International Trade and Income Distribution – Evidence from China

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Abstract

We explore the development of labor's share in income and wage inequality in China since 1999 and estimate the effect of international trade on income distributions on a regional level. Two major shocks have driven Chinese exports after 1999. The first event is China's entry into the World Trade Organization and the second one is the collapse of world trade during the worldwide financial crises. Firstly, we document on the provinces level that export activities and labor's share of income are negatively correlated. Using changes in exports in other provinces as instrument, we show that increasing exports reduce the labor share. Secondly, we use data for prefecture-level cities and consider WTO entry and worldwide financial crises to be exogenous with respect to wage development in the individual cities. We control for individual worker characteristics using several waves of Chinese household survey data (CHIP). We find that more international trade is associated with higher wage inequality.

Keywords: China, international trade, labor share, wage inequality.

JEL: C21, F16, J31

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1 Introduction

While there is a broad consensus both in the theoretical and the empirical literature that international trade has positive effects on aggregate income, the effect of international trade on the income distribution and on inequality is much less clear (Dollar and Kraay 2004). We exploit regional data from a large emerging economy, namely China, to shed more light on the empirical relationship between international trade and the income distribution. Using regional data for China has the advantage that there has been substantial variation in exports and in the functional income distribution during the years 1999 to 2017. We can identify two important events that affected China's export activities substantially but can be considered exogenous for individual provinces or prefecture-level cities. While China's entry into the World Trade Organization (WTO) in December 2001 has boosted Chinese exports (Autor et al. 2013, Autor et al. 2016, Pierce and Schott 2016), the worldwide financial crises 2007/2008 has severely reduced Chinese exports. The share of exports in gross domestic product (GDP) has increased after China's WTO entry from about 20% in 2000 to almost 35% in 2007 (Figure 1) while the share decreased strongly from 2008 onward.

At the same time, the labor share of income exhibited the opposite behavior. It first decreased from about 50% in 2000 to less than 40% in 2007 and started then to increase again. Inequality did also increase since the 1970s but is decreasing since 2008 (Zhuang and Li 2016, Piketty et al. 2017, Li 2018). Using data until 2004, Song et al. (2011) argue that the economic transition of China before 2008 has been associated with increasing inequality, also because of a slow growth of wages in comparison to entrepreneurial income.

The general pattern of the aggregate development can also be observed in the 31 provinces of China for which detailed statistical data is available in the various issues of the Statistical Yearbook for China published by the National Bureau of Statistics of China (NBS), see Figure 8 in the appendix.[1] In this paper, we analyze whether international trade and income distribution are systematically related to each other. Our first hypothesis is that an increase in labor productivity that accompanies increasing international trade integration is not proportionally passed through to employees but benefits firms' profits more than proportionate. As a consequence, the labor share is declining. A decreasing labor share is in general associated with increasing income inequality because capital income is distributed more unequally than labor income (ILO and OECD 2015, Doan and Wan 2017). Our second hypothesis is that productivity gains from international trade are also unequally distributed between employees. Some groups of employees, for example with particular skills, may benefit from international trade more than others. Accordingly, wage income is more unequally distributed if international trade increases.

The paper is structured as follows. In section 2 we explain our conceptual framework. Then we briefly explain the data that we use in section 3. The empirical analysis is presented in section 4. Conclusions are provided in section 5.

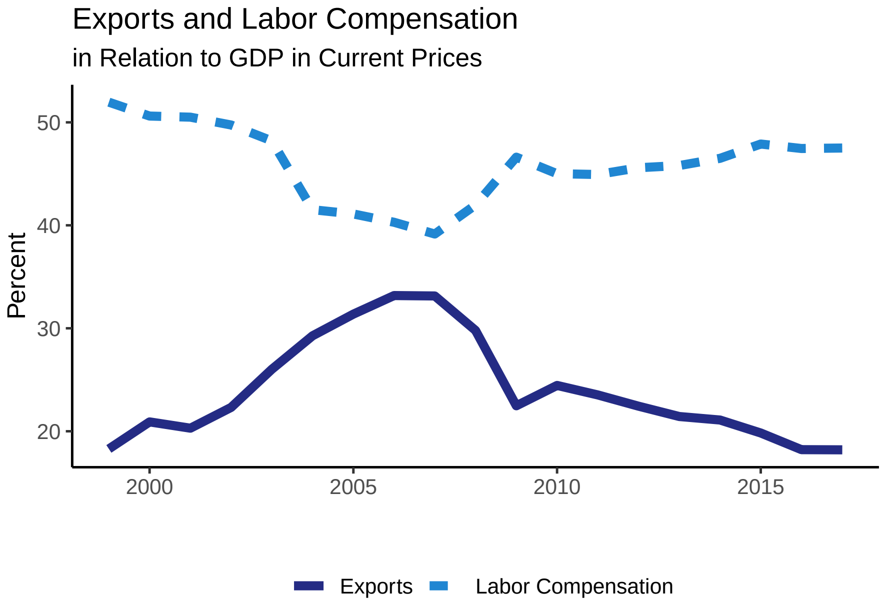
2 Conceptual framework

A declining labor share in the course of increasing international trade integration may partially be explained by increasing market power of firms (Díez et al. 2018, Young and Tackett 2018, Eggertsson et al. 2018, Naidu et al. 2018). The relationship between the labor share and market power can formally be described as follows. Suppose production is determined by the following production function:

$$Y = (A \cdot N)^{1-\alpha}, \tag{1}$$

[1] A list of Chinese provinces is provided in 3 in the appendix. Hong Kong and Macau are not included in the analysis.

Figure 1: Exports and functional income distribution in China



Source: National Bureau of Statistics of China, own calculations.

where Y denotes output and N labor. Changes in A capture technological progress and α is a constant parameter. Marginal productivity of labor is then given by:

$$\begin{aligned} MPL &= A^{1-\alpha}(1-\alpha)N^{-\alpha} = (1-\alpha)\frac{A^{1-\alpha}N^{-\alpha}N}{N} \\ &= (1-\alpha)\frac{A^{1-\alpha}N^{1-\alpha}}{N} = (1-\alpha)\frac{Y}{N}. \end{aligned} \tag{2}$$

Furthermore, suppose that firms set prices according to markup-pricing:

$$P = (1+\mu)MC = (1+\mu)\frac{W}{MPL} = \frac{(1+\mu)W}{(1-\alpha)Y/N} = \frac{1+\mu}{1-\alpha}\frac{WN}{Y}, \tag{3}$$

where MC denotes marginal cost, W nominal wage and μ markup. The labor share is then given by:

$$\frac{WN}{PY} = \frac{1-\alpha}{1+\mu}. \tag{4}$$

The markup μ reflects the market power of firms. Autor et al. (2017a) and Autor et al. (2017b) argue that globalization is in particular beneficial to the most productive firms and contributes to increasing product market concentration and market power. Resources are accordingly shifted to firms with high profits and a low share of labor in value added which leads to a decline in aggregate labor shares. According to Eggertsson et al. (2018), globalization might lead to higher concentration of market shares and rising markups of superstar firms. Using data on over 70,000 firms in 134 countries de Loecker and Eeckhout (2018) show that markups have risen substantially between 1980 and 2016.

Similarly, a rise in the markup could be motivated by a decline in the power of workers to negotiate wages, see Arpaia et al. (2009), among others, or by employment protection deregulation

(Ciminelli et al. 2018).[2] On the other hand, trade liberalization may lead to import substitution and in emerging economies to a reallocation of resources from urban manufacturing sectors to the rural agricultural sector (Chao et al. 2019) which might initially reduce income inequality. Overall, the total effect of international trade integration on the income distribution needs to be explored empirically.

3 Data

We use two main sources for our analysis. The first is 1999 to 2018 issues of the Statistical Yearbook of China published by the National Bureau of Statistics of China. From these Yearbooks we collect data on gross regional product at current prices ($GDPN$), labor compensation at current prices ($COMP$), gross regional product at current prices in the secondary industry sector (IND), regional exports (EXP, in USD, converted into CNY using current market exchange rates), employment ($EMPL$) and population (POP) for 31 Chinese provinces. Additionally, we calculate a volume index for GDP at constant prices ($GDPVol$) from GDP indices which refer to the year-on-year relative changes in GDP at constant prices. Labor compensation ($COMP$) exhibits missing values for the years 2004, 2008 and 2013. We replace the missing values by linearly interpolated values using the year before and the year after the missing value. From this data, we calculate the labor share ($LABS = COMP/GDPN$), the export share in GDP ($EXPS = EXP/GDPN$), the secondary industry share in GDP ($INDS = IND/GDPN$) and gross regional product per capita ($GDPNPC = GDPN/POP$).
Our second data source is the Chinese Household Income Project (CHIP) which offers survey data on the level of Chinese prefecture-level cities. Table 4 in the Appendix shows how many prefecture-level cities are contained in the various waves of CHIP. There are enough observations for the comparison between 2007 and 2013 (85 cities are included in both waves). However, there is only little overlap between 2007 and 1999, 1995 or 1988. However, after WTO entry in December 2001 it took quite some time for international trade to expand. Therefore, we can refer to the difference between 2002 and 2007, this provides us with 41 observations.

4 Empirical analysis

4.1 International trade and labor share on the province level

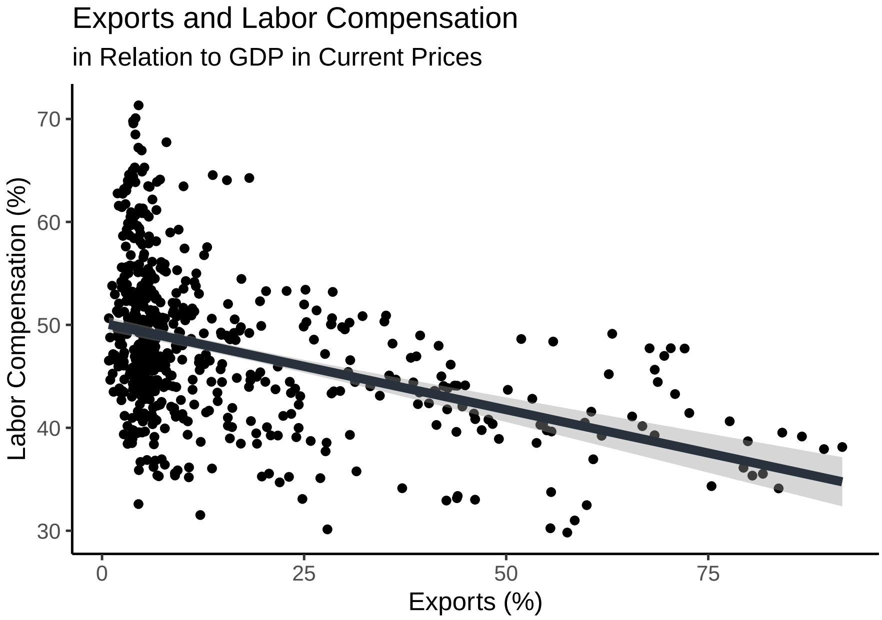
The negative relationship between aggregate export share and aggregate labor share (Figure 1) can also be seen in provincial data. Figure 2 shows a scatter plot of annual data for the 31 Chinese provinces. Time series plots can be found in Figure 8 in the appendix. We further explore the relationship between export share and labor share on the provincial level using a panel regression:

$$\ln LABS_{it} = \alpha_i + \tau_t + \beta_1 \ln EXPS_{it} + \varepsilon_{it}. \tag{5}$$

Table 1 shows the regression results. For all considered regressions, the negative relationship is confirmed ($\widehat{\beta}_1 < 0$). Column (1) shows the pooled OLS regression; the estimated coefficient $\widehat{\beta}_1$

[2] There are also other explanations for the decline in the labor share. Karabarbounis and Neiman (2014), for example, attribute most of the decline to an increase in capital intensity due to lower investment prices, see also Río and Lores (2019). Another driver may be reallocation to highly productive low-labor share firms (Kehrig and Vincent 2018). The statistically increasing capital share could also be a consequence of increasing income for intangibles (Chen et al. 2018). Doan and Wan (2017) show that trade is a determinant of labor share and that export depresses while import increases the labor share. Autor and Salomons (2018) and Peralta Alva and Roitman (2018) attribute a substantial fraction of the fall in the labor share to capital-labor substitution triggered by automation. Abdih and Danninger (2018) show for the USA that there is downward pressure on wages for individuals with occupations that are exposed to automation and offshoring, and in industries with a higher concentration of large firms.

Figure 2: Scatter plot of export share and labor share in Chinese provinces 1999-2017



Source: National Bureau of Statistics of China, own calculations.

Table 1: Labor share and export share (1999-2017)

	Dependent variable:						
	Log. Labor Share						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log. Export	−0.068	−0.119	−0.058	−0.040	−0.050	−0.021	−0.030
Share	(0.009)	(0.020)	(0.008)	(0.020)	(0.012)	(0.016)	(0.015)
	[−7.647]	[−6.020]	[−6.966]	[−1.970]	[−4.122]	[−1.312]	[−2.029]
Log. Share of						−0.416	
Secondary Industry						(0.064)	
						[−6.546]	
Log. GDP							−0.397
per capita							(0.051)
							[−7.767]
Individual FE	No	Yes	No	Yes	No	Yes	Yes
Time FE	No	No	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	No	No	Yes	No	No
Observations	589	589	589	589	589	589	589
R^2	0.185	0.136	0.176	0.021	0.240	0.229	0.282

Source: National Bureau of Statistics of China, own calculations. Panel Newey-West standard errors in parentheses, t-statistics in brackets.

is negative. Columns (2) to (4) present various fixed effects panel regressions: individual-fixed effects (2), time-fixed effects (3) and both time and individual-fixed effects (4). Furthermore, in column (5) we drop individual-fixed effects but include dummies for the economic regions of China (Northeast, East, West and Central). In all these cases, the estimated coefficient $\widehat{\beta}_1$ is negative.

While general macroeconomic effects for China as a whole are controlled for by including time-fixed effects into the regression and time-invariant province-level heterogeneity is taken into account by including individual-fixed effects, there may be further economic determinants of the labor share. In particular, the sectoral composition may be important as the reallocation of resources plays a major role in Chinese economic development (Zilibotti 2017, Manu et al. 2018). Therefore, we add the share of secondary industry in GDP as a control variable to the baseline two-ways fixed effect regression:

$$\ln LABS_{it} = \alpha_i + \tau_t + \beta_1 \ln EXPS_{it} + CONTROLS + \varepsilon_{it}. \tag{6}$$

Adding other control variables like GDP per capita does not change the main result. As can be seen in columns (6) and (7), the estimated export-share coefficient $\widehat{\beta}_1$ is still negative.

4.2 Endogeneity and dynamics

The regressions in Table 1 show that the labor share and the export share are negatively correlated. However, these regressions are not causal evidence that increasing trade integration leads to a lower labor share. In order to investigate a possible causal relationship we need exogenous variation in the export share. We propose the following approach to estimate the causal effect of increasing exports on the labor share: Similar to Autor and Salomons (2018), who estimate the effect of changes in total factor productivity on the labor share, we use the change in exports of other provinces to proxy the change in exports in a province. First, we compute for each of the 31 Chinese provinces the sum of exports for all other 30 provinces (Rest of Country RoC):

$$EXP_{i,t}^{RoC} = \sum_{j \neq i} EXP_{j,t}, \qquad i = 1, ..., 31, \quad t = 1999, \dots, 2017 \tag{7}$$

We use this sum $EXP_{i,t}^{RoC}$ as an instrument. For each province i, we regress the log difference in exports on the difference of log. exports in the rest of the country:

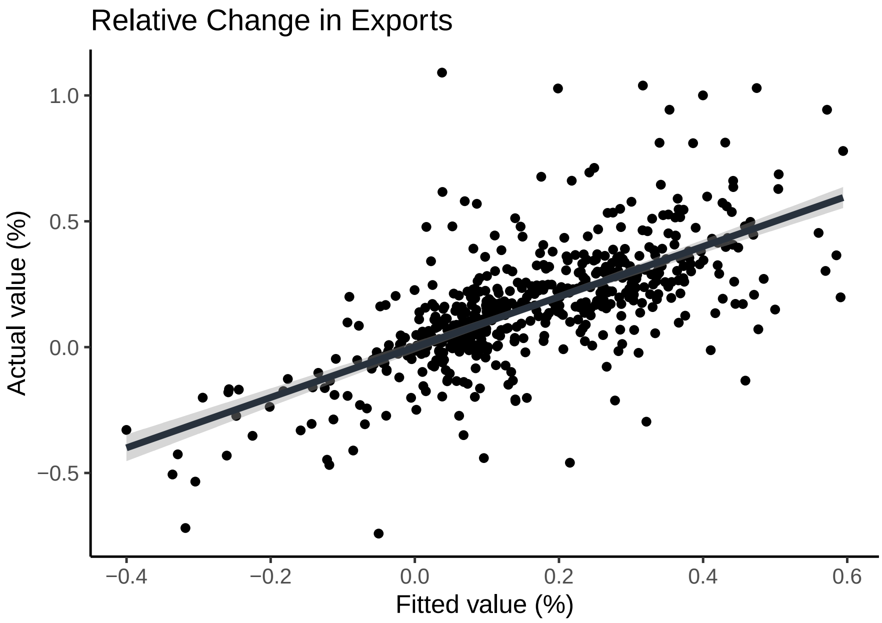
$$\Delta \ln EXP_{i,t} = \beta_{0,i} + \beta_{1,i} \Delta \ln EXP_{i,t}^{RoC} + \varepsilon_{i,t}, \qquad i = 1, ...31, \quad t = 2000, \dots, 2017 \tag{8}$$

and calculate the fitted values $\Delta \ln \widehat{EXP}_{i,t}$. Figure 3 shows that the fitted values are a reasonable predictor for the actual change in provincial exports. To further assess the predictive power of the fitted values, we regress the actual change in exports on the fitted values. The estimated intercept of this regression is zero and the estimated slope coefficient is one (t-statistic 21.73); the R^2 is 0.46, and the F-Statistic 472. Accordingly, the changes in exports of the rest of the country are a good predictor for changes in exports in individual provinces. Since theses fitted values are uncorrelated with province-specific developments, we can use them as exogenous variation in the change of exports of a province.

A second feature of the baseline regressions in Table 1 is that they only capture contemporaneous relationships. However, the effect of international trade on the functional income distribution may evolve over time. In order to account for dynamic adjustments, we estimate local projections (Jordà 2005, Jordà and Taylor 2016). The general framework is:

$$\begin{aligned} \ln Y_{i,t+h} - \ln Y_{i,t} &= \gamma_{1,h} \Delta \ln \widehat{EXP}_{i,t+1} \\ &+ \beta_{0,h} \Delta \ln Y_{i,t} + \beta_{1,h} \Delta \ln Y_{i,t-1} + \gamma_{0,h} \Delta \ln \widehat{EXP}_{i,t} \\ &+ \alpha_{i,h} + \tau_{t,h} + CONTROLS + \varepsilon_{i,t+h}, \end{aligned} \tag{9}$$

Figure 3: Scatter plot of actual changes in exports and fitted values (1999-2017)

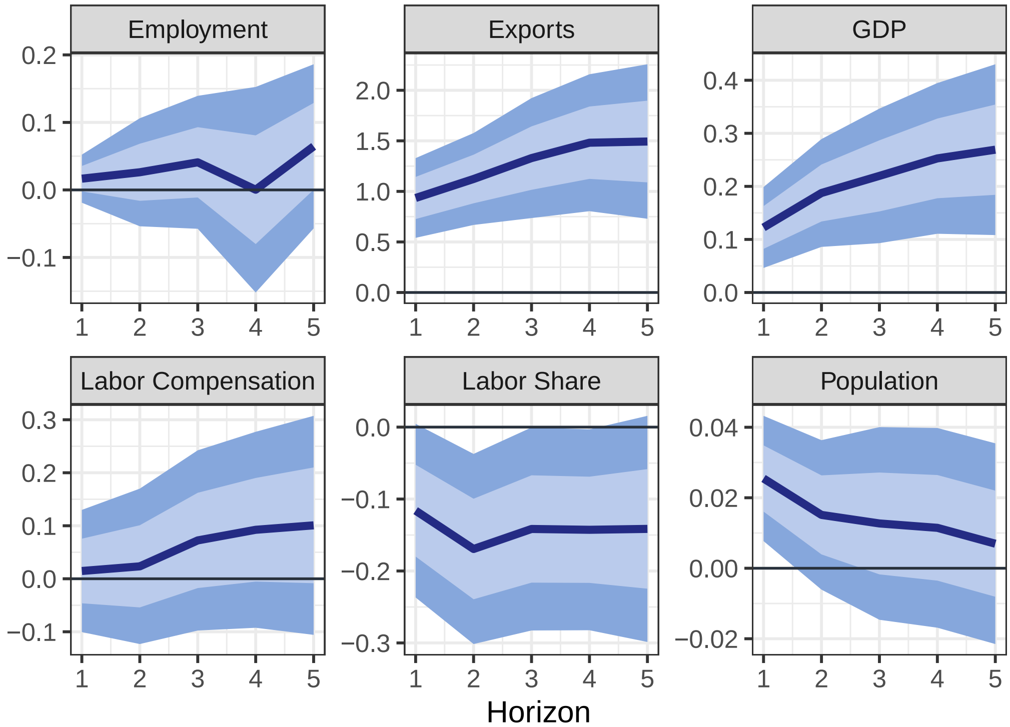


Source: National Bureau of Statistics of China, own calculations.

where Y denotes the endogenous variable of interest and $\gamma_{1,h}$ measures the dynamic effect of a change in exports on the endogenous variable for horizons $h = 1, \ldots, 5$. Two lags of the first differences of the endogenous variables and the lagged fitted value of the change in exports are included in order two allow for rich dynamics. Individual-fixed effects $\alpha_{i,h}$ account for province-specific trends in the endogenous variables, and time-fixed effects $\tau_{i,h}$ for aggregate determinants of changes in the endogenous variables. Additionally, we control for changes in the share of secondary industry in GDP in our local projections. The inclusion of this control variable has no substantial effect on the results.

Figure 4 shows the results for six endogenous variables: employment ($EMPL$), exports (EXP), GDP (GDP), labor compensation ($COMP$), labor share ($LABS$), and population (POP). First, it can again be seen that the proxy for provincial exports calculated from the change in exports in other provinces is reasonable. On impact, exports in a province increase one by one with the fitted value $\Delta \ln \widehat{EXP}_{i,t}$. In the following periods, exports adjust dynamically to a higher level. At the same time, GDP only increases by 0.1 percent on impact and by about 0.25 percent after five years. Accordingly, increases in exports are larger than increases in GDP implying an increasing export share. We do not control for GDP and do not use changes in the export share as independent variable in order to explicitly allow for changes in exports that are compensated by other GDP expenditure components (consumption, imports, investment). The increase in exports and in GDP is not accompanied by an increase in employment implying an increase in labor productivity. Similarly, Ouyang and Yuan (2019) report based on a prefecture-city level analysis that China's export surge between 2000 and 2007 has not contributed to a faster wage increase but has triggered labor allocation from the agricultural sector to the manufacturing sector. The increase in labor productivity is not completely passed through to labor compensation. Therefore, the labor share is decreasing after an exogenous shock to exports. Another interesting finding is that population is increasing after a positive change in exports reflecting the attractiveness of export-oriented provinces.

Figure 4: Local projections



Source: National Bureau of Statistics of China, own calculations. The figures show dynamic effects of a percentage change in exports on the endogenous variables. Bands are 70% and 95% confidence intervals calculated using panel Newey-West standard errors.

4.3 International trade and wage inequality on the prefecture-cities level

We now try to shed more light on the distributional effects within the group of workers of changes in export activities. Firstly, we divide the prefecture-level cities in our sample into cities that have been relatively open or relatively closed in 2007, that is before the worldwide financial crisis. Cities with a degree of openness (exports plus imports over gross domestic product) above the 60%-quantile are classified as open and those with a degree of openness below the 40%-quantile are classified as closed. In our baseline regressions, cities with a degree of openness between the 40%-quantile and the 60%-quantile are classified as "between" and excluded from the regression. Figure 5 shows a map with the resulting classification of cities in our sample. We then estimate the following difference-in-difference regression:

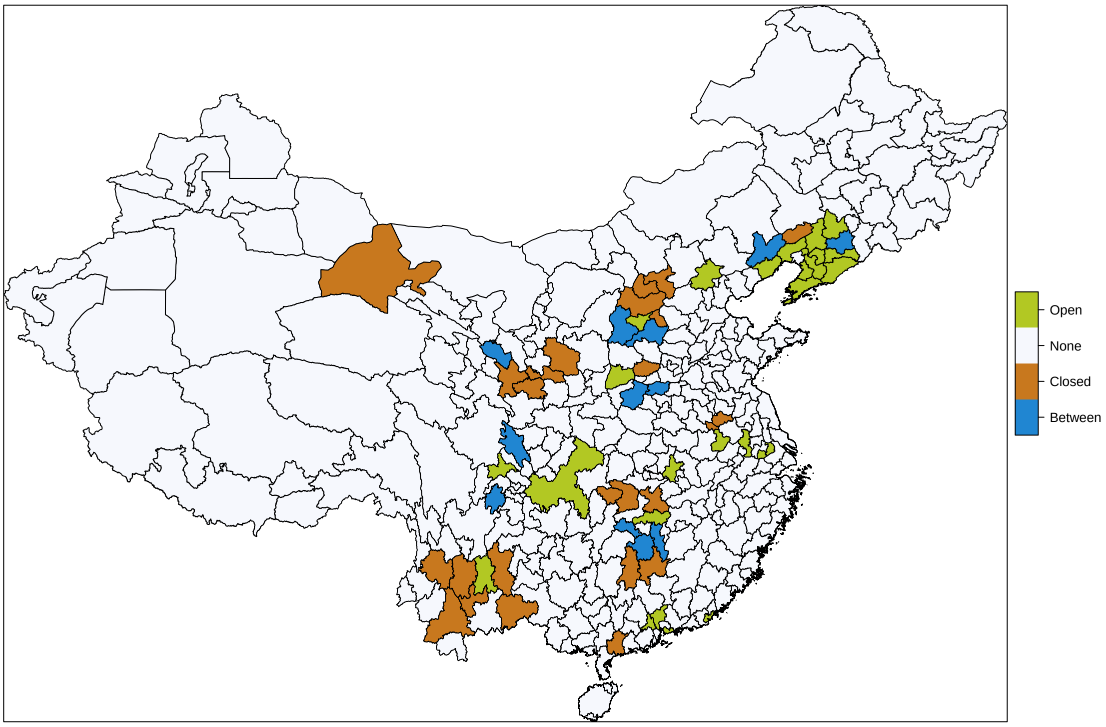
$$wageinequality_{i,t} = \beta_{i,0} + \beta_1 \times Open_{i,0} + \beta_2 \times I(t=1) + \gamma \times I(t=1) \times Open_{i,0}, \qquad t = 0, 1,$$

where $t = 0$ refers to the CHIP wave before the financial crisis, and $t = 1$ to the CHIP wave after the financial crisis, respectively. In first differences, this yields:

$$\Delta wageinequality_i = \beta_2 + \gamma \times Open_{i,0}.$$

Table 2 shows estimation results for three types of inequality measures. On the 10% significance level, we find evidence in favor of hour hypothesis that during the period from 2007 to 2013 the change in inequality has been lower for open prefecture-level cities. However, the coefficients become insignificant if lagged GDP per capita is added as a control variable which may be due to the small sample size. Furthermore, the connection between openness and change in inequality

Figure 5: Classification of prefecture-level cities as open or closed



Sources: CHIP, own calculations.

breaks down if the standard deviation of individual wage regression residuals (Dreger and Zhang 2017) is taken into account. In this case, also the constant is not significant anymore. Once we control for characteristics that explain individual wages, no general increase in inequality is left over. This implies that the unconditional change in inequality is driven by individual characteristics that we control for in the individual wage regressions. This raises the question which of the individual characteristics included in the wage regression is responsible for this finding. This will be explored in further research.

5 Conclusions

In this paper, we have explored the relationship between an increasing export orientation and the income distribution using Chinese regional data. We provide evidence that benefits from trade are not equally distributed to labor and capital but that the labor share declines if export shares go up and increases if export shares go down. This is compatible with the general finding that the Chinese export-led development strategy has been accompanied by increasing social and economic imbalances (Wagner 2018).

Using survey data for individual workers, we are also able to show that wage inequality and export shares are negatively related. Additionally, we find that the relationship between openness and the change in wage inequality disappears if the characteristics of individual workers are explicitly taken into account. This implies that observed changes in wage inequality can partially be explained by systematic changes in workers qualifications. The specific transmission channel from export-orientation to individual characteristics of the labor force is an important area of future

Table 2: Inequality and openness

	Dependent variable:					
	Gini		Log. SD		Res. SD	
	(1)	(2)	(3)	(4)	(5)	(6)
$Open$	-0.054^{*}	-0.054	-0.112^{*}	-0.057	0.015	-0.018
	(0.032)	(0.045)	(0.066)	(0.093)	(0.056)	(0.079)
$GDPPC$		0.0002		-0.057		0.034
		(0.032)		(0.067)		(0.057)
Constant	0.060^{***}	0.058	0.178^{***}	0.720	0.019	-0.300
	(0.021)	(0.309)	(0.043)	(0.639)	(0.036)	(0.542)
Observations	50	50	50	50	50	50
Adjusted R^2	0.037	0.017	0.037	0.031	-0.019	-0.033
Note:				*p<0.1; **p<0.05; ***p<0.01		

Sources: CHIP, own calculations.

research.

6 Appendix

Additional tables

Table 3: List of Chinese province-level divisions

Code	***Province***	***Code***	***Province***
AH	*Anhui Province*	*LN*	*Liaoning Province*
BJ	*Beijing Municipality*	*MO*	*Macau Special Administrative Region**
CQ	*Chongqing Municipality*	*NM*	*Inner Mongolia Autonomous Region*
FJ	*Fujian Province*	*NX*	*Ninxia Hui Autonomous Region*
GD	*Guangdon Province*	*QH*	*Qinghai Province*
GS	*Gansu Province*	*SC*	*Sichuan Province*
GX	*Guangxi Zhuang Autonomous Region*	*SD*	*Shandong Province*
GZ	*Guizhou Province*	*SH*	*Shanhai Municipality*
HA	*Henan Province*	*SN*	*Shaanxi Province*
HB	*Hubei Province*	*SX*	*Shanxi Province*
HE	*Hebei Province*	*TJ*	*Tianjin Municipality*
HI	*Hainan Province*	*TW*	*Taiwan Province*
HK	*Hong Kong Special Administrative Region**	*XJ*	*Xinjiang Uyghur Autonomous Region*
HL	*Heilongjiang Province*	*XZ*	*Tibet Autonomous Region*
HN	*Hunan Province*	*YN*	*Yunnan Province*
JL	*Jilin Province*	*ZJ*	*Zhejiang Province*
JS	*Jiangsu Province*		

Source: `https://en.wikipedia.org/wiki/Provinces_of_China`. Hong Kong and Macau are not included in the analysis (as indicated by the * in the table).

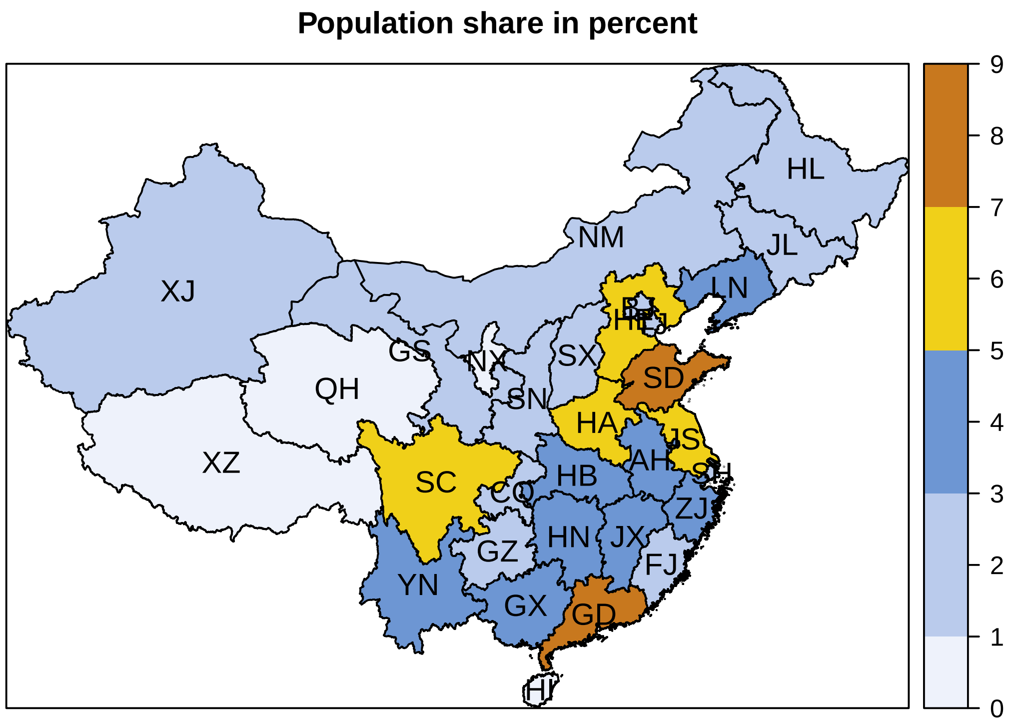
Table 4: Number of cities included in CHIP

Year(s)	2013	2007	2002	1999	1995	1988	88+07	02+07	07+13
Number of cities	123	143	56	4	21	41	26	41	85

Notes: Numbers for single years refer to the number of prefecture-level cities included in the survey. Numbers for combinations of two years refers to the number of prefecture-level cities which are included in two consecutive surveys.

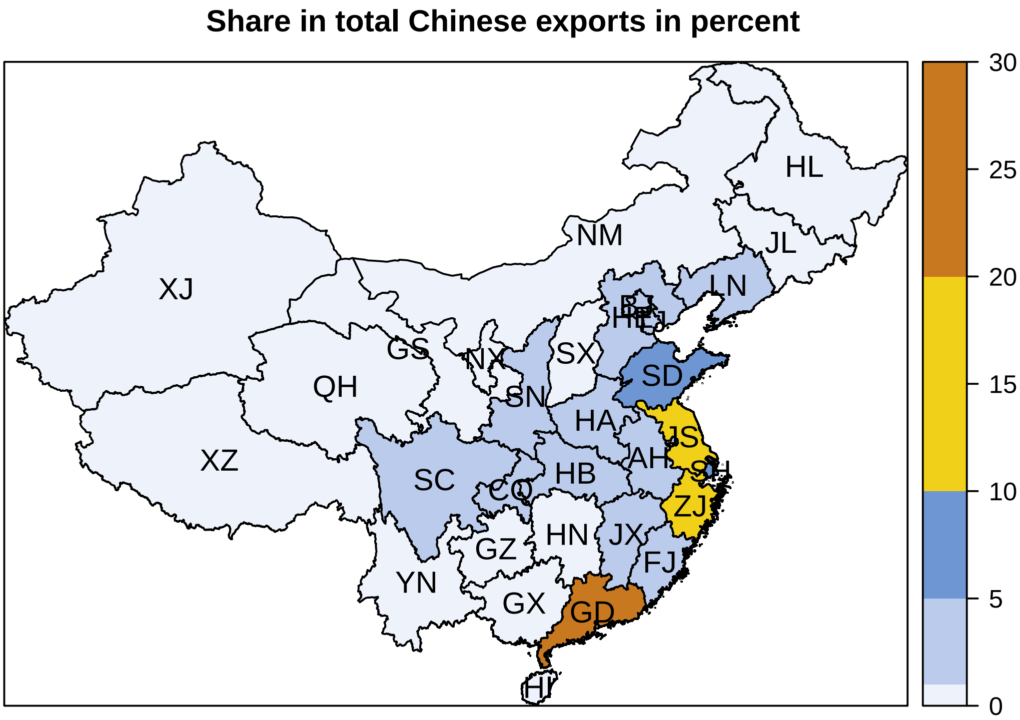
Additional figures

Figure 6: Population distribution across Chinese provinces



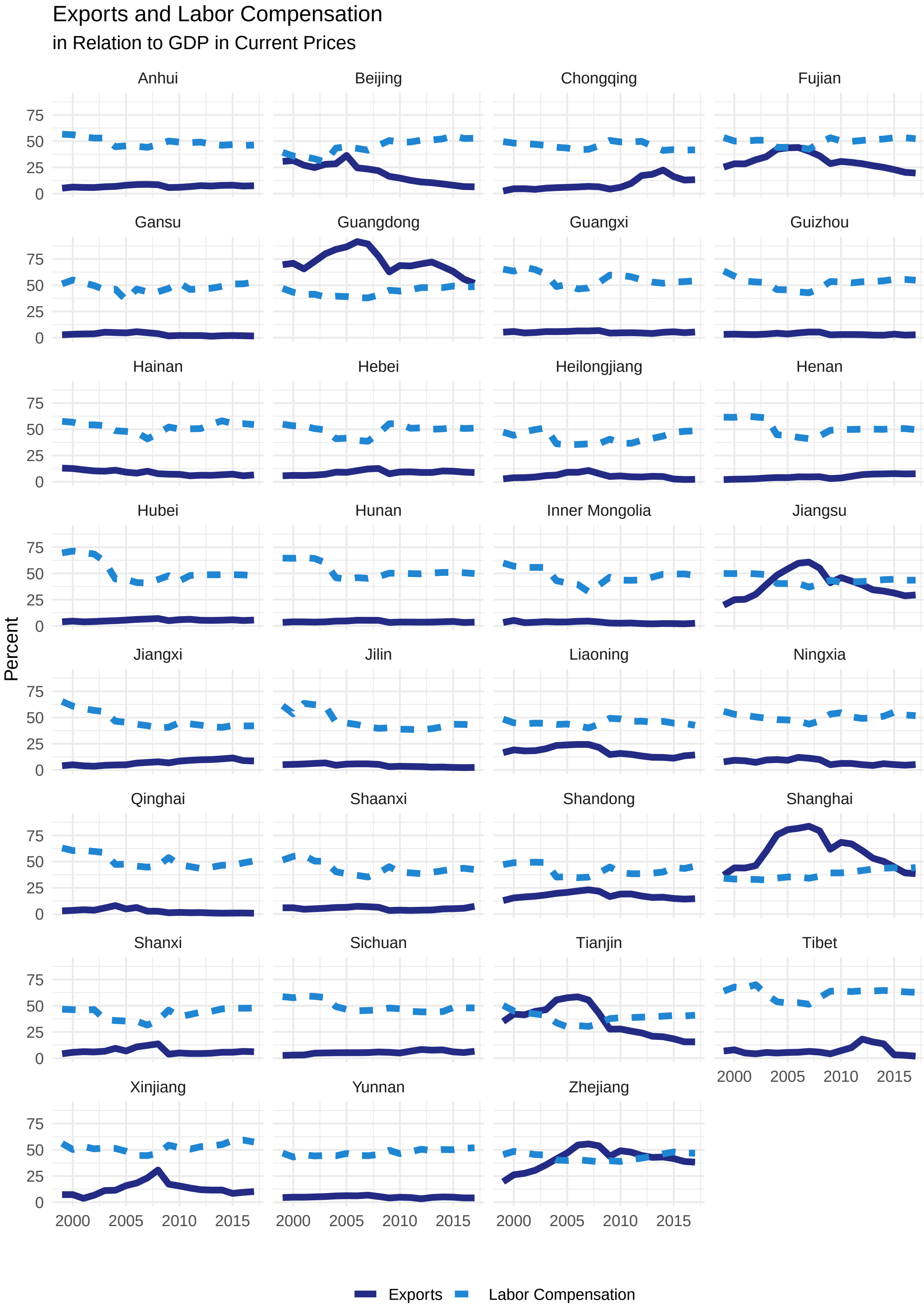
Sources: National Bureau of Statistics of China, own calculations.

Figure 7: Export distribution across Chinese provinces



Sources: National Bureau of Statistics of China, own calculations.

Figure 8: Export an labor share in Chinese provinces 1999-2017



Sources: National Bureau of Statistics of China, own calculations.

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