WAGE INEQUALITY AMONG CHINESE PROVINCES, 1990-2007

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Abstract:

Inequality among Chinese provinces more than doubled between 1990 and 2007, notably in the early 1990s when China was increasingly opening its economy to international competition. This increased competition has had a large impact on wage inequality among domestic firms but almost none on foreign firms. To investigate the evolution of interprovincial wage inequality and the causes behind its increase over the last two decades, we compute the respective importance in inequality between and within these two regions. Within-region inequality accounts for the majority of overall wage inequality, but the between-region component has grown over the last two decades. Overall the results suggest that factors enhancing labor productivity – higher educational attainment, larger manufacturing sector, and larger capital stock endowment per worker – favor wage increases. These factors are furthermore more relevant in coastal provinces. Similarly, better endowment in transportation infrastructure boosts productivity and wages in coastal provinces, but has the opposite effect in inland provinces where better infrastructure endowment might induce further agglomeration of economic activity.

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1. Introduction

The growth of the Chinese economy has been unprecedented. In the past 20 years, China's gross domestic product (GDP) grew at an annualized rate of 13.2%, more than double the rate of growth of the United States at 5.5% and the world at 6.1%. As a result, China has surpassed Germany to become the world's third largest economy. China's stunning economic growth, while lifted the country from a per capita GDP of only 1112 yuan (299 USD) in 1987 to 18934 yuan (2490 USD) in 2007, has benefited its provinces inequitably. More specifically, Table 1 shows that between 1987 and 2007, Fujian's per capita GDP grew by 52.3% which moved it from near the median in per capita income among 29 provinces to top 8 in ranking. Over the same period, Guizhou's per capita income declined by 25.6%, leading it to maintain the least-wealthy-province title. In 1987, Shanghai topped the provincial per capita income at 7.1 times that of Guizhou with 4396 yuan. Shanghai's advantage over Guizhou grew slightly in 2007 with 66367 yuan or a multiply of 8.6 over Guizhou's.

Given the income disparity across this rapidly developing Asian economy, it is important to examine the determinants of regional inequality to better suggest policies to alleviate the unequal distribution of benefits from economic growth. The purpose of this paper is to analyze changes in the provincial wage structures in China between 1990 and 2007. The focus is the differences in average wage paid by the four main firm types in China (state-owned enterprises, collectively-owned enterprises, overseas-Chinese corporations, and foreign-funded enterprises). Table 2 displays the average wage by firm type in 2007 across the 29 provinces. Foreign-funded enterprises (FFE) have the highest national average at 27942 yuan, followed by state-owned enterprises (SOE) with 26620 yuan. Of the four types listed, collectively-owned enterprises (COE) offered the lowest average wage at 15595 yuan. Overseas-Chinese corporations (OCC) also pay below the average across all firm types (24932 yuan) with 21952 yuan. More importantly, table 2 also shows that the wages by firm types vary significantly across provinces. In particular, coastal provinces earned higher average wages regardless of firm types as compared to inland provinces (figure 2).

The combination of higher wages paid by FFEs relative to other firm types and an uneven distribution of wages among the coastal and inland provinces may lead to greater inequality as China becomes more globalized. As Figure 1 shows, the average FFE wages have been consistently higher than other firm types since the mid 1990s. Moreover, the share of SOES

employment in total employment have been decreasing while the FFE employment share has been increasing, albeit slowly.

Currently there is a growing research examining China's inequality. The literature on China's uneven regional distribution can be roughly characterized by two categories. The first provides detailed measures of inequality (Yao, 2004; Yang, 1999; Tsui, 1996; Wei and Ma, 1996; and Tsui, 1993). Research strand in this category include Chang (2002) using the Gini coefficient and Akita (2003) applying the two-stage nested Theil decomposition. Most of the authors find evidence of increasing disparity (Akita, 2003; Fujita and Hu, 2001; Gustafsson and Shi, 2001; Kanbur and Zhang, 1999; Khan et. al, 1999; and Ahmad and Wang, 1991). In a comparative analysis, Kanbur and Zhang (1999) find that between 1983 and 1995 the rural–urban inequality remained relatively stable while the inland–coastal differential increased by several fold.

The second category consists of empirical analysis, varying in their focus on the relationship between rural-urban or inter-urban inequality (Meng et al., 2007; Sicular et al., 2007; Dong, 2005; Liu, 2005; Meng et al., 2005; Chen and Ravallion, 2004; Chang, 2002; and Goh et al., 2008) or regional disparity (Wan, 2004; Yao and Zhang, 2001; Chen and Fleisher, 1996, and Jian et al., 1999). Examining coastal versus inland regions, Fujita and Hu (2001) find that the former has a strong positive effect on the growth rate of per capita GDP. Furthermore, through their descriptive analysis, they find evidence to suggest that globalization as measured by export and FDI increased the regional disparity. Likewise, Tsui (2007) and Wan et al. (2007) noted that the unequal foreign investments attracted by the provinces contributed to interprovincial inequality in the 1990s. Using provincial data, Fleisher et al. (2009) find increases in capital and educated worker have a positive impact on regional GDP; whereas Candelaria et al. (2009) determine that differences in quality of labor and industry composition contributed to the provincial wage inequality. According to Demurger (2001) differences in infrastructure, particularly in transportation, also leads to interprovincial disparities.

Our paper is more closely in line with the second strand. In particular, we use provincial data to analyze wage inequality in China between 1990 and 2007. We contribute to the literature first by focusing on wage inequality instead of inequality in per capita income which depends not only on labor productivity but also on governmental transfers. Our analysis also updates previous papers' findings regarding regional disparity between the coastal and inland provinces.

To that end, we investigate the relative importance of within-and between-regional inequality in overall inequality. One of our main contributions to the literature consists on distinguishing the level of inequality by firm types. To our best knowledge, our paper constitutes the first attempt to conduct such a decomposition. Furthermore, the analysis presented below goes beyond the mere description of inequality trend and decomposition. We also examine which factors explain the growing wage inequality among Chinese provinces. Our results suggest that factors enhancing labor productivity – higher educational attainment, larger manufacturing sector, and larger capital stock endowment per worker – favor wage increases. These factors are furthermore more relevant in coastal provinces. Relative to the inland provinces, the coastal region also benefit more from the openness of China to the global economy.

The remainder of this paper is organized as follows. In the following section, we describe the data, show the trends in the wage inequality, and provide the decomposition analysis. In section 3, we set up the theoretical framework and report the method of analysis. We present and interpret the empirical findings in section 4 and provide concluding comments in section 5.

2. Interprovincial wage inequality

Before we discuss the trends in the interprovincial wage inequality, we provide a brief description of the data.

2.1 Data

To estimate the wage inequality, we use provincial data from 1990 to 2007 compiled by the National Bureau of Statistics. The main sources of our data are the China Labour Statistical Yearbook and the China Statistical Yearbook. We supplement the two national statistical yearbooks with various provincial statistical yearbooks and China Data Online. Table 3 gives summary statistics for the variables used in the paper, while table A3 in the appendix gives their definitions and sources.

Nominal wage data as well as all the other nominal variables used in the empirical analysis presented in section 3 are deflated using provincial CPI as our price index. Year 1978 is

used as our reference year. The bilateral trade data between the Chinese provinces and their foreign trading partners is from the Customs General Administration of the People's Republic of China. The exchange rate is available online (http://research.stlouisfed.org/fred2/categories/282) from the Economic Research of the Federal Reserve Bank of St. Louis. We averaged the monthly exchange rates to obtain the annual rates.

We omit from our sample data for Chonqing which was raised to the status of province in 1997 (the city was previously included in Sichuan), and data for Tibet because many of the variables used in the analysis are missing for this province.

2.2 Trends in wage inequality

There is a great variety of measures available to inequality researchers, each with its merits and shortcomings. Researchers (Cowell, 2000; Bourguignon,1979; Litchfield, 1999) yet agree on a set of axioms that an inequality measure should fulfill: the Pigou-Dalton transfer principle, income scale dependence, the principle of population, and the symmetry principle. The Gini Index, the General Entropy measure with parameter 1 (GE(1), also referred as income-weighted Theil index), and the General Entropy measure with parameter 0 (GE(0), also referred as population-weighted Theil index) satisfy these four axioms, and are therefore used in this paper to assess the level of inequality among Chinese provinces. We also report the value of the coefficient of variation (COV) which is commonly used to measure sigma-convergence (the dispersion in wages). The formulas used to compute these measures are reported in appendix A.1.

Figure 3 illustrates the temporal patterns of the inequality in the average provincial wages. All of the indices show remarkably similar trends. Wage inequality rose significantly between 1990 and 2007. When measured with the Gini index, inequality rose by 44%, while the GE(1) index increased by 140%. Furthermore, inequality rose at a faster pace in the first half of the 1990s, and stabilized in the 2000s. When we distinguish the evolution of wage inequality by types of enterprise (figures 4 to 7), it becomes clear that the aforementioned increase in inequality was driven by the same trend in inequality in wages paid by SOEs and, to a lesser extent, by COEs. Inequality increased by 274% (GE(1) index) for SOEs and by 116% (GE(1)

index) for COEs. While the increase occurred at a constant pace for SOEs, it was larger for COEs during the 1990s.

Wage inequality in the private sector (OCC and FFE) was significantly more stable (figures 6-7). For both types of firms the initial decrease in inequality between 1992 and 1993 is caused by a change in the number of provinces used to compute the inequality measures[1]. Between 1993 and 2007, inequality in FFE wages fell by 16% (using the GE(1) index), whereas inequality in OCC wages increased by 46%.[2] Despite the fall in inequality in FFEs and the smaller increase in OCC funded firms, inequality remained significantly higher in these firms than in SOEs and COEs (see table 3).

2.3 Decomposition of wage inequality

The conventional inequality measures presented in section 2.2 capture the overall spread of provincial wage distribution. Wage inequality among Chinese provinces can be further analyzed by decomposing inequality within and between broader geographical regions, and within and between types of enterprises. The set of provinces is, following the Chinese convention (Fujita and Hu, 2001; Kanbur and Zhang, 1999), further partitioned into two regions—Coast and Inland[3]. This partition allows us to examine the relevance of geography in explaining interprovincial wage inequality. As a robustness check and similar to Tsui (1993, 2007), we performed the same decomposition exercise with 3 regions (Coast, Interior, West). This change did not affect the conclusions presented below.

The decomposition of inequality is carried out using the GE(1) index. The Generalized Entropy class of measures can easily be decomposed into within-group and between-group inequality: $I_{total} = I_{between} + I_{within}$. Figures 8 to 12 plot the shares of within-region and between-region inequality for the overall average provincial wage, and for each type of enterprise. Most

[1] FFE wage data were missing for 6 provinces and HK wage data were missing for 7 provinces.
[2] Heilongjiang omitted due to a quadrupling of the average wage between 2004 and 2005.
[3] The coastal region includes: Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan. The inland region includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang.

interprovincial inequality exists within each of the two regions. Yet, the share of within-region inequality has fallen over time. Overall, within-region component has accounted for 63 to 97% of wage inequality (figure 10). This share has declined to 63% between 1990 and 1999**,** before increasing back to 70% by 2007.

The decomposition of inequality for SOEs (figure 9) looks relatively similar to the overall trend. The within-region component accounted for 97% of inequality in 1990 and dropped to 56% by 2005. The rebound between 2005 and 2007 was smaller than for overall inequality. The evolution of within and between-region inequality is significantly different for COEs (figure 10). While within-region inequality also equaled 85% in 1990, its share rapidly dropped to 58.7% by 1993**,** before continuously increasing back to 86.7% throughout the period covered in this paper. The evolution of both components is quite similar for FFEs and OCCs (once we exclude the outlier data from Heilongjiang). Within-region inequality accounted for 80% of total inequality in 1992 (figures 11 and 12). After dropping to 64-65% in 1993, it rose back to 81% by 2007 for FFEs and 75% for OCCs. What do we learn from this decomposition? While the literature has often studied and documented the income gap between coastal and interior provinces[4], a greater divide exists within the coastal and interior regions than between them. This focus on the coast-interior gap might be explained by the rising importance of between-region inequality, at least of overall wages and SOE wages.

When we decompose total inequality based on firm types (figure 13), we find that the majority of inequality exists within types of enterprises (SOE, COE, FFE, OCC), than between them. The within-component was equal to 80% in 1992, declined to 55% by 1998, and climbed back to 80% by 2007. The magnitude of wage inequality within each firm type highlights the importance of provincial characteristics to understand the extent of wage inequality in China.

[4] See Tsui (1993), Fleisher and Chen (1997), Jian et al. (1996), Kanbur and Zhang (1999), and Fujita and Hu (2001) among others.

3. What causes the increase in wage inequality?

In this section, we look for explanations for the persistence and even increase in wage inequality among Chinese provinces. To better understand what causes interprovincial wage inequality, we need to identify how wages are determined. We begin by deriving some explanatory variables from a simple neoclassical framework.

3.1 Theoretical framework

Our empirical framework is based on a simple neoclassical model. Let national output, *Y*, be a function of labor (*L*), human capital stock (*H*), physical capital stock (*K*), and technology (*A*). Using a Cobb-Douglas production function, we can express national output as

$$Y = A(HL)^{1-\alpha} K^{\alpha} \tag{1}$$

In equilibrium, real wage (*w*) should equal workers' marginal product of labor (MPL).

$$w = AH^{1-\alpha}\left(\frac{K}{L}\right)^{\alpha} \tag{2}$$

Based on this framework, a province's average real wage should be increasing with technological progress, its labor force's human capital stock (such as its education), and its per worker endowment in physical capital.

3.2 Specifications

Based on the framework laid out in section 3.1, wages disparities among Chinese provinces could be explained first by disparities in human capital. Though an imperfect measure, we proxy human capital by the educational attainment of the labor force (Candelaria et al, 2009; Wan, 2004), and more specifically, by the percentage of employed workers who have completed college or a higher level of education (*college*). According to equation 2, larger physical capital stocks per worker (*K/L*) improve labor productivity, and therefore should be positively related to

average wages[5]. The capital stock series is obtained by using the perpetual inventory method with data on investment in fixed assets. We also distinguish the effects of public infrastructures measured as km of highways (*highways*) scaled by provincial area. Démurger (2001) finds that transport facilities are essential to understand income disparities between Chinese provinces.

Like Candelaria et al (2009), we also control for the sectoral composition of the economy with the share of the manufacturing sector in total real GDP (*manuf*). If labor productivity is higher in the manufacturing sector than in the primary and tertiary sectors, then a higher output share in manufacturing should be associated with higher wages. Even though our real wages variables are obtained by deflating nominal series by provincial Consumer Price Indices, they are not adjusted for cross-section differences in provincial costs of living. Wages might therefore be higher in coastal provinces in part because goods and services are more expensive in these provinces. In 2007, per capita consumption expenditures in coastal provinces were 38% and 45% higher than in central and western provinces respectively.[6] We control for disparities in costs of living with real per capita consumption expenditures (*cons*). This variable also captures the strength of labor demand. Given that the demand for labor is derived from the demand for goods and services, everything else constant, higher per capita consumption expenditures trigger into higher labor demand and thus into higher wages.

Finally, we test whether globalization is responsible for the increase in interprovincial wage inequality. Fujita and Hu (2001) find that globalization, measured by export and foreign direct investments (FDI), has been a critical factor in explaining the increase in per capita GDP inequality between 1985 and 1994. This finding is corroborated by Wan et al. (2007) who use data for 1987-2001 and capture globalization with FDI and trade variables. As reported in table 4, coastal provinces have received considerably more FDI per worker than interior provinces. Similarly, the economies of the former rely more on exports (which account for almost 30% of GDP) than the latter. Fujita and Hu (2001) argue that globalization affects the economic development of Chinese provinces for three reasons that they call the multiplier effect, the technology transfer effect, and the competition effect. FDI and exports boost economic growth by providing the provincial economies with additional capital stock that embodies newer

[5] Wan (2004) and Wan et al.(2007)

technology and with additional demand for domestic production. Globalization has also exposed Chinese firms to more competition, leading them to improve their production efficiency and to cut production costs (Fan, 2002).

We capture the effects of globalization with three variables: the amount of FDI in 1978 yuan received by each province, scaled by total employment (*FDI*), the share of exports in provincial GDP (*export*), and a measure of market access (*market access*). Market access is an economic geography concept proposed by Redding and Venables (2004) to measure a location's access to foreign market of export demand. To measure market access, we develop a 2SLS procedure to estimate for each province an appropriately distance-weighted measure of the location of its export demand. This approach was adapted by Ma (2006) to Chinese data. To estimate market access, in stage one, we estimate a gravity equation of Chinese exports by province with year and country dummies. The estimated coefficients from the gravity equation are then used in stage 2 to calculate the market access variable by applying the following equation:

$$\hat{MA}_{i,t} = \sum_{j=1}^{J} e^{\hat{\eta}_j} * IntDis_{ij}^{\hat{\lambda}_1} * ExtDis_{ij}^{\hat{\lambda}_2} \qquad (3)$$

where $\hat{MA}_{i,t}$ denotes province's market access in year t, and $\hat{\lambda}_1$ and $\hat{\lambda}_2$ are the coefficients on internal and external distances (estimated in the first stage), respectively and $\hat{\eta}_j$ denotes the country dummy.

To ease the interpretation of the results and to account for the different units in which the variables are expressed, we estimate the following log-linear specification:

$$\begin{aligned} \ln(wage_{j,i,t}) = {} & \varphi_1 + \varphi_2 \ln(K/L_{i,t}) + \varphi_3 \ln(highways_{i,t}) + \varphi_4 \ln(cons_{i,t}) \\ & + \varphi_5 manuf_{i,t} + \varphi_6\, export_{i,t} + \varphi_7 \ln(marketaccess_{i,t}) + \varphi_8\, FDI_{i,t} \\ & + \varphi_9\, college_{i,t} + t_t + \varepsilon_{i,t} \end{aligned} \qquad (4)$$

where j = overall, SOE, COE, FFE, OCC, and t_t is a time trend to address the risk of spurious results. Table 5 provides summary statistics for the variables used in the estimations.

Equation 4 is estimated with OLS. Moreover, since the focus of the paper is to explain wage disparities between provinces, we do not estimate equation 4 with fixed effects which eliminate variations across provinces and capture only variations within each province. Since within-region inequality accounts for the majority of inequality existing among Chinese provinces, we also run the analysis separately for coastal provinces and then for interior provinces.. The results are presented in the next section.

4. Results

Before we discuss the results, we note that our data exhibit multicollinearity between several of the regressors (see table 6) listed in equation 4, which prevents us from including them all at once. Consequently, the OLS estimation results reported in table 7a exclude capital stock per worker and per capita consumption expenditure which are used in table 7b. Given the strong collinearity between our three measures of globalization - market access, export ratio to GDP, and FDI – they are included separately in table 7a. This allows us to check the robustness of our results.

The first five columns of table 7a present our results with market access as our measure of globalization, while columns 6 to 10 use the export ratio to GDP. For brevity, we omit the results using exports since they are similar to the other two measures of globalization. Our results are quite robust to the use of these different proxies of globalization. Wages tend first to be higher in provinces with larger manufacturing sectors. As indicated in column 1, a one percentage-point increase in the share of employment in the manufacturing sector is associated with a 0.89% increase in real wages. Comparing the coefficients on this variable for the four types of enterprises (columns 2 to 5), this positive relation seems to be stronger for SOES and smaller for FFEs. Regarding the effect of education, we find that, as predicted by the neoclassical model, the higher the percentage of the labor force with a college degree, the higher the wage. Using again the results of column 1, when the share of the labor force with a higher education degree increases by one percentage point, wages increase on average by 1.21%. When we distinguish the impact of education on wage determination by types of firm, this impact is the highest in FFEs and OCCs, and the lowest in COEs (coefficient is 3 times smaller). Unlike

education and the sectoral composition of employment which matter for all types of enterprises, infrastructure endowment affects wages only in the private sector (FFEs and OCCs). A one percent increase in the province's infrastructure endowment is associated with a 0.2-0.3% increase in real wages.

The results presented in table 7a also corroborate the hypothesis that globalization enhances Chinese firms' productivity and wages.[7] The coefficients on our three measures of globalization are all positive and statistically significant. Using the results for overall wages in columns 1, and 6, we find that a one percent increase in market access and in FDI increase wage 0.04% and 0.05% respectively, while a one-percentage point increase in the share of exports in GDP increases wages by 0.5%. Interestingly, the impact of globalization is larger for SOEs, regardless of the measure used. This result could indicate that the competition effect of globalization was stronger on SOEs than on OCCs and FFEs because the latter ones had already been exposed to international competition. The open-economy policy adopted by China has thus required more adjustment from SOEs.

Turning to table 7b, wages are also increasing with physical capital stock: a one-percent increase in the capital per worker endowment is associated with a 0.1% increase in wages. Capital stock endowment has a higher impact on productivity and thus on wages in OCCs and in FFEs, and a smaller impact in COEs. Finally, changes in costs of living significantly impact wages. On average (column 1 of table 7b), when consumption expenditures increase by 1%, wages increase by 0.64%. The effect of cost of living is smaller for OCCs (0.55% increase instead of 0.74% increase for SOEs and COEs and 0.72% for FFEs). Because there could be some issues with the causality direction when one regresses wages on consumption expenditure (one could indeed argue that consumption expenditure might increase thanks to an increase in wage), we regressed wages on one-year-lagged consumption expenditures. Lagging the regressor did not alter the results.

Since most of interprovincial inequality exists within the coastal and interior regions, we want to check whether inequality within each region is driven by the same factors as those described above. Tables 8a and 8b report the results for the coastal provinces and tables 9a and

[7] Results with exports are available upon request.

9b report the results for inland provinces. Wage inequality in each region is driven by different factors.

In coastal provinces, the effects of education and of the economy sectoral composition are even stronger than for the overall sample. This could illustrate the higher efficiency of the manufacturing sector in coastal provinces, and also the fact that the production in these provinces uses more skilled labor than in the rest of the country. The impact of education is especially strong in FFEs where a one-percentage point increase in the share of workers holding a college degree is associated with a 2% increase in wages.

Wages are positively related with highway endowments, regardless of the type of enterprise, and even more so than what we found in table 7a. A 1% increase in a province's endowment in highways is associated with a 0.03% increase in wages. The effect is even stronger for OCCs. However the coefficient loses its significance once we control for globalization with FDI. This could imply that the highway variable captures the effect of FDI on productivity and wage (the correlation between FDI and highway is 0.68 for coastal provinces and 0.17 for the entire sample). Foreign firms are more likely to invest in provinces with good transportation infrastructures because these infrastructures allow these firms to access a larger Chinese domestic market and/or to export their productions more easily.

The impact of globalization depends on how we control for it. Wages tend to increase with more exports and FDI. FDI are more important for FFE wage (column 15): a 1% increase in FDI is associated with a 0.09% increase in overall wages, but with a 0.12% increase in FFE wage. When we control for globalization with the market access variable (columns 1 to 5), the coefficients are insignificant for all types of firms but OCCs for which the effect is negative. Because the market access variable is partly based on the distance between the provinces and the foreign markets where they export their productions, there is less variations among coastal provinces.

As reported in table 8b, disparities in physical capital stock endowments helps explaining wages disparities, notably for OCCs and FFEs for which a 1% increase in capital stock endowment is associated with a 0.28% increase in wages. On the other hand, consumption expenditures are less relevant for wages paid in these firms than for SOEs and COEs, where a

1% increase in consumption expenditure is almost matched by the same increase in wages (0.94% and 0.815 respectively).

As shown in table 9a and 9b, wage disparities among inland provinces are driven by a different set of factors. A larger industrial sector is still positively associated with wages, but the magnitude of the effect is smaller, notably for OCCs and FFEs. This might reflects the lower productivity of this sector in inland provinces. This lower productivity could stem from lower production efficiency and/or to the specialization in industries with lower value-added. This latter point could also explain why the higher-education attainment of the labor force is not relevant to explain wage disparities among these provinces.

One puzzling result is the effect of infrastructure on wages. Larger highway endowments are negatively associated with wages for all types of firms except FFEs. On average, a 1% increase in the infrastructure endowment is associated with a 0.02% decrease in wages. In the new economic geography literature pioneered by Krugman (1991), reduction in transaction and transportation costs could lead to the spatial concentration of increasing-returns-to-scale industries in core provinces, while the periphery specializes in industries with lower productivities (i.e. lower wages). Moreover, as shown by Martin and Rogers (1995), if the infrastructure constructed facilitate trade between provinces, more infrastructure might feed the agglomeration process and lead to higher concentration of economic activity, which would increase interprovincial wage disparities. As explained by Martin (1998), "facilitating inter-regional trade between the two regions [one poor and one richer] is like removing trade barriers that give a relative monopolistic power to firms located in the poor region which protects them from external competition. Once these barriers disappear there is less reason to locate in the poor region." In the case of FFEs, the coefficient might remain positive because their smaller number might make less sensible to agglomeration force.

Globalization usually has a negative effect on these provinces' wages. A 1%-increase in a province's market access is associated with a 0.06% decrease in overall wages (column 1). The negative effect is larger for COEs. This could indicate that they might adapt less well to increasing competition than other types of firms. Unlike other firms, wages in OCCs are not significantly affected by globalization. The results are similar when globalization is proxied by

FDI. When we use the export variable, all the coefficients are positive but statistically insignificant except for COEs.

As reported in table 9b, wages increase with capital stock per worker. This is especially true for SOEs and COEs, whereas capital stock is less relevant for explaining wage disparities in private firms. Similarly, while consumption expenditures are still positively related to wages, their influence on wage determination is larger in inland provinces for all types of enterprises except SOEs.

5. Conclusion

This paper investigates the evolution of interprovincial wage inequality and the causes behind its increase over the last two decades. Inequality among Chinese provinces more than doubled between 1990 and 2007, notably in the early 1990s when China was increasingly opening its economy to international competition. This increased competition has had a large impact on wage inequality among SOEs and COES but almost none on FFEs and OCCs which by nature had never been shielded from that competition. To address the documented development gap between coastal and inland provinces, we compute the respective importance in inequality between and within these two regions. Within-region inequality accounts for the majority of overall wage inequality, but the between-region component has grown over the last two decades.

Overall the results of our regression analysis suggest that factors enhancing labor productivity – higher educational attainment, larger manufacturing sector, and larger capital stock endowment per worker – favor wage increases. These factors are furthermore more relevant in coastal provinces. These provinces also benefit more from the openness of China to the global economy than inland provinces where the increased competition has not necessarily led to higher production efficiency. Similarly, better endowment in transportation infrastructure boosts productivity and wages in coastal provinces, but has the opposite effect in inland provinces where better infrastructure endowment might induce further agglomeration of economic activity. This would limit the demand for labor in some provinces, thus causing wages to fall. Given our results, the policy implication is that it is necessary to improve the production

efficiency of inland provinces, so that larger endowments in factors of production can translate into higher productivity and higher wages; thereby, reducing the great divide between coastal China and the interior of the country.

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Table 1: Provincial Per Capita GDP, 1987 and 2007

	Per Capita GDP (in 1987 yuan)			As Per Cent of National Average		
	1987	2007	Change	1987	2007	Change
National Average	**1112**	**18934**	**16.0**	**100.0**	**100.0**	**0**
Coastal						
Beijing	3,336	58204	16.4	300.0	307.4	2.5
Tianjin	2,682	46122	16.2	241.2	243.6	1.0
Liaoning	1,917	25729	12.4	172.4	135.9	-21.2
Shanghai	4,396	66367	14.1	395.3	350.5	-11.3
Jiangsu	1,462	33928	22.2	131.5	179.2	36.3
Zhejiang	1,470	37411	24.4	132.2	197.6	49.5
Fujian	999	25908	24.9	89.8	136.8	52.3
Shandong	1,131	27807	23.6	101.7	146.9	44.4
Guangdong	1,450	33151	21.9	130.4	175.1	34.3
Hainan	939	14555	14.5	84.4	76.9	-9.0
Average			**19.1**			**17.9**
Interior						
Hebei	921	19877	20.6	82.8	105.0	26.8
Shanxi	962	16945	16.6	86.5	89.5	3.4
Inner Mongolia	1,025	25393	23.8	92.2	134.1	45.5
Jilin	1,269	19383	14.3	114.1	102.4	-10.3
Heilongjiang	1,335	18478	12.8	120.1	97.6	-18.7
Anhui	842	12045	13.3	75.7	63.6	-16.0
Jiangxi	729	12633	16.3	65.6	66.7	1.8
Henan	756	16012	20.2	68.0	84.6	24.4
Hubei	1,031	16206	14.7	92.7	85.6	-7.7
Hunan	818	14492	16.7	73.6	76.5	4.0
Guangxi	607	12555	19.7	54.6	66.3	21.5
Sichuan	702	12893	17.4	63.1	68.1	7.9
Guizhou	546	6915	11.7	49.1	36.5	-25.6
Yunnan	653	10540	15.1	58.7	55.7	-5.2
Shaanxi	794	14607	17.4	71.4	77.1	8.0
Gansu	764	10346	12.5	68.7	54.6	-20.5
Qinghai	1,018	14257	13.0	91.5	75.3	-17.7
Ningxia	922	14649	14.9	82.9	77.4	-6.7
Xinjiang	1,053	16999	15.1	94.7	89.8	-5.2
Average			**16.1**			**0.5**

Table 2: Provincial Average Wage by Firm Type, 2007

	All	SOE	COE	OCC	FFE
National Average	**24932**	**26620**	**15595**	**21952**	**27942**
Coastal					
Beijing	46507	50524	20379	61048	59054
Tianjin	34938	37654	23465	26742	33854
Liaoning	23202	24748	12242	21520	21826
Shanghai	49310	55547	30923	29802	45304
Jiangsu	27374	33411	18837	20966	24636
Zhejiang	31086	48857	25462	22415	22563
Fujian	22283	28011	18853	17496	19717
Shandong	22844	27290	15636	18283	20268
Guangdong	29443	36396	16328	20278	27510
Hainan	19357	18937	12069	14983	20879
Average	**30634**	**36138**	**19419**	**25353**	**29561**
Interior					
Hebei	19911	20900	12443	19156	20758
Shanxi	21525	22309	14141	10582	20696
Inner Mongolia	21884	22822	14338	16402	23674
Jilin	20513	21688	11135	14625	25616
Heilongjiang	19386	19635	10779	72534	19859
Anhui	22180	22428	15340	15477	20138
Jiangxi	18400	19624	12574	11630	13020
Henan	20935	22345	15850	20212	22101
Hubei	19818	21971	12921	15014	23043
Hunan	21534	23336	16071	16718	20117
Guangxi	21898	23369	14266	15422	25966
Sichuan	21312	24365	15176	18791	22138
Guizhou	20668	22106	16893	15455	19607
Yunnan	20481	22884	14054	17922	21430
Shaanxi	21296	21653	11289	19032	24163
Gansu	20987	22314	12979	17181	22995
Qinghai	26166	29683	13228	15557	10967
Ningxia	26210	26687	25362	17121	26742
Xinjiang	21434	21369	17780	17142	21422
Average	**21397**	**22710**	**14559**	**19262**	**21287**

Table 3: Average value of the GE(1) and Gini indices by type of enterprise, 1990-2007

	Overall Wage	SOE Wage	COE Wage	FFE Wage	OCC Wage	OCC Wage*
GE(1) index	0.0229	0.0256	0.0269	0.0417	0.0466	0.0356
Gini index	0.118	0.124	0.129	0.156	0.159	0.147

Note: OCC wage inequality calculated without Heilongjiang

Table 4: Measures Globalization in Coastal and Inland provinces, 1990-2007

Average Value	Coastal	Interior
FDI per worker (in 1978 yuan)	1525.63	183.19
Export share in GDP (%)	28.73	5.98
Market access (unit?)	15.95	2.57

Table 5: Summary Statistics, 1990-2007

Variable	Obs	Mean	Std. Dev.	Min	Max
College Education	348	8.00	7.45	0.80	55.80
Capital Stock per Worker	522	9366.77	8612.96	1174.47	58097.77
Highways	521	0.47	0.85	0.00	9.89
Industry Share in GDP	522	37.19	9.54	11.20	59.24
Per Capita Consumption	522	1056.16	435.37	370.26	2908.63
Export Share in GDP	522	15.39	18.77	1.54	165.07
FDI per Worker	522	738.68	1221.23	0.07	9276.31
Market Access	522	8.11	22.86	0.02	263.40

Table 6: correlation matrix

	College Education	Capital Stock per Worker	Highways	Industry Share in GDP	Per capita Con-sumption	Export Share in GDP	FDI per Worker	Market access
College Education	1							
Capital Stock per Worker	0.5890	1						
Highways	0.0980	0.1900	1					
Industry Share in GDP	-0.0703	0.2624	0.1884	1				
Per capita Consumption	0.4128	0.7418	0.2445	0.355	1			
Export share in GDP	0.3245	0.642	0.1159	0.2963	0.6673	1		
FDI per Worker	0.4681	0.8346	0.1635	0.1897	0.5938	0.7656	1	
Market Access	0.3736	0.3961	0.0615	0.0964	0.4422	0.6129	0.5155	1

Table 7a: Determinants of Wage Inequality-Globalization

Dependent Variable = ln(Wage)										
	All	SOE	COE	OCC	FFE	All	SOE	COE	OCC	FFE
	1	2	3	4	5	6	7	8	9	10
Highways	0.0011	-0.002	-0.0102	0.0266**	0.0399***	-0.006	-0.0083	-0.0114	0.0159	0.0324***
	[0.0072]	[0.0079]	[0.0080]	[0.0107]	[0.0103]	[0.0074]	[0.0081]	[0.0082]	[0.0114]	[0.0111]
Industry Share	0.0089***	0.0119***	0.0101***	0.0078***	0.0031**	0.0080***	0.0108***	0.0095***	0.0068***	0.0021
	[0.0011]	[0.0014]	[0.0016]	[0.0015]	[0.0014]	[0.0011]	[0.0014]	[0.0016]	[0.0015]	[0.0015]
College Education	0.0121***	0.0103***	0.0048**	0.0147***	0.0159***	0.0115***	0.0098***	0.0050***	0.0134***	0.0151***
	[0.0015]	[0.0018]	[0.0019]	[0.0024]	[0.0021]	[0.0014]	[0.0017]	[0.0019]	[0.0023]	[0.0020]
Market Access	0.0390***	0.0453***	0.0383***	0.0231***	0.0333***					
	[0.0066]	[0.0073]	[0.0089]	[0.0085]	[0.0085]					
FDI						0.0473***	0.0504***	0.0331***	0.0429***	0.0437***
						[0.0065]	[0.0068]	[0.0078]	[0.0083]	[0.0084]
Trend	0.1043***	0.1066***	0.0969***	0.0715***	0.0730***	0.1054***	0.1079***	0.0979***	0.0723***	0.0740***
	[0.0024]	[0.0027]	[0.0036]	[0.0043]	[0.0036]	[0.0025]	[0.0028]	[0.0037]	[0.0042]	[0.0037]
Constant	4.8756***	4.7718***	4.6228***	5.6812***	5.9965***	4.6146***	4.4917***	4.4334***	5.4524***	5.7573***
	[0.0675]	[0.0785]	[0.1014]	[0.1253]	[0.1003]	[0.0734]	[0.0884]	[0.1065]	[0.1361]	[0.1119]
Observations	348	348	348	348	348	348	348	348	348	348
R-squared	0.877	0.861	0.766	0.656	0.714	0.883	0.865	0.763	0.669	0.723

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7b: Determinants of Wage Inequality

Dependent Variable = ln(Wage)					
	All Wage	SOE Wage	COE Wage	OCC Wage	FFE Wage
	1	2	3	4	5
Capital Stock	0.1160***	0.1030***	0.0698***	0.1793***	0.1354***
	[0.0133]	[0.0146]	[0.0178]	[0.0221]	[0.0241]
Consumption Expenditure	0.6448***	0.7452***	0.7494***	0.5507***	0.7247***
	[0.0397]	[0.0476]	[0.0482]	[0.0662]	[0.0736]
Trend	0.0404***	0.0331***	0.0220***	0.0261***	0.0280***
	[0.0021]	[0.0024]	[0.0030]	[0.0045]	[0.0038]
Constant	1.2091***	0.8491***	0.9045***	1.5969***	0.8849**
	[0.1863]	[0.2298]	[0.2514]	[0.2777]	[0.3558]
Observations	522	519	519	456	459
R-squared	0.936	0.923	0.858	0.768	0.761

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8a: Determinants of Inequality Among Coastal Provinces

Dependent Variable = ln(Wage)										
	All	SOE	COE	OCC	FFE	All	SOE	COE	OCC	FFE
	1	2	3	4	5	6	7	8	9	10
Highways	0.0345***	0.0362***	0.0217***	0.0856***	0.0378***	-0.0051	0.0071	-0.0001	0.0470***	-0.0214
	[0.0066]	[0.0076]	[0.0067]	[0.0083]	[0.0127]	[0.0075]	[0.0084]	[0.0083]	[0.0113]	[0.0152]
Industry Share	0.0126***	0.0152***	0.0115***	0.0054***	0.0026	0.0129***	0.0154***	0.0115***	0.0062***	0.0034*
	[0.0014]	[0.0018]	[0.0014]	[0.0020]	[0.0022]	[0.0013]	[0.0016]	[0.0013]	[0.0020]	[0.0020]
College Education	0.0140***	0.0110***	0.0032	0.0156***	0.0205***	0.0117***	0.0094***	0.002	0.0131***	0.0169***
	[0.0019]	[0.0024]	[0.0021]	[0.0028]	[0.0028]	[0.0018]	[0.0024]	[0.0021]	[0.0028]	[0.0027]
Market Access	0.0067	0.0116	0.0196	-0.0414***	-0.0213					
	[0.0117]	[0.0142]	[0.0137]	[0.0138]	[0.0182]					
FDI						0.0965***	0.0746***	0.0617***	0.0686***	0.1276***
						[0.0130]	[0.0149]	[0.0180]	[0.0177]	[0.0195]
Trend	0.1014***	0.1110***	0.0924***	0.0632***	0.0686***	0.1024***	0.1122***	0.0939***	0.0616***	0.0684***
	[0.0034]	[0.0043]	[0.0048]	[0.0042]	[0.0047]	[0.0029]	[0.0039]	[0.0047]	[0.0040]	[0.0042]
Constant	4.9103***	4.6697***	4.8052***	6.1650***	6.2006***	4.1774***	4.1087***	4.3490***	5.6064***	5.2070***
	[0.0804]	[0.0951]	[0.1135]	[0.0921]	[0.1318]	[0.1306]	[0.1573]	[0.1962]	[0.1693]	[0.1823]
Observations	144	144	144	144	144	144	144	144	144	144
R-squared	0.915	0.902	0.835	0.829	0.76	0.935	0.912	0.844	0.835	0.804

Table 8b: Determinants of Inequality Among Coastal Provinces

Dependent Variable = ln(Wage)					
	All Wage	SOE Wage	COE Wage	OCC Wage	FFE Wage
	1	2	3	4	5
Capital Stock	0.1128***	0.0644***	-0.0071	0.2777***	0.2897***
	[0.0181]	[0.0225]	[0.0251]	[0.0171]	[0.0322]
Consumption Expenditure	0.7716***	0.9407***	0.8093***	0.3927***	0.3679***
	[0.0576]	[0.0761]	[0.0675]	[0.0577]	[0.0606]
Trend	0.0361***	0.0306***	0.0231***	0.0176***	0.0293***
	[0.0032]	[0.0037]	[0.0034]	[0.0037]	[0.0046]
Constant	0.418	-0.142	1.1625***	1.9841***	1.9491***
	[0.2946]	[0.3789]	[0.3585]	[0.3236]	[0.3357]
Observations	216	216	216	192	192
R-squared	0.958	0.938	0.885	0.883	0.858

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 9a: Determinants of inequality Among inland Provinces

Dependent Variable = ln(Wage)										
	All	SOE	COE	OCC	FFE	All	SOE	COE	OCC	FFE
	1	2	3	4	5	6	7	8	9	10
Highways	-0.0223***	-0.0209**	-0.00003	-0.0419**	0.0593***	-0.0352***	-0.0384***	-0.0239*	-0.0438**	0.0519***
	[0.0084]	[0.0096]	[0.0131]	[0.0198]	[0.0157]	[0.0080]	[0.0099]	[0.0123]	[0.0181]	[0.0146]
Industry Share	0.0025***	0.0049***	0.0040*	0.0084***	0.0008	0.0043***	0.0069***	0.0079***	0.0093***	0.0030**
	[0.0009]	[0.0013]	[0.0023]	[0.0026]	[0.0017]	[0.0009]	[0.0014]	[0.0024]	[0.0022]	[0.0015]
College Education	0.002	0.0018	0.0049	0.0011	0.0049	-0.0001	-0.0009	0.0007	0.0004	0.0031
	[0.0014]	[0.0016]	[0.0030]	[0.0036]	[0.0031]	[0.0014]	[0.0016]	[0.0030]	[0.0034]	[0.0031]
Market Access	-0.0615***	-0.0744***	-0.1272***	-0.0246	-0.0617***					
	[0.0110]	[0.0126]	[0.0202]	[0.0257]	[0.0205]					
FDI						-0.0346***	-0.0345***	-0.0822***	-0.0259	-0.0556***
						[0.0078]	[0.0091]	[0.0127]	[0.0200]	[0.0160]
Trend	0.1232***	0.1216***	0.1168***	0.0953***	0.0902***	0.1225***	0.1202***	0.1159***	0.0958***	0.0909***
	[0.0024]	[0.0024]	[0.0043]	[0.0061]	[0.0048]	[0.0025]	[0.0026]	[0.0046]	[0.0057]	[0.0041]
Constant	4.5751***	4.5580***	4.2085***	5.0103***	5.6587***	4.7391***	4.7355***	4.5781***	5.1105***	5.8830***
	[0.0624]	[0.0753]	[0.1347]	[0.2039]	[0.1356]	[0.0734]	[0.0912]	[0.1352]	[0.2552]	[0.1425]
Observations	204	204	204	204	204	204	204	204	204	204
R-squared	0.936	0.925	0.81	0.631	0.723	0.933	0.918	0.808	0.634	0.731

Table 9b: Determinants of Inequality Among Inland Provinces

Dependent Variable = ln(Wage)					
	All Wage	SOE Wage	COE Wage	OCC Wage	FFE Wage
	1	2	3	4	5
Capital Stock	0.1302***	0.1490***	0.1754***	0.1000***	0.0464
	[0.0203]	[0.0207]	[0.0268]	[0.0334]	[0.0404]
Consumption Expenditure	0.6423***	0.7183***	0.9980***	0.6261***	1.0932***
	[0.0786]	[0.0703]	[0.0876]	[0.1386]	[0.1214]
Trend	0.0364***	0.0252***	-0.0023	0.0361***	0.0184
	[0.0055]	[0.0051]	[0.0065]	[0.0100]	[0.0113]
Constant	1.1997***	0.8119*	-1.1858**	1.5574**	-0.6533
	[0.4513]	[0.4154]	[0.5488]	[0.6853]	[0.6571]
Observations	306	303	303	264	267
R-squared	0.916	0.913	0.844	0.7	0.71

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1: Average Wage by Firm Type, 1995 - 2007

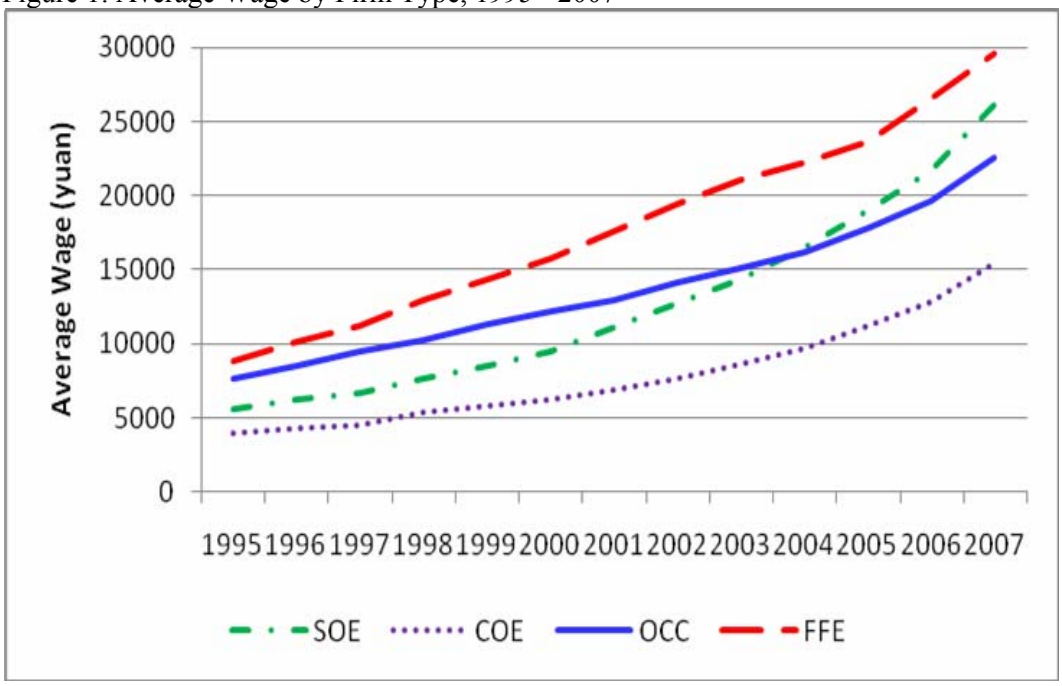


Figure 2: Employment Share by Firm Type, 1995 - 2007

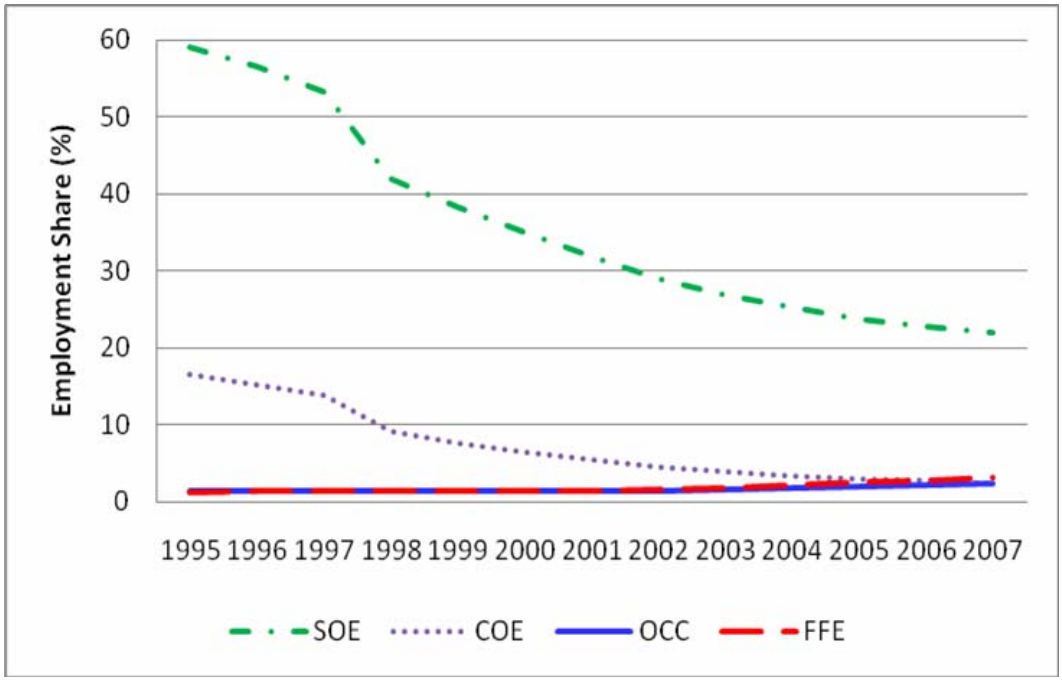


Figure 3: Temporal patterns of Real Wage Inequality, 1990-2007

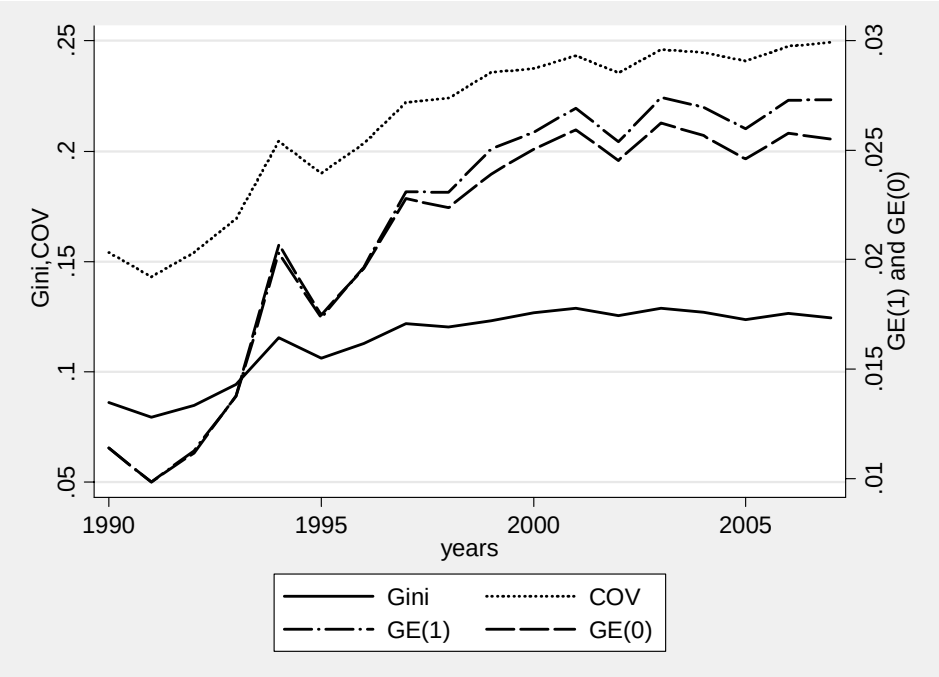


Figure 4: Temporal patterns of Real SOE Wage Inequality, 1990 - 2007

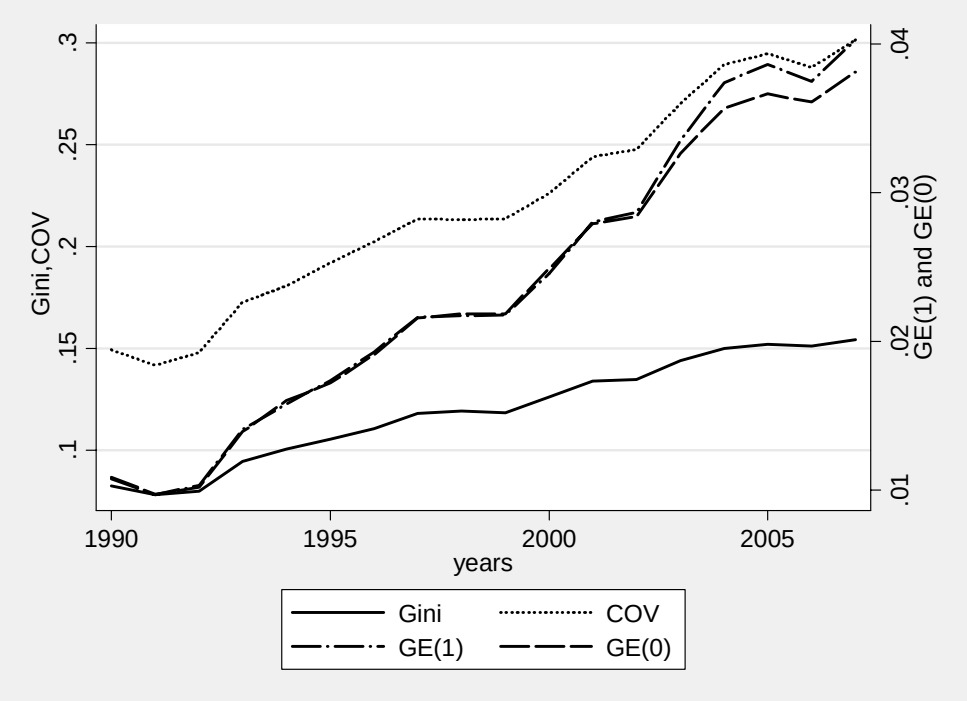


Figure 5: Temporal patterns of Real COE Wage Inequality, 1990 - 2007

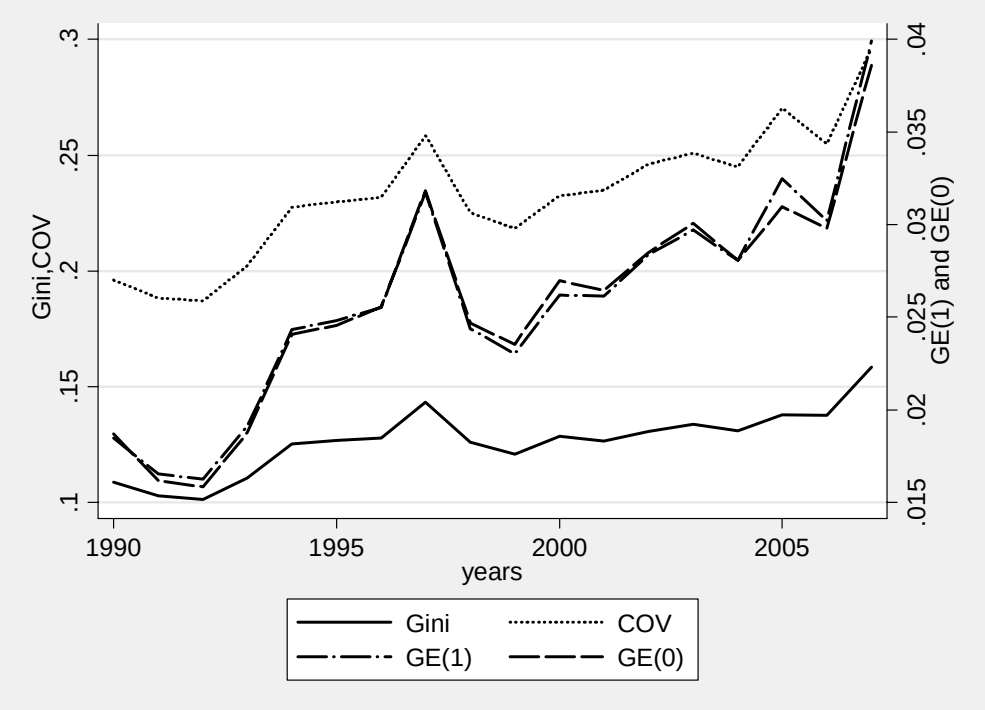


Figure 6: Temporal patterns of Real FFE Wage Inequality, 1990 - 2007

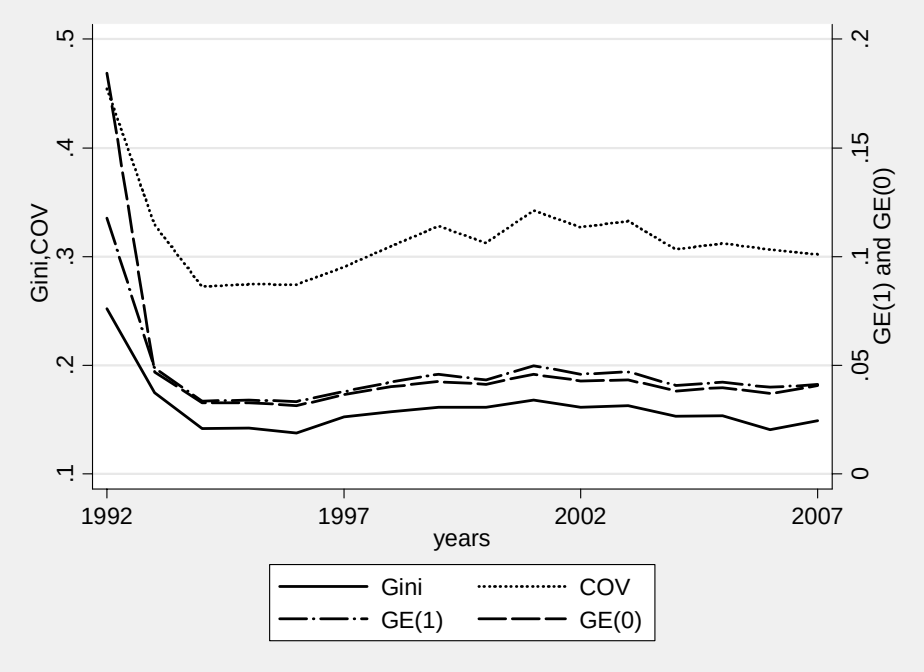
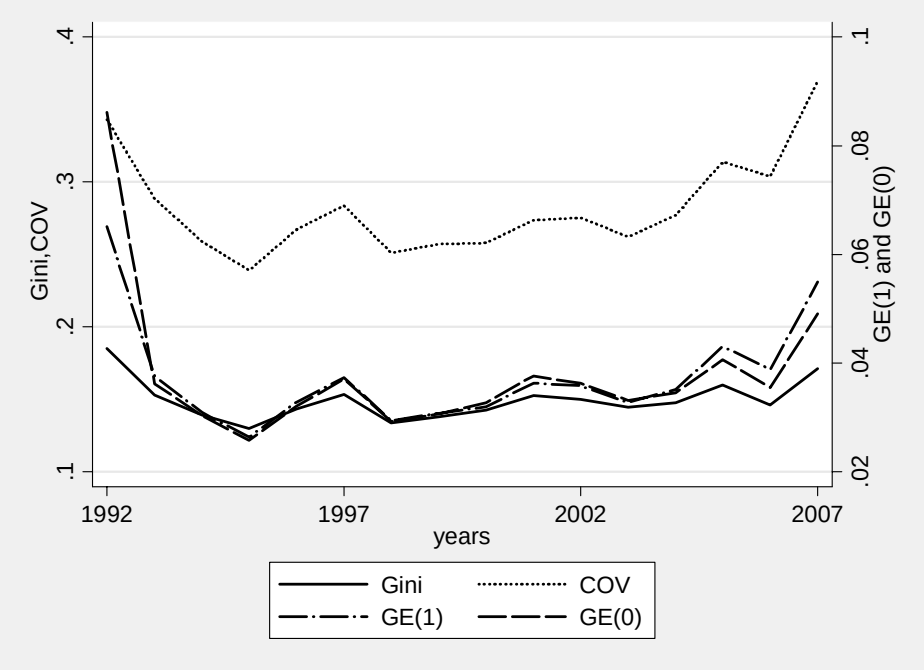


Figure 7: Temporal patterns of Real OCC Wage Inequality, 1990 - 2007



Note: OCC wage inequality calculated without Heilongjiang

Figure 8: Within and Between Region Overall Wage Inequality, 1990-2007

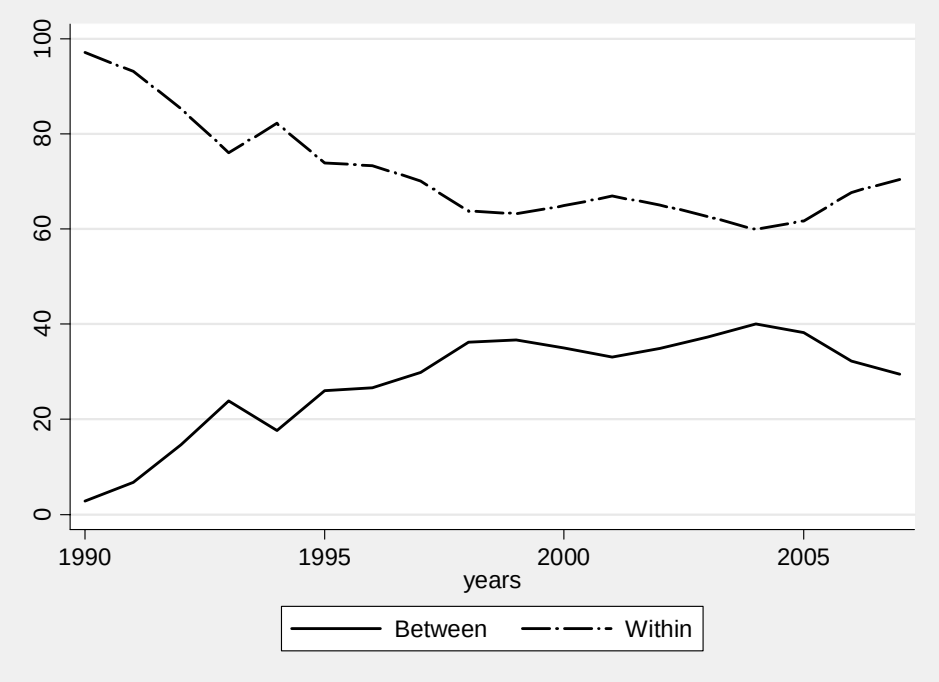


Figure 9: Within and Between Region SOE Wage Inequality, 1990-2007

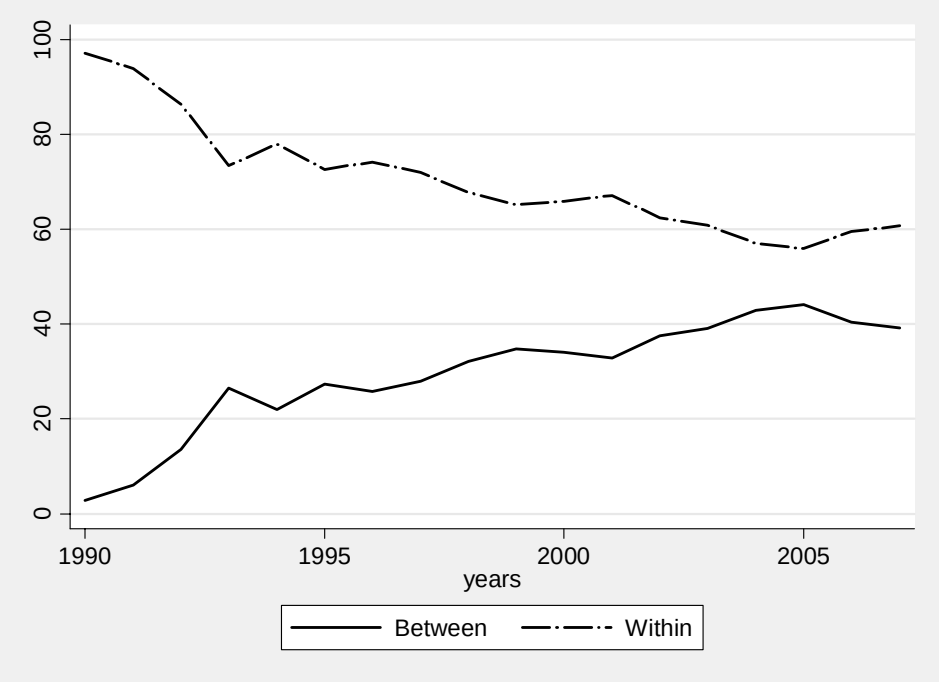


Figure 10: Within and Between Region COE Wage Inequality, 1990-2007

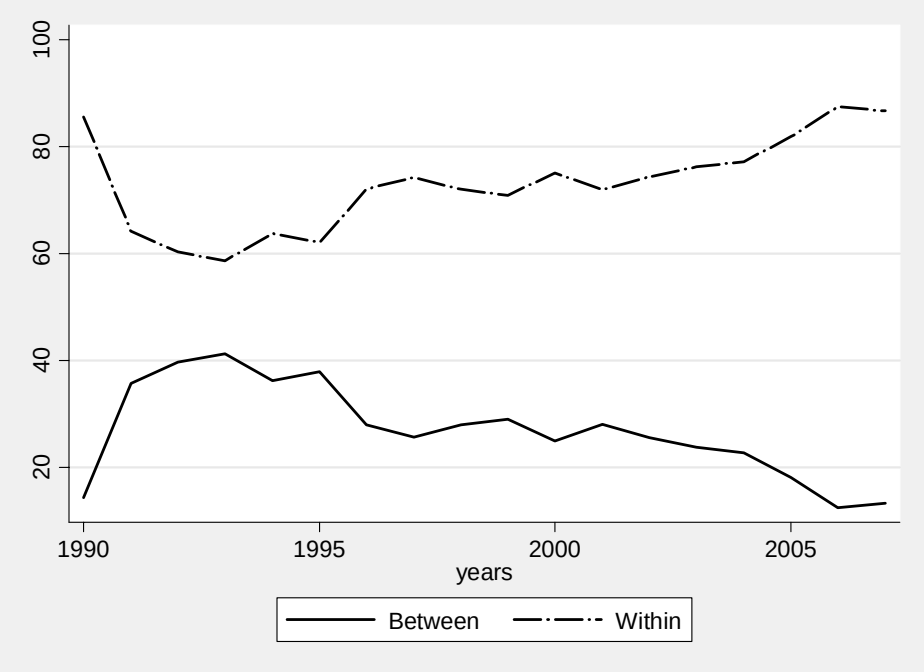


Figure 11: Within and Between Region FFE Wage Inequality, 1990-2007

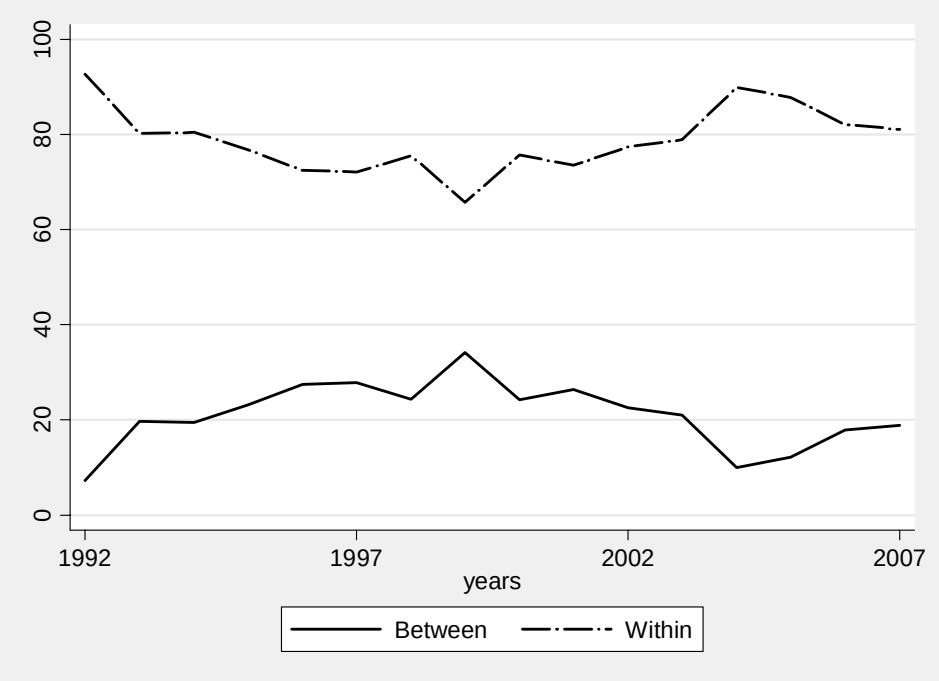
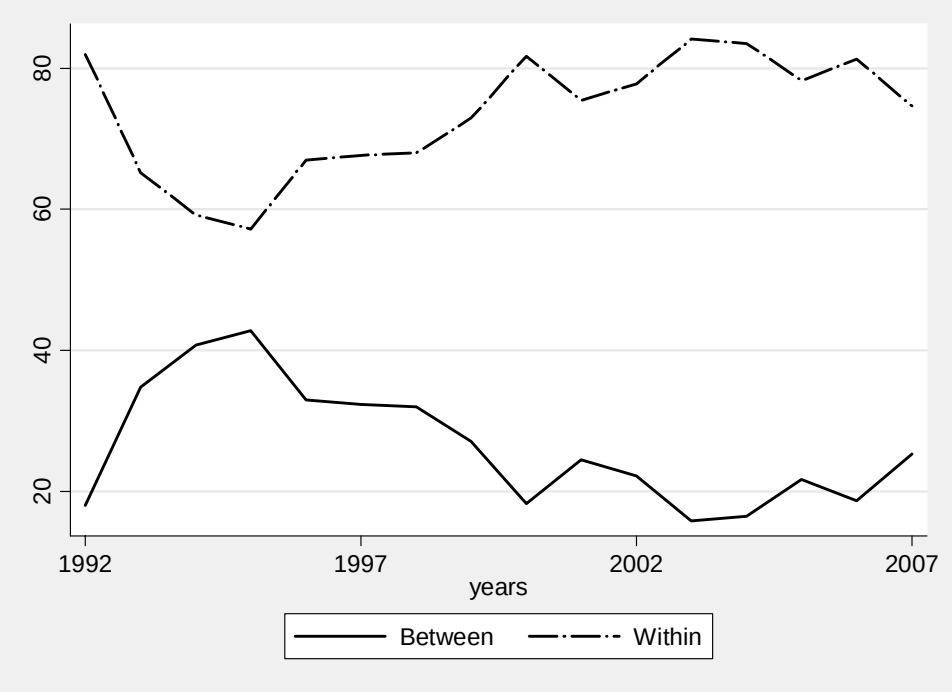
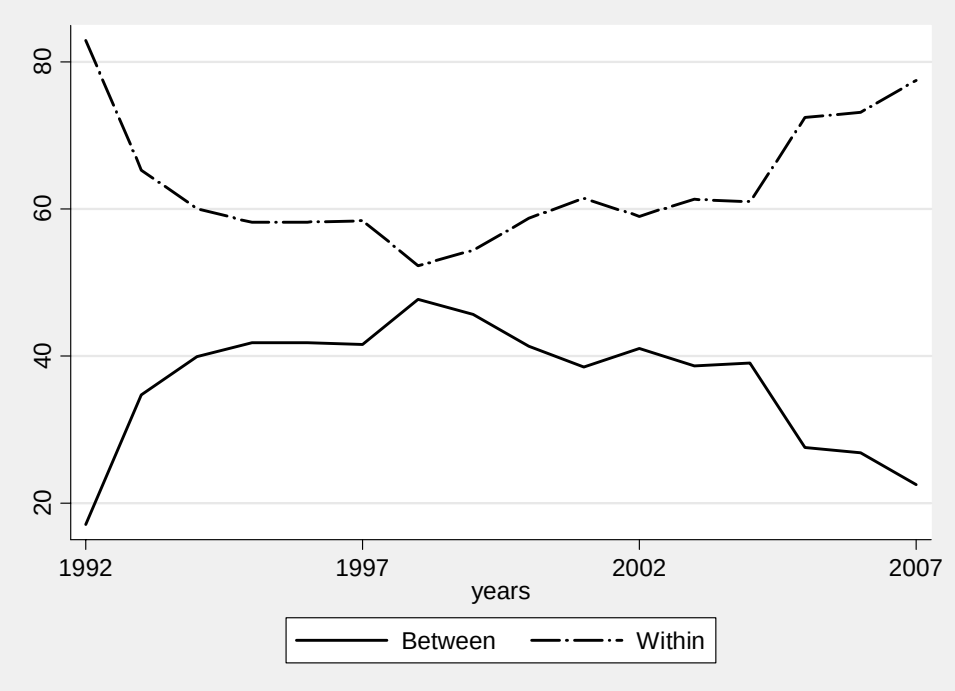


Figure 12: Within and Between Region OCC Wage Inequality, 1990-2007



Note: OCC wage inequality calculated without Heilongjiang

Figure 13: Within and Between-Firm Type Wage Inequality



Appendix

A.1 Inequality Measures: Formulas

Gini index

$$Gini = \frac{1}{2n^2\bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} | y_i - y_j | \tag{A1}$$

where $y_i =$ real wage in region i; $\bar{y} =$ the average wage across all of the regions; $n =$ the number of regions included in the sample.

The Gini coefficient takes on values between zero and one, with zero interpreted as no inequality.

Generalized Entropy index with parameter 1

$$GE(1) = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\bar{y}} \log \frac{y_i}{\bar{y}} \tag{A2}$$

Generalized Entropy index with parameter 0 (or Mean Log Deviation)

$$GE(0) = \frac{1}{n} \sum_{i=1}^{n} \log \frac{\bar{y}}{y_i} \tag{A3}$$

Generalized Entropy measures take values between zero and ∞, with zero representing perfect equality.

Coefficient of variation

$$COV = \frac{1}{\bar{y}} [\frac{1}{n} \sum_{i=1}^{n} (y_i - \bar{y})^2]^{\frac{1}{2}} \tag{A4}$$

An increase in the coefficient of variation captures an increase in inequality.

A.2 Decomposition of the GE(1) index

The GE(1) index can be decomposed in within and between-group inequalities. If the n regions are divided into G groups (here countries), k is the number of regions in each group (country) and s_g is the wage share of group (country) g, T_g is the GE(1) index for that group, and $\bar{y}_g$ is the average wage in group g, then the Theil index can be rewritten as

$$T = \sum_{g=1}^{G} s_g T_g + \sum_{g=1}^{G} s_g \ln \frac{\bar{y}_g}{\bar{y}} \qquad \text{(A5)}$$

where

is the number of countries

is the total number of regions

is the number of regions in country g

is the overall average real wage

is the average real wage in country g

$$= \frac{\sum_{i=1}^{k} y_i}{\sum_{i=1}^{n} y_i}$$

$$= \frac{1}{k} \sum_{i \in g=1}^{k} \frac{y_{i \in g}}{\bar{y}_g}$$

The first term in Equation 8 measures within-country inequality, and the second term is a weighted sum of between-country inequality.

A.3 Variable Definitions

Variable	Definition	Source
Real wage	Average annual wage in 1978 yuan per person for staff and workers, which reflects the general level of wage	China Labour Statistical Yearbook, China Statistical Yearbook
SOE wage	Average annual wage in 1978 yuan per person for staff and workers of state-owned enterprises	China Labour Statistical Yearbook, China Statistical Yearbook
COE wage	Average annual wage in 1978 yuan per person for staff and workers of collectively-owned enterprises	China Labour Statistical Yearbook, China Statistical Yearbook
FFE wage	Average annual wage in 1978 yuan per person for staff and workers of foreign-funded enterprises	China Labour Statistical Yearbook, China Statistical Yearbook
OCC wage	Average annual wage in 1978 yuan per person for staff and workers of enterprises funded by entrepreneurs from Hong-Kong, Macao and Taiwan	China Labour Statistical Yearbook, China Statistical Yearbook
College education	percentage of employed workers who have completed college or a higher level of education	China Labour Statistical Yearbook, China Statistical Yearbook
Capital stock per worker	Computed using the perpetual inventory method and data on investment in fixed assets. Adjusted for inflation using provincial CPI (1978= base year)	China Statistical Yearbook
Highways	Length of highways (in km) scaled by province area	China Statistical Yearbook
Industry share in GDP	Share of manufacturing sector in provincial GDP	China Statistical Yearbook
Per capita Consumption	Per capita real consumption expenditure	China Statistical Yearbook
Export share in GDP	Share of exports in provincial GDP	China Statistical Yearbook
FDI per worker	Amount of FDI per worker (1978 yuan)	China Statistical Yearbook
Market access	Provincial access to international markets	Chinese Customs General