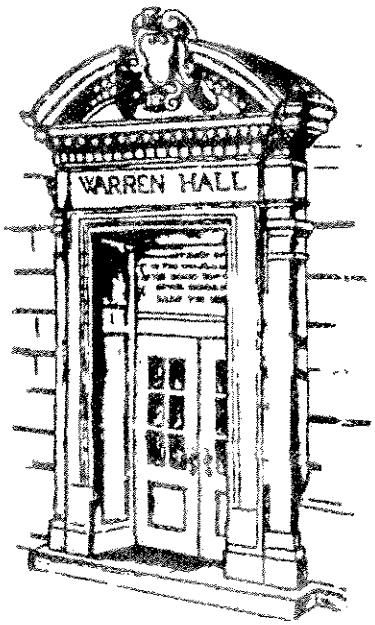

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WHAT DIFFERENCE DO POLARIZATION MEASURES MAKE? AN APPLICATION TO CHINA

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What Difference Do Polarization Measures Make? An Application to China

by

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ABSTRACT

In recent years there has been much discussion of the difference between Inequality and Polarization. The vast literature on inequality is held to miss out key features of distribution change, which are better described as changes in the polarization. Axioms have been proposed which capture some of these differences, and measures of polarization, as distinct from inequality, have been suggested. The theoretical distinctions proposed in this literature are indeed interesting. But the question remains what difference does it all make in actual application? Do the newly proposed measures of polarization give dramatically different results in comparing societies over time, or with each other? We address these questions for China, where dramatic increase in inequality and polarization have been much discussed in the literature. We find that, contrary to theoretical expectation, empirically the new measures of polarization do not give us very different results from the standard measures of inequality. The paper ends by considering a different way of thinking about polarization which might better conform to the empirical patterns observed, and policy concerns expressed.

Contents

1. Introduction

In recent years there has been much discussion of the difference between inequality and polarization. It has been argued that these capture different features of the distribution, and can move in opposite directions. At the same time, phenomena such as "the disappearing middle class" or "clustering around extremes" do not appear to be easily captured by standard measures of inequality such as the Gini coefficient. It is to characterize such phenomena that Wolfson (1984) and Esteban and Ray (1994), Tsui and Wang (1998) have proposed alternative indices of polarization. These indices look for clustering in the personal distribution of income at the lower and upper ends, and the claim is that, at least in theory, they represent a major departure from inequality measures.

But do the new measures of polarization in fact represent a new departure in an empirical sense? Would conclusions drawn from comparisons of inequality measures be reversed if we used the new polarization measures instead? Ravallion and Chen (1997) asked this question for a cross-country comparison of the Gini and Wolfson index, and concluded that "there is a surprisingly close correspondence between them for these data". In this paper we ask the question for changes in inequality and polarization over time for one country. That country is China --- where increasing inequality, and concerns about growing polarization, have been prominent in policy discussion ever since the start of reforms in late 1970s, but increasingly so in the 1980s and the 1990s. Inland-coastal, and rural-urban gaps have been particularly worrisome (Lyons(1991), Tsui (1991,1996), Chen and Fleisher (1996), Jian et. al (1996), Jalan and Ravallion (1998), and Kanbur and Zhang (1998)). Hu (1996) even warned that further increases in regional disparities, especially the coastal-inland gap, might lead to China's dissolution. Li (1996) argues that China is becoming a polarized society in two dimensions --- rural-urban and coastal-inland.

Can the new measures of polarization pick up and reflect these concerns in a distinctive manner from standard inequality measures? Section 2 sets out the data set and the methodology underlying our attempt to answer the question. The main empirical

results are presented in Section 3, which shows that, in fact, standard polarization indices do no give us a very different pictures of patterns and trends in Chinese regional inequality. Based on this finding, Section 4 proposes an alternative way to look at polarization measurement which comes closer to capturing the spirit of many of the concerns in the policy arena. Section 5 concludes the paper.

2. Data and Methodology

2.1 Data

Our focus is on patterns and trends of regional inequality and polarization in China from 1983 to 1995. Of the 30 provinces, Tibet and Hainan had to be excluded due to lack of consistent data. With rural and urban components in each province, we have 56 observations per year for each year from 1983 to 1995. For each component, we derive per capita real consumption expenditures from the China Statistics Yearbook, using a procedure described in Kanbur and Zhang (1998). Rural and urban population in each province are available from various issues of China Population Statistics Yearbook. It is the inequality of this per capita consumption that we are interested in (for a fuller discussion of this method versus others, see Kanbur and Zhang, 1998). The inland coastal divide is developed following the method of Tsui (1993), Huang (1996), Yao (1997), Chen and Fleisher (1996), and Yang (1997). The coastal zone is defined as being the following provinces: Beijing, Liaoning, Tianjin, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong and Guangxi. All remaining provinces are classified as inland.

2.2 Methodology

Two inequality indices and three polarization indices are applied for comparison using the provincial level data in China in the post reform period. The two inequality measures are the Gini coefficient and the Generalized Entropy (GE); the three polarization measures are the Esteban-Ray (1994) index, which we refer to as the ER

index, the Tsui-Wang (1998) index (we will call it TW index hereafter), and the Wolfson (1994) index.

The Gini coefficient (Cowell, 1995) is defined as the ratio of the area between the Lorenz curve and the area under the 45° line. It can be written as:

$$G = \left(\frac{1}{\mu}\right)\sum_{i=1}^{K}\sum_{j=1}^{K} f(y_i)f(y_j)|y_i - y_j| \tag{1}$$

Where y_i is the income for each group and m is the mean income for the whole sample. $f(y_i)$ represents the population share of the i^{th} group. K is the total number of groups. The GE measure (Shorrocks, 1980 and 1984) can be written as:

$$I(y)= \begin{cases} \sum_{i=1}^{K} f(y_i)\left\{\left(\frac{y_i}{\mu}\right)^{c} - 1\right\} & c \neq 0,1 \\ \sum_{i=1}^{K} f(y_i)\left(\frac{y_i}{\mu}\right)\log\left(\frac{y_i}{\mu}\right) & c = 1 \\ \sum_{i=1}^{K} f(y_i)\log\left(\frac{\mu}{y_i}\right) & c = 0 \end{cases} \tag{2}$$

In the above equation, y_i is i^{th} income, μ is the total sample mean, $f(y_i)$ is the population share of y_i in the total population and K is the number of groups.

The ER index is built on the basis of two behavioral functions ("identification" and "alienation") and three axioms. Identification is an increasing function of the number of individuals in the same income class of that individual. For an individual, the more people who have the same income level as him, the more sense of identification he feels. The alienation function characterizes the antagonism caused by the income difference. An individual feels alienated from others that are "far away" from him. With these assumptions, Esteban and Ray (1994) derive the ER index as follows:

$$ER = A\sum_{i=1}^{K}\sum_{j=1}^{K}\pi_i^{1+\alpha}\pi_j|y_i - y_j| = A\sum_{i=1}^{K}\sum_{j=1}^{K}\pi_i\pi_j\pi_i^{\alpha}|y_i - y_j| \tag{3}$$

Where π_i is the number of population in group i, K is the number of groups, y_i is the mean value in group i, and A is a normalization scalar. α represents the degree of

polarization sensitivity and is in the range of [0, 1.6]. α is set to 1.5 here. The greater the value of α, the greater deviation is the of the ER index from the Gini coefficient. It can been seen from (1) and (3) that the ER is equal to the Gini coefficient if α is set to 0. Also, when $\pi_i = 1$ (each group has only one individual or has identical number of members), the ER index is collapsed to the Gini. As the Gini is a special case of the ER index family, we may conjecture that the two indices behave closely when there is a large number of similar size groups. In the above formula, π_i^{α} and $|y_i - y_j|$ represent identification and alienation functions, respectively.

The Wolfson (1994) index is derived from the Lorenz curve. It is twice the area between the Lorenz curve and the tangent line at the median point. It can be written as:

$$W = 2(2T - Gini)/(m/\mu) = 2(\mu^* - \mu^L)/m. \quad (4)$$

Where T=0.5-L(0.5) and L(0.5) denotes the income share of the bottom half of the population; m is the median income; μ is the mean income; μ^* is the distribution-corrected mean income which is given by the actual mean times (1-Gini); and μ^L is the mean income of the bottom half of the population. The maximum polarization occurs when half the population has zero income and the other half has twice the mean. Wolfson (1994) shows that like the Gini index, this index lies between 0 and 1.

Tsui and Wang (1998) generalize a new class of indices based on the Wolfson index using the two partial ordering axioms of "increased bipolarity" and "increased spread". It can be expressed as follows:

$$TW = \frac{\theta}{N} \sum_{i=1}^{K} \pi_i \left| \frac{y_i - m}{m} \right|^r \quad (5)$$

Where N is the number of total population, π_i is the number of population in group i, K is the number of groups, y_i is the mean value in group i, and m is the median income. θ is a positive constant scalar and $r \in (0,1)$. Here we set r=0.5.

3. Empirical Results

For each year we calculated two inequality measures and three polarization indices from the population weighted 56 observations in our data set — one rural and one

urban observation for each of 28 provinces. Table 1 reports the overall inequality and polarization measures over the period of 1983-1995. Figure 1 presents the evolution of these measures relative to their 1983 values.

Two features are immediately apparent from the Table 1 and Figure 1. First, the overall trend for both inequality and polarization measures increases during this period of fast growth. Second, the distinction between the three polarization measures is greater than that between the two inequality measures. The ER index gives very similar results to Gini although the parameter α in the ER formula has been set to 1.5, nearly the largest value, to try and distinguish it from Gini. The Gini and the TW indices exhibit very similar patterns and magnitude. The increase in the Wolfson index is more rapid than all other measures. Moreover, the Wolfson index gives different results from other measures in 1988 and 1991.

Since the rural population accounts for more than 65 percent of total population, it is worthwhile to compare the measures of inequality and polarization for rural China. Table 2 presents the evolution of these measures and Figure 2 graphs the results. Again, the ER index exhibits a similar pattern to Gini. This time, the Wolfson index and the TW index have the lowest increase during the whole period and they show different patterns in 1986 and 1987 from other measures. The GE measure rises much faster than the Gini, suggesting the different sensitivities of these two measures to changes in different parts of the distribution. Because of its sensitivity to the median value, the Wolfson index may fluctuate more rapidly when the median value and its associated group changes. But, the important point for us is that, overall, the polarization and the inequality measures agree on the trend over the sample period.

The measures of inequality and polarization for the four subgroups --- rural, urban, inland, and coast, in the initial year 1983 and the last year 1995 are presented in Table 3. The results are also plotted in Figure 3a and Figure 3b. In 1995, all the five indices agree on the relative rankings of the four subgroups --- the urban has the lowest and the coast has the highest. In 1983, the five measures indicate consistent orderings for these four groupings except for the coast by the ER index which, contrary to others, shows that the polarization in inland is lower than in coast.

In summary, although the three polarization measures are theoretically different from standard inequality measures, empirically the new measures of polarization do not give us very different results from the standard measures of inequality.

4. An Alternative Way of Looking at Polarization

Debates on polarization are often conducted in the framework of recognized and accepted groupings --- black/white, rural/urban, etc. This allows us to get an alternative handle on polarization through decomposition analysis of standard inequality indices, as follows. Consider, for example, the GE index of inequality. For K exogenously given groups indexed by g:

$$I(y) = \sum_{g}^{K} w_g I_g + I(\mu_1 e_1, \ldots, \mu_K e_K) \qquad (6)$$

$$\text{where } w_g = \begin{cases} f_g \left(\dfrac{\mu_g}{\mu} \right)^c & c \neq 0,1 \\ f_g \left(\dfrac{\mu_g}{\mu} \right) & c = 1 \\ f_g & c = 0 \end{cases}$$

where I_g is inequality in the g^{th} group, μ_g is the mean of the g^{th} group and e_g is a vector of 1's of length n_g, where n_g is the population of the g^{th} group. If n is the total population of all groups, then $f_g = \dfrac{n_g}{n}$ represents the share of the g^{th} group's population in the total population. The first term on the right side of (6) represents the within-group inequality. $\dfrac{w_g I_g}{I(y)} * 100$ is the g^{th} group's contribution to total inequality. The second term is the between-group (or inter-group) component of total inequality.

For all values of the parameter c, the GE measure is additively decomposable in the sense formalized by Shorrocks (1980, 1984), and this property allows us to talk about the "contribution" of different component to overall inequality. For values of c less than 2, the measure is transfer sensitive (Shorrocks and Foster, 1987), in the sense that it is more sensitive to transfers at the bottom end of the distribution than at the top. When c is 1 or 0, we have the measures of inequality made famous by Theil (see Cowell, 1995). For simplicity we only present results in this paper for c=0. The results for c=1 are similar.

The within-group inequality part in (6) represents the spread of the distributions in the subgroups; the inter-group inequality indicates the distance between the group means. The ratio of inter-group inequality to within-group inequality can thus be regarded as a scalar polarization index because it captures the average distance between the groups in relation to the sorts of income differences seen within groups.

Table 4 provides the GE inequality decomposition and the alternative polarization measure. The polarization measures for rural-urban and inland-coast are also plotted in Figure 4. It can be seen from Figure 4 that the value of the alternative polarization measure calculated from the rural-urban dimension is much higher than that in the coast-inland dimension. However, the inland-coastal polarization increases by 184 percent from 1983 to 1995, compared to the -32.5 percent decline in the rural-urban polarization. This alternative polarization index offers more consistent findings with the empirical patterns observed in literature (see Kanbur and Zhang, 1998 for more details), and is capable of initiating a richer debate on different types of polarization.

5. Conclusion

The empirical behavior of three newly developed polarization indices is tested against two standard measures of inequality using a complete data set at the provincial level in China over a rather long period. It is found that empirically the polarization indices do not give very distinct results from standard measures of inequality. An alternative polarization index, derived from inequality decomposition analysis, seems to

offer more insight into changes in China's income distribution from two perspectives. It is found that in levels, rural-urban polarization is more serious than inland-coast while, in terms of trend, the inland-coast polarization has increased much more dramatically than rural-urban. In our view, the analysis based on this alternative perspective on polarization reflects better current policy concerns than do the currently available measures of polarization.

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Table 1 Inequality and Polarization (All China)

Year	Gini	GE	ER	Wolfson	TW
1983	0.220	0.079	0.146	0.180	0.493
1984	0.217	0.076	0.142	0.180	0.504
1985	0.216	0.075	0.138	0.172	0.485
1986	0.225	0.080	0.144	0.189	0.506
1987	0.230	0.083	0.146	0.205	0.524
1988	0.239	0.089	0.147	0.221	0.541
1989	0.237	0.088	0.144	0.231	0.539
1990	0.241	0.091	0.147	0.237	0.548
1991	0.250	0.098	0.151	0.235	0.550
1992	0.263	0.108	0.157	0.261	0.570
1993	0.267	0.112	0.157	0.276	0.587
1994	0.273	0.117	0.157	0.286	0.599
1995	0.277	0.120	0.158	0.288	0.605

Table 2 Inequality and Polarization (Rural)

Year	Gini	GE	ER	Wolfson	TW
1983	0.107	0.019	0.140	0.105	0.364
1984	0.111	0.021	0.141	0.107	0.375
1985	0.108	0.020	0.134	0.109	0.379
1986	0.120	0.023	0.150	0.122	0.399
1987	0.123	0.024	0.154	0.115	0.391
1988	0.128	0.026	0.154	0.106	0.385
1989	0.129	0.027	0.152	0.102	0.371
1990	0.128	0.026	0.154	0.102	0.374
1991	0.131	0.028	0.159	0.104	0.382
1992	0.143	0.033	0.172	0.111	0.391
1993	0.139	0.032	0.165	0.110	0.370
1994	0.150	0.036	0.177	0.120	0.395
1995	0.157	0.040	0.187	0.119	0.407

Table 3 Inequality and Polarization, 1983 and 1995

	1983					1995				
	Inequality		Polarization			Inequality		Polarization		
	Gini	GE	ER	Wolfson	TW	Gini	GE	ER	Wolfson	TW
Rural	0.107	0.019	0.140	0.105	0.364	0.157	0.040	0.187	0.119	0.407
Urban	0.074	0.009	0.073	0.084	0.316	0.112	0.020	0.122	0.087	0.353
Inland	0.213	0.077	0.309	0.173	0.477	0.245	0.099	0.309	0.198	0.503
Coast	0.197	0.068	0.439	0.121	0.396	0.251	0.099	0.506	0.222	0.539

Table 4 GE Inequality Decomposition and Alternative Polarization Measure

	Rural/Urban			Coast/Inland		
Year	Between	Within	B/W-RU	Between	Within	B/W-CI
1983	78.09	21.91	3.56	6.45	35.72	0.18
1984	75.76	24.24	3.12	6.55	36.57	0.18
1985	76.95	23.05	3.34	5.96	35.20	0.17
1986	74.50	25.50	2.92	6.26	34.33	0.18
1987	74.84	25.16	2.98	6.65	34.97	0.19
1988	74.70	25.30	2.95	8.02	36.55	0.22
1989	73.28	26.72	2.74	7.23	37.59	0.19
1990	74.88	25.12	2.98	7.49	38.42	0.19
1991	75.53	24.47	3.09	9.07	36.85	0.25
1992	73.54	26.46	2.78	11.60	37.25	0.31
1993	75.12	24.88	3.02	12.90	37.15	0.35
1994	73.25	26.75	2.74	14.74	35.13	0.42
1995	70.65	29.35	2.41	17.33	33.77	0.51
Growth(%)	-9.5	33.9	-32.5	168.5	-5.5	184.0

Figure 1 Inequality and Polarization (All China)

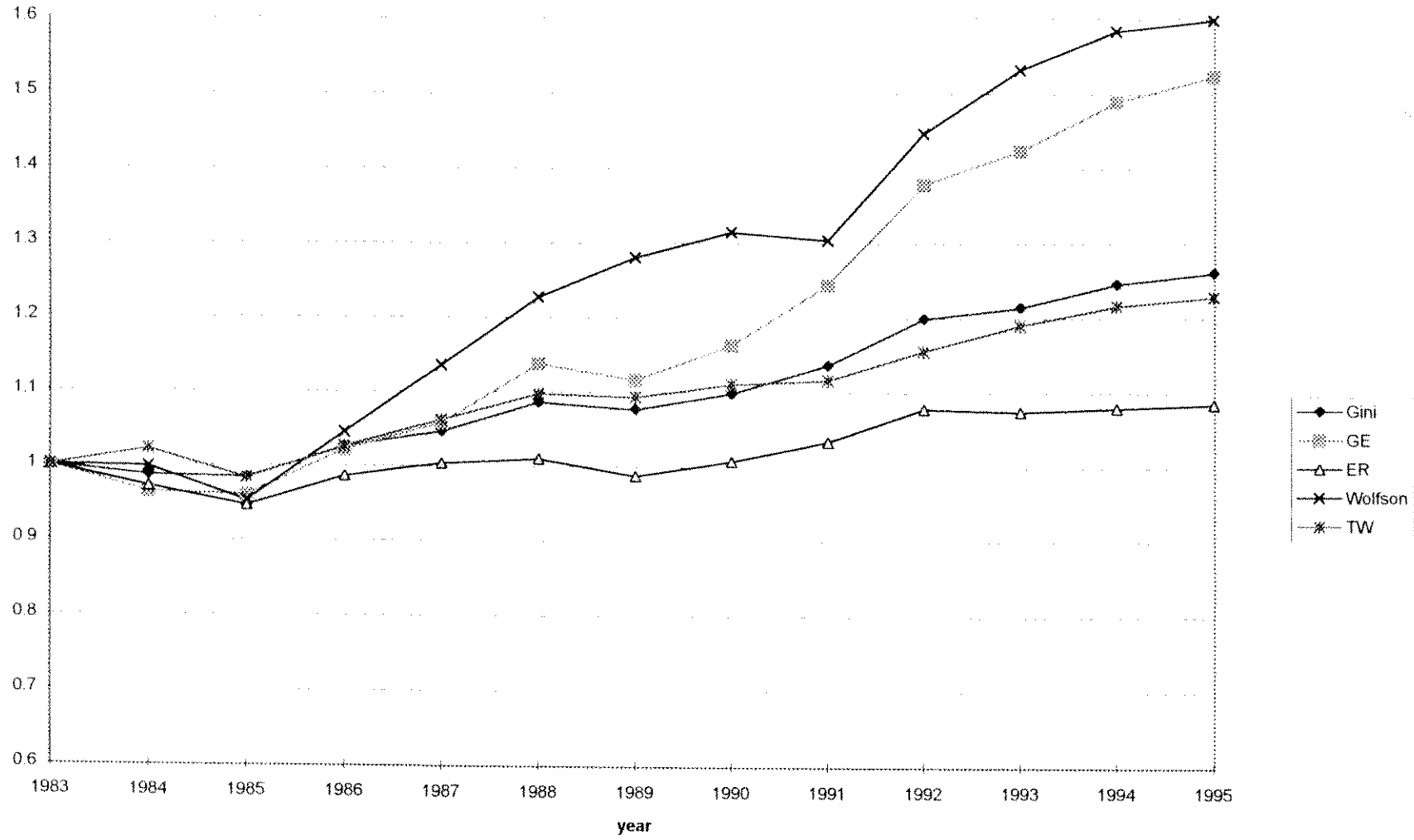


Figure 2 Inequality and Polarization (Rural)

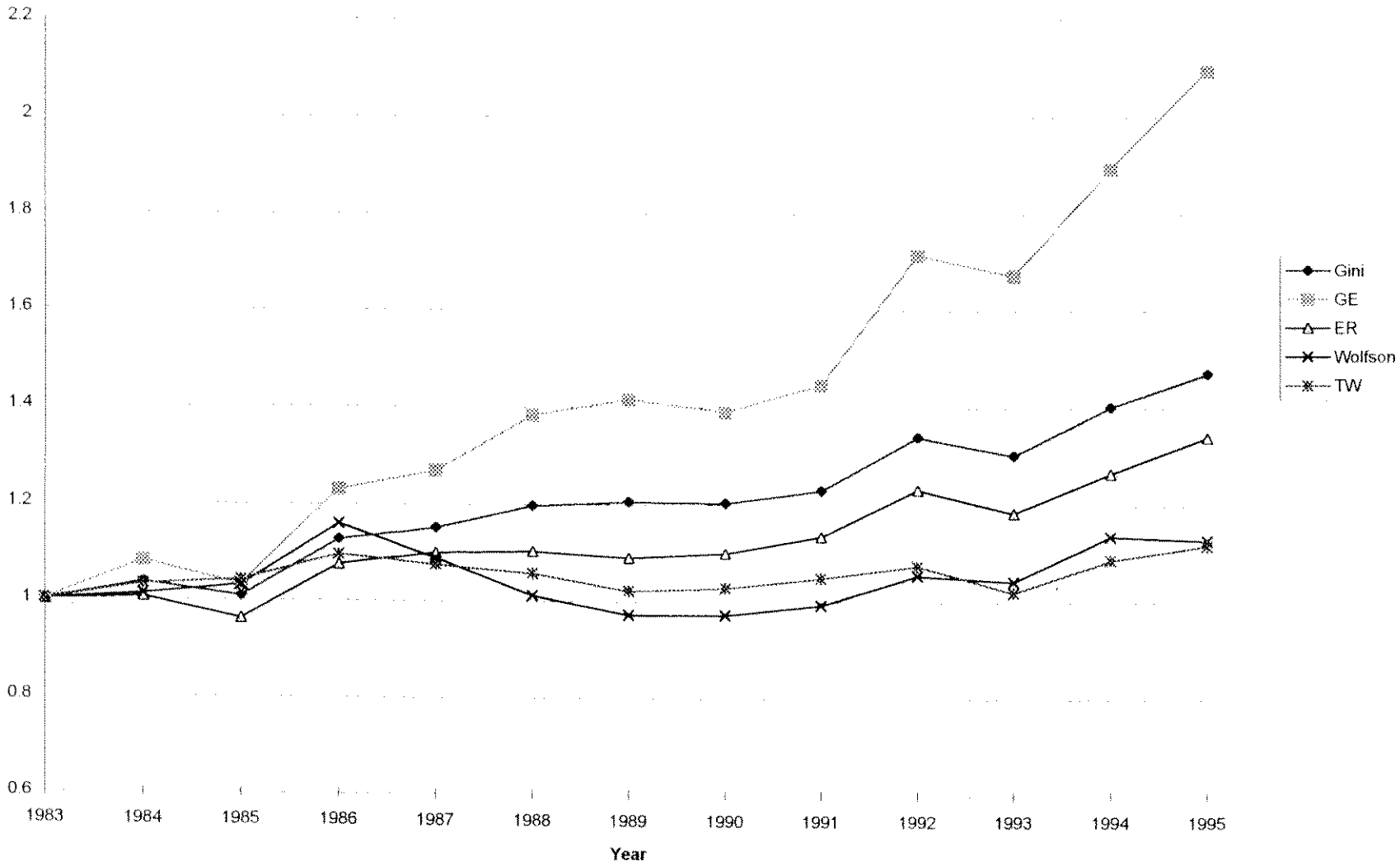


Figure 3A Inequality and Polarization, 1983

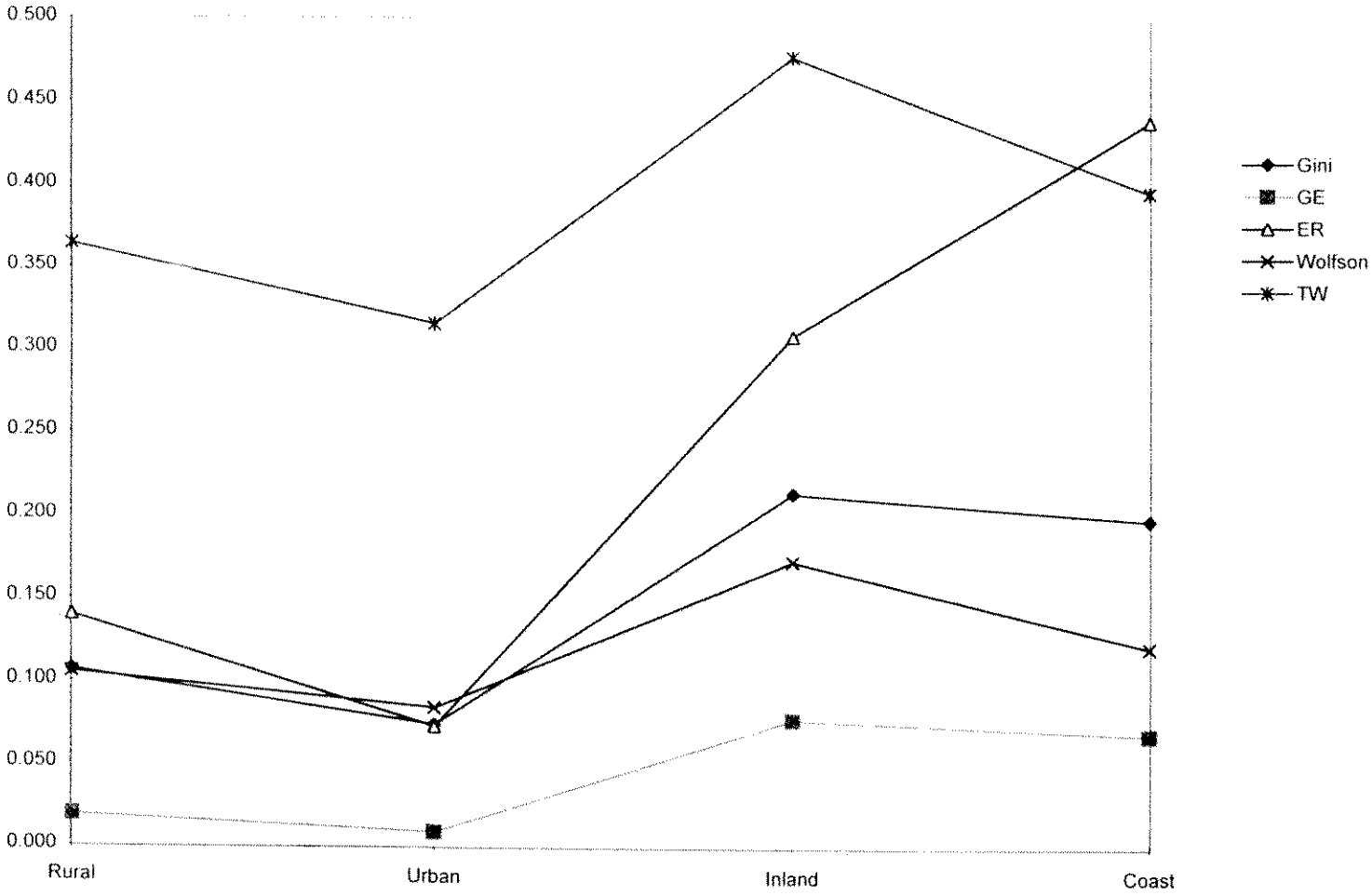


Figure 3B Inequality and Polarization, 1995

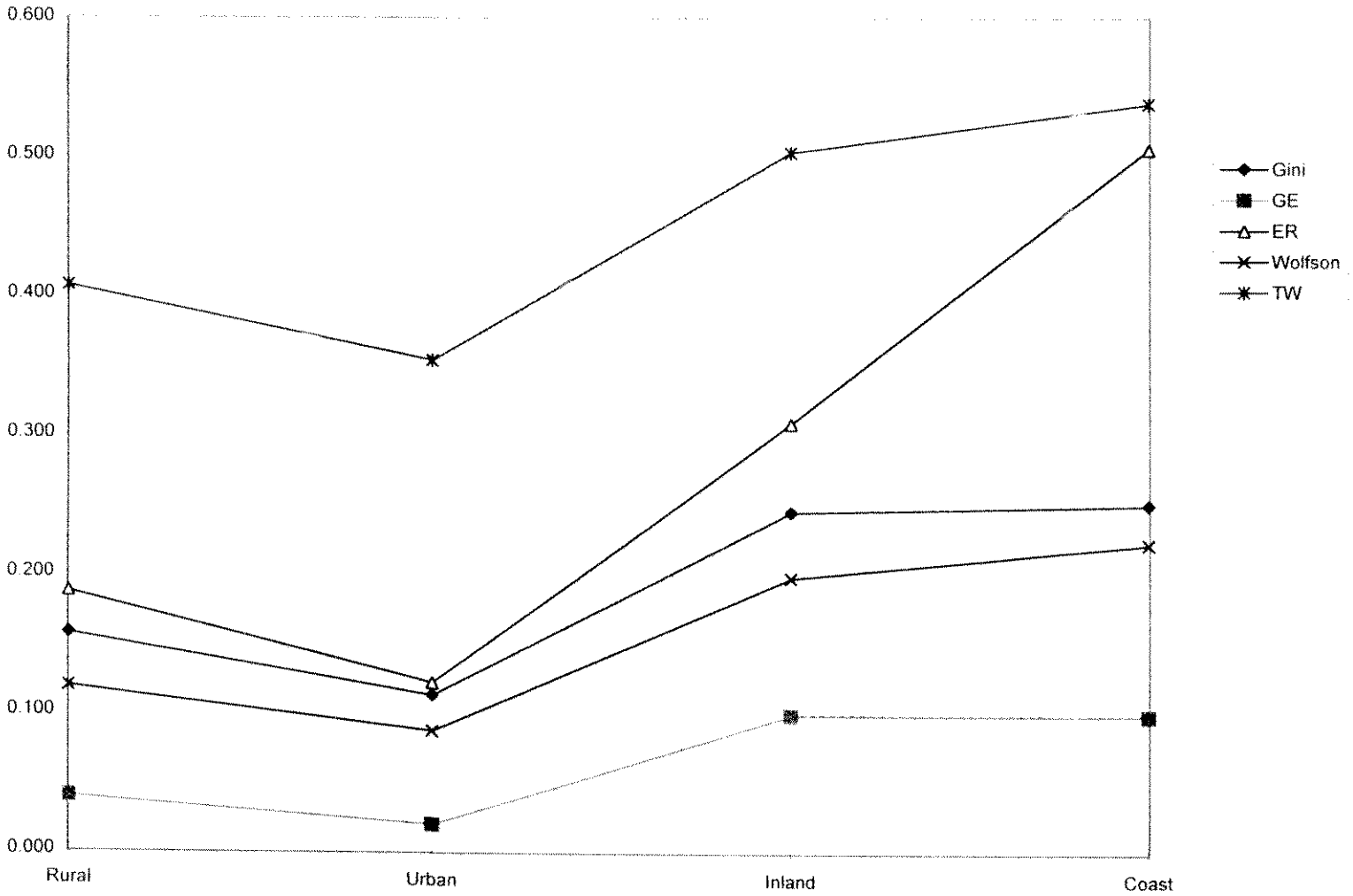
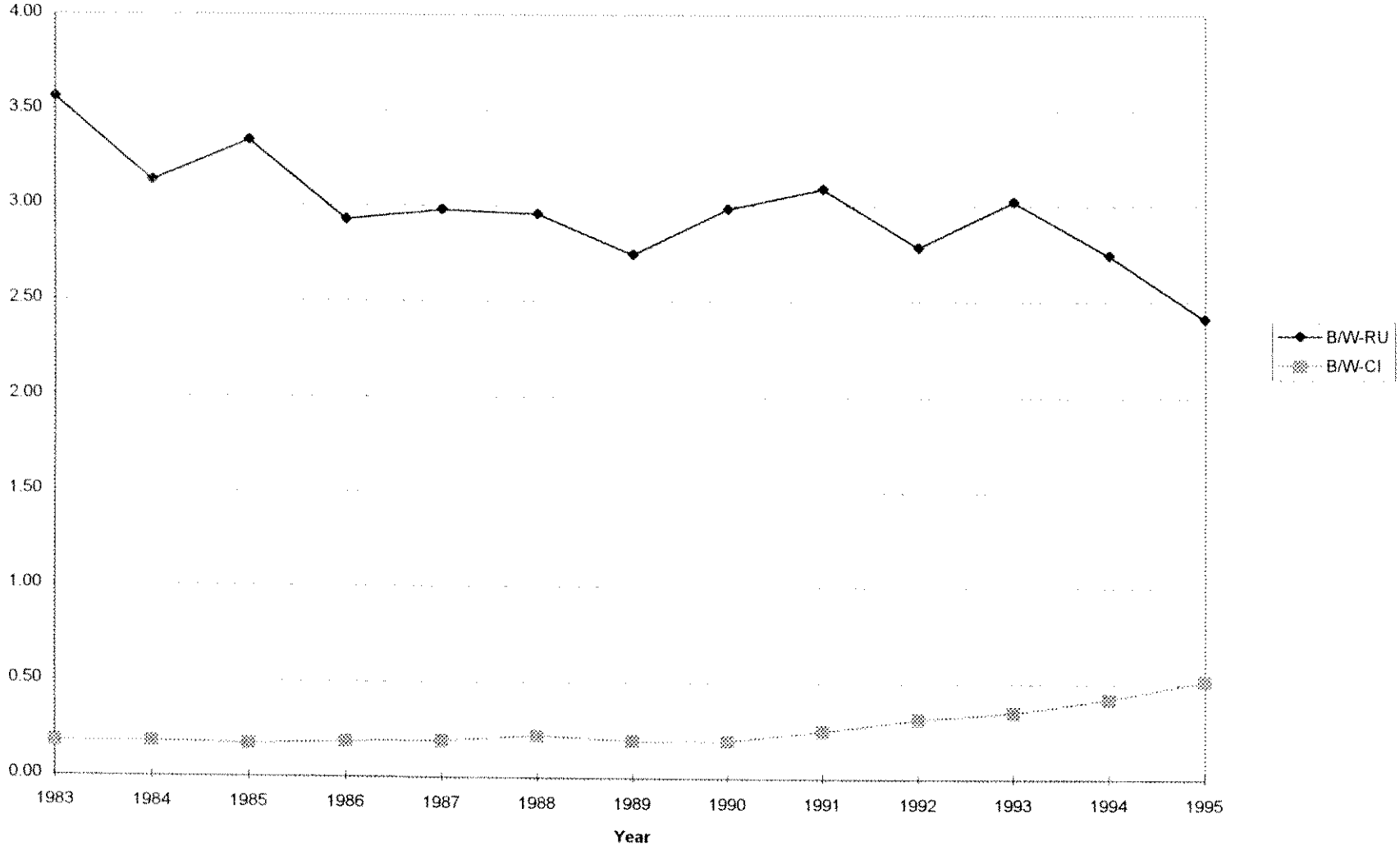


Figure 4 The Ratios of Between to Within



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