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Comparative study of relationship between income inequality and economic growth in China with India.

[1] Liu Li, [2]Charuk Singhapreecha, [3]Jirakom Sirisrisakulchai
[1][2][3] Faculty of Economics,Chiang Mai University, Chiang Mai, Thailand

Abstract: **This paper applies the Engle-Granger two-step ECM approach to estimate the long-term and short-term relationships between inequality and economic growth for China and India. Our estimation results support the S-shaped curve hypothesis relating GDP per capita to inequality with different starting points for the two countries. We find a positive causal relationship for China, showing that increased income inequality spurred economic growth. Furthermore, we find the same results that the trade openness increased inequality in China and India. As for redistribution, fiscal redistributive measures show a negative effect in China and India. In the inequality-GDP per capita relationship, export show a negative effect in China and had no significant effect in India.**

Index Terms—Income inequality, Economic growth, Redistribution, S-shaped curve

I. INTRODUCTION

Economic inequality is rising in emerging economies across the world. The World Economic Forum's 2016 Global Risk Report found that "serious income disparities" will be one of the greatest risks to global risk in the next decade. In Asia ,China has one of the most rapidly growing economies in the world, income inequality is still a major challenge. In India, it has become one of the world's most unequal states headlines. Some economists worry that increased inequality itself may weaken economic growth.[1] The others are concerned that sustained unbalanced sharing of dividends will undermine public support for growth policies and lead to political instability.

There are theoretical and political paths that economic growth may affect income inequality and vice versa. We suggest contributing to this document by: (1) conducting time-series analysis of individual countries, and (2) by examining the bilateral relationship between growth and inequality. We first build a baseline error-correction model (ECM) suitable for all countries to examine the long-run equilibrium relationship between income inequality and economic growth. We also analyze the short-run impulse responses of the variables. Our survey is aimed at China and India.

II. LITERATURE REVIEW

The discussion in the theoretical and empirical literature thus far has suggested different channels for the relationship between inequality and economic growth.

Much of the literature on the effects of economic growth on inequality has focused on the inverted U-shaped curve of the

notable Kuznets (1955).[2] The curve indicates that inequality increased early in the industrialization process and then further declined. By using the semiparametric method, Chambers(2010)[3] showed that economic growth reduces inequality in not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation. developing countries but has the opposite effect in developed countries in terms of the long-run effect. As for the short-term and medium-term impact, economic growth increases income inequality for all countries. Considering trade openness and human capital as determinants of inequality, Wahiba and El Weriemmi (2014) [4]demonstrated that in Tunisia, economic growth is positively associated with inequality. Nissim(2007)[5] found that as economic growth occurs, workers mobilize to the jobs associated with higher incomes, which beneficial to reduce income inequality. As can be seen from the above, the impact of economic growth on income inequality is still no clear answer.

As for the effect of inequality on economic growth, Forbes (2000)[6] showed that the inequality has positive impact on short-term economic growth. Halter et al. (2014)[7], however, found that in the long-term, greater inequality causes slower growth. Shin (2012)[8] points out that, the country in the early stage of development, the impact of inequality on economic growth is negative; however, it is positive in the mature stage of development. According to

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Cingano (2014)[9] and Neves et al.(2012)[10], inequality has positive influences on economic growth in panel datasets and negative impacts in cross-sectional datasets. From the above, most studies use cross-sectional or panel data to estimate the bi-directional causal relationship between economic growth and income inequality. A few previous studies adopted a time-series methods, Kang (2015)[11] and Bahmani-Oskooee et al. (2008)[12] included fiscal redistribution and trade openness, respectively, in their estimations but ignored the effect of other possible determinants. So, our research employs time-series analysis to capture the heterogeneity of individual countries and to examine the bidirectional causality between economic growth and income inequality while including other explanatory variables.

III. METHODOLOGY

We employ country-level time-series analysis and use an error-correction model (ECM).[13] Following Engle and Granger's two-step approach, we first test for a cointegrating relationship between output level and inequality. By using augmented Dickey-Fuller statistics, each time-series variable is examined in isolation for its non-stationarity. Then, after estimating the cointegrating regression, the regression residuals were retrieved and tested for stationarity. If the residual term is stationary, then the time-series variables are cointegrated and the long-run relationship among variables can be established.

We use GDP per capita to measure average income level and the Gini coefficient to measure income inequality. The link between average income level and income inequality is discussed bilaterally. In our time-series study, we model income inequality in the long run as a function of the average income level and other determinants as follows:

$$Gini_t = a_0 + a_1(\ln GDP\ per\ capita_t) + a_2(\ln GDP\ per\ capita_t)^2 + a_3(\ln GDP\ per\ capita_t)^3 + \sum_{i=1}^{n} \varphi_i \lambda_{i,t} + \varepsilon_t, (1)$$

where $\lambda_{i,t}$ indicates all other explanatory variables, and ε_t is egression residual. Similarly, we adopt the following formulation to estimate the effect of income inequality and other determinants on output level in the long run:

$$\ln GDP\ per\ capita_t = b_0 + b_1 Gini_t + \sum_{i=1}^{n} \delta_i Y_{i,t} + \nu_t, (2)$$

where $Y_{i,t}$ are all explanatory variables but $Gini_t$ for determining the effect on $\ln GDP\ per\ capita_t$, and ε_t is the regression residual.

In the second step, we try to capture the short-run effect of each variable on inequality and output level, respectively. A similar equation is used to capture the short-term effects of each variable on GDP per capita. The respective error correction models to Eqs. (1) and (2) are shown as follows:

$$\Delta Gini_t = c_0 + c_1(\Delta \ln GDP\ per\ capita_{t-1}) + c_2(\Delta \ln GDP\ per\ capita_{t-1})^2 + c_3(\Delta \ln GDP\ per\ capita_{t-1})^3 + \sum_{i=1}^{n} \rho_i \Delta\lambda_{i,t-1} + c_4 \varepsilon_{t-1} + \varepsilon_t, (3)$$

$$\Delta \ln GDP\ per\ capita_t = d_0 + d_1 \Delta Gini_{t-1} + \sum_{i=1}^{n} \delta_i Y_{i,t-1} + \pi_t, (4)$$

where Δ indicates the change of variables, ϵ_t and π_t are the residuals. Among the coefficients, c_4 and d_2 are the adjustment rates of speed and are expected to be negative and significant. In addition, the Durbin–Watson test is used to check if the serial correlation problem exists and the Prais–Winsten correction is applied if necessary.

The dataset this analysis used is mainly from the Standardized World Income Inequality Database 6.0 (SWIID) and World Development Indicators (WDI). The variables used in the regression are listed and explained in Figeure1.

Variables	Definition	Source
GDP per capita	GDP per capita (constant 2005 US$)	WDI
Gini_net	Gini index of inequality in equivalized household disposable (post-tax and post-transfer) income	SWIID
Gini_mkt	Gini index of inequality in equivalized household (pre-tax and pre-transfer) income	SWIID
Redistribution	The difference between Gini_mkt and Gini_net	SWIID
Export	Exports of goods and services (% of GDP)	WDI
Trade	Export plus import (% of GDP)	WDI
Gov. con.	General government final consumption expenditure (% of GDP)	WDI
Investment	Gross fixed capital formation (% of GDP)	WDI
Fertility rate	Fertility rate, total (births per woman)	WDI
Labor force	Population ages 15–64 (% of total)	WDI
Primary	School enrollment, primary (% of gross)	WDI

Figure1:Variables' name of the research

IV. SUMMARIZES RESULTS

Table 1: The effect of economic growth on inequality: country model

Dependent variable: Gini	CHN_CR coefficients	IND_CR coefficients
ln GDP per capita	-370.7654***	-173.9462 ***
	(56.28712)	(46.05784)
(ln GDP per capita)2	52.84029***	27.77734***
	(8.092991)	（6.932966）
(ln GDP per capita)3	-2.449149***	-1.450073***
	(0.308523)	（0.346016）
Trade	0.041690	-0.004937
	(0.027296)	（0.006310）
Redistribution	-12.51423***	-23.14775***
	(3.223880)	（1.366849）
Redis*Gini_mkt	0.267500***	0.476416***
	(0.077853)	（0.029163）
Constant	886.6733***	402.7415***
	(128.6144)	（101.6062）
N	39	41
r2	0.990141	0.998966
r2_a	0.988292	0.998784

rmse	0.840084	0.089884
Res.ADF test	I(0)	I（0）

Dependent variable:D.Gini	CHN_ECM coefficients	IND_ECM coefficients
D.ln GDP per capita $_{t\_1}$	-366.2981**	-443.6721***
	(177.1554)	(145.4213)
D.(ln GDP per capita)2 $_{t\_1}$	52.78604**	67.84987***
	(24.68275)	（21.99390）
D.(ln GDP per capita)3 $_{t\_1}$	-2.520033**	-3.443627***
	(1.140081)	（1.103220）
D.Trade $_{t\_1}$	-0.017693	-0.000769
	(0.039934)	（0.010531）
D.Redistribution $_{t\_1}$	-8.096018	-2.942750
	(6.029521)	(3.670610)
D.Redis*Gini_mkt $_{t\_1}$	0.163778	0.049812
	(0.144604)	(0.074625)
Error correction $_{t\_1}$	-0.433206*	0.321474
	(0.224909)	(0.337185)
Constant	0.727601	0.190093***
	(0.571493)	（0.048843）
N	37	39
r2	0.456050	0.426298
r2_a	0.324752	0.296753
rmse	0.894071	0.161829
Res.ADF test	I(0)	I（0）
DW	2.020209	2.232232

a. *,**,***indicate 10, 5, 1 percent level of significant respectively.

b. Numbers in parentheses are the standard error.

c. The sample period for the China is 1978–2016,and for India is 1975-2016.

In Table1, we summarize the estimation results for each individual country. For China and India, the three GDP per capita coefficients are all significant at the 1% level in the cointegrating regression. The first term is negative, the second term is positive and the third term is negative which is consistent with the S-curve hypothesis[14]. While, it starts with the back portion of inverted U-shaped curve. Among them, redistribution * Gini _mkt is an interactive term reflecting the impact of government redistribution on income inequality, which may depend on the level of income inequality before government intervention. For other factors, redistribution has a negative impact on income inequality as expected. On the other hand, the interaction term of Redis * Gini _mkt has a positive influence, which shows that the redistributive effect of government taxes and transfer rely on the level of income inequality prior to government interventions. The negative impact of the government's income inequality policy is clearly offset by the original state of income distribution.

As for short-run dynamic effects, all determinants, expect the Redistribution * Gini _mkt and Redistribution , in change form have significant effect on income inequality in China. However, for India, three GDP per capita terms on income inequality are all statistically significant at the 1% level. The sign of the first term is negative, second term is positive, and third term is negative.

Table2:The effect of inequality on economic growth

Dependent variable:ln GDP per capita	**CHN_CR coefficients**	**IND_CR coefficients**
Gini	0.000163	-0.045108*
	(0.005617)	(0.024697)
Labor force	0.069144***	0.145183***
	(0.007669)	（0.019684）
Export	-0.005250	-0.006628
	(0.003413)	（0.004724）
Govt con.	-0.023660*	-0.001415
	(0.013150)	（0.010921）
Investment	0.004798	0.017194***
	(0.003651)	（0.004344）
Primary	0.018728***	0.017612**
	(0.001247)	(0.007219)
Fertility	-0.494712 ***	-0.076048**
	(0.050631)	(0.037141)
Redistribution	-0.177594***	0.164469***
	(0.049007)	(0.043523)
Constant	3.253935***	-0.487068
	(0.556112)	（1.130601）
N	39	41
r2	0.997614	0.997262
r2_a	0.996977	0.996578
rmse	0.053212	0.028889
Res.ADF test	I(0)	I（0）

Dependent variable:D.ln GDP per capita	CHN_ECM coefficients	IND_ECM coefficients
D.Gini $_{t\_1}$	-0.001723	-0.001778
	(0.003938)	(0.031194)
D.Labor force $_{t\_1}$	0.007796	0.110308*
	(0.010689)	（0.056288）
D.Export $_{t\_1}$	0.000972	0.001781
	(0.001633)	（0.003993）
D.Govt con. $_{t\_1}$	-0.008895	0.001587
	(0.006081)	（0.012818）
D.Invertment $_{t\_1}$	0.005126***	-0.000245
	(0.001602)	(0.004564)
D.Primary $_{t\_1}$	0.003227*	0.004063
	(0.001684)	(0.007737)
D.Fertility $_{t\_1}$		

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	-0.005670	-0.003350
D.Redistribution $_{t\_1}$	(0.061760)	(0.537138)
	-0.045891	0.008670
	(0.028863)	(0.058336)
Error correction $_{t\_1}$	0.301422***	-0.302137
	(0.088912)	(0.220028)
Constant	0.072611***	0.012308
	(0.008208)	（0.044183）
N	37	39
r2	0.497957	0.292934
r2_a	0.330610	0.073500
rmse	0.020411	0.027559
Res.ADF test	I(0)	I（0）
DW	0.971660	1.761815

a. *,**,***indicate 10, 5, 1 percent level of significant respectively.

b. Numbers in parentheses are the standard error.

c. The sample period for the China is 1978–2016,and for India is 1975-2016.

We summarize the estimated results for each country in Table 3. For China, Gini has a positive effect on GDP per capita but it is not statistically significant. The labor force variable and primary variable have positive impact on GDP per capita at the 1% significance level. In addition, we find that the fertility and redistribution shows the negative impact on GDP per capita. However, fiscal redistribution policies increase per capita output. Finally, the long run effects of government expenditure is negative but insignificant for China. With respect to the short-run responses, we estimate a negative effect of the change in Gini on GDP per capita growth but it is not statistically significant. Among other determinants, only the changes of investment and primary variable are statistically significant determinants of output growth in the short-run dynamics.

Compare with China, the gini has a negative impact on GDP per capita at the 10% significance level. This suggests that income inequality has been harmful to economic development from the experience of India. In addition, we find labor force, investment and primary have positive effects on real per capita output. However, the fertility rate have negative effects. The other variables did not produce significant coefficients. From the results estimated by the ECM equation, changes in income inequality have a negative but insignificant effect on GDP per capita growth. The labor force has a positive impact on per capita output in short run. Also, the effects of other determinants, on GDP per capita growth are all statistically insignificant.

V. BRIEF ANALYTICAL COMPARISONS AND DISCUSSIONS

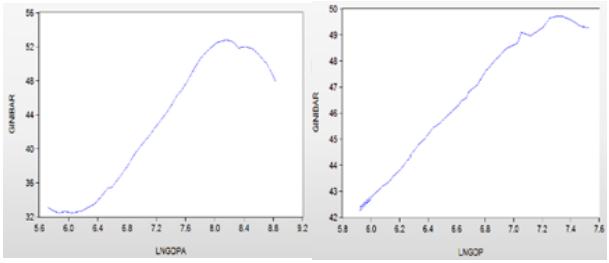

Figure2:The projected relationship between output level and inequality(1st China, 2nd India)

Using beta weights, we can compare the contribution of each variable to growth and inequality within each country or in different countries. We find that per capita GDP is the most important determinant of the income gap between the two countries. For the inequality of income growth, the labor force is the most important variable. The S-curve relationship between output level and inequality for each individual country is projected and showed in Fig. 2. The two countries all experienced rapid growth and huge inequality.

The reality of the various bidirectional relationships between economic growth and income inequality found in our study fall into four possible scenarios, as shown in Fig.3. Case I shows that if the signs of the bidirectional relationship are both negative, it means that lower inequality further increases economic growth and economic growth lessens inequality. Cases II and III indicate cases of interchanging equilibrium outcomes when the bidirectional relationship involves one positive and one negative effect. Finally, in Case IV, we have the classic "Trade-off" problem when both causal effects are positive. If we want to achieve higher growth, we must take the higher inequality at the cost. Where to put higher priority between growth and equality poses a great challenge to policy-makers in this case.

		From inequality to growth (I to G)	
		Negative	Positive
From growth to inequality (G to I)	Negative	I: High growth with low inequality (Virtuous Cycle)	II: High growth with low inequality and low growth with high inequality (Virtuous Cycle) (Interchanged)
	Positive	III: High growth and high inequality and low growth with low inequality	IV: High growth with high inequality versus low growth with low inequality (Interchanged) (Trade-off)

Figure3: Four possible scenarios of the relationships between economic growth and income inequality

CONCLUSION

As found in our study, all countries experience the S-curve in the economic development process, for the economic growth-inequality relationship. This clearly demonstrates that each individual country has the opportunity to experience both positive and negative causal links from growth to inequality throughout the development process. However, for the inequality-economic growth relationship, we found positive links for China, and negative impact for India. As a result, India may have benefited from the Virtuous cycle relationship with high growth and low inequality during some parts of its development over our study period.

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