 16), *services* (industry 17), *electronic products* (industry 12), *chemical products* (industry 7), and *textile and wearing apparel* (industry 4) would be affected most, account for roughly two-thirds of the total change. The one trillion exports reduction in EC would give small spillovers of maximum ten billion value added reduction in CR (industry 16) and NC (industry 7). One the other hand, the one trillion exports reduction in SC would pass on losses of maximum 18 billion value added in EC (industry 7).

Concerning the investment shocks, three industries are most important in all three regions, namely *construction* (industry 15), *trade and transport* (industry 16), and *services* (industry 17). One interesting finding here is that for *construction*, the value added by definition can solely be realized within the region. Importantly, the one trillion investment programs in NW and/or SW would give small spillovers maximum 19 billion in CR (industry 16 and industry 1, respectively); for one trillion investment programs in CR, the benefit of investment would pass relatively more on the EC and the NC. It can be concluded that the short run demand effects of investments in the

least developed regions seems to contribute to narrow the regional disparity (similar findings are reported in HE and DUCHIN, 2009).

6. Conclusion and discussion

Regarding the regional disparity problem, it is concluded that it is important to study comparative advantage in an interregional, interindustry context. To set-up the necessary input-output data, the GRAS method is combined with national cell constraints to update China's 1997 interregional input-output table to 2002, which is one of the first attempts to do so empirically. Addition to the conventional convergence approach, this paper adds the analysis of interregional interindustry interdependency to address this issue. It is shown that the interregional trade, and therefore the position of regions in the global supply chain hierarchy serve as an additional explanation of regional per capita differences.

In fact, China's regions show a clear hierarchy. The three least developed regions (the Central Region, the NW, and the SW) occupy the lowest tier of that hierarchy, providing natural resource and raw materials to regions higher in the global supply chain, such as the East Coast and the South Coast). This partly explains their relatively low per capita income. In contrast, their industrial composition and their direct access to foreign markets explain why EC and SC locate in the top tier of the hierarchy and end up with relatively high GDP per capita. In short, position in global supply chains partly explains the regional income per capita disparities. Future research may be fruitful by adding two more dimensions, namely more economies and more years.

Besides, the impacts of two specific external shocks on regional disparity are studied. Despite the common feature that impacts are mainly confined within the own region, investment seems to be an effective tool for income generation. Hence, the regional development program is effective and beneficial and can be a feasible way to narrow regional disparity in the short run. For long-run, since economic structure is found to be crucial for per capita income differences, upgrading

of production structures (to gain the ability to participate in foreign export) need to be added to narrow regional income disparities.

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APPENDIX A: REGIONAL DELIMITATION OF CHINA

Code	Region	Provinces included
NE	Northeast	Heilongjiang, Jilin, Liaoning
NM	Northern Municipalities	Beijing and Tianjin
NC	North Coast	Hebei and Shandong
EC	East Coast	Shanghai, Jiangsu, Zhejiang
SC	South Coast	Guangdong, Fujian, Hainan
CR	Central Regions	Shanxi, Henan, Hubei, Hunan, Anhui, Jiangxi
NW	Northwest	Inner Mongolia, Shannxi, Ningxia, Gansu, Xinjiang
SW	Southwest	Sichuan, Chongqing, Yunnan, Guizhou, Guangxi, Qinghai, Tibet

APPENDIX B: SECTOR CLASSIFICATION OF CHINA

17-industry classification:		42-industry classification:	
01	Agriculture	01	Agriculture
02	Mining	02	Coal mining, washing and processing
		03	Crude petroleum and natural gas products
		04	Metal ore mining
		05	Non-ferrous mineral mining
03	Food products	06	Manufacture of food products and tobacco processing
04	Textile and wearing apparel	07	Textile goods
		08	Wearing apparel, leather, furs, down and related products
05	Wooden products	09	Sawmills and furniture
06	Paper and printing	10	Paper and products, printing and record medium reproduction
07	Chemical products	11	Petroleum processing, coking and nuclear fuel processing
		12	Chemicals
08	Non-metallic mineral products	13	Non-metal mineral products
09	Metal products	14	Metals smelting and pressing
		15	Metal products
10	Machinery	16	Common and special equipment
11	Transport equipment	17	Transport equipment
12	Electronic products	18	Electric equipment and machinery
		19	Telecommunication equipment, computer and other electronic equipment
13	Other manufacturing products	20	Instruments, meters, cultural and office machinery
		21	Other manufacturing products
		22	Scrap and waste
14	Electricity, gas and water supply	23	Electricity and heating power production and supply
		24	Gas production and supply

		25	Water production and supply
15	Construction	26	Construction
16	Trade and transport	27	Transport and warehousing
		30	Wholesale and retail trade
17	Services	28	Post
		29	Information communication, computer service and software
		31	Accommodation, eating and drinking places
		32	Finance and insurance
		33	Real estate
		34	Renting and commercial service
		35	Tourism
		36	Scientific research
		37	General technical services
		38	Other social services
		39	Education
		40	Health service, social guarantee and social welfare
		41	Culture, sports and amusements
		42	Public management and social administration

Fig. 1. *Layout of China's interregional input-output table**

	Intermediate deliveries				Domestic final use			Export	Import	TO
	$\tilde{\mathbf{Z}}^{11}$	$\mathbf{Z}^{12}$	$\cdots$	$\mathbf{Z}^{1R}$	$\tilde{\mathbf{F}}^{11}$	$\cdots$	$\mathbf{F}^{1R}$	$\mathbf{e}^{1}$	$-\mathbf{m}^{1}$	$\mathbf{x}^{1}$
	$\mathbf{Z}^{21}$	$\tilde{\mathbf{Z}}^{22}$	$\cdots$	$\mathbf{Z}^{2R}$	$\mathbf{F}^{21}$	$\cdots$	$\mathbf{F}^{2R}$	$\mathbf{e}^{2}$	$-\mathbf{m}^{2}$	$\mathbf{x}^{2}$
	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$
	$\mathbf{Z}^{R1}$	$\mathbf{Z}^{R2}$	$\cdots$	$\tilde{\mathbf{Z}}^{RR}$	$\mathbf{F}^{R1}$	$\cdots$	$\tilde{\mathbf{F}}^{RR}$	$\mathbf{e}^{R}$	$-\mathbf{m}^{R}$	$\mathbf{x}^{R}$
VA	$(\mathbf{v}^{1})'$	$(\mathbf{v}^{2})'$	$\cdots$	$(\mathbf{v}^{R})'$	$\mathbf{0}$	$\cdots$	$\mathbf{0}$	$\mathbf{0}$	$\mathbf{0}$	v
TI	$(\mathbf{x}^{1})'$	$(\mathbf{x}^{2})'$	$\cdots$	$(\mathbf{x}^{R})'$	$(\mathbf{f}^{1})'$	$\cdots$	$(\mathbf{f}^{R})'$	e	$-m$	

*: TO = total output; VA = value added; TI = total input.

Fig. 2. *Layout of China's IRIO table with imports being split-up**

	Intermediate deliveries				Domestic final use			Export	TO
	$\mathbf{Z}^{11}$	$\mathbf{Z}^{12}$	$\cdots$	$\mathbf{Z}^{1R}$	$\mathbf{F}^{11}$	$\cdots$	$\mathbf{F}^{1R}$	$\mathbf{e}^{1}$	$\mathbf{x}^{1}$
	$\mathbf{Z}^{21}$	$\mathbf{Z}^{22}$	$\cdots$	$\mathbf{Z}^{2R}$	$\mathbf{F}^{21}$	$\cdots$	$\mathbf{F}^{2R}$	$\mathbf{e}^{2}$	$\mathbf{x}^{2}$
	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$	$\cdots$
	$\mathbf{Z}^{R1}$	$\mathbf{Z}^{R2}$	$\cdots$	$\mathbf{Z}^{RR}$	$\mathbf{F}^{R1}$	$\cdots$	$\mathbf{F}^{RR}$	$\mathbf{e}^{R}$	$\mathbf{x}^{R}$
IM	$\hat{\mathbf{t}}^{1}\tilde{\mathbf{Z}}^{11}$	$\hat{\mathbf{t}}^{2}\tilde{\mathbf{Z}}^{22}$	$\cdots$	$\hat{\mathbf{t}}^{R}\tilde{\mathbf{Z}}^{RR}$	$\hat{\mathbf{t}}^{1}\tilde{\mathbf{F}}^{11}$	$\cdots$	$\hat{\mathbf{t}}^{R}\tilde{\mathbf{F}}^{RR}$	$\mathbf{0}$	m
VA	$(\mathbf{v}^{1})'$	$(\mathbf{v}^{2})'$	$\cdots$	$(\mathbf{v}^{R})'$	$\mathbf{0}$	$\cdots$	$\mathbf{0}$	$\mathbf{0}$	v
TI	$(\mathbf{x}^{1})'$	$(\mathbf{x}^{2})'$	$\cdots$	$(\mathbf{x}^{R})'$	$(\mathbf{f}^{1})'$	$\cdots$	$(\mathbf{f}^{R})'$	e	

* TO = total output; IM = import; VA = value added; TI = total input. A hat indicates diagonalization.

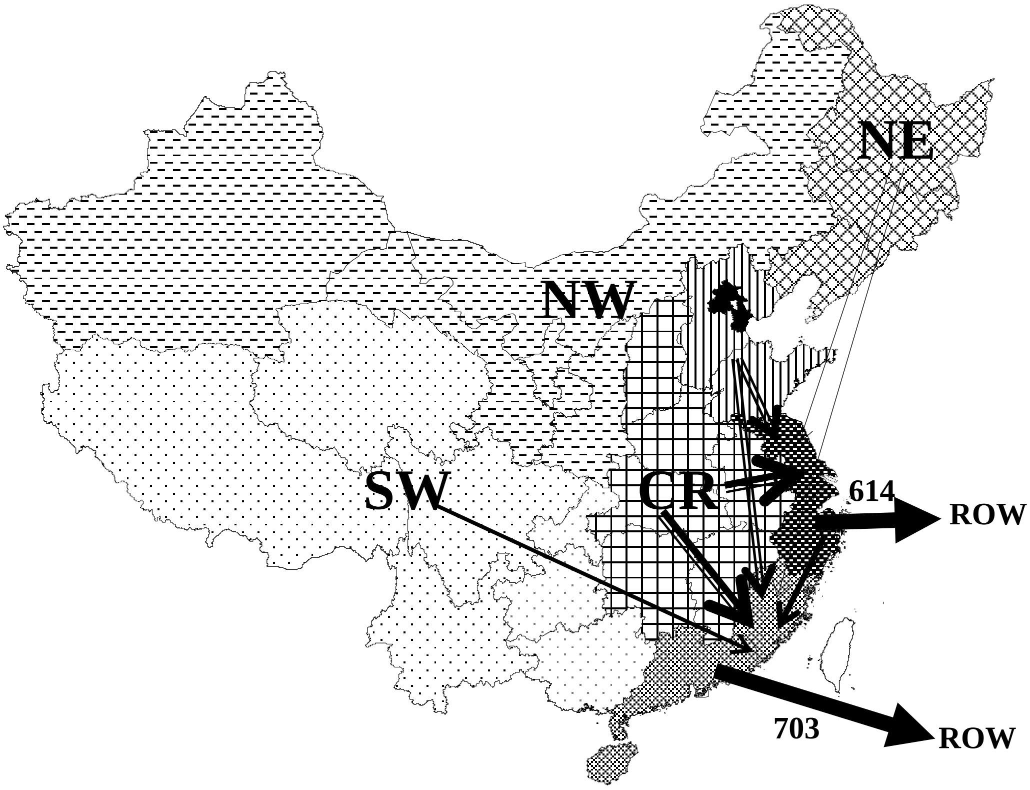

Fig. 3. *2002 China's regional hierarchies in the global supply chain and interregional interdependencies, absolute values (billion RMB)*

*Table 1. 31 Provincial GDP per capita, series disparities, and trends for 1995-2010**

Year	Mean	Mean/Median	S.d./Mean	Max/Min	σ	σ*
1995	1.82	1.29	0.57	7.94	0.20	0.17
1996	2.37	1.32	0.57	8.67	0.20	0.17
1997	2.92	1.32	0.59	9.23	0.20	0.17
1998	3.42	1.37	0.62	9.77	0.21	0.18
1999	3.94	1.37	0.65	10.12	0.22	0.19
2000	4.61	1.31	0.61	8.93	0.21	0.19
2001	5.61	1.39	0.64	10.11	0.22	0.20
2002	7.16	1.51	0.71	10.47	0.23	0.23
2003	9.17	1.38	0.71	10.40	0.23	0.23
2004	12.35	1.39	0.71	10.83	0.24	0.23
2005	16.13	1.41	0.67	9.71	0.23	0.22
2006	21.38	1.37	0.66	9.35	0.23	0.21
2007	29.15	1.37	0.64	8.79	0.23	0.21
2008	38.65	1.29	0.60	7.84	0.22	0.20
2009	46.21	1.32	0.56	6.20	0.21	0.18
2010	61.66	1.27	0.52	6.26	0.20	0.17

* The mean is measured in thousand RMB per head, in 2005 constant prices; s.d. = standard deviation; σ, defined in footnote 2, relates to 31 provinces, whereas the similarly defined σ* relates to eight regions.

Source: Authors' calculation based on various years of *China Statistics Yearbook*.

*Table 2. 2002 Location quotients for value added * 100% and disparity measures**

	NE	NM	NC	EC	SC	CR	NW	SW	Natio. Sh.%	Natio. Prod.
Industry	Location Quotients (= regional VA share/national VA share)									
1	0.94	0.22	1.10	0.61	0.75	1.37	1.32	1.56	13.65	4.51
2	2.60	0.66	1.38	0.15	0.51	1.16	1.94	0.68	4.90	38.30
3	0.85	0.48	1.86	0.66	0.66	1.07	0.52	1.56	3.69	41.06
4	0.40	0.42	1.07	2.12	1.26	0.70	0.30	0.21	3.17	24.57
5	1.19	0.27	0.55	0.73	2.09	1.27	0.27	0.60	0.88	32.53
6	0.52	0.70	1.25	1.10	1.65	0.83	0.50	0.74	1.95	32.86
7	1.16	0.92	1.21	1.34	0.94	0.80	0.67	0.63	5.63	40.41
8	0.14	0.39	1.42	0.77	0.76	1.69	0.89	1.13	1.57	22.03
9	1.15	0.64	1.09	1.08	0.77	1.11	0.92	0.96	4.24	44.33
10	1.08	0.66	1.44	1.43	0.68	0.96	0.50	0.56	2.99	36.74
11	1.53	0.68	0.66	1.34	0.65	0.99	0.63	1.25	2.08	41.60
12	0.49	1.74	0.44	1.62	2.25	0.39	0.30	0.37	3.65	47.90
13	0.67	0.84	0.82	1.40	1.45	0.98	0.48	0.55	1.52	47.86
14	1.14	0.54	0.80	0.97	0.99	1.07	1.33	1.13	3.55	76.93
15	0.94	1.02	0.89	0.89	0.74	1.09	1.59	1.27	5.41	20.01
16	1.08	0.92	0.88	1.03	1.18	0.95	0.92	0.95	13.22	18.43
17	0.85	1.79	0.85	1.03	1.05	0.89	1.05	0.99	27.92	27.54
RSC%	12.47	24.91	10.66	12.08	11.97	8.53	14.64	12.38		***16.5***[a]
Area%	8.37	0.29	3.59	2.18	3.48	10.64	37.03	34.41		
Pop. den.	133	864	456	648	361	351	31	77	***133***[a]	
GDP/cap.	10.68	26.67	10.30	17.84	15.33	6.29	6.67	5.20	***9.46***[a]	

* "Natio. Sh.%" gives the value added per industry as a % of the national total; "Natio. Prod." gives the national value added per worker, measured in thousand RMB per employment year. RSC stands for the *regional specialization coefficient* (see Hoen & Oosterhaven, 2006). Area% give the regional surface as a % of the national total. Pop. den. gives the number of inhabitants per square kilometre. GDP per capita is given in thousand RMB per inhabitant. The three figures with ***a*** give the national averages of productivity (16.53 thousand RMB per employment*year), of population density in 2002 (133 people per square kilometre), and of GDP per capita in 2002 (9.46 thousand RMB).

Sources: China's 2002 updated IRIO table (this paper) and China's 2002 Statistics Yearbook.

Table 3. 2002 Regional value added due to domestic final demand: aggregate

		NE	NM	NC	EC	SC	CR	NW	SW
Value Added		994	427	1449	1724	1150	2144	709	1213
% of total VA		85	67	87	71	61	92	92	94
Direct (% VA)	RHC	5.71	1.95	7.06	5.88	6.54	9.14	6.00	10.35
	UHC	17.51	16.94	11.64	14.96	19.51	14.30	16.85	12.97
	GC	9.72	9.47	8.63	8.79	11.33	9.02	11.22	10.55
	GFK	9.38	9.35	9.96	10.31	9.11	9.34	12.57	9.63
	CI	-0.10	1.06	0.39	0.83	1.68	0.19	0.08	0.45
subtotal		**42.22**	**38.78**	**37.69**	**40.77**	**48.18**	**41.99**	**46.73**	**43.96**
Indirect (% VA)	RHC	4.57	1.82	5.61	3.99	3.34	6.25	3.70	6.41
	UHC	14.58	14.90	10.08	10.75	10.47	11.33	10.57	9.35
	GC	6.71	7.63	4.48	4.52	5.08	4.83	4.90	6.50
	GFK	15.94	15.56	15.70	15.22	9.77	15.17	15.16	21.34
	CI	0.08	1.64	0.15	1.06	1.17	-0.28	0.32	0.49
subtotal		**41.89**	**41.55**	**36.01**	**35.53**	**29.83**	**37.31**	**34.64**	**44.08**
Spillovers *from domestic final use in* (% VA):	NE	--	2.03	2.81	1.81	1.46	1.39	1.44	0.51
	NM	0.75	--	1.85	0.49	0.39	0.73	0.82	0.16
	NC	4.72	5.14	--	4.97	2.23	2.99	2.81	0.87
	EC	3.16	3.15	6.44	--	6.00	5.78	3.05	2.11
	SC	1.45	2.15	3.08	4.48	--	4.43	1.87	3.54
	CR	2.73	3.56	7.09	7.44	5.85	--	5.55	2.86
	NW	1.97	2.46	2.78	2.21	1.94	2.53	--	1.91
	SW	1.11	1.18	2.24	2.29	4.12	2.85	3.10	--
subtotal		**12.68**	**15.89**	**19.67**	**26.30**	**23.70**	**21.99**	**20.70**	**18.63**

Note: Value added is in billion RMB, which is generated by production for domestic final use for each region. The effects, including direct effect (equation (6.1)), indirect effect (formula (6.2)), and seven spillovers from domestic final use in other regions (subtotals of equation (6.3) for each single region), are percentage contributions which add to 100%. RHC, UHC, GC, GFK, and CI stand for, respectively, rural household consumption, urban household consumption, government consumption, gross fixed capital formation, and changes in inventories.

Table 4. 2002 Regional value added due to foreign exports: aggregate

	Value Added	% of total VA	Direct (% VA)	Indirect (% VA)	Spillovers *from exports of* (% VA): NE	NM	NC	EC	SC	CR	NW	SW
NE	176	15	39	41	-	1.10	3.56	8.02	6.04	0.74	0.46	0.26
NM	207	33	41	47	0.89	-	1.47	3.80	4.46	0.44	0.31	0.14
NC	225	13	30	34	2.19	2.86	-	16.17	11.70	1.95	0.72	0.54
EC	690	29	41	48	0.66	0.37	1.18	-	7.64	0.73	0.22	0.23
SC	743	39	57	38	0.32	0.18	0.34	3.77	-	0.35	0.11	0.23
CR	199	8	20	23	1.90	2.11	3.54	23.28	23.98	-	1.08	1.10
NW	58	8	29	28	2.44	2.70	4.43	14.85	14.51	3.52	-	1.46
SW	79	6	25	27	1.04	0.70	1.45	11.52	30.02	1.68	0.98	-

Note: Value added is in billion RMB, which is generated by production for foreign export. The effects, including direct effect (formula 5.1), indirect effect (formula 5.2), and seven spillovers from foreign exports in other regions (formula 5.3), are percentage contributions which add to 100%.

Table 5. Net spillover from each region due to foreign export, 2002

	Value added generation by local foreign export (billion RMB)	Net spillover *from* (billion RMB): NE	NM	NC	EC	SC	CR	NW	SW
NE	140	-	0.1	1.3	***9.6***	***8.3***	-2.5	-0.6	-0.4
NM	183	-0.1	-	-3.4	5.3	7.9	-3.3	-0.9	-0.3
NC	144	-1.3	3.4	-	***28.2***	***23.8***	-2.6	-1.0	0.1
EC	614	-9.6	-5.3	-28.2	-	***24.7***	-41.3	-7.1	-7.5
SC	703	-8.3	-7.9	-23.8	-24.7	-	-45.1	-7.6	-21.9
CR	86	2.5	3.3	2.6	***41.3***	***45.1***	-	0.1	0.9
NW	33	0.6	0.9	1.0	7.1	7.6	-0.1	-	0.1
SW	41	0.4	0.3	-0.1	7.5	***21.9***	-0.9	-0.1	-
	Total	**-15.9**	**-5.3**	**-50.5**	**74.3**	**139.3**	**-95.7**	**-17.2**	**-29.0**

Notes: 1. All figures in the table are absolute values (in 2002 billion RMB).

2. A positive entry indicates a net spillover from the region in a row to the region in a column; while negative entries indicate the opposite.

3. The thickness of the lines represents the strength of net spillovers (only those with absolute values more than 8.3 billion RMB are shown in the Figure 3).

*Table 6. 2002 Regional value added due to foreign exports: by industry**

Industry	Value Added	Direct (% VA)	Indirect (% VA)	Spillovers *from exports of* (% VA): NE	NM	NC	EC	SC	CR	NW	SW
NE (includes 68.5% of total VA generated by foreign exports)											
2	39	21	34	-	1.51	8.40	18.82	13.87	1.40	0.65	0.45
16	31	49	40	-	0.92	1.69	4.24	3.03	0.46	0.37	0.18
17	19	50	43	-	0.48	1.19	2.76	2.09	0.28	0.20	0.10
7	18	39	38	-	1.13	4.74	7.79	7.70	1.06	0.57	0.42
1	14	40	51	-	0.79	1.65	2.82	2.22	0.34	0.24	0.14
NM (includes 80.3% of total VA generated by foreign exports)											
17	95	27	65	0.59	-	0.97	2.56	2.98	0.29	0.21	0.10
16	30	52	38	0.86	-	1.46	3.49	3.56	0.39	0.30	0.13
12	23	70	21	0.98	-	0.82	2.15	5.15	0.34	0.13	0.09
7	11	17	47	1.99	-	3.49	11.67	16.17	1.32	1.28	0.51
2	8	37	28	2.78	-	4.05	12.63	12.43	1.55	0.67	0.39
NC (includes 60.1% of total VA generated by foreign exports)											
16	35	37	31	2.14	2.56	-	14.02	9.40	1.77	0.76	0.51
1	29	25	50	1.73	1.91	-	10.95	7.92	1.45	0.63	0.41
2	25	15	25	3.42	4.27	-	27.84	19.85	2.95	0.72	0.77
17	24	32	44	1.48	1.86	-	10.74	7.95	1.32	0.49	0.37
7	23	14	33	2.91	2.98	-	22.15	20.72	3.17	1.08	0.91

Table 6. 2002 Regional value added generation by foreign export: by industry (*cont.*)

Industry	Value Added	Direct (% VA)	Indirect (% VA)	Spillovers *from exports of* (% VA): NE	NM	NC	EC	SC	CR	NW	SW
EC (includes 67.6% of total VA generated by foreign exports)											
16	126	46	45	0.63	0.36	1.24	-	5.82	0.66	0.22	0.21
17	109	34	59	0.43	0.24	0.76	-	4.84	0.47	0.14	0.15
4	102	57	39	0.20	0.11	0.31	-	3.13	0.33	0.14	0.10
7	68	21	53	1.13	0.62	1.75	-	20.12	1.46	0.37	0.53
12	61	53	34	0.80	0.59	0.92	-	10.24	0.74	0.17	0.18
SC (includes 68.5% of total VA generated by foreign exports)											
16	157	58	38	0.28	0.15	0.31	3.06	-	0.27	0.11	0.19
17	135	36	61	0.19	0.11	0.19	2.20	-	0.21	0.07	0.14
12	106	82	14	0.42	0.29	0.23	2.50	-	0.34	0.09	0.18
4	63	82	16	0.08	0.05	0.10	2.11	-	0.13	0.06	0.11
7	47	50	36	0.54	0.35	0.80	9.90	-	0.92	0.23	0.80
CR (includes 58.5% of total VA generated by foreign exports)											
16	34	27	22	2.04	1.89	3.75	21.43	20.12	-	1.23	1.13
1	22	10	42	1.55	1.36	3.51	16.39	22.50	-	1.04	1.00
2	22	7	14	3.08	2.47	4.10	36.27	30.38	-	1.15	1.25
17	21	25	33	1.45	1.48	2.58	17.31	17.40	-	0.82	0.81
7	17	10	17	1.84	1.65	4.13	26.39	36.61	-	1.08	1.63
NW (includes 68.6% of total VA generated by foreign exports)											
2	11	9	19	4.57	4.03	4.36	24.79	25.36	5.88	-	2.16
16	8	35	25	2.06	2.65	9.47	12.11	10.28	2.52	-	1.13
1	8	12	63	1.56	2.22	2.83	6.91	9.05	1.51	-	1.13
17	7	33	38	1.59	1.78	3.12	9.79	9.60	2.32	-	0.97
9	5	26	8	2.49	4.05	5.06	27.11	19.26	6.73	-	1.20
SW (includes 64.1% of total VA generated by foreign exports)											
16	19	29	21	0.90	0.60	1.19	9.16	35.96	1.39	0.88	-
17	11	23	41	0.77	0.52	1.06	8.58	23.42	1.25	0.74	-
9	9	20	16	1.46	0.92	2.00	21.31	35.98	1.91	0.86	-
7	6	18	23	0.97	0.74	1.65	12.66	39.84	1.85	1.15	-
2	6	8	24	1.79	1.00	2.21	21.04	38.14	2.78	1.16	-

* The absolute value added in column two is in billion RMB in 2002 prices. The effects are decomposed into direct effects (formula 5.1), indirect effect (formula 5.2), and seven spillovers from foreign exports in other regions (formula 5.3), which add up to 100%.

*Table 7. Scenarios analysis: exports and investments changes of one trillion RMB**

	Total VA Change	Within-region Direct	Within-region Indirect	Interregional spillover effects *on*: NE	NM	NC	EC	SC	CR	NW	SW
Aggregate impact per scenario											
EC	-1103	-412	-474	-20	-11	-52	-	-40	-67	-12	-13
SC	-1156	-552	-371	-14	-12	-34	-69	-	-62	-11	-31
CR	1027	313	503	16	11	51	58	30	-	28	18
NW	1208	405	478	32	23	59	55	32	88	-	36
SW	1014	269	587	9	5	23	28	29	45	19	-
EC exports by industry (includes 63.2% of the total VA change due to this scenario)											
16	-197	-84	-81	-1.9	-1.5	-7.1	-	-6.9	-10.4	-1.5	-2.5
17	-167	-54	-93	-0.8	-3.5	-3.7	-	-4.3	-5.3	-1.0	-1.3
4	-150	-83	-57	-0.2	-0.2	-3.6	-	-1.9	-3.2	-0.1	-0.1
7	-99	-21	-52	-2.0	-1.8	-7.3	-	-6.8	-6.6	-1.0	-1.1
12	-84	-46	-30	-0.3	-0.7	-0.8	-	-3.8	-1.9	-0.2	-0.2
SC exports (includes 65.7% of the total VA change due to this scenario)											
16	-233	-119	-78	-1.2	-1.4	-4.3	-9.6	-	-8.9	-1.1	-8.9
17	-194	-64	-107	-0.5	-3.7	-2.5	-6.9	-	-4.9	-0.9	-3.2
12	-150	-114	-19	-0.4	-1.5	-1.0	-8.2	-	-4.1	-0.3	-0.8
7	-95	-31	-22	-1.8	-2.3	-6.2	-17.9	-	-8.4	-1.2	-3.2
4	-89	-67	-13	-0.1	-0.1	-1.6	-4.2	-	-1.9	-0.1	-0.2
CR investments (includes 57.7% of the total VA change due to this scenario)											
15	190	188	1	0.0	0.0	0.1	0.1	0.1	-	0.0	0.1
16	133	18	84	1.8	1.5	7.3	9.6	5.0	-	2.9	3.4
17	102	3	78	0.7	3.4	3.8	6.0	3.2	-	2.3	1.8
9	86	3	53	1.8	1.0	6.3	7.7	2.6	-	6.8	3.1
10	81	44	23	0.6	0.4	3.8	6.1	1.2	-	0.7	0.7
NW investments (includes 65.1% of the total VA change due to this scenario)											
15	257	254	3	0.0	0.0	0.1	0.1	0.1	0.2	-	0.2
16	201	35	101	5.1	3.8	11.5	11.2	7.4	18.7	-	7.9
17	149	19	96	1.6	7.3	4.7	5.8	3.5	7.5	-	3.6
2	97	0	60	9.1	1.5	7.5	0.8	2.7	11.2	-	4.9
1	81	31	38	0.7	0.1	3.2	1.3	1.1	4.0	-	1.1
SW investments (includes 72.1% of the total VA change due to this scenario)											
1	316	9	282	0.9	0.3	3.8	2.1	3.2	10.0	4.8	-
15	182	180	2	0.0	0.0	0.0	0.1	0.1	0.1	0.0	-
16	104	20	61	1.0	0.7	3.1	4.4	4.8	6.6	1.7	-
17	74	3	57	0.4	1.6	1.5	2.8	3.0	3.2	1.4	-
9	54	3	38	0.8	0.3	2.2	3.1	1.6	3.9	1.5	-

* All are hypothetical values in billion RMB, respectively, generated by exports (1 trillion RMB decrease in EC and SC) and by investments (1 trillion RMB directs to either CR, or NW, or SW). These are changes due to short-run demand shock.