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A Reconsideration of Kuznets Curve across Countries: Evidence from the Co-summability Approach

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Abstract

This study re-examines the existence of an inverted U-shaped relationship between economic growth and income inequality using advanced time series techniques, which enable analysing nonlinear long-run relationships among stochastic processes. Applying the concepts of summability, balancedness, and co-summability on a sample of 55 countries from 1980 to 2010, we find no evidence in support of the nonlinear long-run relationship between economic growth and income inequality.

JEL Classification Codes: O47; O15; C23

Keywords: income distribution; economic development; summability; balancedness; co-summability; cross-country studies

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1. Introduction

A study conducted by Kuznets in 1955 and an inverted U-shaped relationship (so-called the Kuznets curve) between economic growth and income inequality was found (Kuznets, 1955). Not too long after, in the early 1960s, President John F. Kennedy (JFK) made a famous saying about the relationship between inequality and economic growth and illustrated the relationship as a rising tide that lifts all boats to picture the idea that economic growth is beneficial to both the poor and the rich in the society.[1] It is uncertain that one compliments the other, yet there was inevitably an optimism of being better off at that time.

Since then, the Kuznets curve is continuously visited and referenced by most of the researches evaluating the possible relationship between economic growth and income inequality. Although there were several criticisms on the Kuznets curve, it initiated many economists to examine deeper and further about the relationship between growth and inequality over the past sixty-five years. Furthermore, as the well-being of individuals often depends on the distribution of income, the issue of increasing income inequality has drawn significant interest from researchers, politicians, and policymakers for necessary policy implications (Balcilar et al., 2019).

The researches have been conducted over the past sixty-five years, and yet the results converge into one generalised inequality-growth relationship. There are four positions in the literature: the studies, which have found a positive correlation (see e.g., Chan et al., 2014; Forbes, 2000; Frank, 2009; Li and Zou, 1998; Partridge, 2005; Rubin and Segal, 2015), a negative relationship (see e.g., Alesina and Perotti, 1996; Alesina and Rodrik, 1994; Babu et al., 2016; Banerjee and Newman, 1993; Clarke, 1995; De la Croix and Doepke, 2003; Knowles, 2005; Persson and Tabellini, 1994; Sukiassyan, 2007). There is also a non-linear relationship (see, e.g., Banerjee and Duflo, 2003; Barro, 2000; Bengoa and Sanchez-Robles, 2005; Castello-Climent, 2010; Chen, 2003; Henderson et al., 2015; Voitchovsky, 2005). Finally, some studies could not find a robust relationship (see, e.g., Panizza, 2002).

As consequences, these disparities, both theoretical and empirical studies, have derived into a complex debate for the relationship between growth and inequality. The empirical differences in existing datasets, conceptual approach and methodological differences have been proposed as possible reasons for the differing results from previous studies. There are challenges for the analysis of potentially nonlinear relationships; for example, the order of integration of the square or cube of an integrated variable is not defined within the linear integration and cointegration framework.

In line with these developments, to extend to the quadratic econometric techniques, our paper evaluates the Kuznets inverted U-shaped relationship using the idea of co-summability proposed by Berenguer-Rico and Gonzalo (2013 and 2014). The co-integration methods are mostly applied to examine the linear relationships among continuous non-stationary time series data. However, the linearity in the integration and co-integration techniques makes it inappropriate to evaluate non-linear long-run relations among persistence processes.

Therefore, our paper employs the idea of the order of summability formalised by Berenguer-Rico and Gonzalo (2013 and 2014) to deal with non-linear transformations of heterogeneous and persistent processes. The co-integration framework can be generalised by defining balancedness and co-summability. Balancedness is achieved when the order of summability of a dependent variable in a postulated hypothesis being equal to that of the persistent and heterogeneous

[1] In the early 1960s, JFK's leading act in economic policy was a significant cut in income tax rates.

explanatory variables, which are possibly non-linear. Co-summable relationship describes a long-run equilibrium that can be non-linear when the errors have a lower order of summability (Nasr et al., 2019). The analysis of our study is focused on whether there exists non-linearity in the long-run growth-inequality nexus. If there is no evidence supporting non-linear long-run relations between economic growth and income inequality, then standard empirical specifications in the existing literature, which apply polynomial or threshold functions, can be seen as misspecified.

To the best of our knowledge, our paper is the first study to use the idea of co-summability proposed by Berenguer-Rico and Gonzalo (2013 and 2014), to reconsider the Kuznets curve across countries on a sample of 55 countries (5 Low-Income, 9 Lower-Middle-Income, 13 Upper-Middle-Income, and 28 High-Income countries) for the period from 1980 to 2010. The empirical specifications are informed via testing procedures for variable summability, balancedness, and co-summability of the model specifications. The novelty of our study is the application of a new econometric approach. The results of our papers are to find no supporting evidence of Kuznets inverted U-shaped curve. The paper also discusses the potential implications of this evidence.

The remaining parts of the article organised as follows: Section 2 describes the theoretical background and the empirical literature. Section 3 provides an overview of the econometric methodology and the empirical model. Section 4 presents our data and empirical results, and Section 5 provides the conclusion.

2. Theoretical Background and Empirical Literature

The relationship between income inequality and economic growth remains debatable both theoretically and empirically. One illustrates the positive relationship between growth and inequality as follows: (i) The saving rate of the rich generally is higher than that of the poor. Narrowing the gap of inequality via income redistribution, from the rich to poor, would lower the aggregate saving rate of the economy; and therefore, decreasing economic growth (see the theoretical models in Lewis, 1954; Kaldor, 1957). (ii) Inequality incentivises individuals to work harder, save and invest more to increase their income, which will positively impact on economic growth (see the theoretical models in Lazear and Rosen, 1981; Mirrlees, 1971; Shin, 2012). (iii) Government spending is used entirely on production services such as the construction of public infrastructure; and thus, it provides the redistribution of the income (Gozgor and Ranjan, 2017).

The inverse relationship can be explained through the following channels: (i) The poor experience much difficulty in accessing financial and credit markets, and these market imperfections can influence the occupational outcomes (Banerjee and Newman, 1993; Galor and Zeira, 1993). Besides, it hinders investment opportunities resulting in increasing inequality (Cyrek and Fura, 2019). (ii) Government spending is used on consumption services, for example, social transfer (Gozgor and Ranjan, 2017). (iii) Higher taxation and regulation, which create an unfavourable environment for investment and saving. (Alesina and Rodrik, 1994; Bertola et al., 2014; Persson and Tabellini, 1994). (iv) Extreme inequality can cause political instability and social unrest, which have detrimental effects on growth (Alesina and Perotti, 1996).

The third notion posits a non-monotonic relationship between inequality and growth (see, e.g., Aye et al., 2019; Barro, 2000; Banerjee and Duflo, 2003; Bengoa and Sanchez-Robles, 2005; Castelló-Climent, 2010; Henderson et al., 2015; Voitchovsky, 2005).

Few studies have specifically investigated the inverted U-shaped relationship between economic growth and income inequality.[2] Using the cross-country analysis, Banerjee and Duflo (2003) showed that economic growth is an inverted U-shaped function of income inequality. Chen (2003) revealed an inverted U-shaped relationship between Gini coefficient and economic growth for a data of 54 countries from 1970 to 1992 by employing the Barro-type model over a period. Using a semi-parametric approach, Lin and Weng (2006) apply to examine the existence of an inverted U-shaped relationship between inequality and gross domestic product (GDP) per capita in a cross-country analysis and document evidence in support of Kuznets hypothesis. Lessmann (2014) obtained significant evidence in support of the inverted U-shaped relationship between inequality and development using the parametric and semi-parametric regression for 56 countries for the period from 1980 to 2009.

On the other hand, Higgins and Williamson (2002), Jacobsen and Giles (1998), and Savvides and Stengos (2000) failed to find evidence for the Kuznets curve. Jacobsen and Giles (1998) found no evidence supporting the Kuznets inverted U-shaped relationship between economic growth and income inequality by using non-parametric estimation techniques in the United States (U.S.) for the period from 1947 to 1991. Using a threshold regression model on panel data, Savvides and Stengos (2000) could not find evidence for the Kuznets curve.

3. Econometric Methodology

In this section, the concepts of summability, balancedness, and co-summability methods are explained.

3.1 Summability

The idea of summability was conceived in Gonzalo and Pitarakis (2006) and recently formalised by Berenguer-Rico and Gonzalo (2013 and 2014). According to Berenguer-Rico and Gonzalo (2013 and 2014), a random process (y_t) is said to be summable of order β, represented as $S(\beta)$, if non-random sequence (m_t) exist in such a way that

$$S_T = \frac{1}{T^{\frac{1}{2}+\beta}} L(T) \sum_{t=1}^{T} (y_t - m_t) = O_p(1) \text{ as } T \to \infty, \tag{1}$$

where β denotes minimum real number such that S_T is stochastically bounded, and $L(T)$ represents a slowly varying function.

This concept generalises the idea of integration in linear form and gives room for establishing the order of summability for several non-linear models. If a linear (y_t) time series is $I(d)$; thus, it will be summable of order d, that is $S(d)$. In a situation, where time series (y_t) is a non-linear transformation, and this demands the use of the concept of summability. In this empirical application, our focus lies on evaluating the order of summability of the variables of interest to be incorporated in the polynomial specification or framework.

3.2 Balancedness

Once the assumption regarding the concept of summability is established, then the balance specification or requirement of the empirical relationship that exists between the variables is then evaluated. That is, assessing whether both parts of the empirical equation of the model maintain a matching order of summability. The empirical equation specified for the model is given as:

[2] See Banerjee and Duflo (2003), Chen (2003), Huang (2004), Huang et al. (2012), Kim et al. (2011), Lessmann (2014), Lin (2007), Lin and Weng (2006), Lin et al. (2007), Ram (1991), and Robinson (1976).

$y_{it} = f(x_{it}, \theta)$ where $y_{it}$is assumed to be balanced, if $y_{it} \sim S(\beta_y); f(x_{it}, \theta) \sim S(\beta_f)$ and $(\beta_y = \beta_f)$. Therefore, we specified the null and alternative hypothesis of balancedness as:

$$H_0: \beta_y - \beta_f = 0$$
$$H_1: \beta_y - \beta_f \neq 0$$

Thus, under the null hypothesis of balancedness, the related confidence interval includes zero. Notably, evaluating the variables for balancedness is crucial for the soundness and credibility of the empirical specification in this study.

3.3 Co-summability

Co-summability is a critical pre-estimation test that should be conducted, to evaluate the validity of an empirical model specified for use along with the balancedness test. Besides, two summable random processes $x_{it} \sim S(\beta_x)$ and $y_{it} \sim S(\beta_y)$ are assumed to be co-summable, if $f(x_{it}, \theta_f) \sim S(\beta_y)$ in such a way that $u_{it} = y_{it} - f(x_{it}, \theta_f)$ is $S(\beta_u)$, where $\beta_u = \beta_y - \beta, \beta$ is greater than zero and $(y_{it}, x_{it}) \sim CS(\beta_y, \beta)$.

However, the parametric function of $f(\cdot, \theta_f)$ can be substituted with a conventional nonlinear function. While β, β_y and $\beta_x$are unknown in the application, Berenguer-Rico and Gonzalo (2014) introduced a consistent and more reliable estimator with a slow convergence rate of $\frac{1}{\ln(T)}$. The strong co-summability will indicate that the order of summability β_u of u_t is statistically not different from zero. It is worth noticing that under the null hypothesis, we specified that, the confidence interval contains zero.

3.4 Empirical Model

Using the assertion by Berenguer-Rico and Gonzalo (2013), the relationship between economic growth and income inequality in a polynomial form is given as:

$$y_{it} = \beta_0 + \beta_1 z_{it} + \beta_2 z_{it}^2 + \cdots + \beta_k z_{it}^k, i = 1 \cdots 55, t = 1 \cdots 31, k=4 \tag{2}$$

where, y_{it} measures different levels of income distribution and z_{it} is a measure of economic growth. The measures were chosen for z_{it}, the most commonly used measure of economic growth is the growth rate of the real GDP per capita. In this study, per adult national income is employed to measure the level of economic growth based on data availability for the period from 1980 to 2010. As comparing income and wealth in different countries using GDP is not convincing (Alvaredo et al., 2017). In this study, polynomials of up to 4th order are used, i.e. k=4. y_{it} and z_{it} are in natural logarithms forms. Note that the order of the polynomial used in the existing literature has either been quadratic or cubic. For quadratic polynomial (see, e.g., Banerjee and Duflo, 2003; Chen, 2003; Patriarca and Vona, 2013; Robinson, 1976), and cubic polynomial (see, e.g., Lessmann, 2014).

Eq. (2) allows for testing the various forms of the relationship between inequality and per adult national income; (1) $\beta_1 > 0$ and $\beta_k = 0$, for $k > 1$, suggests an increasing linear relationship, meaning that rising levels of inequality accompany rising incomes; (2) $\beta_1 < 0$ and $\beta_k = 0$, for $k > 1$, presents a decreasing linear relationship; (3) $\beta_1 > 0, \beta_2 < 0$ and $\beta_k = 0$, for $k > 2$, reveals an inverted-U quadratic relationship between inequality and per adult national income, indicating that high levels of income are associated with decreasing levels of inequality once a certain level of income is reached. The peak of this quadratic curve is reached at the turning point where $z =$

$-\beta_1/2\beta_2$ (4) $\beta_1 < 0, \beta_2 > 0$ and $\beta_k = 0,$ for $k > 2$, suggests a quadratic relationship in U pattern; (5) $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0$ and $\beta_k = 0,$ for $k > 3$, indicates a cubic polynomial, representing the N-shaped pattern, where the inverted-U hypothesis occurs up to a certain point, from which inequality increases again; (6) $\beta_1 < 0, \beta_2 > 0, \beta_3 < 0$ and $\beta_k = 0,$ for $k > 3,$ reveals a cubic polynomial, representing the inverted-N shape; (7) $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 < 0$ and $\beta_k = 0,$ for $k > 4,$ indicates a 4th order polynomial, representing the M-shaped pattern, where the inverted-U hypothesis occurs twice at a certain point. (8) $\beta_1 < 0, \beta_2 > 0, \beta_3 < 0, \beta_4 > 0$ and $\beta_k = 0,$ for $k > 4,$ reveals a 4th order polynomial, representing the inverted-M shape.

4. Variables, Data Source, and Empirical Analysis

In this section, the data and the empirical model considered in this study are discussed. We use per-adult national income[3], instead of the widely used per capita GDP, from the World Inequality Database to compare levels of economic welfare across countries. The World Inequality Database comprises fiscal, survey and national accounts data to compile per-adult national income in a systematic manner which is different than GDP per capita. National income as being more meaningful than GDP as it nets out depreciation of capital stock as well as the fraction of domestic output of foreign capital owners. This net national income is the one distributable to a country's population. Besides, the idea of the Distributional National Accounts considers the evolution of the distribution of national income and wealth, unlike GDP per capita that focuses exclusively on aggregates and averages; and therefore, per adult national income indicates the extent to which the different social groups benefit from economic growth.

Gini coefficients, countries' income inequality data, is sourced from the Standardized World Income Inequality Database. The Standardized World Income Inequality Database is considered to be a better source of income inequality data as its coverage and comparability across countries surpasses those of the alternatives (Solt, 2016). The dataset is thus better suited for extensive cross-country analysis on income inequality than other available sources. While there are two ways (pre-tax and pre-transfers versus post-tax and post-transfers) of expressing income inequality, as detailed in Solt (2016), we focus on inequality in disposable (post-tax, post-transfer) income inequality.

A balanced sample was constructed from the unbalanced panel data sample from 1980 to 2010.[4] The sample contains 1,705 observations from 55 countries (5 Low-Income, 9 Lower-Middle-Income, 13 Upper-Middle-Income, and 28 High-Income countries).[5] The selection of the period and the countries is due to the availability of the data.

The idea of co-summability is adopted to find the suitable model specification for the study data to achieve the research objective of investigating the inverted U-shaped relationship between economic growth and income inequality in 55 countries. Based on the results of summability, an evaluation of balancedness is carried out to see the order of summability of our dependent variable (income inequality) is same from that of the explanatory variables in a hypothesised model

[3] The per-adult national income is measured by the Purchasing Power Parity (PPP) at constant 2016 prices.
[4] Following Nasr et al. (2019), we take natural logarithms to account dimensional differences between the series.
[5] These countries are as follows. Argentina, Australia, Bangladesh, Barbados, Belgium, Brazil, Canada, Chile, China, Colombia, Costa Rica, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Iran, Ireland, Israel, Italy, Japan, Korea Republic, Madagascar, Malawi, Malaysia, Mexico, Nepal, the Netherlands, Norway, Pakistan, Panama, Peru, the Philippines, Portugal, Puerto Rico, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Ukraine, the United Kingdom, the United States, Venezuela, and Zambia.

specification. If balancedness of the variables is confirmed, then it is not out of place to evaluate whether the postulated model is co-summable. The related results are reported in Table 1.

[Insert Table 1 around here]

Table 1A and Table 1B present the mean-based subsampling summability results, with models assuming a constant term in the left panel and constant and trend terms in the right panel. Table 1C and Table 1D present median-based subsampling results. These results show that the estimates are matching 95 per cent confidence intervals of the order of summability over the coverage period for the specified model in Eq. (2) for $k = 4$. The confidence intervals, for the tests on per capita national income and Gini-coefficient in natural logarithms, do not include zero, thus, rejecting the null hypothesis of summability of order zero, i.e. Gini-coefficient and per capita adult national income are $S(0)$ can be rejected.[6] The results for the order of co-summability give prominence to the persistence of the data and present a strong incentive for the analysis over time-series properties earlier posited to be of ultimate significance when evaluating the economic growth and income inequality relationships. Concerning the integrated data, there is a possibility of having spurious results, if there is a failure to confirm that the specified empirical models are balanced and co-summable. The related results are provided in Table 2.

[Insert Table 2 around here]

In Tables 2A from to 2D, the results of balancedness tests are contained. As mentioned in Section 3.2, the two sides of the equation to be balanced the balance statistic should be close to zero. For the sampled periods, results in Table 2A and Table 2C, which are the mean-based and the median-based subsampling results for a specification with a constant only, reveal balancedness with a maximum polynomial degree as 4. That is, under the 2nd, 3rd and 4th-degree polynomial specifications, since zero is included in the confidence interval and the null hypothesis of the balanced specification cannot be rejected for the specified model. However, the results in Table 2B and Table 2D, which are the mean-based and the median-based subsampling results for a specification with a constant and trend term, do not confirm the balancedness of the specified model.

Based on the results of summability, we tested for balancedness, which is confirmed only for specifications with a constant term. Therefore, we further check co-summability for the two specified models, and the detailed results are reported in Table 3.

[Insert Table 3 around here]

In the co-summability results presented in Table 3, and the results reject co-summability in the nonlinear model, whether we focus on the mean-statistic or the median-statistic. Table 3 also reports the results of co-summability tests, and the results show that co-summability is rejected for all considered specifications. Note that Table 3 only shows the regressions for which the balancedness is achieved, as balancedness is a prerequisite for co-summability. When the model is not balanced, there are uncertainties regarding the presence or absence of a long-run equilibrium relationship. These results imply that the Kuznets curve does not hold for the samples in this study. Unlike previous empirical studies (e.g., Banerjee and Duflo, 2003; Chen, 2003; Lessmann, 2014; Lin and Weng, 2006), our research finds no supporting evidence of the Kuznets inverted U-shaped curve between economic growth and income inequality.

[6] Lag of each variable cannot reject the null hypothesis of summability of order zero, as the results of summability include zero.

Two implications can be drawn from this empirical analysis: first, there is strong evidence for significant persistence in the data investigated, which may severely impact estimation and inference. Second, we found the least convincing evidence for nonlinear model specifications.

5. Conclusion

One posits a negative inequality-growth nexus and a contradicting notion argues for a positive relation. The third supports a non-monotonic or mixed relationship and the fourth for no link. Researchers confront the fundamental difficulties arising from conventional empirical analysis when assuming a non-linear model in the presence of integrated variables.

In this study, we empirically re-examined the existence of Kuznets inverted U-shaped relationship between income inequality and economic growth by investigating model specifications using the concept of co-summability. Contribution of our paper to the empirical literature is that we used novel empirical estimators and procedures to discover the potential non-linearity in the long-run equilibrium relationship between economic growth and income inequality for 55 countries, which is a distinction previously absent from the empirical literature. Also, this study chooses functional forms to construct theories. Our finding challenges some of the previous results and presents no evidence in support of the Kuznets inverted U-shape, which implies that conventional empirical specifications in the existing literature adopting polynomial or threshold functions are misspecified. Consequently, such policy implications based on misspecification should be taken with cautiousness. Gene Sperling, who was Director of the National Economic Council under Presidents Bill Clinton and Barack Obama, said that in the absence of appropriate policies the rising tide would lift some boats**,** but others will run aground. Therefore, future studies can re-examine the relationship between economic growth and income inequality by applying new econometric techniques.

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Table 1
Results of the Estimated Order of Summability

A	Mean Constant Only			B	Mean Constant and Trend		
Variables	$\hat{\beta}^*$	I_{low}	I_{up}	Variables	$\hat{\beta}^*$	I_{low}	I_{up}
Gini	0.7223	0.2575	1.1869	Gini	0.8952	0.4610	1.3294
p.c. inc	1.0792	0.4292	1.7290	p.c. inc	0.4575	0.2504	0.6646
p.c. inc^2	1.0820	0.4306	1.7335	p.c. inc^2	0.4092	0.2272	0.5912
p.c. inc^3	1.0834	0.4315	1.7363	p.c. inc^3	0.3968	0.2212	0.5724
p.c. inc^4	1.0870	0.4330	1.7410	p.c. inc^4	0.3913	0.2186	0.5640

C	Median Constant Only			D	Median Constant and Trend		
Variables	$\hat{\beta}^*$	I_{low}	I_{up}	Variables	$\hat{\beta}^*$	I_{low}	I_{up}
Gini	1.0037	0.3571	1.6504	Gini	0.8970	0.4188	1.3752
p.c. inc	1.0468	0.3778	1.7158	p.c. inc	0.4194	0.1890	0.6498
p.c. inc^2	1.0546	0.3816	1.7276	p.c. inc^2	0.3755	0.1679	0.5832
p.c. inc^3	1.0624	0.3853	1.7395	p.c. inc^3	0.3404	0.1510	0.5298
p.c. inc^4	1.0703	0.3891	1.7515	p.c. inc^4	0.3518	0.1565	0.5470

Notes: The table presents estimates of the order of summability $\hat{\beta}^*$. All variables are in logarithms. The constant term is accounted for by partial demanding, and linear trend term is accounted by double partial demanding as Berenguer-Rico and Gonzalo (2013 and 2014). For each variable, we present two sets of statistics: the upper (lower) panel shows mean (median) $\hat{\beta}^*$ across the panel as well as the mean- (median-) based subsampling results (lower and upper 95% confidence bands).

Table 2
Results of Test for Balancedness

A		Mean Constant Only			B		Mean Constant and Trend		
		β_T	I_{low}	I_{up}			β_T	I_{low}	I_{up}
Gini	inc, inc^2	-0.0432	**-0.1710**	**0.0845**	Gini	inc, inc^2	0.4953	0.2251	0.7656
Gini	inc, inc^2, inc^3	-0.0459	**-0.1733**	**0.0815**	Gini	inc, inc^2, inc^3	0.4814	0.1936	0.7693
Gini	inc, inc^2, inc^3, inc^4	-0.0486	**-0.1757**	**0.0784**	Gini	inc, inc^2, inc^3, inc^4	0.4942	0.2050	0.7835

C		Median Constant Only			D		Median Constant and Trend		
		β_T	I_{low}	I_{up}			β_T	I_{low}	I_{up}
Gini	inc, inc^2	0	**-0.0702**	**0.0702**	Gini	inc, inc^2	0.5690	0.3119	0.8260
Gini	inc, inc^2, inc^3	0	**-0.0724**	**0.0724**	Gini	inc, inc^2, inc^3	0.5510	0.3012	0.8008
Gini	inc, inc^2, inc^3, inc^4	0	**-0.0746**	**0.0746**	Gini	inc, inc^2, inc^3, inc^4	0.5429	0.2864	0.7993

Notes: The table presents estimates of the balancedness in the indicated regression models ($\hat{\beta}_y - \hat{\beta}_f$). All variables are in logarithms. The constant term is accounted for by partial demanding, and linear trend term is accounted by double partial demanding as Berenguer-Rico and Gonzalo (2013 and 2014). The bolded mean or median balancedness statistics indicate evidence for the hypothesis of a balanced regression model, $(\hat{\beta}_y - \hat{\beta}_f) = 0$. $I_{low}$and I_{up} represent lower and upper bounds of the corresponding 95 per cent confidence intervals.

Table 3
Results of Test for Co-Summability

	Gini	Gini	Gini		Gini	Gini	Gini
inc	0.500 (***)	5.948 (***)	12.916 (***)	inc	0.558 (***)	6.016 (***)	13.386 (**)
inc^2	-0.020 (***)	-0.629 (***)	-2.596 (**)	inc^2	-0.024 (***)	-0.634 (***)	-2.683 (**)
inc^3		0.022 (***)	0.220 (***)	inc^3		0.022 (***)	0.227 (***)
inc^4			-0.007 (***)	inc^4			-0.007 (***)
Country FE	Yes	Yes	Yes	Country FE	Yes	Yes	Yes
Year FE	No	No	No	Year FE	Yes	Yes	Yes
	Mean Constant Only				Median Constant Only		
$\hat{\delta}_{\varepsilon}$	1.0173	1.0639	1.0469	$\hat{\delta}_{\varepsilon}$	0.9704	1.0247	1.0549
I_{low}	0.9039	0.9191	0.9050	I_{low}	0.7584	0.8122	0.8563
I_{up}	1.1306	1.2087	1.1888	I_{up}	1.1824	1.2373	1.2536

Notes: Gini-coefficient is a dependent variable in the model specification. *Inc.* indicates per-adult national income. Per-adult national income and the Gini coefficient were transformed to logs. $\hat{\delta}_{\varepsilon}$ represents the estimated order of summability of the residual from the regression $(\hat{\beta}_y - \hat{\beta}_f)$ as Berenguer-Rico and Gonzalo (2013). I_{low} and I_{up} represent lower and upper bounds of the corresponding 95 per cent confidence intervals. *, ** and *** denote significance at the 10, 5, and 1 per cent levels, respectively.