CHAPTER 5

China’s Rise as An Export Giant and Regional Inequality: A Value Chain Analysis

5.1 Introduction

In recent years, two of the most salient phenomena in the global economy have been a rapid increase in global interconnectedness and a significant rise in income inequality (Antrás et al., 2017). Decreases in trade and communications costs have allowed firms to split production processes into geographically distinct activities. Consequently, national and regional economies have specialized in those particular stages of production in which they have a comparative advantage. So-called global value chains (GVCs) emerged. By now, several studies have quantified characteristics of GVCs and the roles countries play in these (e.g., Johnson and Noguera, 2012; Koopman et al., 2014; Los et al., 2015a; Timmer et al., 2014). These studies generally found substantial changes in the extent to which countries contributed to GVCs. In a different strand of literature, authors also have studied the impact of globalization on income distribution within countries (Feenstra and Hanson, 1996; Marchand, 2012; Wan et al., 2007), reflecting the long-standing interest in income inequality among economists and policymakers. By combining value chains and inequality considerations, this chapter investigates the effect of globalization on regional labor income inequality in China from a value chain perspective. In this respect, China is an interesting case, given its emergence as the “World’s Factory” (massively attracting production activities in GVCs after its accession to the World Trade Organization in 2001) and its high levels of regional income inequality.

China’s economic integration with the world has been accompanied by growing regional inequality, with coastal regions developing much faster than inland regions (Kanbur and Zhang, 2005; Tsui, 2007). Exports have always been regarded as an important contributor to inequality; however, after decades of increases, China’s regional inequality in terms of gross domestic product (GDP) per capita has decreased
recently (Li and Gibson, 2013; Xie and Zhou, 2014). The ratio of GDP per capita of the wealthiest province and the poorest province decreased from 8.5 in 2000 to 4.5 in 2018.\(^1\) It seems that China has entered an era of convergence in regional development. This development raises the question of how exports have affected regional inequality in the era of decreasing inequality. Several—somewhat older—studies have focused on this issue and found a significant positive relationship between globalization and regional inequality in China (Fujita and Hu, 2001; Kanbur and Zhang, 2005; Li and Wei, 2010; Wan et al., 2007; Zhang and Zhang, 2003). However, they ignored the indirect income effects of exports on inland regions, which provide materials and components to the production of the exports in the coastal regions.

The recent convergence in regional development also questions how different types of exports have contributed to China’s regional inequality. There are two prevalent types in China: processing exports and ordinary exports, each of which comprised about half of the country’s total exports until a few years ago.\(^2\) These two types of export products use substantially different input mixes; processing exports require far more imported intermediate inputs than ordinary exports, and ordinary exports have stronger domestic backward linkages (Pei et al., 2012). Accordingly, processing exports tend to generate considerably less domestic value added than the same amount of ordinary exports (Chen et al., 2012; Koopman et al., 2012; Pei et al., 2012). The two types of exports thus likely exert different impacts on China’s regional growth and income disparities.

Against this background, this chapter aims to quantify the contributions of different export types to China’s regional inequality by taking “indirect income effects” into full consideration. To this end, we introduce a new framework to disentangle the major forces that shape China’s regional inequality. We quantify the contributions of both processing exports and ordinary exports to regional inequality and examine temporal changes using a value chain perspective.\(^3\) This perspective implies an

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\(^1\) These provincial gross regional product (GRP) per capita levels were reported by the Chinese National Bureau of Statistics (NBS) and are expressed in current prices. In 2000, Beijing and Guizhou were the wealthiest province and the poorest province, respectively. Beijing and Gansu ranked as such in 2018.

\(^2\) Processing trade refers to the business activities of importing all or some materials abroad, and then re-exporting the finished products after processing or assembly in China. Since the 1990s, processing exports have comprised about half of China’s total exports, but this share has decreased steadily in recent years, to 33.5% in 2017.

\(^3\) This chapter is related to the literature on value chains and Chinese regions, which relies on interregional input–output (IRIO) tables. Pei et al. (2017), for example, investigated interregional income effects across regions and
accounting approach, rather than a (regression) approach that would try to identify causal relationships between income inequality and underlying factors. Our value chain approach considers the Chinese (domestic) parts of GVCs. The value of a particular final product (consumer products or capital goods) used in China or a particular exported product (either an intermediate input used by sectors abroad or a final product) equals the sum of the costs of imported products required in the Chinese stages of production and value added contributed by sectors in each of the Chinese regions. Consequently, the sum of these contributions by a region to domestic parts of all GVCs constitutes its gross regional product (GRP). We use Shorrocks’s (1982) decomposition method to quantify the contributions to regional inequality of value chain activities for domestically used final products and for exported products, respectively. Our use of recently developed interregional input-output tables for China, which explicitly distinguish between production of processing exports and that of ordinary exports in each region (the so-called IRIOP tables, see Duan et al., 2019, and Table 4.2) allows for a rich analysis of the impact of China’s exports dependence (and changes therein) on regional inequality.

The remainder of this chapter is structured as follows: In Section 5.2, we summarize the nature of China’s regional inequality to motivate the subsequent empirical exercise. In Section 5.3, we introduce the framework that decomposes overall regional inequality into the contributions of activities in the three types of value chains that we consider. In Section 5.4, we discuss the data. Section 5.5 presents our empirical results, and Section 5.6 concludes.

5.2 China’s regional income inequality

This section contains a brief descriptive overview of China’s regional income, the distribution of export activities and the changes in China’s regional income inequality.
It provides some first insights into China’s regional economic development.

5.2.1 China’s regional income and export activities

Table 5.1 documents descriptive statistics on exports and per capita income by region for 2002 and 2012. For each of these years, the first two columns depict regional labor income per capita and GRP per capita (LPC and GPC), while the third and fourth columns list regional processing exports and ordinary exports per capita (PPC and OPC) for the eight regions.\(^4\) The regional exports, the labor income, and GRP data come from the IRIOP tables (Duan et al., 2019). The population data are from NBS (2003, 2013) and include only those persons actually living in each region, taking interregional labor migration into consideration.

<table>
<thead>
<tr>
<th></th>
<th>LPC (1)</th>
<th>GPC (2)</th>
<th>PPC (3)</th>
<th>OPC (4)</th>
<th>LPC (5)</th>
<th>GPC (6)</th>
<th>PPC (7)</th>
<th>OPC (8)</th>
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<td>42.7</td>
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<td>41.6</td>
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<td>5.4</td>
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<td>2.5</td>
<td>4.4</td>
<td>29.4</td>
<td>64.5</td>
<td>12.1</td>
<td>18.1</td>
</tr>
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<td>SC</td>
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<td>15.5</td>
<td>7.1</td>
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<td>36.4</td>
<td>0.2</td>
<td>2.3</td>
</tr>
<tr>
<td>SW</td>
<td>2.9</td>
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<td>0.1</td>
<td>0.2</td>
<td>13.7</td>
<td>25.8</td>
<td>0.4</td>
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</tr>
<tr>
<td>National</td>
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<td>9.6</td>
<td>1.2</td>
<td>1.3</td>
<td>19.9</td>
<td>39.8</td>
<td>4.0</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019). LPC = labor income per capita, GPC = GRP per capita, PPC=Processing exports per capita, OPC=Ordinary exports per capita. NE=North East; NM=North Municipality; NC=North Coast; EC=East Coast; SC=South Coast; CR=Central Region; NW=North West; SW=South West.

Table 5.1 shows a large heterogeneity in income per capita across regions. The North Municipality, which includes the national capital Beijing, is the wealthiest region.

\(^4\) The eight regions analyzed here are those that can be analyzed by means of the IRIOP tables. See Appendix 4.2 for the regional classifications.
in terms of per capita labor income (LPC), whereas the South West is the poorest. In both 2002 and 2012, LPC in the wealthiest region was more than three times as high as that of the poorest region. More generally speaking, GDP per capita (GPC) and LPC are much larger in the coastal regions (i.e., North Municipality, North Coast, East Coast, and South Coast) than in the inland regions (i.e., North East, Central Region, North West, and South West).

The processing exports and ordinary exports per capita also reveal sizable regional inequalities, especially for processing exports; exports were more concentrated in North Municipality, the East Coast, and South Coast. In contrast, exports from the inland regions were extremely low; in 2012 for example, processing export per capita in North West was 200 RMB, only 5% of the national average.

From 2002 to 2012, labor income per capita grew quickly in all regions, with the national average increasing from 4.6 thousand RMB to 19.9 thousand RMB, at a nominal annual growth rate of 15.8%. This increase was quite rapid for a large country like China; in contrast, the growth rate of the U.S. was only 2.4% during this period.\(^5\) The growth rates varied across China’s regions, however, ranging from a high of 18.1% in the North West to a low of 12.3% in the South Coast. In general, the inland regions show higher growth rates than the coastal regions, suggesting a decline in regional income inequality. Further, more rapid export growth in the inland regions suggests an important role of exports in this declining income inequality. We further investigate the changes in China’s regional income inequality over time in a more formal way in the next sub-section.

5.2.2 China’s regional income inequality

5.2.2.1 Regional inequality measures

The existing literature uses various mathematical measures to quantify inequality. Bourguignon (1979) and Shorrocks (1982) agreed on a set of simple principles that

\(^5\) The growth rate for the U.S. is calculated by using data from the World Input-Output Database (Timmer et al., 2015), which provides the labor compensation for around 40 countries over the period 2000-2014. Population data of the U.S. come from the World Development Indicators. The U.S. growth rate is also in nominal terms.
define a sound inequality index. The Theil (1967) index follows these principles; it is one of the most popular measures because of its attractive decomposition property. This index measures the entropic distance between the actual distribution of income over regions and the state in which every region would have the same per capita income. A high (low) value represents a large (small) deviation from an equal distribution, which indicates a high (low) degree of inequality. Therefore, to measure regional inequality, we resort to a population-weighted version of the Theil index, expressed mathematically as:

\[ I = \sum_r p_r \frac{y_r}{\bar{y}} \ln \left( \frac{y_r}{\bar{y}} \right) = \sum_r \frac{v_r}{v} \ln \left( \frac{v_r}{p_r v} \right), \tag{5.1} \]

where \( p_r \) indicates the population share of region \( r \) in the national total; \( y_r \) and \( v_r \) indicates the income per capita and total income in region \( r \), respectively; and \( \bar{y} \) is the national average of the income per capita, calculated as \( \bar{y} = \sum_r p_r y_r \). \( v \) is the national income.

We classify the regions into two larger geographic entities, which we call “macro-regions”: the coastal macro-region and the inland macro-region. We then decompose the overall regional inequality into the contributions of inequality between regions within the coastal macro-region (\( I_c \)), inequality between regions within the inland macro-region (\( I_i \)), and the inequality between the two macro-regions (\( I_b \)) (See Appendix 4.2 for the classification of regions into macro-regions):

\[ I = \sum_{r \in c} \frac{v_r}{v} \ln \left( \frac{v_r}{p_r v} \right) + \sum_{r \in i} \frac{v_r}{v} \ln \left( \frac{v_r}{p_r v} \right) \]

\[ = \frac{v_c}{v} \sum_{r \in c} \frac{v_r}{v_c} \ln \left( \frac{v_r}{p_cr v_c p_c v} \right) + \frac{v_i}{v} \sum_{r \in i} \frac{v_r}{v_i} \ln \left( \frac{v_r}{p_ir v_i p_i v} \right) \]

\[ = \frac{v_c}{v} I_c + \frac{v_i}{v} I_i + \frac{v}{v} \ln \left( \frac{v_c}{p_c r v_c} \right) + \frac{v}{v} \ln \left( \frac{v_i}{p_i r v_i} \right) = \frac{v_c}{v} I_c + \frac{v_i}{v} I_i + I_b; \tag{5.2} \]

where \( c \) denotes the coastal macro-region and \( i \) the inland macro-region; \( v_c \) and \( v_i \) are total income in the two macro-regions; \( p_{cr} \) and \( p_{ir} \) are the population share of a

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6 We focus on regional income variation and do not consider income inequality between persons or households within regions.
region \( r \) in the macro-region it is part of; finally, \( p_c \) and \( p_l \) are the population shares of the two macro-regions in total population, respectively. Then, \( v_c I_c /vI \), \( v_l I_l /vI \), and \( I_b /I \) provide the contributions of \( I_c \), \( I_l \), and \( I_b \) to overall regional inequality, respectively.

To measure the level of regional inequality, ideally regional household income should be used.\(^7\) Existing studies (Li and Gibson, 2013; Zhang and Zhang, 2003; Zhang and Zou, 2012) used the GRP (Gross Regional Product, the sum of value added levels over industries) per capita as a measure. This approximation suffers from a major drawback. The location at which value is added is not necessarily identical to the location to which the generated income eventually accrues. Value added includes both labor income and capital income.\(^8\) Sizable investment flows across regions frequently lead to parts of capital income of one region accruing as income to firms with headquarters in other regions or countries (Timmer et al., 2014, 2019; Ma et al., 2015). Duan et al. (2012) demonstrate that in 2007, about 40% of Chinese capital income induced by processing exports was actually generated by foreign-owned activities (see also Duan et al., 2018).

Since the aim of this chapter is to link regional income inequality to the production of exported products and the intermediate inputs required for these, considering household income would only have been possible if we would have had information about interregional and international flows of capital income. This information is not available. Hence, we use regional labor income inequality as an approximation of regional household income inequality. Labor income is defined as employment compensation as reported in the National Accounts and is a component of value added; it refers to the total of various forms of payment to employees for the productive activities they engage in, including all wages, bonuses, subsidies, and allowances in cash or in kind.\(^9\) The empirical consequences of exclusively looking at labor income are most probably limited in this context. Labor income is the main source of household income in Chinese regions. In 2007, about 69% of urban household income consisted

\(^7\) Household income includes four components by income source: wages and salaries, net business income, income from properties, and income from transfers.

\(^8\) Capital income is defined as a residual measure, by subtracting labor income from gross value added.

\(^9\) Employment compensation also includes medical expenses, transport subsidies, social insurance, and housing funds paid by employers.
of wages and salaries (NBS, 2008). For rural households, about 92% of income came from wages, salaries and household operations; such rural household operations consisted mainly of agriculture production, for which 95% of value added was counted as labor income (NBS, 2008). Accordingly, regional labor income constitutes very large parts of regional household income and is most likely a good proxy for it when considering regional income inequality.

5.2.2.2 The temporal changes of China’s regional income inequality

Based on the regional labor income data from NBS (various years), Figure 5.1 depicts China’s overall labor income inequality across the eight regions and its three components shown in Equation 5.2 from 2000 to 2016: (income weighted) inequality within the coastal macro-region \( (\nu_i I_c / \nu) \), (income weighted) inequality within the inland macro-region \( (\nu_i I_i / \nu) \), and inequality between the coastal macro-region and the inland macro-region \( (I_b) \).

Figure 5.1 indicates that labor income inequality across regions measured with a Theil index amounted to 0.032 in 2016. Inequality between the two macro-regions is the major source of China’s regional inequality, explaining about 80% of China’s total regional inequality in that year.

China’s regional inequality increased rapidly from 2000 to 2003, remained steady until 2006, and then started to decrease. This result is consistent with recent studies that demonstrate declining regional inequality in terms of GRP per capita (Li and Gibson, 2013). Inequality between the coastal and inland macro-regions shows a similar trend and has been the major source of China’s overall decreasing regional inequality from 2006 to 2016. About 72% of this total decrease was due to decreases in the declining inequality between the two macro-regions.\(^10\) The importance of the inland regions in exporting (as documented in Table 5.1) grew, while regional inequality declined. This leads us to our main research question: To what extent did changes in export levels and mixes contribute to the reduction of China’s regional

\(^{10}\) This share was calculated according to Equation 5.2. We divided changes in inequality between the two macro-regions by the change in overall regional inequality.
inequality?

**Figure 5.1 China’s regional inequality from 2000 to 2016, measured by Theil indexes**

![Graph showing the Theil indexes from 2000 to 2016](image)

Notes: Author’s calculation based on the labor income and population data from NBS (various years). The labor income levels have been deflated to 2002 Beijing prices using the method of Brandt and Holz (2006) (Section 5.4 explicitly describes the deflation procedure).

### 5.3 Methodology

In this section, we propose a new framework to account for the contribution of exports to regional inequality. Our methodology includes two parts. First, we decompose regional income into the contribution of each final product, using value chain analysis. Second, by regarding each final product as a source of labor income, we further decompose overall regional inequality into the contributions of each final product, using Shorrocks’s (1982) decomposition method.

#### 5.3.1 Tracing value chains

We begin by estimating regional labor income generated in Chinese parts of value chains for final products. For some of these final products, the last stage of production
takes place in China itself, whereas Chinese exports of intermediate products are
directly or indirectly used for the production of final products abroad.

We follow a decomposition technique originally introduced by Leontief (1936)
and popularized in multi-country settings by Johnson and Noguera (2012), Timmer et
al. (2014), and Los et al. (2015a), among others. We start by modeling the Chinese
economy as an input–output structure, according to the idea that the production of final
products requires primary inputs (labor and capital) and intermediate inputs, the
production of which in turn also requires primary and intermediate inputs. By
accounting for all intermediate inputs in each stage of production, Leontief (1936)
provided a mathematical model in which the value of any particular final product can
be decomposed into the values of all labor and capital employed in any stage of
production. Accordingly, the input–output model can be used to measure how each
final product contributes to the factor income of any given region. We apply Timmer
et al.’s (2014) approach to a case in which the input-output table does not contain data
for the global economy split into countries, but for the Chinese economy split into
regions.

5.3.1.1 Illustrative example: Labor income for textiles production in East Coast

To demonstrate our methodology, we start by discussing the value chain activities in
China to produce the ordinary exports of the textiles sector in the East Coast region.
We aim to calculate not only labor income in the final production stage in East Coast,
but also labor income in more upstream activities in other regions. The data used are
those contained in the IRIOP tables, which will be described in the next section,
alongside a formal discussion of the methodology. In 2002, every RMB of ordinary
textiles exports from East Coast generated 0.366 RMB of domestic (i.e., Chinese) labor
income (see Table 5.2). Labor income in East Coast itself accounted for as much as 84%
of this 0.366 RMB. This East Coast labor income included income earned by workers
in the textiles sector, but also in East Coast sectors that indirectly contribute to local
textile production.
Table 5.2 Labor income shares in the domestic stages of the production of ordinary exports of East Coast textiles (% of exports)

<table>
<thead>
<tr>
<th></th>
<th>DLI</th>
<th>NE</th>
<th>NM</th>
<th>NC</th>
<th>EC</th>
<th>SC</th>
<th>CR</th>
<th>NW</th>
<th>SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>36.6</td>
<td>0.2</td>
<td>0.3</td>
<td>1.2</td>
<td>30.6</td>
<td>0.9</td>
<td>2.5</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>2012</td>
<td>42.9</td>
<td>0.7</td>
<td>0.4</td>
<td>1.3</td>
<td>33.2</td>
<td>0.8</td>
<td>4.5</td>
<td>1.4</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Notes: Authors’ calculations with the IRIOP tables for 2002 and 2012 (Duan et al., 2019). DLI = Domestic labor income. The remaining share of value added (e.g. 63.4% in 2002) consists of capital income or taxes in China and the costs of imports. Since the IRIOP tables do not provide information on the global production structure, we have to assume that imports into China do not embody Chinese labor income.

The Chinese labor compensation share in an RMB of ordinary textiles exports grew from 0.366 RMB in 2002 to 0.429 RMB in 2012. The labor income share contributed by inland regions grew faster than the share of East Coast and other coastal regions. For example, the labor income in the Central Region amounted to 2.5% of the value of the exports considered in 2002, increasing to 4.5% in 2012.

However, this specific value chain may be not representative of the income generation due to exports at the macroeconomic level. In the next section, we use our accounting framework to analyze labor income patterns for all product groups from all regions taken together.

5.3.1.2 Analyzing the Chinese part of GVCs

In this sub-section, we will explicitly describe the methodology to quantify the role of exports in the generation of regional income. An IRIOP table is a special interregional input-output table that divides a national economy into several regional sectors and each regional sector into two production types: production of processing exports and other production (including the production of ordinary exports). Appendix 5.1 outlines the schematic framework of the IRIOP table for a two-region case.

In this system, output in each sector in each region is produced using local production factors and intermediate inputs, which can be sourced from local markets, other domestic regions, or foreign countries. Output can satisfy final demands, be used as intermediate inputs in various regions, or be sold to other countries. In an economy
with $m$ regions and $n$ sectors, the product market clearing condition can be written as:

$$x_{(i,r)} = \sum_{s=1}^{m} \sum_{j=1}^{n} z_{(i,r)(j,s)} + \sum_{s=1}^{m} d_{(i,r)(s)} + e_{(i,r)}, \tag{5.3}$$

where $x_{(i,r)}$ is the output in sector $i$ of region $r$, and $z_{(i,r)(j,s)}$ is the value of product $i$ in region $r$ used as intermediate input by sector $j$ in region $s$. Furthermore, $d_{(i,r)(s)}$ indicates the value of products $i$ provided by region $r$ and used for final use of region $s$, and $e_{(i,r)}$ is the value of product $i$ provided by region $r$ and sold to foreign countries. When we refer to a final product provided by region $r$, we refer to the product for which the final production stage is located in region $r$ (the ‘region-of-completion’, in the terminology of Los et al. [2015a]).

This market-clearing condition can also be expressed using matrix algebra. We use a two-region case as an example (i.e., $m = 2$) in which the national economy is divided into region $r$ and region $s$. We use superscript $P$ to denote the processing export variables and the superscript $O$ to denote ordinary production variables. The $n$-dimension vectors $x^P_r$ and $x^O_r$ indicate the sectoral output levels for production of processing exports subsectors and ordinary production subsectors, respectively, in region $r$; $e^P_r$ and $e^O_r$ indicate the sectoral values of processing exports and ordinary exports provided by region $r$; $d^P_r$ and $d^O_r$ indicate the amounts of domestically sold final products provided by region $r$. $d^P_r$ is a vector consisting of zeros, because processing exports can by definition not be sold to domestic users. The $n \times n$ dimension matrix $Z_{rs}^{OP}$ describes the intermediate deliveries of ordinary production subsectors from region $r$ used as intermediate input by processing exports subsectors in region $s$, and $Z_{rs}^{OO}$ indicates the intermediate deliveries of ordinary production subsectors from region $r$ used as intermediate input for ordinary production subsectors in region $s$. The product market-clearing conditions in Equation 5.3 can then be written as:

$$x = Zu + d + e^P + e^O, \tag{5.4}$$
where \( \mathbf{x} = \begin{pmatrix} x_r^p \\ x_r^o \\ x_s^p \\ x_s^o \end{pmatrix} \); \( \mathbf{Z} = \begin{pmatrix} 0 & 0 & 0 & 0 \\ Z_{rr}^{op} & 0 & Z_{rs}^{op} & Z_{rs}^{oo} \\ 0 & 0 & 0 & 0 \\ Z_{sr}^{op} & Z_{ss}^{op} & Z_{ss}^{oo} \end{pmatrix} \); \( \mathbf{d} = \begin{pmatrix} 0 \\ d_r^o \\ 0 \\ d_s^o \end{pmatrix} \); the two types of exports are denoted by \( \mathbf{e}^p = \begin{pmatrix} e_r^p \\ e_s^p \end{pmatrix} \) and \( \mathbf{e}^o = \begin{pmatrix} e_r^o \\ e_s^o \end{pmatrix} \); and \( \mathbf{u} \) is the summation column vector with all elements equal to 1.

We define the matrix with domestic input coefficients with dimensions \((2mn \times 2mn)\) as \( \mathbf{A} = \mathbf{Z}(\mathbf{\hat{x}})^{-1} \), where a hat indicates a diagonal matrix with elements of a vector on the diagonal. \( \mathbf{A} \) describes the direct input requirements of all intermediate goods across sectors and regions per RMB of region-sector-specific output. Equation 5.4 can then be rewritten as:

\[
\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{d} + \mathbf{e}^p + \mathbf{e}^o. \tag{5.5}
\]

Solving this Equation for \( \mathbf{x} \), we arrive at the fundamental input–output identity:

\[
\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}(\mathbf{d} + \mathbf{e}^p + \mathbf{e}^o). \tag{5.6}
\]

where \( \mathbf{I} \) is an \((2mn \times 2mn)\) identity matrix with ones on the diagonal and zeros elsewhere. \((\mathbf{I} - \mathbf{A})^{-1}\) is the well-known Leontief inverse, which represents the region-subsector–specific output levels required per RMB of region-subsector–specific final demand.

To link final products to labor income, we define \( l_{(i,r)} \) as the labor income earned in sector \( i \) in region \( r \). We define \( w_{(i,r)} = l_{(i,r)}/x_{(i,r)} \) as the labor income directly required to produce an RMB of output in this particular sector and region. We create two column vectors, \( \mathbf{w}_r^p \) and \( \mathbf{w}_r^o \), given that the IRIOP table distinguishes two types of production. We derive the labor incomes generated in region \( r \) and region \( s \) directly and indirectly required for a final product vector \( \mathbf{f} \) by post-multiplying the matrix \( \mathbf{W} \) with the gross outputs needed for the production of this final demand:
\[ l = W(I - A)^{-1}f, \]  
(5.7)

where \( W = \begin{pmatrix} w_r^p & w_r^o \\ 0 & w_s^p & w_s^o \end{pmatrix} \). Primes indicate transpositions of a vector or matrix. When \( f \) represents all final products in the system, that is, \( f = d + e^p + e^o \), the \( m \) elements in \( l \) indicate the total labor incomes in each region.

We obtain regional labor income generated in activities in value chains for each region-subsector–specific final product by diagonalizing the final demand vector in Equation 5.7. That is:

\[ L = W(I - A)^{-1}\hat{f} = W(I - A)^{-1}(\hat{e}^p + \hat{e}^o + \hat{d}) = W(I - A)^{-1}\hat{e}^p + W(I - A)^{-1}\hat{e}^o + W(I - A)^{-1}\hat{d} = L^p + L^o + L^D. \]  
(5.8)

The element \( l_{r(1,s)} \) in the \( m \times 2mn \) dimension matrix \( L \) indicates the labor income in region \( r \) generated by final demand for the product of the first subsector \( 1 \) in region \( s \). Similarly, \( L^o \), \( L^p \), and \( L^D \), indicate the regional labor incomes implied processing exports demand, ordinary exports demand, and domestic final demand for the outputs of every region-sector, respectively. Equation 5.8 thus allows us to decompose the total labor income of each region into the amount induced by processing exports, ordinary exports, and domestic final demand. In what follows, we refer to the sum of \( L^p \) and \( L^o \) as “labor income from exports”.

### 5.3.2 Decomposing regional inequality by source

In this subsection, we aim to decompose overall regional inequality into the contributions of each type of final product, using Shorrocks’s (1982) decomposition.

One of the well-known methods of decomposing inequality by income source is the Shapley decomposition, which evaluates how overall inequality would change if income from one source were eliminated (or replaced by its mean, to evaluate the marginal effect of this source) (Shapley, 1953; Shorrocks, 1999). However, as Sastre and Trannoy (2002) indicate, the Shapley decomposition has an important problematic
feature: The contribution it assigns to any income source depends on the level of disaggregation, such that it is sensitive to the ways in which other sources are clustered. Shorrocks (1982) offers a unified approach to quantify the proportional contribution of income sources to overall inequality, which has been widely used (see, e.g., Chi, 2012; Tsui, 1998). Shorrocks proves that this decomposition solution is unique in meeting a number of desirable decomposition principles, including symmetry, independence, and consistency.\footnote{Symmetry and independence properties ensure that the contribution of any income component to overall inequality is not affected by the way the components are numbered or named, or how many types of components are distinguished. The consistency property ensures that the sum of effects of all income sources yields the overall inequality (Paul, 2004). Shorrocks’s decomposition also meets two other conditions: (1) the contribution of an income source to aggregate inequality is 0 if every household receives the same income from that source and (2) if overall inequality is divided into two income sources for which the distribution of one source is a permutation of the distribution of the other, they contribute equally to total inequality.} According to Shorrocks (1982), the Theil index (Equation 5.1) can be modified to calculate the absolute contribution of income source $k$ to the overall inequality as:

$$\text{con}^k = \sum_r p_r \frac{y_r^k}{\bar{y}} \ln \left( \frac{y_r}{\bar{y}} \right) = \left( \frac{\bar{y}^k}{\bar{y}} \right) \left[ \sum_r p_r \frac{y_r^k}{\bar{y}^k} \ln \left( \frac{y_r}{\bar{y}} \right) \right] = \phi^k I(y^k, y), \quad (5.9)$$

where $y_r^k$ is the amount of the income per capita in region $r$ received from income source $k$, $p_r$ stands for the share of $r$ in the national population, and $\bar{y}^k$ indicates the mean of the $k$th type of income per capita. Equation 5.9 indicates that two elements determine the absolute contribution of income source $k$ to overall inequality: the share of labor income from source $k$ in total labor income ($\phi^k = \bar{y}^k / \bar{y}$) and the inequality implied by the distribution of labor income from source $k$ itself ($I[y^k, y]$). $I(y^k, y) = \sum_r p_r (y_r^k / \bar{y}^k) \ln(y_r / \bar{y})$ represents a “pseudo-Theil” index that captures the inequality regarding the $k$th income source. The difference between $I(y^k, y)$ and the regular Theil index for the $k$th income source is in the second factor between parentheses $(y_r / \bar{y})$. It represents the ratio of income per capita in region $r$ to the national average in the pseudo-Theil index, but the ratio of the $k$th type of income per capita in region $r$ to its national average $(y_r^k / \bar{y}^k)$ in the Theil index.

We derive the contribution share of $k$th income source to overall inequality by dividing its absolute contribution by the overall inequality:
\[ \text{cons}^k = \text{con}^k / I, \]  

(5.10)

where \( I \) is the overall inequality, as shown in Equation 5.1. Observe that the shares add up to one (i.e. \( \Sigma_k \text{con}^k = I \)), because \( \Sigma_r \text{yr}^k = y_r \).

We split labor income into three income sources: labor income from processing exports (indicated by superscript \( P \)), labor income from ordinary exports (\( O \)), and labor income from domestic final demands (\( D \)) as given by Equation 5.8.

By using the decomposition method illustrated above, we calculate the contribution of each final product to overall inequality adopting an accounting perspective. If we compute the inequality attributed to exports, we implicitly assume that the workers involved in the associated activities would in the absence of these exports not be employed in other activities. We believe this assumption is reasonable for China, given its initially massive rural surplus labor force (Carter et al., 1996; Chu et al., 2000), which was at least partly absorbed when it became a massive exporter of manufactured products (Los et al., 2015b). Another assumption is that wage rates paid to workers producing for domestic final demand have responded uniformly across regions to the increasing export-driven labor demand. Such general equilibrium effects might well have been different across regions, but are not considered in our analysis.

We think that the export boom has actually had stronger positive effects on wage growth in the coastal regions than elsewhere in China (Han et al., 2012; Fan, 2019). If so, our results would provide a lower bound on the regional inequality effects of China’s growing exports.

### 5.4 Data

To calculate regional income inequality, data on regional labor income and regional population are needed. We draw measures of regional labor income from Chinese interregional input-output tables that distinguish processing trade (IRIOP tables) as constructed by Duan et al. (2019) (see the previous Chapter). Appendix 5.1 presents the outline of IRIOP tables. These tables include value added (which is split into labor and capital income), exports, and interregional and intraregional production linkages.
between sectors. To date, we have constructed IRIOP tables for 2002, 2007, and 2012. The tables contain data for 17 sectors and cover eight regions (North East, North Municipality, North Coast, East Coast, South Coast, Central Region, North West, and South West; see Appendix 4.2 for the region classification and Appendix 4.3 for the sector classification).

The variables in the IRIOP tables are expressed in current local prices. Product prices may differ significantly across time and space, which implies spatial and temporal differences in costs of living. This affects economic outcomes in general and inequality in particular. For this reason, after computing the related region labor income levels based on the IRIOP tables, we convert these into levels expressed in Beijing 2002 prices by using spatial price deflators from Brandt and Holz (2006). These authors combine a meticulous analysis of household expenditures and prices at the province level for the year 1990 with annual provincial consumer price indices (CPIs) to provide a reliable estimation of spatial price deflators at the provincial level for 1984 to 2004. We extend their 2004 price deflator to 2012 by chaining the annual provincial CPIs. We then deflate all provincial price levels in 2002, 2007, and 2012 by taking the 2002 Beijing price as the benchmark, such that the 2002 Beijing price equals 1. Finally, we aggregate the provincial deflators to the regional level by using provincial consumption as weights and obtain the price deflators for the eight regions.12

5.5 Empirical results

In this section, we apply our framework to China to determine how each type of final product, and exports in particular, contributed to regional inequality. To provide a comprehensive picture, we begin quantifying labor income earned in the Chinese parts of value chains. Next, we analyze the effect of exports on regional income. Finally, we address in detail the contributions of exports to regional inequality.

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12 Both provincial CPI and consumption data have been taken from the NBS official website (http://www.stats.gov.cn/english/Statisticaldata/AnnualData/).
5.5.1 Labor income earned in value chains

Equation 5.8 allows us to investigate the distribution of labor income along value chains over regions and examine their dynamics from 2002 to 2012. We distinguish 408 final products (17 products × 8 regions of completion × 3 final product categories).\(^\text{13}\) We follow Los et al. (2015a) by aggregating the elements of each column of L into three parts, local labor income (LLI), inland labor income (ILI) and coastal labor income (CLI).\(^\text{14}\) For the processing exports by sector \(j\) in region \(r\), for example, we define (i) LLI as \(l_{(r)(j,r)}^p\), indicating the labor income earned in the region of completion; Here, \(l_{(t)(j,r)}^p\) is the element of \(L^p\) in Equation 5.8 that indicates the labor income in region \(t\) generated by processing exports of sector \(j\) in region \(r\). (ii) ILI as \(\sum_{t\in \text{inland}} l_{(t)(j,r)}^p\), showing the labor income earned in inland regions other than the region of completion; and (iii) CLI as \(\sum_{t\in \text{coast}; \; t\neq r} l_{(t)(j,r)}^p\), i.e. labor income earned in coastal regions, but excluding the region of completion. The sum of LLI, ILI, and CLI yields the total domestic labor income (DLI) in each value chain. For each value chain, we divide the four labor income measures by the value of the product sold to Chinese final users and foreign users, which yields three shares: the local labor income share (LLS), the inland labor income share (ILS) and the coastal labor income share (CLS). Furthermore, we define the domestic labor income share (DLS) as the sum of LLS, ILS and CLS.

Table 5.3 presents the average results for the three final product categories. For each category, the results are the final demand-weighted averages of the shares of each value chain in this group (17×8 = 136 value chains for each group). The bottom row for each year shows the weighted averages of shares in all 408 value chains.

\(^{13}\) The three final product categories are processing exports, ordinary exports, and domestic final demands. For some value chains, the values are all 0, because there is no final output for some sectors, such as processing exports of agriculture.

\(^{14}\) The results in this subsection are based on labor income shares obtained from Equation 5.8 and have not been corrected for differences in price levels across regions and over time (see Section 5.4), since this subsection does not deal with income inequality.
Table 5.3 Labor income shares of final products, by type (in %)

<table>
<thead>
<tr>
<th></th>
<th>LLS</th>
<th>ILS</th>
<th>CLS</th>
<th>DLS</th>
<th>Local Share</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Processing exports</strong></td>
<td>11.7</td>
<td>1.0</td>
<td>0.9</td>
<td>13.6</td>
<td>86.0</td>
</tr>
<tr>
<td>2002 Ordinary exports</td>
<td>31.6</td>
<td>3.3</td>
<td>3.2</td>
<td>38.1</td>
<td>82.9</td>
</tr>
<tr>
<td>Domestic demand</td>
<td>35.9</td>
<td>4.2</td>
<td>5.1</td>
<td>45.2</td>
<td>79.4</td>
</tr>
<tr>
<td>Average</td>
<td>32.9</td>
<td>3.8</td>
<td>4.4</td>
<td>41.1</td>
<td>80.0</td>
</tr>
<tr>
<td><strong>Processing exports</strong></td>
<td>10.2</td>
<td>1.5</td>
<td>1.0</td>
<td>12.6</td>
<td>81.0</td>
</tr>
<tr>
<td>2007 Ordinary exports</td>
<td>23.0</td>
<td>4.6</td>
<td>3.2</td>
<td>30.8</td>
<td>74.7</td>
</tr>
<tr>
<td>Domestic demand</td>
<td>25.2</td>
<td>5.9</td>
<td>5.7</td>
<td>36.8</td>
<td>68.5</td>
</tr>
<tr>
<td>Average</td>
<td>22.7</td>
<td>5.1</td>
<td>4.6</td>
<td>32.4</td>
<td>70.1</td>
</tr>
<tr>
<td><strong>Processing exports</strong></td>
<td>15.1</td>
<td>2.2</td>
<td>1.2</td>
<td>18.5</td>
<td>81.6</td>
</tr>
<tr>
<td>2012 Ordinary exports</td>
<td>29.9</td>
<td>5.1</td>
<td>2.9</td>
<td>37.9</td>
<td>78.9</td>
</tr>
<tr>
<td>Domestic demand</td>
<td>31.7</td>
<td>6.6</td>
<td>6.0</td>
<td>44.3</td>
<td>71.6</td>
</tr>
<tr>
<td>Average</td>
<td>30.0</td>
<td>6.0</td>
<td>5.1</td>
<td>41.1</td>
<td>73.0</td>
</tr>
</tbody>
</table>

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019). Local Share = (LLS/DLS)*100, DLS = LLS + ILS + CLS.

We report three important findings. First, while China is characterized by increasing geographical fragmentation, the largest part of domestic labor income embodied in final products is still earned in the region of completion. To see this, we define the local share as (LLS)/(DLS). A high local share indicates that a large share of domestic labor income in value chains was earned in the region of completion. Table 5.3 presents the local shares of the three final product categories. In 2012, the average local share for all value chains was 73%. This suggests that the final production stage tends to require lots of labor input from the local market, and that firms often prefer to purchase materials from the local market, for example to minimize transport costs.

Second, income distributions along the value chains of the three types of final products appear to be considerably different, as expected: An RMB of processing exports generates far lower domestic labor income than the same amount of ordinary exports or domestic demand. Most materials for processing export production are imported from foreign countries, so processing exports tend to show high international
China’s rise as an export giant and regional inequality: a value chain analysis

fragmentation (Yang et al., 2015). We also find lower degrees of domestic fragmentation for processing exports than for ordinary exports. In 2012, the local shares for processing exports and ordinary exports were 81.6% and 78.9%, respectively. In other words, one RMB of extra domestic labor income due to processing exports would have implied 0.184 RMB of labor income to other regions. For ordinary exports, the corresponding figure is 0.211 RMB. This finding indicates less domestic fragmentation in processing export production.

Third, the decreasing local shares (over 2002-2012) indicate increasing domestic fragmentation of production processes, for all three final product types. This has not been a steady process, however: after 2007, substantial parts of the decrease in local shares before 2007 were undone, again for all three types of final products. This is most probably because of China’s increased capabilities to produce high-quality intermediate inputs domestically, which improved the LLS and also the local share from 2007 to 2012. ILS and CLS, however increased in both periods. ILS grew more rapidly than CLS, indicating that increased regional fragmentation of Chinese parts of GVCs benefited inland regions more than coastal regions, which might be relevant for the dynamics of regional inequality.

5.5.2 Importance of exports to labor income

Improving household income is one of the most important objectives of the Chinese government. Therefore, an interesting question is how the contributions of exports to regional income compare to the contributions of final demands by domestic users. In this section, we address this issue from a value chain perspective and decompose regional labor income into three sources: labor income earned in value chains for processing exports (LPE), labor income earned in activities required for the production of ordinary exports (LOE), and labor income earned in the production of output sold to domestic final users (LFD). We use Equation 5.8 for this. Our calculations are based on the IRIOP tables, and the results are further deflated into the

\[ \text{\textsuperscript{15}} \text{China’s policy of granting firms duty exemptions on imported materials for processing exports also induces that firms prefer to purchase imported inputs for producing processing exports.} \]
2002 Beijing price using the regional price deflators constructed in Section 2.2.

Columns 1–9 in Table 5.4 present the share of each income source in regional labor income. The first figure in Column 1, for example, indicates that in 2002, 1.9% of the North East’s labor income was generated by its direct or indirect participation in the production of China’s processing exports. The bottom row gives the results for the national economy, using regional labor income levels as weights. As shown in Equation 5.9, these shares \( \phi^k \) are important to the absolute contribution of each income source to the overall regional inequality.

A first, not very surprising, observation from Table 5.4 is that exports contribute much more to the labor incomes of coastal regions than of inland regions. In 2002, the share of labor income due to exports ranged from a high of 27.2% (11.1% + 16.1%) in South Coast to a low of 5.6% (1.0% + 4.6%) in South West. Within the coastal regions and the inland regions, the contribution of exports to labor income also varies greatly. It was 27.2% for South Coast but only 11.3% for North Coast in 2002. In particular, the contribution of processing exports to labor income was up to 11.1% for South Coast, but less than 4% for other coastal regions.

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2007</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPE</td>
<td>LFD</td>
<td>LPE</td>
<td>LFD</td>
</tr>
<tr>
<td>2002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPE</td>
<td>LOE</td>
<td>LFD</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPE</td>
<td>LFD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LFD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| NE         | 1.9  | 8.0  | 90.1 | 2.8  | 12.8 | 84.4 | 2.4  | 9.5  | 88.1 |
| NM         | 3.7  | 17.2 | 79.1 | 5.4  | 25.7 | 69.0 | 3.0  | 15.6 | 81.3 |
| NC         | 2.1  | 9.2  | 88.7 | 2.9  | 14.8 | 82.3 | 2.7  | 12.1 | 85.2 |
| EC         | 3.9  | 17.9 | 78.2 | 10.3 | 24.7 | 65.0 | 6.9  | 17.2 | 75.9 |
| SC         | 11.1 | 16.1 | 72.8 | 13.6 | 20.6 | 65.8 | 9.5  | 21.0 | 69.5 |
| CR         | 0.8  | 5.2  | 94.0 | 2.0  | 10.2 | 87.7 | 1.7  | 6.8  | 91.5 |
| NW         | 0.8  | 6.0  | 93.2 | 1.7  | 14.4 | 83.9 | 1.3  | 8.3  | 90.4 |
| SW         | 1.0  | 4.6  | 94.4 | 1.4  | 8.4  | 90.2 | 0.8  | 6.7  | 92.5 |
| Average    | 3.5  | 10.5 | 86.0 | 5.6  | 16.2 | 78.3 | 3.9  | 12.2 | 83.9 |

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019). LPE = labor income from processing exports, LOE = labor income from ordinary exports, LFD = labor income from domestic final demand.

A second observation is that labor income was mainly generated by domestic
demand rather than exports. This might be less in line with the idea that China became the "Factory of the World", but is less unexpected if the size of the domestic economy is considered. Even in 2007, when they were most important, exports generated less than 22% of national labor income. Although the scale of processing exports was almost equal to that of ordinary exports (see Table 5.1), its contribution to income was only one-third the contribution of ordinary exports. This reflects the fact that processing exports are much more based on foreign than on domestic intermediate inputs, which implies that indirect effects in upstream sectors are relatively modest.

Although the contribution of exports to labor income varies strongly across regions, our third observation from Table 5.4 is that all regions experienced a similar pattern over time. That is, exports made increasing contributions to regional labor income from 2002 to 2007, but their share decreased after the global financial crisis. Before the financial crisis, both processing exports and ordinary exports played increasing roles in generating regional labor income, with sharply rising shares of LPE and LOE. In this regard, the East Coast region stood out, with its share of labor income due to exports dramatically increasing by 13.2 percentage points from 2002 to 2007 and then remarkably declining by 10.9 percentage points from 2007 to 2012.

Figure 5.2 displays the sectoral exports that contributed most to regional labor income in each of the regions considered. Together, they explained 62.4% of national labor income exports in 2012. Two groups of products—Textile (sector 4) and Mechanical and electrical products (sectors 10, 11, and 12)—accounted for 53.6% of total Chinese exports and 48.4% of the national labor income involved. These national shares hide some regional variation. The exports of the two sectors mentioned accounted for as much as 61.4% of labor income due to exports from the East Coast region and for 50.9% from the Central Region. A notable exception is North Municipality, where about half of labor income due to exports was generated by service exports. This is mainly due to the higher service export share in North Municipality’s total exports, which was 13.7% for Trade and Transport (sector 16) and 24.8% for Other Services (sector 17). For a comparison, their export shares were only 9.6% and 3.4% in East Coast’s total exports.
Figure 5.2 Regional labor income due to exports in 2012, by most important sectors (%; total regional labor income due to exports = 100)

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019). Mechanical and electrical products is the aggregate of sectors 10, 11, and 12.

5.5.3 Contribution of exports to regional inequality

5.5.3.1 Decomposition of inequality by income source

In this section, we apply Equations 5.9 and 5.10 to decompose overall regional inequality into the contributions of each type of final product. Table 5.5 presents the results. Included are the Theil indexes (which indicate regional income inequality per type of final product and for all three types together), the contributions of the three types of final product to total inequality, expressed in levels and in shares in 2002, 2007, and 2012.

Of the three income sources, the Theil index of LPE is astonishingly high: 0.694 in 2002, more than twice that of LOE and 26 times higher than that of LFD. Put differently, across regions, labor income along the value chains for processing exports was more unequally distributed than along the value chains of ordinary exports and domestic final demand. This is largely a result of the features of exports and processing exports in particular. Processing exports tend to generate labor income in the region in which the processing sector is located (and hardly anywhere else in China), since most inputs are imported. The Theil index for processing exports decreased over time, which
indicates a convergence of labor income across regions, probably as a consequence of the government's policy to increasingly locate processing exports activities in the Central Region. Increasing domestic fragmentation (sourcing inputs from other regions rather than from abroad) may also have been an important contributor, enabling regions beyond the region of completion to benefit more from final product production.

### Table 5.5 Contribution of types of final products to regional income inequality

<table>
<thead>
<tr>
<th></th>
<th>LPE</th>
<th>LOE</th>
<th>LFD</th>
<th>TOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theil index</td>
<td>0.694</td>
<td>0.327</td>
<td>0.026</td>
<td>0.046</td>
</tr>
<tr>
<td>2002 Contribution to total</td>
<td>0.008</td>
<td>0.019</td>
<td>0.020</td>
<td></td>
</tr>
<tr>
<td>Share in total</td>
<td>16.9%</td>
<td>41.0%</td>
<td>42.1%</td>
<td></td>
</tr>
<tr>
<td>Theil index</td>
<td>0.555</td>
<td>0.220</td>
<td>0.025</td>
<td>0.048</td>
</tr>
<tr>
<td>2007 Contribution to total</td>
<td>0.011</td>
<td>0.023</td>
<td>0.014</td>
<td></td>
</tr>
<tr>
<td>Share in total</td>
<td>23.1%</td>
<td>47.3%</td>
<td>29.6%</td>
<td></td>
</tr>
<tr>
<td>Theil index</td>
<td>0.456</td>
<td>0.214</td>
<td>0.016</td>
<td>0.029</td>
</tr>
<tr>
<td>2012 Contribution to total</td>
<td>0.006</td>
<td>0.014</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Share in total</td>
<td>19.9%</td>
<td>46.7%</td>
<td>33.4%</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019). LPE = labor income from processing exports, LOE = labor income from ordinary exports, LFD = labor income from domestic final demand, and TOT= total regional labor income.

Foreign demand proves to be the dominant contributor to China’s regional inequality. In 2012, processing exports together with ordinary exports explained 66.6% of overall regional inequality; ordinary exports alone explained 46.7%. The contribution of processing exports is relatively small, though LPE shows much larger inequality than other income sources. Table 5.4 shows that processing exports generated only a small share of total labor income, resulting in a limited contribution to regional inequality. These results resonate with early studies that identify globalization as the main contributor to Chinese regional inequality (Kanbur and Zhang, 2005; Zhang and Zhang, 2003). We will provide a deeper analysis of the drivers of change in inequality in the next subsection, but first pay some attention to the role of value chains for exports by specific sectors.

Table 5.6 lists the regional labor income inequality generated by exports by sectors and their contributions to overall inequality. The sum of their contribution
shares equal the total contribution shares of processing exports and ordinary exports in 2012 listed in Table 5.5 (i.e. 66.6%). Labor incomes generated by exports of Other services, Construction, Other manufacturing, and Paper & printing were the most unequally distributed among regions, with Theil indexes greater than 0.4. However, as the second column reveals, the sectors that contributed most to China’s overall inequality, are the five sector groups included in Figure 5.2, which generated the largest part of regional labor income induced by exports. Hence, these sectoral exports have large weights in the determination of total inequality: in 2012, their exports caused 60.2% of China’s regional income inequality.16

**Table 5.6 Contribution of sectoral exports to regional income inequality caused by all exports, 2012**

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Theil index</th>
<th>Contribution share (%)</th>
<th>Sectors</th>
<th>Theil index</th>
<th>Contribution share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0.233</td>
<td>0.2</td>
<td>Machinery</td>
<td>0.305</td>
<td>5.5</td>
</tr>
<tr>
<td>Mining</td>
<td>0.285</td>
<td>0.5</td>
<td>Transport equipment</td>
<td>0.290</td>
<td>3.1</td>
</tr>
<tr>
<td>Food</td>
<td>0.203</td>
<td>1.0</td>
<td>Electronic products</td>
<td>0.380</td>
<td>15.5</td>
</tr>
<tr>
<td>Textile</td>
<td>0.273</td>
<td>10.1</td>
<td>Other manufacturing</td>
<td>0.492</td>
<td>0.9</td>
</tr>
<tr>
<td>Wood</td>
<td>0.205</td>
<td>1.4</td>
<td>Electricity, gas and water</td>
<td>0.243</td>
<td>0.0</td>
</tr>
<tr>
<td>Paper &amp; printing</td>
<td>0.477</td>
<td>1.8</td>
<td>Construction</td>
<td>0.506</td>
<td>0.3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>0.143</td>
<td>2.9</td>
<td>Trade and transport</td>
<td>0.380</td>
<td>11.3</td>
</tr>
<tr>
<td>Nonmetallic minerals</td>
<td>0.092</td>
<td>0.4</td>
<td>Other services</td>
<td>0.888</td>
<td>9.4</td>
</tr>
<tr>
<td>Metal products</td>
<td>0.108</td>
<td>2.4</td>
<td>Sum</td>
<td>0.029</td>
<td>66.6</td>
</tr>
</tbody>
</table>

Notes: Authors’ calculations based on the IRIOP tables (Duan et al., 2019).

### 5.5.3.2 Counterfactual analysis

Over time, China’s regional inequality increased slightly from 2002 to 2007 and then sharply declined from 2007 to 2012. During this period, the contribution of exports to

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16 The number is obtained by summing up the contribution shares (Table 5.6) of the five sectoral groups in Figure 5.2.
total inequality increased from 57.9% to 70.4%, and then decreased to 66.6% in 2012 (see the sums of LPE and LOE in Table 5.5). To determine how exports affected the changes in regional inequality over time, we conducted several counterfactual analyses. We sought to identify the effect of change in one particular factor, by comparing real inequality with inequality in the counterfactual situation of no change in this factor at all. If the counterfactual inequality was lower than the actual level, actual change in this factor accelerated the inequality, and vice versa.

To show the determinants of regional labor income clearly, we rewrite Equation 5.8 in more detailed terms. We denote $t^p = u^p e^p$ as the scale of processing exports and $e^p = e^o / t^p$ as the region-sector composition of processing exports, that is, the shares of region–sector–specific processing exports in the national total for processing exports. Similarly, we denote $t^o = u^o e^o$ and $e^o = e^o / t^o$, indicating the scale and composition of ordinary exports, respectively:

$$I = W(I - A)^{-1} t^p e^p + W(I - A)^{-1} t^o e^o + W(I - A)^{-1} d. \quad (5.11)$$

The right hand side of Equation 5.11 provides the potential determinants of the regional income and shows how final products affect regional inequality through the value chains.

The determinants include the scale and composition of processing exports ($t^p$ and $e^p$), the configuration of the value chains for processing exports ($A_{ik}$ and $w_i^p$), the scale and composition of ordinary exports ($t^o$ and $e^o$), the value chain configurations for ordinary production ($A_{ik}$ and $w_i^o$), and domestic final demand ($t^D$ and $e^D$ combined).\(^\text{17}\) We analyzed seven counterfactual situations, for both 2007 and 2012. We recalculated Equation 5.11 by assuming that only one of the seven factors did not change (we assume that the values for 2002 still applied in 2007, and those for 2007 in 2012), while allowing the other six factors to change to their 2007 and 2012 values, respectively.\(^\text{18}\) Table 5.7 presents the counterfactual results for regional income.

\(^\text{17}\) Note that changes in the value chain configuration can relate to (1) the substitution of production in the sector itself by purchased inputs (or the reverse), (2) substitution of inputs from a region (or foreign countries) by inputs from a different region, and (3) substitution of inputs from one industry by inputs from a different industry.

\(^\text{18}\) It is worth noting that this is not a full structural decomposition analysis. As a mirror case, we might look at regional inequality in a situation in which only one factor takes its value in 2007 while all other factors take their values in 2002, then compare this measure of inequality with actual inequality in 2002.
inequality between the eight regions. Taking the effect of processing export scale as an example, Table 5.7 shows that if the scale of processing exports had maintained its 2002 level while everything else had taken the 2007 values, regional inequality in 2007 would have markedly decreased to 0.042, compared with the actual level of 0.048. This implies that the change in scale of processing exports increased the regional inequality from 2002 to 2007.

**Table 5.7 Counterfactual levels of regional inequality in 2007 and 2012**

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Processing exports</th>
<th>Ordinary exports</th>
<th>Domestic demand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scale (1)</td>
<td>Compositional (2)</td>
<td>Chain configuration (3)</td>
</tr>
<tr>
<td>2007</td>
<td>0.048</td>
<td>0.042</td>
<td>0.048</td>
<td>0.041</td>
</tr>
<tr>
<td>2012</td>
<td>0.029</td>
<td>0.028</td>
<td>0.029</td>
<td>0.028</td>
</tr>
</tbody>
</table>

Notes: Authors’ calculation based on IRIOP tables (Duan et al., 2019). The row “2007” presents the counterfactual results for 2007, while the row “2012” lists the counterfactual results for 2012, assuming that only the actual changes indicated by the column headings would not have taken place.

From 2002 to 2007, China’s regional inequality slightly increased from 0.046 to 0.048 but then sharply decreased to 0.029 in 2012 (see also the last column in Table 5.5). From 2002 to 2007, changes in scales of processing exports and ordinary exports and the value chain configuration of processing exports increased inequality, whereas domestic final demands, the value chain configuration of ordinary production, and the composition of ordinary exports reduced inequality. However, from 2007 to 2012, processing exports had a negligible effect; the change in domestic final demands mainly drove the decrease. This result was already apparent in Table 5.5. At the same time, the change in scales and value chain configurations of ordinary exports caused more inequality.

This analysis reveals three additional findings. Table 5.7 shows that the actual changes of processing and ordinary export volumes were the main culprits of increasing inequality from 2002 to 2007. The IRIOP tables show that both processing and ordinary exports tripled, whereas domestic final demand merely doubled. Since the labor incomes earned in the value chains of exports were extremely unequally distributed over regions, the export growth significantly increased regional inequality
from 2002 to 2007. In contrast, export growth led to only slightly more inequality from 2007 to 2012 since it grew by only 35.0% while domestic final demand increased by against 112%.\footnote{The growth rates are in nominal terms, and are calculated based on the IRIOP tables.} This finding shows that China’s recent policy of stimulating domestic demand and dampening foreign demand has been helpful in decreasing regional inequality.

Second, changes in the value chains for ordinary exports from 2002 to 2007 significantly reduced regional inequality. If these would have remained as in 2002, regional inequality in 2007 would have sharply increased to 0.065, instead of attaining its actual value of 0.048. This is mainly the result of inland regions getting more involved in value chains for ordinary exports by coastal regions. In 2002, for ordinary export production on the coasts, about 7.6% of intermediate inputs were provided by the inland regions; this share rapidly increased to 11.1% in 2007.\footnote{This calculation is based on the IRIOP tables.} This progress reduced the income gap between the coastal and inland regions, narrowing overall regional inequality. This suggests that China’s regional policy of promoting the inland regions to more actively participate in GVCs has effectively decreased China’s regional inequality.\footnote{The Chinese government launched different policies to encourage the processing sectors to move from advanced coastal regions to inland regions. For example, by extending the Economic and Technological Development Zones from the coastline to inland regions. It is important to note explicitly that our analysis cannot say anything about the role these policies have played, but the outcomes are in line with the objectives of these.}

The third interesting finding is that the change in export compositions exerted a minor effect on regional inequality, even though export compositions underwent obvious changes in both commodity structure and geographic distribution. For example, Chinese exports shifted from labor-intensive products to the output of high-tech sectors. According to the IRIOP tables, in 2002, about 17.8% of the exports were Textile (sector 4) and 29.0% were Mechanical and electrical products (sectors 10, 11, 12); in 2012, these shares were 11.8% and 41.8%, respectively. With regard to geographic distribution of exports (see Table 5.1), a considerable share of exports had shifted from South Coast to East Coast and North Coast. However, most of these shifts happened between coastal regions and made little difference to the overall income gaps between the coastal and inland regions, which account for most of the overall inequality.

It is worth noting that we investigated the effect of globalization on regional
income inequality from a value chain perspective, according to the assumption of Leontief production technologies. In other words, we attributed the effects of changing exports bundles on the labor income distribution over regions, assuming that relative prices (including wage rates) would have remained unchanged and would therefore not cause further substitution effects. We believe that considering the effects of globalization on inequality from the perspective of production networks is a useful exploration. We leave a full, comprehensive analysis of globalization and inequality, by nesting the production network into a general equilibrium framework to further research.

5.6 Conclusions

Using newly developed IRIO tables for China, we explored the contributions of both processing exports and ordinary exports to regional inequality. This novel data set, which separates the production of processing exports from other production (which includes production of ordinary exports), allowed us to distinguish the Chinese part of value chains of these two types of exports and identify their different effects on regional inequality.

This research contributes both methodologically and empirically. With regard to methodology, we proposed a new accounting framework to explore the contribution of exports to regional inequality from a value chain perspective. This framework fully accounts for a region’s indirect exports, which arise through the provision of materials, components and services to export production activities in other regions. This allows for a more comprehensive analysis of the contribution of exports to regional inequality. Empirically, we find that exports explained about 70% of China’s regional income inequality in the period 2002-2012. Processing exports contributed little, although the value chain activities were very unequally distributed over regions. They generated only little labor income in China itself (3-6% of the total, due to its reliance on imported inputs), however, which implies that its consequences for income inequality remained limited. Rather, it is ordinary exports that predominantly contributed to China’s regional inequality. These accounted for 10-16% of Chinese labor income and the
regional labor income distribution within their value chains is much more regionally clustered than in value chains for domestically sold consumption and investment products.

The substantial decline of regional inequality in the period 2002-2012 has not been due to changes in exporting activity. Even though value chains for processing exports and for ordinary exports have become distributed more equitably among regions, but in particular the growth in ordinary exports still had inequality-increasing effects. The increasing levels of domestic final demand and the changing value chain configurations of ordinary production—which have become more domestically fragmented, with inland regions increasingly involved—have been the main reasons for declining regional inequality. In this regard, the outcomes are in line with China’s recent policy of stimulating domestic demand to decrease regional inequality.