Revisiting Income Inequality in China from an Evolving Productivity Perspective

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Abstract: *Income inequality in China has evolved substantially amid rising productivity since reform and opening up in the late 1970s. Based on the group decomposition equation for Gini coefficient, this paper estimates China's inequality possibility frontier (IPF) and the inequality extraction rate (IER). Results indicate that: (i) From 1978 to 2017, China's IPF continuously expanded amid improving productivity, and the maximum feasible Gini coefficient rose from 0.2281 to 0.8446. (ii) Meanwhile, China's overall IER decreased from 123% to 55%. More specifically, China's IER fell sharply over the period 1978-1980, stabilized in the period from the mid-1980s to 2012, and further declined after the 18th CPC National Congress in 2012. Currently, 55% of China's maximum feasible inequality has been converted into actual inequality. The correlation between inequality and productivity is recognized in academia but seldom explored in the literature. To fill this void, this paper empirically measures inequality in light of productivity development. Our research conclusions explain why yawning income gaps in China have been tolerated since reform and opening up, and offer empirical evidence for setting income distribution policies according to economic development in the new era.*

Keywords: *maximum feasible inequality, inequality possibility frontier (IPF), inequality extraction rate (IER), tolerable inequality*

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1. Introduction

Amid remarkable economic growth since reform and opening up in the late 1970s, China has transformed from an egalitarian society to a highly unequal society (Li, 2018) with increasingly non-standard and unequal income distribution (Jia, 2018). China's income distribution was almost as equal as in Nordic countries at the inception of reform and opening up, but is now as unequal as in the United States (Piketty *et al*., 2019). This argument is verified by the inequality measurement results of representative literature shown in Figure 1 (Li and Luo, 2012; Luo and Cao, 2018; Xu and Zhang, 2011; Cheng, 2007; Hu *et al*., 2011; Gong and Xiong, 2016; Hong, 2009). After allowing some people to become rich first, China has set a more ambitious goal to deliver common prosperity to all its people in the new era. Insights on the past and present of income inequality are of great significance to improving income distribution and economic growth quality in China.

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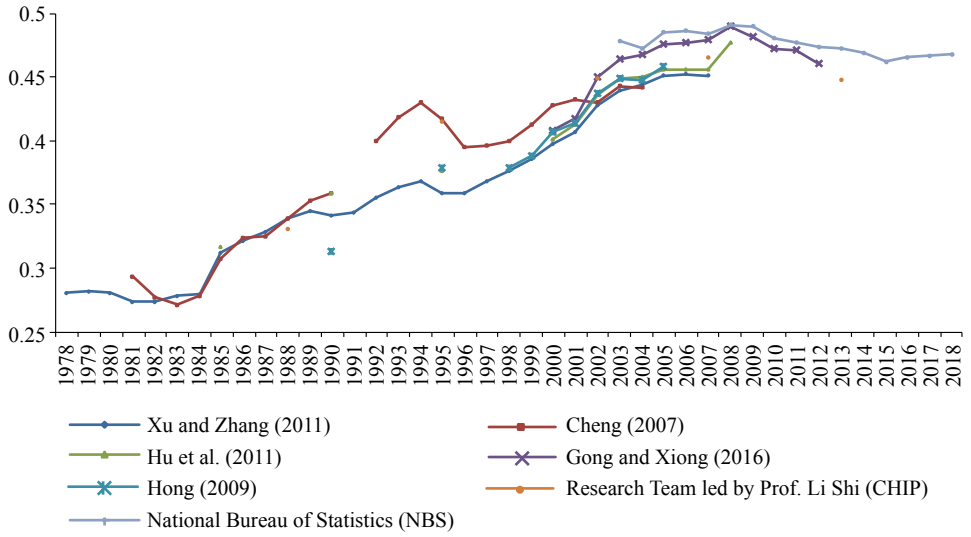

Figure 1: China's Gini Coefficient Measured by Representative Literature, 1978-2017

Note: Li's (CHIP) results are from Li and Luo (2012) and Luo and Cao (2018).
Source: Drawn by the author according to relevant literature.

Amid economic development, income inequality will neither automatically diminish in Kuznets's inverted U shape (Kuznets, 1955) nor exacerbate as Piketty gloomily forecasted (Piketty, 2014). Drivers of change in income gaps have been extensively investigated by a large body of literature from such perspectives as market-based economy, the household registration system and urbanization, ownership structure, demographics, rural reform, social security, labor skills, technology upgrade, automation, economic opportunities in the sense of changing demand for domestic and foreign goods, as well as trade unions (Han *et al*., 2012; Karabarbounis and Neiman, 2013; Elsby *et al*., 2013; Autor and Salomon, 2018; Li, 2018). However, none of these factors is inevitable to a specific stage of development. To a great extent, these factors are subject to policy arrangements in a certain stage of economic development. To date, there is no universal theory or mechanism for income distribution (Atkinson and Bouignon, 2009).

Income distribution and economic growth as reflected in rising productivity are two sides of the same coin. According to Marxist economics, production structure determines distribution structure, and production and distribution are intrinsically unified (Wei and Zhang, 2007; Liu, 2018). From a productivity perspective, equality or inequality may have implications that are unlike common understandings. As shown in Figure 1, China's income distribution was relatively equal at the inception of reform and opening up, but such equality was achieved against the backdrop of very poor productivity. Despite the present state of unequal distribution, the level of productivity has advanced to such an extent that even the poor are much better off than before. Hence, China's evolving income distribution should be put under the perspective of productivity improvement.

Yet existing studies on the relationship between productivity and distribution are confined to theoretical analysis and seldom bring a productivity perspective into the empirical analysis framework for income gaps or inequality.

(i) The first common approach measures income gaps between individuals, households, or social groups. Existing studies have widely applied Gini coefficient, Theil index, and quantile approach (Luo and Li, 2016; Piketty, 2016).

(ii) Another approach deals with multidimensional poverty based on Sen's feasible capacity theory

(1999), and is of great practical significance to targeted poverty reduction in China.

(iii) Regarding the third approach, which examines inequality from the perspective of factor income shares, academics disagree over the scope of measurement, e.g. Should the denominator be the gross domestic product (GDP) or national income? Should depreciation be deducted from the denominator (Karabarbounis and Neiman, 2014)? Should distribution involve labor and capital only (Piketty, 2014, 2016) or three sectors that include the government?

(iv) The fourth approach investigates intertemporal inequality from a social mobility perspective, including intergenerational mobility and class mobility, and focuses on dynamic inequality.

(v) Inequality from a redistribution point of view, such as redistribution ratio (Fochesato and Bowles, 2015).

The above-mentioned studies have objectively estimated income inequality in various countries, but none of them has examined inequality in light of productivity or economic growth. That is to say, there is a paucity of an analytical framework that links productivity with distribution for empirically measuring inequality.

While the relationship between productivity and distribution is recognized in academia, existing studies have measured inequality on the sole basis of distribution. Based on the group decomposition method for Gini coefficient, this paper tactfully specifies the average income as a multiple of subsistence income, and derives the inequality possibility frontier (IPF) and inequality extraction rate (IER) as determined by productivity in a given period. In this manner, this paper attempts to put China's income inequality into the perspective of evolving productivity since reform and opening up in the late 1970s. This paper offers the following contributions:

(i) Productivity is embedded in the measurement of inequality and the two are dynamically correlated from an evolution perspective, which was overlooked in existing studies.

(ii) China's IPF and IER are estimated based on theoretical derivation to provide new insights into China's income inequality, unifying theory with empirical evidence.

(iii) The discovery that China's inequality extraction rate (IER) barely nudged up since reform and opening up answers the question "Why yawning income gaps have been tolerated in China over the past four decades?"

Unlike existing studies that measured inequality over short periods, this study examines income inequality over a long timeframe of 1978-2017, which makes a long-term trend analysis possible.

2. Basic Theoretical Framework

2.1 Methodology

When researchers assess the degree of inequality, they often follow a benchmark for reference. For instance, when two countries report their Gini coefficients to be 0.47 and 0.56, the critical values of 0.4 and 0.5 normally become thresholds for putting these two countries in the categories of "unequal" and "very unequal" income distribution. Theoretically, the value of Gini coefficient is in the range of [0,1], but in reality, no economy would reach the extreme values of 0 and 1. In the pre-reform era, China was an egalitarian society with a considerable percentage of the population living below the poverty line. Given the limited surplus product for distribution, the feasible inequality was low, and Gini coefficient was unlikely to reach the maximum value of 1. Even with the rising fortunes of the few over the past four decades of reform and opening up and the consequent yawning income gaps, China's Gini coefficient is nowhere near the maximum value of 1. Hence, the theoretical maximum value 1 of Gini coefficient has lost its actual meaning.[1] In this sense, it is tempting to ask this question: In the real-world

[1] Except for the use of comparing the relative gap between actual values with maximum value 1.

economy, is it possible to identify the maximum feasible inequality in a given period?

Income inequality is closely related to the level of productivity. Apart from the Marxist theory on the relationship between productivity and distribution, this conclusion may also be drawn from the assumption that in a society consisting of the rich and the poor, the poor only receives a certain amount of subsistence income while surplus income is entirely shared among the rich. When the overall average income is very low, e.g. barely above the subsistence income, the rich will end up with little surplus income to share, and at this moment, income inequality will be limited. With rising productivity and average income, the poor will remain at the subsistence level,[2] but the rich will have much more surplus income to spare, i.e. the maximum feasible inequality will increase. It can be found that the maximum feasible inequality is an increasing function of average income. It varies across different stages of economic development or between economies of different productivity levels. In our view, the correlation between income distribution and productivity means that income inequality cannot be discussed in isolation from economic development. New perspectives can be derived from income inequality in the context of economic change.

Hence, this paper attempts to identify the maximum feasible inequality in light of economic reality in a given period. After decomposing Gini coefficient by social groups, the result of decomposition is compared with actual inequality, such as the traditional measurement of Gini coefficient, to find out the share of actual income inequality in the maximum feasible inequality of a certain period. Under this approach, the maximum feasible inequality is linked to the level of productivity and no longer confined to Gini coefficient's traditional theoretical maximum value 1. Also, the maximum feasible inequalities of various periods are connected to form a curve of the "inequality possibility frontier." Following this approach, this paper offers a new perspective on income inequality in China.

2.2 Theoretical Derivation

In this paper, the maximum feasible inequality is derived based on Gini coefficient's group decomposition method. If an economy contains n groups and the average income is y, the average income for each social group can be ranked ($y_j > y_i, j > i$). Then, Gini coefficient decomposed by social groups can be expressed as (Milanovic *et al*., 2011):

$$\begin{aligned} G &= \sum_{i=1}^{n} G_i p_i \pi_i + G_{between} + R \\ &= \sum_{i=1}^{n} G_i p_i \pi_i + \frac{1}{\mu} \sum_{i}^{n} \sum_{j>i}^{n} (y_j - y_i) p_i p_j + R \end{aligned} \tag{1}$$

Equation (1) means that for a society that contains n social groups, the individual incomes within group i form an income distribution. This social group's Gini coefficient can be calculated, and other social groups have their respective average incomes (e.g., y_j, y_i). Income inequality between social groups, i.e. inter-group Gini coefficient $G_{between}$, can be thus calculated. Specifically, π_i and p_i are the shares of income and population of group i, and their product is the weight assigned to group i; $\sum_{i=1}^{n} G_i p_i \pi_i$ measures intra-group inequality, and $G_i p_i \pi_i$ is the contribution of group i to the overall Gini coefficient; R is an interaction term that cannot be fully decomposed within a group or between groups, and is related to the degree of overlap in the income distribution of various social groups.[3]

As mentioned before, we assume that only two social groups exist, i.e. the rich and the poor, and that all the poor live at the subsistence level. Further, we assume that s is the subsistence income level

[2] In reality, subsistence level increases at a slower pace relative to the increase of average income.

[3] Interaction term in the decomposition equation equals 0 only when all incomes are ranked in the descending order and clustered by group and not crossed over social groups. See Shorrocks (1984).

for the poor; μ is the average income for all social groups; N is the total population; ε is the share of the rich in the total population. Hence, the average income of the rich (y_h) can be expressed as:

$$y_h = \frac{\mu N - sN(1-\varepsilon)}{\varepsilon N} = \frac{1}{\varepsilon}[\mu - s(1-\varepsilon)] \quad (2)$$

Where, $(1-\varepsilon)N$ denotes the share of the poor in the total population. If the rich and the poor as a share of the total population and their average incomes can be obtained, we may calculate the potential inequality of distribution measured by any indicator.

Based on the consideration of solving the maximum inequality, this paper assumes that both social groups will receive their respective average incomes, i.e. no income inequality exists within each social group. At this moment, equation (1) can be simplified into the following form:

$$G = \frac{1}{\mu}(y_j - y_i)p_i p_j \quad (3)$$

The average income for the rich expressed by equation (2) is substituted into y_j of equation (3). Since the average income for the poor is $y_i = s$, the rich and the poor as a share of the total population are $p_j = \varepsilon$ and $p_i = 1-\varepsilon$. Thus, equation (3) is equivalent to:

$$G^*(\mu) = \frac{1}{\mu}\left\{\frac{1}{\varepsilon}[\mu - s(1-\varepsilon)] - s\right\}\varepsilon(1-\varepsilon) \quad (4)$$

Where, G^* is the maximum feasible Gini coefficient for a given average income level (μ). Further, the average income level (μ) is expressed as a multiple (α) of the subsistence income (s) of the poor, i.e. $\mu = \alpha s(\alpha > 1)$. Equation (4) can be re-arranged as:

$$G^*(\mu) = \frac{1-\varepsilon}{\alpha s}s(\alpha - 1) = \frac{\alpha - 1}{\alpha}(1-\varepsilon) \quad (5)$$

Normally, the elite class or the rich represents a small portion of society. In an extreme scenario, there can be only one rich person in a society, i.e. the rich class as a share of the total population can be deemed as close to $0(\varepsilon \to 0)$. Then, equation (5) is simplified as:

$$G^*(\mu) = \frac{\alpha - 1}{\alpha} \quad (6)$$

Equation (6) is the final maximum feasible Gini coefficient (α is given). As the economy evolves, the maximum Gini coefficient will change with average income as a multiple (α) of subsistence income. For instance, when $\alpha = 1$, i.e. average income equals the subsistence level,[4] the maximum feasible Gini coefficient is $G^* = 0$; when, i.e. $\alpha = 5$, the average income is five times the subsistence level, the maximum Gini coefficient is $G^* = 0.8$.

Theoretically, for any $\alpha(\alpha > 1)$, the corresponding maximum feasible Gini coefficient can be calculated. In the coordinate system with α as horizontal axis and G^* as vertical axis, each G^* corresponding to α can be connected to form a theoretical inequality possibility frontier (IPF) (see Figure 2). IPF is a concave curve that increases with average income as a multiple of the subsistence level. When the average income is extremely high, the response of the maximum Gini coefficient to a given change in average income converges to 0.

On this basis, the inequality extraction ratio (IER) is defined as the ratio between actual inequality and the maximum feasible inequality. It reflects the share of actual income inequality extracted from the maximum feasible inequality in an economy. Similar to traditional indicators for measuring inequality, higher IER means more unequal income distribution. The difference is that both IPF and IER have

[4] Since the two social groups receive their respective average incomes, overall average income becomes equal to the minimum subsistence level, i.e. incomes for all the members of the two groups are all at the subsistence level.

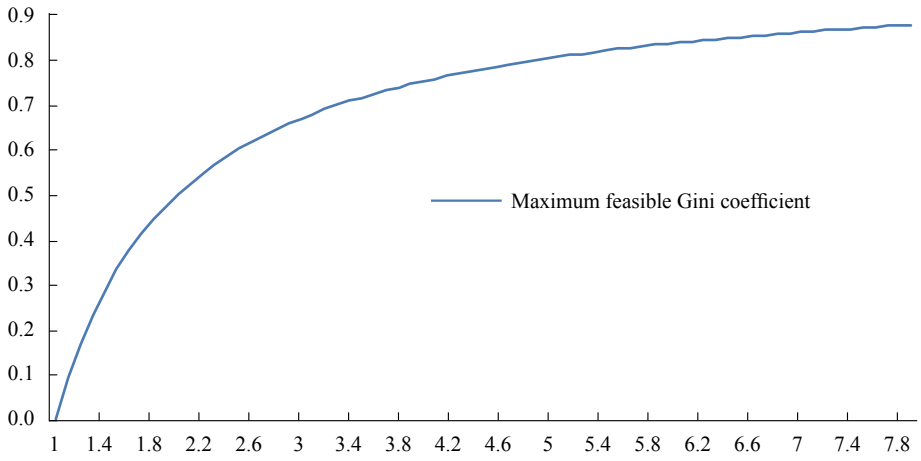

Figure 2: Inequality Possibility Frontier (IPF) Based on Gini Coefficient

Notes: Horizontal axis is the multiple of average income relative to the subsistence level (α, α>1); the vertical axis is the maximum feasible Gini coefficient G^*.

Source: Drawn by the author.

put inequality into the perspective of economic change (taking α into full account). When conducting estimation, IER can be expressed as the ratio between actual Gini coefficient and the maximum feasible Gini coefficient, i.e.:

$$IER_{Gini} = G_{actual}/G^* \quad (7)$$

Where, IER_{Gini} is the inequality extraction rate based on Gini coefficient, and G_{actual} is the actual Gini coefficient.

This equation properly measures inequality from the perspective of evolving productivity in terms of methodology, derivation and graphic relationship. In this equation, the average income is expressed as a multiple of the subsistence income (α) to tactfully associate income inequality with productivity for an empirical measurement of distribution that takes productivity into account.

Next, this paper measures the income inequality boundary and the inequality extraction rate (IER) since China's reform and opening up in 1978 for a new perspective on the long-term evolution of income inequality in China.

3. Variable Creation and Data Explanation

As can be learned from equation (6), equation (7) and $\mu = \alpha s(\alpha > 1)$, we should ascertain the subsistence income and the average income for measuring the maximum Gini coefficient and thus obtain the maximum inequality possibility frontier. We should also obtain the actual Gini coefficient for measuring IER. Hence, this paper explains the calculation and acquisition of rural, urban and national subsistence income, average income and actual Gini coefficient.

First, the subsistence income (s). Apart from the rural poverty line, China does not set a national subsistence standard. This paper sets out to identify rural and urban subsistence standards, and then calculates the national subsistence standard based on the weight of the population.

(i) China has been following the World Bank's minimum poverty line,[5] which only takes into account expenses on basic needs such as food, clothing and heating. Before 2010, China's rural poverty line was equivalent to the extreme poverty line (Wang, *et al.*, 2015). China's rural poverty line is

consistent with the definition of the "subsistence standard of living." This paper follows the national poverty line as the minimum rural subsistence standard.[6]

(ii) China has never specified a uniform urban poverty line. Referencing Chen and Yu's (2015) methodology, this paper calculates a more reasonable urban subsistence standard of living according to China's economic transition and the principle of urban-rural comparability.

(iii) According to the rural and urban subsistence standards of living, we calculate the national subsistence income based on weights of urban and rural populations as a share of the total population, i.e. National subsistence income = Rural subsistence income × Share of rural population + Urban subsistence income × Share of the urban population. All the basic data in the above estimation is from the National Bureau of Statistics (NBS). Rural subsistence income (s_1), urban subsistence income (s_2) and national subsistence income (s) are shown in Columns (1)-(3) of Table 1.

Second, the average income level (μ). The average income level is calculated based on the NBS

Table 1: Subsistence Income and Average Income (yuan/person, year)

	Subsistence income			Average income		
	Rural (s_1)	Urban (s_2)	National (s)	Rural (μ_1)	Urban (μ_2)	National (μ)
	(1)	(2)	(3)	(4)	(5)	(6)
1978	100	279	132.13	133.57	343.40	171.16
1980	130	306	164.13	191.33	477.60	246.84
1985	206	375	246.06	397.60	739.10	478.56
1990	300	621	384.72	686.31	1,510.20	903.90
1995	530	1,576	833.75	1,577.74	4,283.00	2,363.36
2000	625	2,301	1,231.87	2,253.42	6,280.00	3,711.84
2005	683	3,033	1,693.16	3,254.93	10,493.00	6,366.58
2010	1,274	4,200	2,735.53	5,919.00	19,109.40	12,507.56
2011	2,536	4,423	3,503.26	6,977.30	21,809.80	14,581.96
2012	2,673	4,542	3,655.54	7,916.60	24,564.70	16,668.52
2013	2,736	4,660	3,769.81	9,429.59	26,467.00	18,583.73
2014	2,800	4,758	3,872.38	10,488.88	28,843.85	20,541.96
2015	2,855	4,829	3,962.60	11,421.71	31,194.83	22,514.40
2016	2,952	4,931	4,086.81	12,363.41	33,616.25	24,551.85
2017	2,999	5,010	4,175.62	13,432.00	36,396.00	26,870.45

Notes: All income data is based on the current-year price level. The rural subsistence income for 2007 and before is the rural absolute poverty line, which was revised in 2008 by incorporating low-income populations into poor populations. Since 2011, China has established a national poverty line of 2,300 yuan/person.year at the 2010 price level, which is subject to adjustment according to the consumer price index (CPI) for the rural poor. In the interest of length, data of some years is not displayed.

Source: Urban subsistence income is estimated by the author following Chen and Yu's (2015) method; NBS data.

[5] The World Bank recommends two methods for determining the poverty line: (i) the low standard takes into account expenses on basic food and non-food necessities such as essential clothing and heating that one must obtain even at the expense of starvation; (ii) the high standard includes expenses on food and equally important non-food necessities. The difference is in the determination of non-food expenses. Normally, the utility of non-food expenses is smaller than the utility of food expenses by the low standard, i.e. extreme poverty; the high standard is the real subsistence standard of living.

[6] After 2010, the rural poverty was raised to a subsistence poverty line, but this change will not affect our assessment. See explanations in the subsequent section.

data of rural/urban per capita incomes. In 2012, the NBS implemented the reform of integrated urban and rural household survey. As a result, rural household income data are net income before 2013 and disposable income after 2013 while all the urban household per capita income data are disposable income. Yet such a statistical change does not affect our analysis in any substantive manner.[7] This paper calculates national average income based on the following equation: Average income = Rural per capita income × Share of rural population + Urban per capita income × Share of the urban population. Rural average income (μ_1), urban average income (μ_2) and national average income (μ) are shown in Columns (4)-(6) of Table 1.

Third, actual Gini coefficient. The actual Gini coefficient is only a transitional indicator for measuring IER and not this paper's primary concern. Hence, we follow official information or reference existing studies for measuring this indicator. Aside from national-level IER, this paper will also calculate rural and urban IERs. For this reason, the following paragraphs explain the national Gini coefficient (G_{actual}), rural Gini coefficient ($G_{actual1}$) and urban Gini coefficient ($G_{actual2}$), respectively:

(i) National Gini coefficient can be obtained from two data sources: NBS official Gini coefficient since 2003 and estimated Gini coefficient for 2002 and before. In this paper, we reference Cheng's (2007) estimate of national Gini coefficient for 1978-2002.[8]

(ii) Rural and urban Gini coefficients can also be obtained from official and academic sources. The official source is NBS estimates for the period 1990-2011. Specifically, 1990-2010 data are from the *Annual Report on Chinese Household Income Distribution (2011)* (Zhang, 2012) jointly compiled by NBS's Department of National Economic Accounting, Household Survey Office, and Department of Population and Employment Statistics. Rural and urban Gini coefficients for 2011 were made public by then NBS Director Ma Jiantang during a panel discussion at the China People's Political Consultative Conference (CPPCC) in 2012.[9] In subsequent years, no separate urban and rural Gini coefficients were released due to the integrated urban and rural household survey. Some academics have estimated urban and rural Gini coefficients for 1989 and before. Urban and rural Gini coefficients for the period 1978-1989 are decomposed by Cheng (2007).

4. Estimation Results and Analysis

4.1 Evolution of China's Income Inequality Possibility Frontier (IPF)

The inequality possibility frontier is the curve of the maximum feasible Gini coefficient $G^*(\mu) = \frac{\alpha-1}{\alpha}$ corresponding to each α. It is the premise for estimating the inequality extraction rate (IER). The relationship between average income in China and the subsistence income for the period 1978-2017 and the estimated maximum feasible Gini coefficient are shown in Annex Table 1.

Over the past four decades, China's rising national income available for distribution and a slow increase in the subsistence poverty line have led to a widening gap between average income and subsistence income (α). As shown in Table 2, the ratios between China's rural, urban and national average incomes and their respective subsistence incomes were 1.34, 1.23, and 1.30 times in 1978, which increased to 4.48, 7.27, and 6.44 times, respectively in 2017. With rising productivity, income distribution in China may have become increasingly dispersed.

Parameter α closely links income distribution with productivity. Accordingly, China's rising

[7] In 2014, urban per capita disposable income was 28,844 yuan. By the old standard before the integrated household survey reform, China's current national urban household per capita income is 29,381 yuan. Difference between the two is limited. See the 34th note of the *Statistical Communique on National Economic and Social Development in 2014*.

[8] Missing years are supplemented with Xu and Zhang (2011).

[9] See http://china.rednet.cn/c/2012/03/08/2542131.htm.

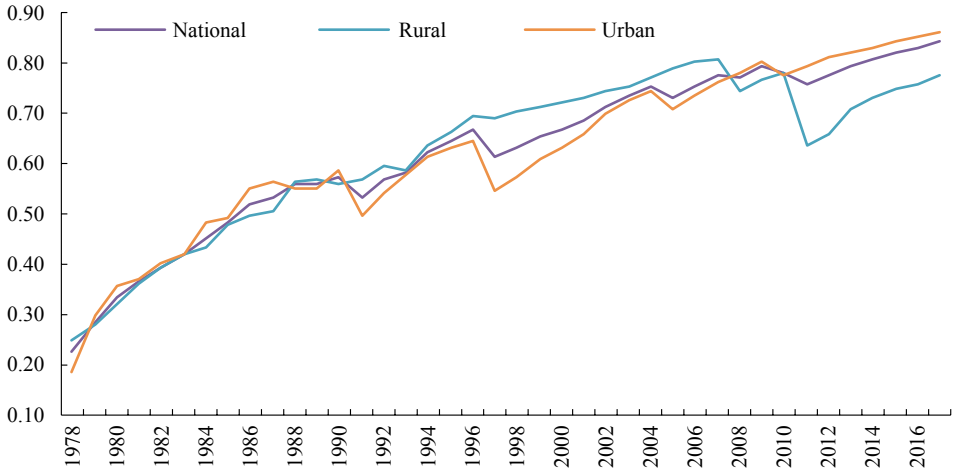

Figure 3: Maximum Feasible Gini Coefficients for Chinese Households, 1978-2017 (inequality possibility frontier)

Source: Drawn by the author based on estimation results.

maximum feasible inequality has led to a continuous increase in the inequality possibility frontier. From 1978 to 2017, China's national maximum feasible Gini coefficient sharply increased from 0.2281 to 0.8446. Specifically, the rural maximum feasible Gini coefficient rose from 0.2513 to 0.7767, and the urban maximum feasible Gini coefficient hiked from 0.1866 to 0.8624. The long-term evolving trend of the maximum feasible Gini coefficient is more clearly shown in Figure 3. In specific years, the maximum feasible Gini coefficient fell sharply. For instance, the rural maximum Gini coefficient plummeted in 2011 due to an adjustment in the rural poverty line. For the same reason, urban and national maximum feasible Gini coefficients became smaller in specific years. This reasonable adjustment in the subsistence standards of living does not affect our assessment of the expansion in the inequality possibility frontier.

In Figure 3, the horizontal axis for the inequality possibility frontier denotes year, which is slightly different from Figure 2 with parameter α as the horizontal axis. Of course, parameter α itself tends to increase over time. The maximum feasible Gini coefficient estimated based on productivity is the maximum inequality for a given stage of economic development. Compared with the traditional Gini coefficient, the maximum feasible Gini coefficient contains broader implications. By creating parameter α, the maximum feasible Gini coefficient in this paper reflects productivity in a given period: Smaller α means less productivity and more poverty, and vice versa. The maximum value 1 of traditional Gini coefficient is divorced from the reality of productivity. Hence, the inequality possibility frontier in this paper is unlike the maximum theoretical value of the traditional inequality indicator in the sense that the maximum feasible Gini coefficient is directly embedded into inequality measurement.

The discovery that the inequality possibility frontier tends to increase casts doubt over Kuznets's inverted U-shaped curve hypothesis (1955). As shown in our theoretical derivation and estimation results, increasing inequality possibility frontier (maximum feasible inequality) amid rising productivity creates conditions for actual income gaps to rise, although actual income gaps may not necessarily widen. More empirical evidence contradicts Kuznets's view (Gottschalk and Smeeding, 1997).

4.2 Estimation and Analysis of China's Inequality Extraction Rate (IER)

Before estimating IER, we first display the relationship between the actual Gini coefficient and the inequality possibility frontier (maximum feasible Gini coefficient) for a better understanding of

IER. The relationship between national, rural, and urban Gini coefficients and the maximum feasible Gini coefficients is shown in Figure 4(a)-(c). Results suggest the following changes in the relationship between the actual Gini coefficient and the maximum feasible Gini coefficient: China's actual Gini coefficient was close to the inequality possibility frontier at the beginning of reform and opening up in the early 1980s, but divergence started to occur in subsequent years. As far as the actual Gini coefficient is concerned, China's income inequality has substantially increased since reform and opening up but started to abate in recent years.

Based on actual and maximum feasible Gini coefficients, we continue to estimate the inequality extraction rate (IER) with the results shown in Annex Table 2 and Figure 5. With rising income inequality possibility frontier, China's IER, which remains at a plateau despite minor changes, tends to decrease. In very few years such as 1978, actual inequality exceeded the maximum feasible inequality, causing IER to exceed 100%. Such a discrepancy primarily stemmed from measurement error.[10] It may also reflect that certain groups of people lived below the subsistence standard, and that such information was captured by actual Gini coefficient as IER's denominator and not covered by the maximum feasible Gini coefficient as the numerator. After four decades of relentless poverty reduction, those living below the extreme poverty line should account for a very small percentage of the Chinese population, and the overall error of IER should be limited.

Next, we will uncover the evolving trends of national, rural, and urban IERs.

First, the evolution of national IER can be divided into three stages: Stage I (the late 1970s to mid-1980s) saw a sharp decrease in national IER from 1.23 in 1978 to 0.61 in 1984, i.e. China's actual inequality as a share of maximum feasible inequality turned from 123% to 61%, or the actual inequality as a share of maximum feasible inequality fell from 123% to 61%. A key reason behind this falling ratio is China's enormous productivity unleashed from reform and opening up. Unlike in the pre-reform era when egalitarianism held sway in a society of universal poverty, China's maximum feasible inequality swelled while actual inequality increased slowly.

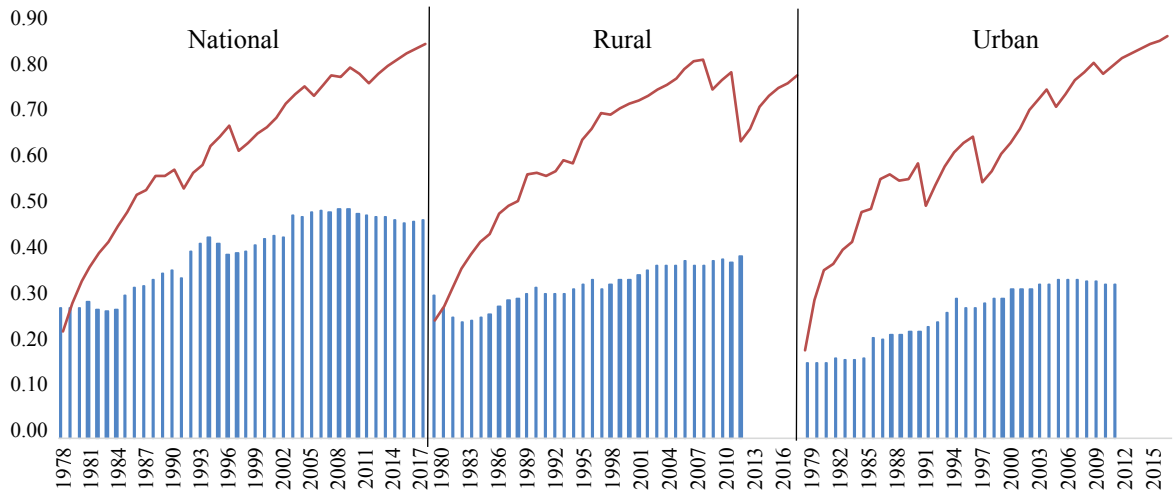

Figure 4: China's Gini Coefficient and Inequality Possibility Frontier, 1978~2017

Source: Drawn by the author based on estimation results.

[10] According to IER's design principles, there are three types of theoretical errors: (i) error in the measurement of per capita income; (ii) inaccurate measurement of actual inequality; (iii) inappropriate application of the minimum subsistence standard.

Stage II (the mid-1980s to around 2012): Except for minor volatility in the early 1990s, IER remained slightly higher than 0.6. The implication is that China's actual Gini coefficient changed in sync with the maximum feasible Gini coefficient, which is consistent with the fact that both increased substantially.

Stage III (2012 onwards): IER slightly reduced from 0.61 in 2012 to 0.55 in 2017, i.e. the percentage of the maximum feasible inequality that became converted into actually feasible inequality decreased from 61% to 55%. Notably, this trend does not change with the adjustment of the subsistence standard (poverty line) for 2011. A reduction in the inequality possibility frontier (maximum feasible Gini coefficient) (see Figure 3) will only cause IER to increase. In reality, however, IER has been on the decline. That is to say, IER's downward trend will not change even if IER's reduction is underestimated.

Our findings suggest that China's income distribution policy has achieved some effects since the 18th CPC National Congress.[11] Yet to answer the question of whether the short-term decline represents the beginning of a long-term trend, further observations are yet to be made given the uncertainties over falling Gini coefficient in recent years (Li, 2018). In any case, 55% of China's maximum feasible inequality has been converted into actual inequality. That is to say, income inequality in China remains high.

Second, the evolution of rural IER may also be divided into three stages: Stage I (1978-1984) saw a sharp decrease in rural IER due to the implementation of the rural household contract responsibility system. The system encouraged farmers to raise productivity and led to a rapid rise in the rural maximum feasible inequality, causing IER to decrease.

Stage II (1985-1985): Rural IER slowly reduced, indicating that the maximum feasible inequality continued to increase at a faster pace than actual inequality. Main reasons are: As the state lifted its control over rural labor force, they were allowed to migrate.[12] The mid- and late-1980s saw the emergence of township and village enterprises and the legalization of individual and private economies.[13] In this context, China lifted its restrictions on rural labor migration, allowing rural labor to seek diversified incomes, which led to an increase in rural actual inequality. Yet a substantial increase in rural average income due to rapid development in rural productivity resulted in a more significant increase in the maximum Gini coefficient (inequality possibility frontier).

Stage III (1996-2010): Rural IER stayed at around 0.47, and rural actual inequality changed in sync with maximum feasible inequality (linked to productivity development). The increase in IER in 2011 primarily stemmed from an adjustment in the rural poverty line.

Lastly, the evolution of urban IER can be divided into the following three stages: Stage I (1978-1984): Urban IER sharply decreased from 0.86 to 0.35. Stage II (1984-1998) saw a gradual increase in urban IER from 0.35 to 0.52. In this period, China started to transition from the planned economy to a market-based one. Yet before this transition was complete, well-connected merchants took advantage of the difference between government-set and market-based prices, and state assets were often undersold by government officials to their cronies (Wu, 2018). Myriad institutional loopholes gave rise to unlawful and illicit incomes, causing urban household income gaps to widen.

Stage III (1998-2011): Rapid economic development and rising urban household incomes after China's WTO entry led to a further increase in the inequality possibility frontier. Actual urban inequality increased slowly and, after 2005, stabilized and somewhat decreased. As a result, urban IER slowly shrank.

From the inception of reform to the mid-1980s, China's national, rural and urban IERs have all decreased sharply. Since the late 1980s, IERs have experienced limited change. That is to say,

[11] Of course, the possible under-estimation of actual Gini coefficient is another question to be discussed. See Li (2018) and Luo (2019b).

[12] In the 1980s, China's labor policy started to relax. Over the period 1983-1989, China's cross-township labor migration increased from 2 million people to about 30 million people. See Wu (2018).

[13] The Amendments to the Constitution (1988) stipulated that "private economy is a supplement to the socialist public economy and the state allows it to exist and develop within the scope prescribed by law." Until that time, development of the private economy had not obtained legal status.

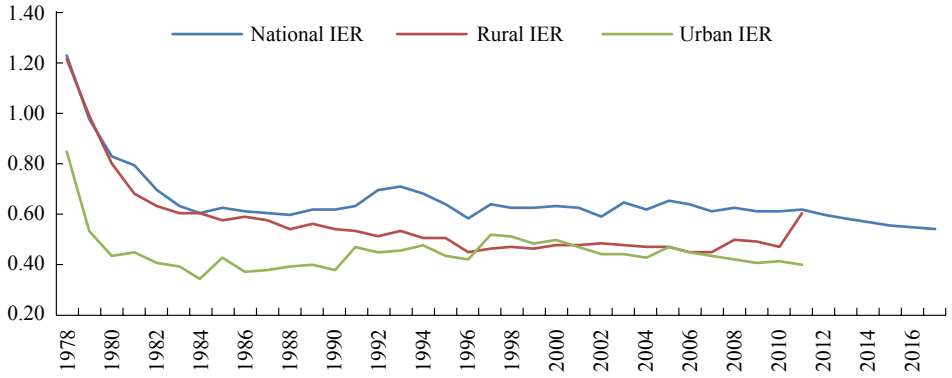

Figure 5: Change in China's IER Based on Gini Coefficient, 1978-2017

Source: Compiled by the author according to estimation results.

China's actual Gini coefficient, albeit low, was close to the inequality possibility frontier (extremity) at the beginning of reform and opening up. After the late 1980s, actual inequality increased steeply, and so did the maximum feasible inequality at a similar pace. Hence, there was no significant volatility or reduction in IER. Over the past four decades of reform and opening up, China's miraculous economic transition has become the "most thrilling example in the history of human development."[14] Yet despite falling IER amid rising productivity, China's actual income gaps remain significant with 55% of the maximum potential inequality converted into actual inequality. In the new era, China will continue to face considerable challenges in addressing income inequality.

China's inequality possibility frontier and inequality extraction rate provide new insights on income inequality. The above estimation results and analyses prove that income inequality evolves in sync with economic development. The maximum feasible inequality increases with a country's rising prosperity and average income. Even if actual inequality keeps stable, IER is still likely to fall as long as the maximum feasible inequality increases. Similarly, IER may not increase despite rising actual inequality as long as the maximum feasible inequality grows at the same pace with actual inequality. In a society of economic recession, however, IER may increase even if actual inequality remains stable or declines. Hence, we may arrive at the following inference: With other conditions held constant, economies in recession will face more inequality challenges than growing economies do.

To some extent, this inference explains why growing income inequalities in China have been tolerated over the past four decades. The lower IER, the more inequalities are tolerated in an economy. In a fast-growing economy, most people will benefit from improving productivity. Even the poorest are not left out from the positive externalities or spillover effect of such rapid development. When people of all income brackets become better-off, yawning income gaps are more likely to be tolerated.

Let us envision this example: In period , a society lives in poverty but income distribution is relatively equal; in period , productivity gains lead to rising incomes for all at the expense of widening income gaps. Despite more unequal distribution, most people tend to feel better off in period after enduring poverty in period . The public may more care about significant productivity improvement while IER barely budges. With rising productivity over the past four decades, the Chinese economy became more tolerant about inequality; with rising incomes, the general public also found a certain degree of inequality acceptable.

[14] See former IMF chief economist Branko Milanovic's comment on China's four decades of reform and opening up: http://world.people.com.cn/n1/2018/0108/c1002-29750726.html.

Yet such tolerance does not mean that we should turn a blind eye to income inequality. Extensive studies have found that excessive income inequality takes a toll on consumption, human capital, social mobility, trust, and stability. Even if the actual inequality remains constant, IER will decrease as per capita income rises. With rising maximum feasible inequality as the denominator, IER will inevitably decrease when actual inequality as the numerator becomes smaller. In this case, IER will decrease as long as actual inequality remains constant or increases at a smaller pace than the maximum feasible inequality. Yet China's reality is that IER has remained stable for a long period despite rapid economic growth and did not nudge down until recently. China's actual inequality remains rather significant.

5. Conclusions and Future Outlook

Theoretically, productivity and distribution are two sides of the same coin. Yet existing studies have discussed inequality in isolation from distribution. Based on the group decomposition method for Gini coefficient, this paper tactfully expresses average income as a multiple of subsistence income for measuring China's evolving inequality possibility frontier and inequality extraction rate (IER) in the context of evolving productivity.

Our findings can be summarized as follows: (i) Since reform and opening up in the late 1970s, the Chinese society has become more affluent amid rapid productivity improvement; inequality possibility frontier (maximum feasible inequality) continuously increased; the maximum feasible Gini coefficient rose from 0.2281 in 1978 to 0.8446 in 2017. The maximum feasible Gini coefficient contains broader implications than the maximum value 1 of the traditional Gini coefficient in the sense that it takes into full account the reality of economic development in a given period. In normal income distribution, an increase in the maximum feasible Gini coefficient is a natural result of productivity gains, which creates conditions for rising inequality.

(ii) From 1978 to 2017, China's IER had been falling. Specifically, national IER fell from 123% in 1978 to 55% in 2017, and particularly the decrease continued after a long period of stability preceding the 18th CPC National Congress in 2012. Rural IER fell from 121% in 1978 to 48% in 2010. Urban IER declined from 86% in 1978 to 41% in 2011. The downward trend of IER has strong explanatory power for the tolerance of yawning income gaps in Chinese society over the past four decades.

(iii) The reduction of China's IER does not mean that we may turn a blind eye to income inequality as a significant social problem. Currently, 55% of China's maximum potential inequality has already been converted into actual inequality. There is no evidence that the minor reduction of IER since 2012 has become a long-term trend. In the new era, China's income distribution reform still has a long way to go.

China's economic reform is an explorative journey of "building a market-based economy to deliver social justice and common prosperity" (Wu, 2018). At another crossroads of reforms, the above-mentioned income inequality constitutes the biggest problem to be addressed through reforms in the new era. Without a doubt, smaller income gaps and fairer distribution are inalienable aspects of high-quality development. In the top-down design of reforms, we should further balance the relationship between economic development and income distribution to ensure that economic growth will benefit the vast majority of people.

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Annex:

Annex Table 1: Maximum Feasible Gini Coefficients for Chinese Households, 1978-2017 (G*)

Year	Average income as a multiple of subsistence income			Maximum feasible Gini coefficient		
	National	Rural	Urban	National (G^*)	Rural (G_1^*)	Urban (G_2^*)
	α	α_1	α_2	$\frac{(\alpha-1)}{\alpha}$	$\frac{(\alpha_1-1)}{\alpha_1}$	$\frac{(\alpha_2-1)}{\alpha_2}$
1978	1.2954	1.3357	1.2294	0.2281	0.2513	0.1866
1979	1.4038	1.3928	1.4228	0.2877	0.2820	0.2972
1980	1.5040	1.4718	1.5608	0.3351	0.3205	0.3593
1981	1.5814	1.5735	1.5955	0.3676	0.3645	0.3732
1982	1.6560	1.6470	1.6733	0.3961	0.3928	0.4024
1983	1.7305	1.7306	1.7303	0.4221	0.4222	0.4221
1984	1.8331	1.7767	1.9459	0.4545	0.4371	0.4861
1985	1.9449	1.9301	1.9709	0.4858	0.4819	0.4926
1986	2.0866	1.9895	2.2452	0.5207	0.4974	0.5546
1987	2.1394	2.0377	2.2954	0.5326	0.5092	0.5644
1988	2.2788	2.3091	2.2398	0.5612	0.5669	0.5535
1989	2.2857	2.3224	2.2420	0.5625	0.5694	0.5540
1990	2.3495	2.2877	2.4327	0.5744	0.5629	0.5889
1991	2.1553	2.3308	1.9864	0.5360	0.5710	0.4966
1992	2.3188	2.4732	2.1798	0.5687	0.5957	0.5412
1993	2.4086	2.4317	2.3877	0.5848	0.5888	0.5812
1994	2.6738	2.7750	2.5912	0.6260	0.6396	0.6141
1995	2.8346	2.9769	2.7177	0.6472	0.6641	0.6320
1996	3.0279	3.2924	2.8221	0.6697	0.6963	0.6457
1997	2.6058	3.2658	2.2183	0.6162	0.6938	0.5492
1998	2.7212	3.4047	2.3462	0.6325	0.7063	0.5738
1999	2.8946	3.5365	2.5650	0.6545	0.7172	0.6101
2000	3.0132	3.6055	2.7298	0.6681	0.7226	0.6337
2001	3.2079	3.7562	2.9610	0.6883	0.7338	0.6623
2002	3.5348	3.9484	3.3586	0.7171	0.7467	0.7023
2003	3.7921	4.1165	3.6611	0.7363	0.7571	0.7269
2004	4.0688	4.3958	3.9413	0.7542	0.7725	0.7463
2005	3.7602	4.7656	3.4599	0.7341	0.7902	0.7110
2006	4.1189	5.1761	3.8202	0.7572	0.8068	0.7382
2007	4.5065	5.2743	4.2856	0.7781	0.8104	0.7667
2008	4.4565	3.9805	4.6456	0.7756	0.7488	0.7847
2009	4.8836	4.3087	5.1019	0.7952	0.7679	0.8040
2010	4.5723	4.6460	4.5499	0.7813	0.7848	0.7802
2011	4.1624	2.7513	4.9314	0.7598	0.6365	0.7972
2012	4.5598	2.9617	5.4083	0.7807	0.6624	0.8151
2013	4.9296	3.4465	5.6795	0.7971	0.7098	0.8239
2014	5.3047	3.7460	6.0622	0.8115	0.7331	0.8350
2015	5.6817	4.0006	6.4594	0.8240	0.7500	0.8452
2016	6.0076	4.1881	6.8177	0.8335	0.7612	0.8533
2017	6.4351	4.4788	7.2652	0.8446	0.7767	0.8624

Source: Estimated by the author.

Annex Table 2: China's Inequality Extraction Rate (IER) Based on Gini Coefficient (IER_{Gini}), 1978-2017

Year	National IER	Rural IER	Urban IER
	G_{actual}/G^*	$G_{actual1}/G_1^*$	$G_{actual2}/G_2^*$
1978	1.2265	1.2143	0.8576
1979	0.9758	0.9953	0.5418
1980	0.8341	0.8083	0.4453
1981	0.7962	0.6870	0.4587
1982	0.6990	0.6402	0.4205
1983	0.6418	0.6147	0.4011
1984	0.6101	0.6090	0.3528
1985	0.6325	0.5835	0.4397
1986	0.6220	0.5951	0.3817
1987	0.6097	0.5854	0.3912
1988	0.6030	0.5488	0.4027
1989	0.6274	0.5672	0.4118
1990	0.6245	0.5507	0.3905
1991	0.6403	0.5430	0.4833
1992	0.7021	0.5204	0.4619
1993	0.7153	0.5435	0.4646
1994	0.6869	0.5159	0.4885
1995	0.6441	0.5120	0.4430
1996	0.5892	0.4596	0.4337
1997	0.6433	0.4756	0.5280
1998	0.6325	0.4814	0.5229
1999	0.6301	0.4740	0.4917
2000	0.6399	0.4843	0.5050
2001	0.6293	0.4906	0.4832
2002	0.5992	0.4955	0.4557
2003	0.6506	0.4887	0.4540
2004	0.6271	0.4790	0.4422
2005	0.6607	0.4809	0.4782
2006	0.6431	0.4586	0.4606
2007	0.6220	0.4566	0.4435
2008	0.6330	0.5075	0.4307
2009	0.6162	0.5014	0.4167
2010	0.6156	0.4821	0.4230
2011	0.6278	0.6122	0.4139
2012	0.6072	—	—
2013	0.5934	—	—
2014	0.5779	—	—
2015	0.5607	—	—
2016	0.5579	—	—
2017	0.5529	—	—

Note: Since China ceased to publish separate urban and rural Gini coefficients after the integrated urban and rural household survey reform in 2012, urban and rural IER data for relevant years are missing.

Source: Calculated by the author.