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Threshold Estimation on the Globalization-Poverty Nexus

Evidence from China

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Abstract

China has experienced rapid integration into the global economy and achieved remarkable progress in poverty reduction over the last two decades. In this paper, by employing panel data covering twenty-five Chinese provinces over the period of 1986-2002, and applying the endogenous threshold regression techniques, we empirically investigate the globalization-poverty nexus in China, paying particular attention to the nonlinearity of the impact of globalization on the poor. Estimation results provide strong evidence to suggest that there exists a threshold in the relationship between globalization and poverty: globalization is good for the poor only after the economy has reached a certain threshold level of globalization.

Keywords: globalization, poverty reduction, economy, China

JEL classification: I32, O11, O53

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Acknowledgements

Acronyms

SEZs   special economic zones

FDI   foreign direct investment

NBS   National Bureau of Statistics

WTO   World Trade Organization

1   Introduction

The last several years have witnessed a growing interest amongst both academics and policymakers in exploring the relationship between globalization and poverty (e.g., World Bank 2002; Dollar and Kraay 2002, 2004; Nissanke and Thorbecke 2005; Ravallion 2001, 2005; Winters, McCulloch and McKay 2004). Are the distributional effects of globalization neutral? More specifically, to what extent and under what condition will globalization benefit the poor? These critical issues have been at the centre of many studies and subject to passionate debate worldwide.

Globalization can affect poverty through multifaceted channels, creating both winners and losers. In their more recent excellent work, Nissanke and Thorbecke (2005) conclude that globalization could affect poverty both indirectly through the 'growth effects' and directly through other channels, such as changes in relative prices of factors and products; differential cross-border factor mobility; the nature of technological progress and the technological diffusion process; volatility and vulnerability; the nature of the worldwide flow of information; and global disinflation. Meanwhile, a large number of empirical studies have been conducted to investigate the various channels and linkages through which globalization may affect the poor (e.g., Agénor 2004; Dollar and Kraay 2002, 2004; Hertel, Preckel and Reimer 2001; Levinsohn, Berry and Friedman 2003).

However, the existence of threshold effects and the possible nonlinearity in the transmission of impacts of greater global integration on the poor may result in more complex and heterogeneous globalization-poverty relationship. While earlier studies shed great light on this globalization-poverty linkage, there appears to have been comparatively little reported empirical evidence on the possible nonlinear relationship between globalization and poverty.

In this paper, using panel data from Chinese provinces over the period of 1986-2002, and applying recent endogenous threshold regression techniques, we attempt to empirically investigate the globalization-poverty nexus in China, paying particular attention to the nonlinearity of the impact of globalization on the poor.

Since the implementation of the *open door* policy in the late 1970s, China has experienced increasingly intensive integration into the world economy, and China has also recorded remarkable success in promoting economic growth. China's successful global integration and impressive economic growth were accompanied by great achievements in poverty reduction. Based on China's official poverty line, rural poverty population dropped from 250 million in 1978 to 28 million in 2002, and the incidence of rural poverty, measured by the proportion of the poor in the rural population, declined dramatically from 30.7 per cent in 1978 to 3 per cent in 2002. Similar trend can also be noted using various poverty lines or different estimated standards (see e.g., World Bank 2000; Park and Wang 2001; Ravallion and Chen 2004).

Meanwhile, China is a vast country with diverse regional development levels and contrasting economic structures, and as such both the development paths and the impacts of globalization on poverty reduction may vary across the regions of the country. Therefore, provincial level analyses on this variation allow us to better understand the causal links between globalization and poverty, and to obtain deeper insights into this critical nexus.

In the present study, due to the limits of the data, we focus primarily on rural poverty in China. More recently, urban poverty problems have also attracted considerable attention. However, China's urban poor have been relatively few in number; the size and severity of urban poverty remain on a much lesser scale than that in the rural areas, and therefore poverty in China is still mainly a rural phenomenon (Fan, Zhang and Zhang 2004). In our study, by focusing on China's rural poverty and using endogenous threshold estimation, we offer new insights on China's successful approach in reducing poverty during the globalization era, and thus contribute to the literature.

The rest of this paper is organized as follows. Section 2 reviews some critical literature on the threshold effects and the nonlinear relationship between globalization and poverty. Section 3 briefly presents the process of China's openness and the evolving approach of poverty reduction in rural areas. Empirical analyses are presented in section 4. Finally, the paper concludes with section 5.

2 Threshold effects and nonlinearities in globalization-poverty nexus: a review

In the literature, the nonlinearity and threshold phenomena have been increasingly recognized as one of critical issues in the ongoing process of globalization. Indeed, the globalization-poverty relationship is complex and heterogeneous, and it is highly probable that this relationship may be nonlinear in many aspects, involving several threshold effects (Nissanke and Thorbecke 2005). In this section, we focus primarily on some critical literature concerning the existence of threshold effects and the nonlinear relationship between globalization and poverty.[1]

The possibility of a nonlinear relationship between globalization and poverty has been acknowledged and well documented in a number of recent studies (e.g., Agénor 2004; Nissanke and Thorbecke 2005; Sindzingre 2005). For example, Agénor (2004) suggests that the globalization-poverty linkage may be nonmonotonic, since possible discontinuities or threshold effects may come into play and lead to nonlinear relationship between globalization and poverty. Two types of globalization effects on poverty are analysed in the study by Agénor (2004). The first is an *output effect* through which globalization may have an inverted J-curve effect on poverty: at the initial stage, globalization with greater trade liberalization may lead to a decline in the output of import-competing sectors, resulting in a decline in both aggregate output and per capita income that may adversely affect the poor; and then at the following stage, with the expansion of the exportable sector, aggregate output will gradually increase and contribute to poverty reduction. The second effect is the *relative wage effect* through the impact of globalization on skilled-unskilled wage differential: at the initial stage, greater openness may increase the wage differential between skilled and unskilled labour, and thus worsen the living condition of the latter and increase poverty; this initial widening in wage differentials may lead to an increase in investment in human capital and thus an increase in the supply of skilled labour over time, which tends to narrow the wage

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[1] For more extensive survey on the globalization-poverty nexus, please refer to Winters (2000), Reimer (2002), and more recent excellent overview papers of Hertel and Reimer (2004); Winters, McCulloch and McKay (2004); Nissanke and Thorbecke (2005).

differential across skill categories and reduce poverty in the later stage, indicating an inverted U-shape relationship between globalization and poverty.

Sindzingre (2005) considers institutions as an essential factor in creating the nonlinear relationship between globalization and poverty, since institutions may generate threshold effects in the sense that they introduce processes of cumulative causation and create discontinuities and multiple equilibria. Therefore, the ultimate net effects of globalization on poverty in a given setting will depend on the characteristics of certain institutions, e.g., their levels of development, historical depth and stability (or 'quality'), the extent of their regulation of economic activity, the coherence between them and the associated linkage effects, their credibility, and the ways they organize and support particular market structures.

Meanwhile, a number of empirical studies have suggested that there exist thresholds in the impacts of openness on growth, through which openness may affect the poor. For example, using cross-country data, Edwards (2001) investigates the effects of capital market openness on economic growth, and his empirical results suggest the existence of a threshold in development levels, i.e., an open capital account can positively affect growth only after a country has achieved a certain degree of economic development. Moreover, in a more recent study, with the help of a dataset covering 83 countries over the period 1970-89, Girma *et al.* (2003) empirically explore the heterogeneity in the 'openness-productivity growth' relationship, and find evidence that there exist thresholds in the effects of openness on growth that depend on the level of natural barriers.

However, few empirical studies have been conducted to test the nonlinear relationship between globalization and poverty. A representative exception is the recent work of Agénor (2004). Using a sample of 11 developing countries covering the late 1980s and the 1990s, Agénor (2004) empirically investigates the nonlinear globalization-poverty linkage. Estimation results suggest that there exists a nonlinear, Laffer-type relationship between poverty and globalization: at low degrees of globalization, globalization does hurt the poor; while at higher levels, globalization leads to a decline in poverty. Therefore, Agénor (2004) concludes that globalization may have hurt the poor, not because it went too far but rather because it did not go far enough.

However, Agénor's research suffers from several limitations. First, to capture the nonlinear relationship between globalization and poverty, Agénor includes a squared term of globalization index in his regression model. This approach has obvious disadvantages since it assumes that the nonlinearity in the globalization-poverty linkage is of a particular form. Meanwhile, the inclusion of a square term implies that the number of the thresholds is arbitrarily chosen as being one, completely ignoring the possibility of multiple thresholds. Second, as Agénor has recognized, his research also suffers from problems concerning the quality of data and a lack of sufficient numbers of observations. Therefore, further studies with broader and more reliable datasets and more advanced regression techniques are required to draw more convincing and robust conclusions.

With the help of more recent and systemic data from Chinese provinces, this paper attempts to add to the literature by empirically exploring the nonlinear globalization-poverty nexus in China. In order to test the existence of threshold effects and avoid the potential biases, we employ the endogenous threshold regression techniques proposed

by Hansen (1996, 1999), with which the number and location of thresholds are endogenously determined in a given sample dataset, and therefore regression models can be tested with unknown threshold points, rather than some specific values that are exogenously and arbitrarily chosen. To the best of our knowledge, this is the first paper investigating the possible nonlinear relationship between globalization and poverty for the case of China.

3 China's global integration and poverty reduction

3.1 Economic openness in China

The implementation of the *open door* policy since the late 1970s and the choice of regional development strategy in accordance with its comparative advantage have accelerated China's integration into the global economy, resulting in huge inflows of foreign direct investment (FDI) and remarkable increase in foreign trade.

Local experimentation of the *open door* policy was first pursued in Guangdong and Fujian provinces with the establishment of four special economic zones (SEZs) in 1979-80 (i.e., Shenzhen, Zhuhai and Shantou in Guangdong province, and Xiameng in Fujian province), being followed by the opening-up process along the coast (i.e., the successive establishment of 14 open coastal cities, a number of open coastal development zones, an open coastal belt, the Hainan special economic zones and Pudong new area in Shanghai) and then to inland regions.

Priority to the development of the coastal regions has been clearly and definitely stipulated in the government's sixth five-year plan (1981-85) and the seventh five-year plan (1986-90), because the coastal regions are not only closer to international markets and hence more advantageously located in geographical terms to engage in international trade, but are also more advanced in the level of human capital and social development. As such, they are better able to benefit from the favourable circumstances and make use of new opportunities to improve their productive efficiency, exploit their comparative advantage, expand their production and attain sustainable growth. Meanwhile, preferential policies were formulated for the coastal provinces for the purpose of promoting international trade, attracting FDI, and accelerating economic development in these regions.

Preferential policies for the coast and geographical advantages of these regions have significantly promoted economic growth in the coastal areas. In consistent with regions' comparative advantages, a new pattern of regional specialization emerged. Coastal regions became highly specialized in the production of industries with high value added and up-graded technologies, while the inland regions, originally less industrialized, were to concentrate on energy production, raw material and transformation industries, and energy consuming industries. Hence, one notable objective of China's regional development strategy in the reform era was to exploit the comparative advantage of the regions and speed up regional development in the ongoing process of globalization.

More recently, China's accession to the World Trade Organization (WTO) further accelerated the expansion of its foreign trade. From 1978 to 2002, China's total exports and imports grew at an average annual rate of 15.7 per cent and 14.7 per cent,

Figure 1
Foreign trade in China, 1978-2002 (US$ 100 million)

Total exports   Total imports
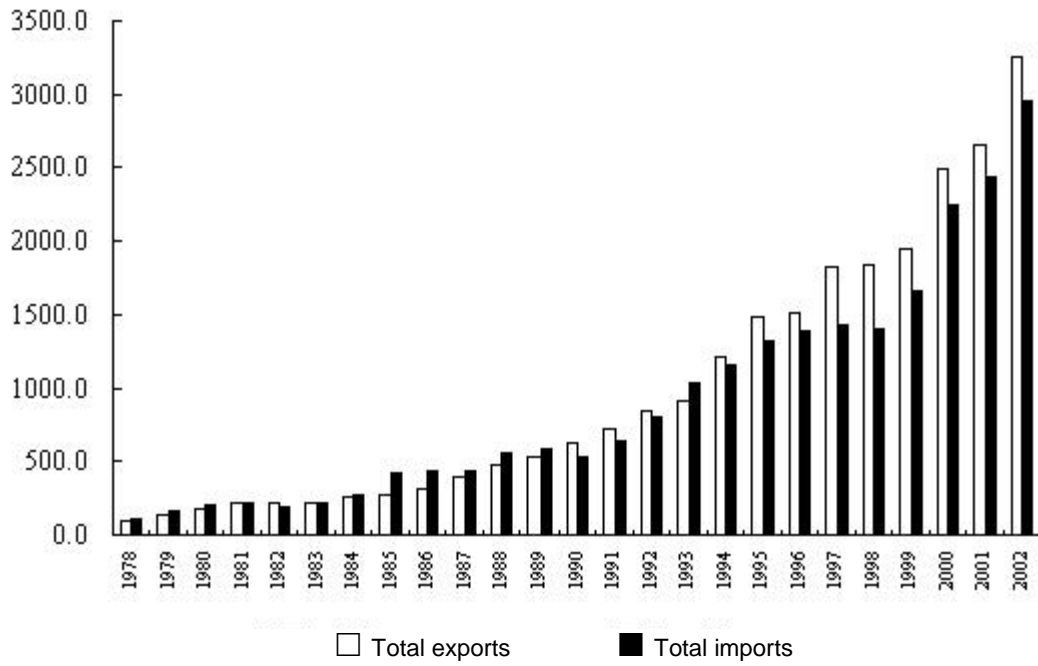
Source: NSB (*China Statistical Yearbook,* various years).

Figure 2
Foreign direct investment in China, 1984-2002
(US$ 100 million)

Foreign direct investment
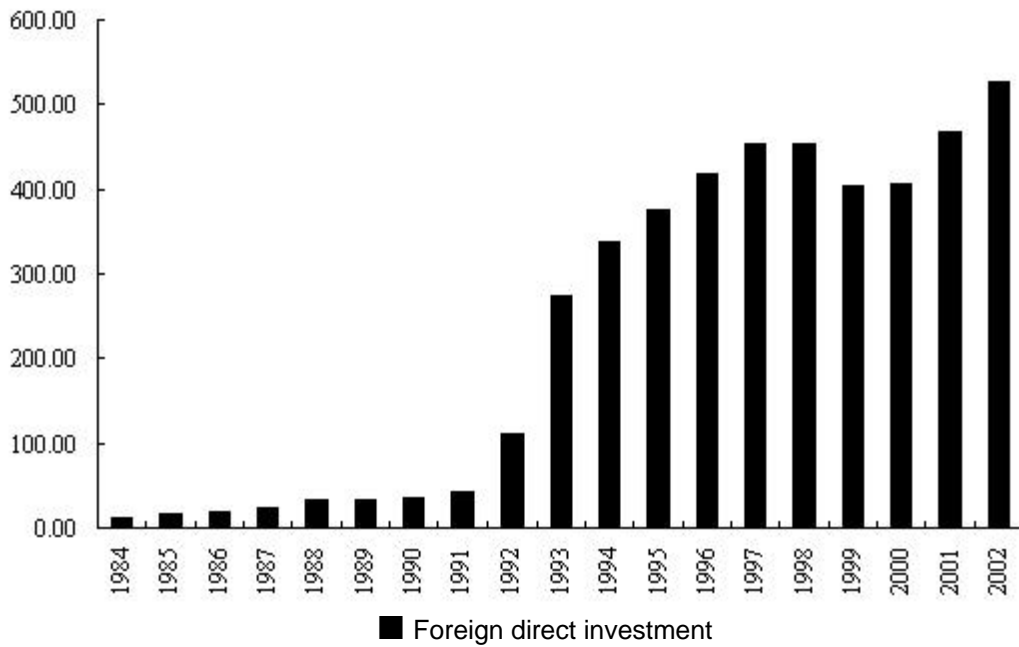
Source: NSB (*China Statistical Yearbook,* various years).

respectively (Figure 1); in 2002 China's share in total world exports and total world imports also amounted to 4.3 per cent and 3.8 per cent, respectively, making China the fifth largest international exporter and the sixth largest importer in the world. A similar trend can also be noted with regard to foreign capital utilization. The total amount of FDI in China grew from US$1.23 billion in 1984 to US$52.7 billion in 2002 (Figure 2), making the country the largest recipient of FDI among developing countries. Through greater liberalization in trade and foreign investment, the opening-up policy has significantly stimulated China's economic growth.[2]

3.2 Poverty reduction in rural China

After more than two decades of market-oriented reforms, China's rapid developments, especially its considerable achievements in stimulating economic growth and reducing poverty, have been widely highlighted in the literature. According to China's official poverty line, more than 220 million people have been lifted out of absolute poverty in the country's rural regions over the period from 1978 to 2002 (see Table 1).[3]

Rural poverty estimates for China based on several alternative standards are presented in Table 1. For instance, using the World Bank's international standard poverty line of income measure of one dollar per day (in purchasing power parity), the number of China's rural poor decreased dramatically from 261 million in 1990 to 88 million in 2002. When estimated with the poverty line of consumption measure set at one dollar per day, the rural poverty population in China also indicated a substantial drop from 358 million in 1990 to 161 million in 2002 (Table 1). Therefore, although the virtual magnitude of China's absolute poor population and of poverty incidence has still been the issue of much debate, there is no doubt that the country's rural poverty has sharply decreased over the last several years.

There is also strong evidence that the evolving patterns of rural poverty reduction are highly influenced by the country's reform policies and development strategies. Four distinct stages can be observed in China's progress of rural poverty reduction since the beginning of the market-oriented reforms in 1978.

During the first stage (1978-85), China experienced one of the most impressive rural poverty reductions in history, with the number of rural poor declining substantially from 250 million in 1978 to 125 million in 1985 based on China's official estimates of rural poverty, and the rural poverty incidence decreasing dramatically from 30.7 per cent in 1978 to 14.8 per cent in 1985. This remarkable achievement can be attributed mainly to the rapid growth in both agricultural production and rural income during this period.

During the second stage (1986-93), due mainly to stagnation in agricultural productivity and rural economy, rural income increased at a much slower rate than earlier, and the

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[2] However, foreign trade and foreign direct investment were more concentrated in the coastal regions. The unbalanced spatial distribution of foreign trade and foreign investment has led to increasing regional income disparity in China. The coast-interior dichotomy has also posed serious challenges for China's further development.

[3] China's official poverty lines currently adopted by the National Bureau of Statistics (NBS) are based on a minimum nutritional standard at a daily calories intake of 2100 per person and a standard food bundle recommended by the Chinese Nutrition Association.

impacts of agricultural growth on rural poverty became less significant. As a result, progress in rural poverty reduction during this stage slowed down: the number of the rural poor declined at an average annual rate of 6.2 per cent in this period, in contrast to that of 9.4 per cent between 1979 and 1985.

Meanwhile, new features emerged in China's poverty. For instance, there was evidence that China's rural poor population became more and more concentrated in the less-developed inland regions and other remote areas, particularly in the old revolutionary base areas, minority nationality regions, and border areas. In 1986, the Chinese government worked out its seventh five-year plan (1986-90). The plan formally placed on the agenda promoting the economic development of the poor areas, and helping the poor in the old revolutionary base, those of minority nationality, and those in the remote and frontier areas to alleviate poverty. This also marked the beginning of the implementation of targeted poverty reduction programmes in rural China. Soon after, the Leading Group for Economic Development of Poor Areas was established, under the leadership of the state council. For better targeting, at first 258 poor counties were selected in 1986 as the 'national designated poor counties', which would receive special poverty alleviation funds from the central government to finance three main targeted poverty investment programmes, i.e., (i) the subsidized loan programme,

Table 1
Poverty line, and incidence of poverty in rural China, 1978-2002

| Year | China's official estimates | | | World Bank's international standard | | | |
| | | | | Income measure ($1/day) | | Expenditure measure ($1/day) | |
	Poverty line (current RMB)	Poor population (million)	Rural poverty incidence	Poor population (million)	Rural poverty incidence	Poor population (million)	Rural poverty incidence
1978		250	30.7				
1986	213	131	15.5				
1987	227	122	14.3				
1988	236	96	11.1				
1989	259	106	12.1				
1990	300	85	9.5	261	29.1	358	40
1991	304	94	10.4	255	28.2	344	38
1992	320	80	8.8	253	27.7	344	37.7
1993	350	75	8.2	247	27.1	346	37.9
1994	440	70	7.6	220	24	296	32.3
1995	530	65	7.1	186	20.3	264	28.8
1996	580	58	6.3	129	14	208	22.6
1997	630	49	5.4	116	12.7	208	22.7
1998	635	42	4.6	99	10.8	210	22.8
1999	625	34	3.7	97	10.5	217	23.5
2000	625	32	3.4	111	12	195	21
2001	635	29	3.1	99	10.6	182	19.5
2002	627	28	3	88	9.4	161	17.2

Source: NBS (various years) and World Bank (2000, 2002).

(ii) the public works programme of food-for-work, and (iii) the budgetary grant programme.[4] Total amount of the government's poverty alleviation funds in 1986 was RMB 4.2 billion (at current prices), increasing steadily in the following years (see Table 2). In addition, the Chinese government also put forward a series of important measures to strengthen the effects of poverty reduction. According to official statistics, the number of the rural poor dropped from 131 million in 1986 to 75 million in 1993.

During the third stage (1994-2000), both increasing rural income and sustained government's anti-poverty efforts contributed to a reduction in rural poverty. In 1994, the Chinese government launched an ambitious poverty reduction programme, i.e., the National Eight-Seven Poverty Reduction Plan. It was designed to lift the remaining 80 million rural poor out of absolute poverty by the end of twenty-first century, and was also the first action programme for China's poverty reduction with clear and definite objectives, targets, measures and a time limit (IOSC 2001). China recorded great success in poverty reduction over this period, and based on China's official poverty line, the estimated number of rural poor declined dramatically from 70 million of 1994 to 32 million in 2000.

More recently, the Chinese government has launched the 2001-10 rural poverty reduction plan, i.e., a new programme that emphasizes multidimensional development objectives and multiple poverty reduction approaches, according to which poor villages, rather than poor counties, are the basic targeting unit, so as to improve the anti-poverty effectiveness. This also marked the start of a new stage (i.e., the fourth stage) of China's nationwide development-oriented poverty reduction work.

Table 2
Government's poverty alleviation funds, 1986-2002 (RMB 100 million)

Year	Subsidized loans	Food for work	Budgetary funds	Subtotal
1986	23.0	9.0	10.0	42.0
1987	23.0	9.0	10.0	42.0
1988	29.0	0.0	10.0	39.0
1989	30.0	1.0	10.0	41.0
1990	30.0	6.0	10.0	46.0
1991	35.0	18.0	10.0	63.0
1992	41.0	16.0	10.0	67.0
1993	35.0	30.0	11.0	76.0
1994	45.0	40.0	12.0	97.0
1995	45.0	40.0	13.0	98.0
1996	55.0	40.0	13.0	108.0
1997	85.0	40.0	28.0	153.0
1998	100.0	50.0	33.0	183.0
1999	150.0	50.0	43.0	243.0
2000	150.0	50.0	48.0	248.0
2001	185.0	60.0	40.0	285.0
2002	185.0	66.0	40.0	291.0

Source: Leading Group (various years).

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4 The number of nationally designated poor counties increased to 328 in 1988. After the establishment of Hainan province, three poor counties were added to this list. Then in 1994, according to the adjustment and the new poverty estimations, 592 poor counties were designated as national poor counties.

Figure 3
Geographic distribution of rural poor in China, 1990-2002

| | Eastern regions | Central regions | Western regions |
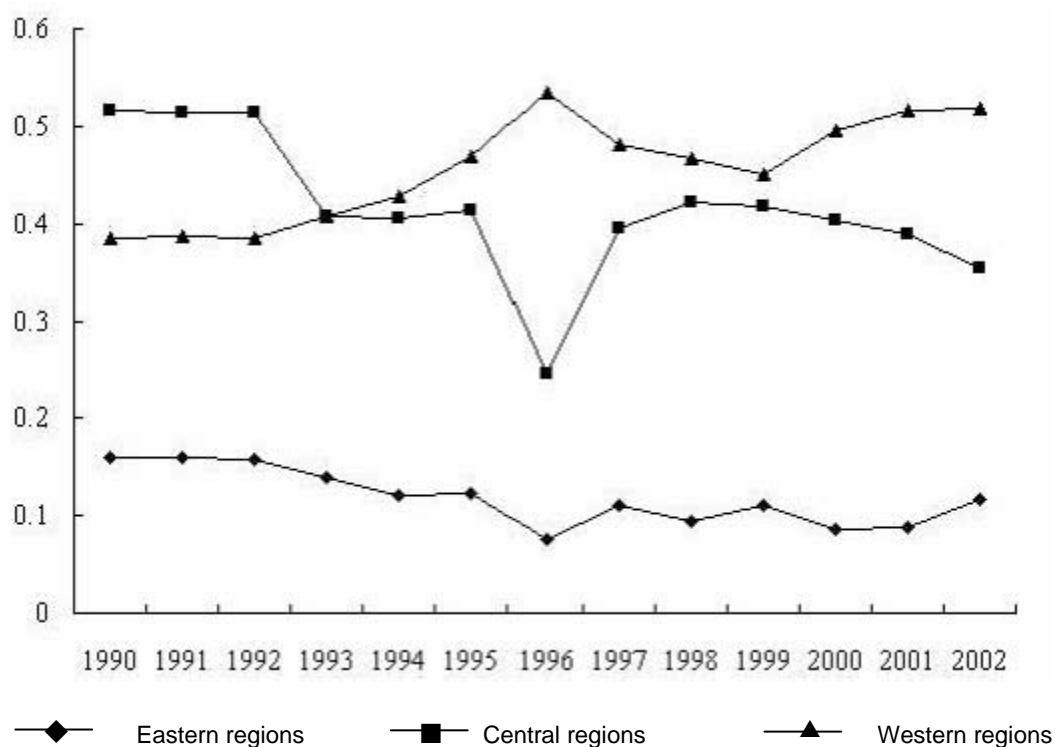
Source: NBS (various years) and author's calculations.

Figure 4
The incidence of rural poverty in China, 1990-2002

| | Eastern regions | Central regions | Western regions |

Source: NBS (various years) and author's calculations.

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Figure 3 presents the geographic distribution of the rural poor over the period of 1990-2002. We find that the rural poor population has become concentrated further in western regions since 1990. The ratio of western rural poor to the total number of China's rural poor rose from 38.6 per cent in 1990 to 51.8 per cent in 2002, whereas this ratio declined from 51.7 per cent to 35.4 per cent for the central regions, and from 15.9 per cent to 11.7 per cent for the coastal regions during the same period. Meanwhile, the incidence of rural poverty based on official estimates was also much higher in the western regions than in the other two regions for all these years (Figure 4). By the end of 2002, the number of rural poor according to by the official poverty line dropped to 28 million, and the implementation of the new century poverty alleviation plan will certainly accelerate further the pace of poverty reduction in China.

4 Threshold estimations on the globalization-poverty nexus

In this section, we follow Hansen (1996, 1999) to apply the threshold regression techniques to investigate the nonlinear relationship between globalization and poverty in China.

4.1 Modelling threshold effects

It has long been recognized in the literature that threshold effects and nonlinearities exist in different economic relationships. Traditional threshold analyses are usually based on the exogenous sample-splitting approach, with which the splitting of sample depends simply on some value of threshold variable that is given *ad hoc*, chosen arbitrarily, or determined exogenously. However, disadvantages of the traditional approach in dealing with nonlinearity and threshold effects are obvious: First, as Gomanee, Girma and Morrissey (2003) argue, under this approach, both the number of regimes and location of sample splits are arbitrarily selected and not based on prior economic guidance. Furthermore, as the threshold is not determined within the model, it is not possible to derive confidence intervals for the threshold. Second, the robustness of estimated results based on this approach is also questionable, since they are more likely to be highly sensitive to the choice of the value of threshold point. Therefore, the use of *ad hoc* and arbitrary sample splitting in empirical estimations has been highly disputed, and econometric estimators generated on the basis of such procedures may pose serious inference problems (Hansen 2000).

Another approach used in threshold analysis is the regression-tree methodology, with which the number and location of thresholds can be endogenously determined through the method of data sorting. However, this approach suffers seriously from the limitation that it fails to provide any distribution theory to test the statistical significance of thresholds.

In a series of original research studies, Hansen (1996, 1999 and 2000) develops new econometric techniques for threshold regression analysis, i.e., the endogenous threshold regression techniques. Hansen's endogenous approach has critical advantages. First, it does not require any specified functional form of nonlinearity, and the number and location of thresholds are completely endogenously determined by the data. Second, it provides an asymptotic distribution theory to construct confidence intervals for the

parameters. A bootstrap method is also applied to assess the statistical significance of the threshold effects.

In the following discussion, we examine the impacts of globalization on China's poverty reduction by applying Hansen's endogenous threshold techniques. The threshold regression model can be described as follows:

$$POV_{it} = \alpha_1 G_{it} + \alpha_2 FUND_{it} + \beta_1 GLOB_{it} \cdot I(GLOB_{it} \leq \gamma) + \beta_2 GLOB_{it} \cdot I(GLOB_{it} > \gamma) + \mu_i + \varepsilon_{it} \quad (1)$$

where POV is the rural poverty incidence, measured by the proportion of the poor in the rural population; G denotes the growth rate of real per capita income; $FUND$ is the per capita government expenditure for rural poverty alleviation; $GLOB$ is the globalization index, measured by the ratio of total trade volume (i.e., the sum of exports and imports) to GDP, which is used as a proxy to measure the level of globalization, and is chosen as the threshold variable in our estimations; $I(.)$ is the indicator function used to sort the data; γ is the threshold value; the subscript i indexes the individual province; and the subscript t indexes time. This specification also contains an unobservable province-specific effect u_i and an error term ε_{it}. In our estimations, the threshold value and the slope parameters are jointly determined. Meanwhile, Equation (1) can also be rewritten as:

$$POV_{it} = \begin{cases} \alpha_1 G_{it} + \alpha_2 FUND_{it} + \beta_1 GLOB_{it} + \mu_i + \varepsilon_{it}, & GLOB_{it} \leq \gamma, \\ \alpha_1 G_{it} + \alpha_2 FUND_{it} + \beta_2 GLOB_{it} + \mu_i + \varepsilon_{it}, & GLOB_{it} > \gamma. \end{cases} \quad (1^*)$$

Three steps are developed for our threshold estimations. In the first step, we follow Hansen (1999) to eliminate the individual effects in our model. After these transformations, the threshold value and regression slopes can be obtained by least squares estimations through the procedure of minimizing the concentrated sum of square errors, as recommended by Chan (1993) and Hansen (1999, 2000). The second step is to test the statistical significance of the threshold effects. More specifically, we attempt to test the null hypothesis of no threshold effect: $H_0 : \beta_1 = \beta_2$, against the alternative hypothesis of having at least one threshold: $H_1 : \beta_1 \neq \beta_2$. The null hypothesis of no threshold effect will be rejected if the bootstrap estimate of the asymptotic p-value for this likelihood ratio test is smaller than the desired critical value. When we find a threshold, the last step is to construct confidence intervals for the threshold value and slope coefficient. We test the null hypothesis: $H_0 : \gamma = \gamma_0$, against the alternative hypothesis: $H_0 : \gamma \neq \gamma_0$. The null hypothesis will be rejected if the likelihood ratio test statistic exceeds the desired critical value. After the confidence interval for the threshold value is obtained, the corresponding confidence interval for the slope coefficient can also be easily determined because the slope coefficient and the threshold value are jointly determined. Moreover, similar procedures can be conducted to deal with the case of multiple thresholds.

4.2 Data

Using panel data covering twenty-five Chinese provinces and regions over the period of 1986-2002, we investigate the nonlinear relationship between globalization and

poverty.[5] Data used in our study are from *China Statistical Yearbook* (various years), *China Rural Statistical Yearbook* (various years), *Comprehensive Statistical Data and Materials on 50 Years of China,* and National Bureau of Statistics. Descriptive statistics for all the variables are given in Table 3.

Table 3
Relationship in China

	Mean	Std dev.	Minimum	Maximum	Observations
POV	0.094	0.085	0	0.507	425
G	0.083	0.044	-0.134	0.268	425
FUND[1]	0.274	0.320	0	1.914	425
GLOB	0.176	0.262	0.021	1.845	425

Note: The variable of FUND is expressed in 100 *yuan*.

POV, rural poverty incidence; G, growth rate of real per capita income; FUND, per capita government expenditure for poverty alleviation; GLOB, the globalization index.

4.3 Estimation results

Following Hansen (1999, 2000), we first estimate the number and the location of the threshold effects. Table 4 presents the results of the likelihood ratio test statistics for the test of the statistical significance of threshold effects as well as their 1000 bootstrap p-value. We find that the test for a single threshold is significant with a 1000 bootstrap p-value of 0.082, while the test for a second threshold is statistically insignificant with a 1000 bootstrap p-value of 0.239. These results provide strong evidence to suggest that there exists one threshold in the regression relationship. The estimated threshold point is 0.040, with which our sample can be split into two regimes, i.e., the 'less globalized' economies and the 'more globalized' economies.

Table 4
Test results for threshold effects

Test for single threshold	
The likelihood ratio statistic:	32.13
P-value	0.082
(10%, 5%,1% critical value)	(30.69, 35.70, 48.67)
Test for double threshold	
The likelihood ratio statistic:	15.96
P-value	0.239
(10%, 5%, 1% critical value)	(22.53, 26.28, 36.42)

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[5] China is composed of 31 provinces, autonomous municipalities and autonomous regions. In this paper, we focus primary on rural poverty in China, and thus three autonomous municipalities, i.e., Beijing, Tianjin and Shanghai, are excluded from our sample because these three cities are mainly urban economies. In addition, Tibet is also excluded from our sample because of the serious problem of omitted data and missing value for this region. Moreover, Chongqing municipality area, which was established quite recently and separated from Sichuan province in year 1997, is still included in the calculations for Sichuan province. Similarly, Hainan province is included in the calculations of Guangdong province. In general, 25 provinces and regions are retained in our sample.

Figure 5
Confidence interval construction in a single threshold model
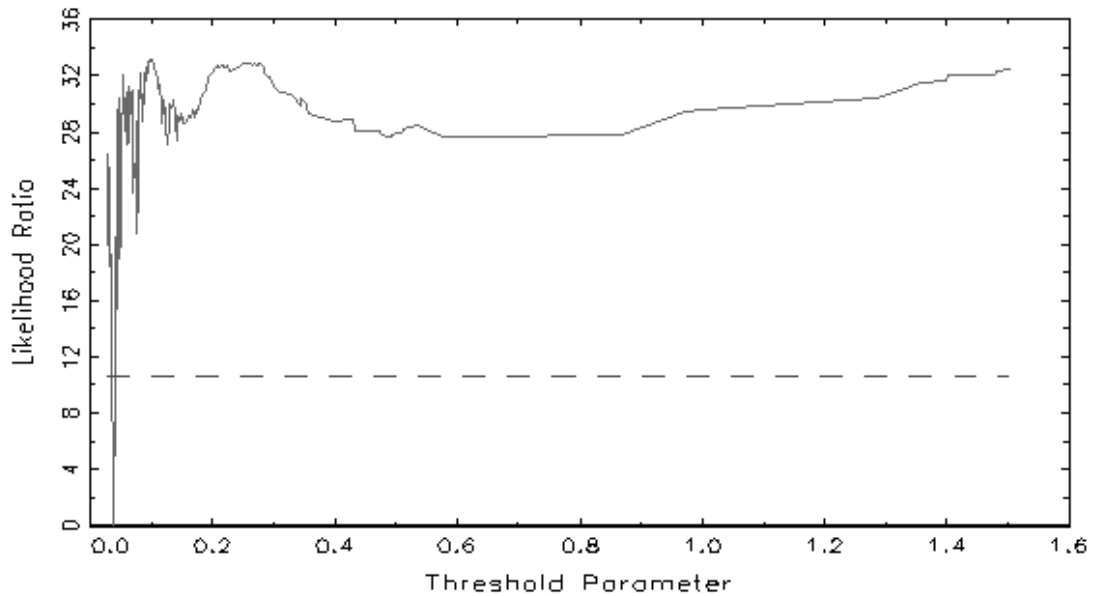
Source: Compiled by the author.

Table 5
Regression estimate on globalization and poverty in China:
Single threshold model (Dependent variable: POV)

	Coefficient	OLS std error	White heteroskedasticity*-corrected std error	Robust T-statistics
G	-0.148*	0.066	0.078	-1.91*
FUND[1]	-0.132***	0.017	0.021	-6.39***
$GLOB \cdot I(GLOB \leq \gamma)$	3.511***	0.653	0.985	3.57***
$GLOB \cdot I(GLOB > \gamma)$	-0.052**	0.032	0.021	-2.49**
Observations	425			
Provinces	25			

Notes: The variable of FUND is expressed in 100 *yuan*;

POV, rural poverty incidence; G, growth rate of real per capita income; FUND, per capita government expenditure for poverty alleviation; GLOB, the globalization index.

The estimate of the threshold value r is based on Hansen's endogenous threshold regression techniques (see Hansen 1996, 1999 and 2000);

The calculation of the robust t-statistics is based on the White heteroskedasticity-corrected standard error;

***: significant at the 1% level; **: significant at the 5% level; *: significant at 10% level.

In the analysis, our threshold estimations are based on this single threshold model. Figure 5 presents the plots of the concentrated likelihood ratio test statistics. The estimated threshold is the value at which the likelihood ratio hits the zero axis.

The regression results are reported in Table 5. We find that both the growth of per capita income (G) and the increase in per capita government expenditure for poverty alleviation (FUND) significantly contribute to China's poverty reduction. The

coefficient of G is negative and significant at 10 per cent level, and the coefficient of FUND is negative and significant at 1 per cent level. Therefore, empirical results show that economic growth and government's investments for alleviating poverty are two critical driving forces behind China's successful achievement in poverty reduction.

More interesting results are found for the role of globalization in China's poverty reduction. Our estimation results strongly suggest the existence of the threshold effects and the nonlinearity in the relationship between globalization and poverty: globalization is good for the poor only after the economy has reached a certain threshold level of globalization.

According to our estimations, for the 'less globalized' regions with a globalization level lower than the threshold value (i.e., 0.040 in our case), the globalization index (GLOB) is positively and significantly correlated with poverty, which implies that globalization will increase poverty at low levels of globalization. However, in sharp contrast, the coefficient of GLOB becomes negative and statistically significant for the 'more globalized' regions with a globalization level beyond this threshold value, indicating that globalization leads to a decline in poverty at high levels of globalization. Therefore, there is strong evidence that globalization does hurt the poor at low levels while at higher levels, globalization helps to reduce poverty. These results are consistent with the findings of Agénor (2004).

5 Conclusion

Recent literature has highlighted the heterogeneity and nonlinearity of the globalization-poverty relationship (e.g., Agénor 2004; Nissanke and Thorbecke 2005; Sindzingre 2005). In this paper, with the help of more recent data from Chinese provinces over the period of 1986-2002, we apply the endogenous threshold regression techniques to investigate the impacts of globalization on China's poverty reduction. The estimation results provide strong evidence to suggest that a threshold exists in the relationship between globalization and poverty, i.e., the poverty-reducing effect of globalization becomes positive only after it has reached a certain threshold level. Our results confirm the findings in Agénor (2004) that globalization may hurt the poor, not because it went too far, but rather because it did not go far enough.

Moreover, we also find evidence that China's rapid economic growth and the government's sustained efforts and investments in the fight against poverty are the two critical driving forces behind its successful achievement in poverty reduction over the last two decades.

These findings have important policy implications to China's future efforts in poverty alleviation. Effective policy measures have to be put forward to accelerate China's integration further into the global economy in order to stimulate economic growth, and to provide more opportunities for the poor to increase income and escape poverty.

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