Income Inequality and Economic Growth: A Re-examination of Theory and Evidence

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Abstract

We re-examine the theoretical and empirical relationship between income inequality and economic growth in an endogenous growth model with a flat tax on income, distributive conflicts among agents and median voter dynamics. We show that when government spends tax revenue on the provision of public goods in the form of both production and consumption services, the theoretical relationship between inequality and economic growth is neither strictly positive nor strictly negative but that it is ambiguous. An empirical evaluation of the theoretical findings is done by applying a semi-parametric model on a sample of 55 low-income, lower-middle-income, upper-middle-income and high-income countries for the period 1980 to 2010. Results show that the relationship between income inequality and growth takes the form of an inverted-U shape in that income inequality initially has a positive impact on growth up to an average Gini coefficient threshold of 35.92 beyond which it negatively impacts on growth.

1 Introduction

The relationship between income inequality and economic growth has remained topical and debatable in recent years. Post 1980 and more so in the aftermath of the 2007 global financial and economic crisis, inequality has been rising in a number of countries. The causes of this trend are varied, ranging from a perpetuation of dual social set-ups anchored on the legacies of past social hierarchies and ownership rights as well as the dynamics of modern capitalist economies (Assouad et al., 2018). In addition, the continued increase in global interconnectedness and interdependence is widening income and wealth inequality (Cingano, 2014). Interest in the inequality-growth nexus also stems mainly from the general consensus that inequality matters for growth and that the relationship has important policy implications. In addition, there are three alternative theoretical views in standard endogenous growth models that propose how inequality affects growth (Charles-Coll, 2013; Kennedy et al., 2017). One posits a negative inequality-growth relationship that runs from inequality to growth and a contradicting notion

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that argues for a positive relationship. The third supports a non-monotonic relationship. The first two contrasting views on the link between inequality and economic growth have dominated the debate. There is, however, yet to be consensus on the nature of the relationship, despite extensive theoretical and empirical research dedicated to this subject.

In this paper, we envisage a political economy set up (majority rule) with income taxation and in which government spending is used for the provision of both production and consumption services. We show that under this political economy mechanism, the theoretical relationship between inequality and economic growth is neither strictly positive nor strictly negative, but that it is non-monotonic. In order to do so, we revisit the theoretical relationship between income inequality and long-term economic growth in a simple endogenous growth model with government spending and taxation. We extend Li and Zou (1998)'s model by apportioning government spending between production and consumption services. Specifically, we include part of government spending on consumption services to an individual's utility function, as in Li and Zou (1998)'s model and the other portion on production services to the production function, as in Alesina and Rodrik (1994). Li and Zou (1998) reiterate that this political economy set up is more realistic than the ones that focuses on the government's provision of either consumption or production services.

Our study contributes to existing literature in two distinct ways. First, to the best of our knowledge, this is the first attempt to show that under a political economy mechanism with income taxation and in which government spending is used for the provision of both production and consumption services, the theoretical relationship between inequality and economic growth is neither positive nor negative but non-linear. This relationship runs from income inequality to growth. Second, we estimate and test this relationship using a semi-parametric model. Based 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 1980 to 2010, results show that income inequality has a positive impact on growth in per adult income up to an average Gini coefficient threshold of 35.92, beyond which it negatively impacts on growth in per adult income. As such, countries with inequality levels below a Gini coefficient of 35.92 are more likely to witness a positive relationship between inequality and growth, while those with a Gini coefficient above 35.92 are likely to experience a negative relationship between inequality and growth. Understanding the channels through which this may occur is crucial for policy makers. This paper outlines the various channels through which income inequality can affect growth in a political economy set up (majority rule) with income taxation and in which government spending is used for the provision of both production and consumption services.

The remainder of this paper is organised as follows: Section 2 discusses existing theoretical and empirical literature. Section 3 sets up and solves the theoretical model that details the relationship between income inequality and growth. Section 4 details the relationship between income inequality and economic growth. Section 5 describes the model variables, data, an overview of econometric method we apply as well as the results. Section 6 concludes.

2 Theoretical and Empirical Literature

The relationship between income inequality and economic growth remains debatable both theoretically and empirically. The first proposition to emerge in the early 1990s, known as the Conventional Consensus View, was that inequality can impact negatively on economic growth via two main channels. First, in an economy with relatively high levels of inequality, there is bound to be tendencies for rent-seeking, abuse of political power for self-enrichment and distrust of the incumbent government. Alternatively, voters may deem the levels of inequality to be unacceptable and proceed to insist on higher taxation and regulation. In both cases, this creates a hostile environment for investment, and ultimately lead to low growth (Hibbs, 1973; Bertola, 1994; Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Benabou, 1996). Alesina and Perotti (1996) reiterate that in extreme cases, inequality may ferment political instability and social unrest, with detrimental effects on growth. Second, financial and credit market imperfections, as outlined in Banerjee and Newman (1991) and in Galor and Zeira (1993), are a hindrance to the needy to borrow for investment in physical and human capital. In such an environment inequality is considered to perpetuate low growth. Recent studies that also argue for a negative relationship that runs from inequality to growth include Agnello et al. (2012),Esarey et al. (2012) and Cingano (2014).

The view that inequality exerts a positive impact on economic growth emerged as a direct challenge to the Conventional Consensus View and came to be known as the Alternative Consensus View. There are two main transmission mechanisms for the positive relationship between income inequality and economic growth. First, the classical argument is that inequality channels resources towards the rich, whose marginal propensity to save is higher than for the poor. This increases an economy's aggregate savings, leading to accumulation of physical capital and ultimately higher economic growth (Lewis, 1954; Kaldor, 1957; Bourguignon, 1981). Second, inequality incentivises individuals or a society to work harder, save and invest in both human capital and productive industries in order to improve incomes, all of which have a positive impact on economic growth (Mirrlees, 1971; Lazear and Rosen, 1981; Shin, 2012). Other studies that argue for a positive relationship that runs from inequality to growth include Li and Zou (1998),Partridge (1997) and Forbes (2000).

The third argument, which emerged in more recent literature, posits a non-monotonic relationship between inequality and growth (Barro, 2000; Banerjee and Duflo, 2003; Pagano, 2004; Voitchovsky, 2005; Bengoa and Sanchez-Robles*, 2005; Castelló-Climent, 2010; Charles-Coll, 2010; Henderson et al., 2015). This view is perhaps considered to be a reconciliation of the two views discussed above, which impose a linear structure (parametric specifications) on the inequality-growth nexus and hence conveniently ignore the potential non-linearities that may define the relationship between the two. In Barro (2000) and Pagano (2004), a non-linear relationship between inequality and growth is found to be conditional on the average income level, below which the relationship is negative and above which it is positive. In other words, the impact of equality on growth is considered to be different depending on an economy's stage of development. In particular, inequality is growth enhancing in rich countries and is detrimental to growth in poor economies. Banerjee and Duflo (2003) argue that an economy's growth rate is maximized when there are no changes in inequality and that any deviation of inequality, in either way, lowers growth.

There is a large body of empirical literature that attempts to establish the direction and magnitude by which inequality affects growth. There, however, remains no consensus on the sign and strength of the relationship (Cingano, 2014). In addition, a few empirical studies attempt to identify which of the possible theoretical channels discussed above is at work. The earliest and most influential theoretical and empirical studies in support of the Conventional Consensus View, according to Charles-Coll (2013), encountered several drawbacks which became the basis on which they were criticized. First, they were mostly limited to only two channels through which inequality negatively impacted on growth: the political economy and the socio-political instability channels. Second, the studies employed inconsistent data sets of income inequality measures and predominantly used various income shares and ratios, instead of the Gini indices which, as pointed by Rodriguez (2000), are considered to have better properties. Third, they used cross-sectional data from a variety of countries. The use of cross-sectional data meant that these studies were likely to report an average relationship that suffers from aggregation bias while at the same time estimating the relationship at a point in time, with no inference to the evolvement of the economy over time (Kennedy et al., 2017). Fourth, these studies employed mostly econometric methodologies such as ordinary least squares (OLS) and two stage least squares (2SLS).

The Alternative View, in support of a positive impact of inequality on growth, is anchored on both theoretical and empirical outcomes emanating from improved data quality and panel time series methodologies (Li and Zou, 1998; Partridge, 1997; Iradian, 2005) and improved data quality only (Forbes, 2000). Charles-Coll (2013) notes that the theoretical positive inequality-growth nexus is mainly moored on political economy arguments while a statistically significant positive relationship is supported by methodological techniques. These better estimation techniques have mainly involved panel data methodologies (Barro, 2000; Forbes, 2000; Panizza, 2002; Partridge, 2005; Frank, 2009; Cingano, 2014; Naguib, 2015) . The political economy channel, whose main building blocks are borrowed from Meltzer and Richard (1981), links inequality and redistribution of income/wealth through the median voter theorem (for a review, see Rodriguez (2000)). The mechanism can produce two contrasting outcomes: an inequality-growth nexus that is positive or one that is negative, depending on whether government spending is used entirely on consumption services (social transfers) or on production services, for example, construction of public infrastructure. The most notable studies that are grounded in this political economy channel are Alesina and Rodrik (1994) and Li and Zou (1998). These two studies form the basis for this paper in re-examining the theoretical and empirical relationship between income inequality and economic growth.

In an endogenous growth model under a political economy set-up with tax on income, distributive conflicts among agents, median voter dynamics and with government spending being used entirely for the purpose of production of services, Alesina and Rodrik (1994) find a negative relationship between inequality and growth. The political mechanism (distributive conflicts) implies that when income inequality is high, there will be strong pressure, by the majority, for redistribution in the form of transfer payments (or other policies) funded by some form of progressive taxation. The economic mechanism postulates that the high tax rate on capital income results in a low after-tax rate of return on saving. The overall result is low aggregate saving and investment, leading to low growth.

In the same set-up as in Alesina and Rodrik (1994) but with government spending wholly devoted to consumption services and hence only entering the household utility function, Li and Zou (1998) find that inequality impacts positively on economic growth. They argue that a more equal distribution of income leads to a higher rate of capital taxation (through majority voting) and a lower rate of economic growth while higher income inequality can generate higher savings rates and growth rates if the larger share of income is in the hands of the rich or in other words, if income inequality is high. They further support their theoretical argument by claiming that since government spending is only for the provision of consumption services, agents will endeavour to allocate resources between private and public consumption, informed by the respective marginal utilities. When income inequality is low, such that the median voter income is relatively high, preferences will be for a high income tax in order to allocate more resources to the provision of consumption services in order to match private and public consumption marginal utilities. As such, income/capital taxation is highest (lowest) at low (high) levels of inequality, and hence a positive impact of inequality to growth.

3 The Economy

We extend Li and Zou (1998)'s model by specifying an individual's utility function with government spending on consumption services and a production function with government spending on production services. As noted by Li and Zou (1998), this split of government expenditure is explicitly made in Barro (2000).[1]

3.1 The Individual

Consider an individual i who maximises their present discounted lifetime utility, given by the following constant elasticity of substitution (CES) utility function:

$$\cup^i = \int_0^\infty \left[\frac{c_i^{(1-\theta)} - 1}{1-\theta} + \ln g_c \right] e^{-\rho t} dt \tag{1}$$

where $c_1 \geq 0$ is the i'th individual's consumption at time t, $i = 1, ...N$, N is the total number of infinitely-lived heterogeneous individuals in an economy. g_c is government spending on consumption services, viewed by individuals as being beyond their control. $0 < \theta < \infty$ is the coefficient of relative risk aversion with respect to private consumption and ρ is the discount rate, or constant rate of time preference.

The production function for individual i is of the Barro-type, given by

$$y_i = Ak_i^\alpha g_p^{1-\alpha} \tag{2}$$

as in Alesina and Rodrik (1994), where $0 < \alpha < 1$. y_i is individual i's total output, $A > 0$ is a technology parameter and k_i is the capital stock held by individual i. g_p is government spending on public production services (no rivalry).

The wealth/income/capital share for individual i is:

$$\sigma_i = \frac{Ak_i}{A\sum_{i=1}^N k_i} = \frac{k_i}{k} \tag{3}$$

where $0 < \sigma_i < 1$. An individual with a high σ is income/capital rich and the one with a low σ is capital/income poor. Individual i accumulates capital as follows:

$$\frac{dk_i}{dt} = \dot{k}_i = (1-\tau)Ak_i^\alpha g_p^{1-\alpha} - c_i \tag{4}$$

$k_i > 0$ is given.

3.2 The Government

The government levies a flat tax on income and its tax revenue is given by

$$g = \tau y \tag{5}$$

where τ is the tax rate on income. According to (5), the government runs a balanced budged. In our model, government spending, g, is a sum of expenditure on public consumption services (g_c) and expenditure on production services (g_p) and is given by

$$g = g_c + g_p$$

[1]Detailed step by step mathematical derivations of the theoretical relationship between inequality and growth are contained in a Technical Appendix, which is available upon request from the authors.

$$g = \varphi\tau y + (1-\varphi)\tau y \tag{6}$$

where where φ and $(1-\varphi)$ are shares of government expenditure on consumption services and production services, respectively. We can use (2) to show that

$$g_c = \varphi\tau A k_i^{\alpha} g_p^{1-\alpha} \tag{7}$$

and that

$$g_p = (1-\varphi)\tau A k_i^{\alpha} g_p^{1-\alpha} \tag{8}$$

We can simplify (8) to

$$g_p = (1-\varphi)^{\frac{1}{\alpha}} \tau^{\frac{1}{\alpha}} A^{\frac{1}{\alpha}} k_i \tag{9}$$

and substituting (9) into (7) simplifies (7) to

$$g_c = \varphi(1-\varphi)^{\frac{1-\alpha}{\alpha}} \tau^{\frac{1}{\alpha}} A^{\frac{1}{\alpha}} k_i \tag{10}$$

3.3 The Model

The individual i maximizes (1) subject to the dynamic constraint in (10), as follows

$$\begin{aligned} \max \qquad & \cup^i = \int_0^\infty \left[\frac{c_i^{(1-\theta)} - 1}{1-\theta} + \ln g_c \right] e^{-\rho t} dt \\ \text{s.t.} \qquad & \frac{dk_i}{dt} = \dot{k}_i = (1-\tau) A k_i^{\alpha} g_p^{1-\alpha} - c_i \end{aligned}$$

Hamiltonian:

$$H = \left[\frac{c_i^{(1-\theta)} - 1}{1-\theta} + \ln g_c \right] e^{-\rho t} + \lambda_t \left[(1-\tau) A k_i^{\alpha} g_p^{1-\alpha} - c_i \right]$$

$$e^{-\rho t} \frac{(1-\theta) c_i^{-\theta}}{1-\theta} - \lambda_t = 0$$

$$e^{-\rho t} c_i^{-\theta} = \lambda_t \tag{11}$$

$$\frac{dH}{dk_t} = \dot{\lambda}_t = 0$$

$$\dot{\lambda}_t = -\lambda_t \left[(1-\tau)\alpha A k_i^{\alpha-1} g_p^{1-\alpha)} \right] \tag{12}$$

Re-arranging (11) to $c_i^{-\theta} = \lambda_t e^{\rho t}$ and taking the derivative w.r.t t, we have

$$\frac{-\theta c_i^{-\theta-1} c_i}{c_i^{-\theta}} . \frac{\dot{c}_i}{c_i} = \rho + \frac{\dot{\lambda}_t}{\lambda_t}$$

Given that $\dot{\lambda}_t = -\lambda_t[(1-\tau)\alpha A k_i^{\alpha-1} g_p^{1-\alpha}]$, then

$$\frac{\dot{c}_i}{c_i} = \frac{1}{\theta}[(1-\tau)\alpha A k_i^{\alpha-1} g_p^{1-\alpha} - \rho] \tag{13}$$

and the first-order condition for individual i's optimization problem is then given by

$$\gamma \equiv \frac{\dot{c}_i}{c_i} = \frac{\dot{k}_i}{k_i} = \frac{\dot{y}_i}{y_i} = \frac{1}{\theta}\left[(1-\tau)\alpha A k_i^{\alpha-1} g_p^{1-\alpha} - \rho\right] \tag{14}$$

According to (14), the optimal growth rates of income, consumption and capital accumulation are the same on the balanced path.

From (9), we have, $g_p = (1-\varphi)^{\frac{1}{\alpha}} \tau^{\frac{1}{\alpha}} A^{\frac{1}{\alpha}} k_i$, and from (3) we have $\sigma_i = \frac{Ak_i}{A\sum_{i=1}^{N} k_i} = \frac{k_i}{k}$ such that the marginal product of capital, $\alpha A k_i^{\alpha-1} g_p^{1-\alpha}$, can be expressed as

$$\alpha \sigma_i^{\alpha-1} A^{\frac{1}{\alpha}} \tau^{\frac{1-\alpha}{\alpha}} (1-\varphi)^{\frac{1-\alpha}{\alpha}} \tag{15}$$

hence (14) can then be expressed as

$$\gamma \equiv \frac{\dot{c}_i}{c_i} = \frac{\dot{k}_i}{k_i} = \frac{\dot{y}_i}{y_i} = \frac{1}{\theta}\left[\alpha(1-\tau)\sigma_i^{\alpha-1} A^{\frac{1}{\alpha}} \tau^{\frac{1-\alpha}{\alpha}} (1-\varphi)^{\frac{1-\alpha}{\alpha}} - \rho\right] \tag{16}$$

where γ represents the economy's growth rate. γ is independent of the initial distribution of capital stock and σ_i is time-invariant along a balanced growth path. For individual i,

$$k_i(t) = k_i(0) e^{\frac{\left[\alpha(1-\tau)\sigma_i^{\alpha-1} A^{\frac{1}{\alpha}} \tau^{\frac{1-\alpha}{\alpha}} (1-\varphi)^{\frac{1-\alpha}{\alpha}} - \rho\right]}{\theta} t} \tag{17}$$

The consumption function for individual i is determined by combining (10) and (16) by first dividing (10) by k_i and equating it to (16). The consumption function for individual i is then given by

$$c_i(t) = \frac{\rho - (1-\tau)\tau^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B(\alpha-\theta)}{\theta} k_i(0) e^{\frac{\rho-(1-\tau)\tau^{\frac{1-\alpha}{\alpha}}\sigma_i^{\alpha-1}B(\alpha-\theta)}{\theta} t} \tag{18}$$

and

$$\sigma_i(t) = \frac{k_i(0)}{k(0)} \tag{19}$$

where $k(0) = \sum_{i=1}^{N} k_i(0)$. According to (19), all individuals in this economy are similar in all aspects expect their initial capital endowments. We then proceed to investigate the relationship between economic growth, tax policy and distribution of capital ownership in three steps.

4 Relationship between Income Inequality and Economic Growth

4.1 Relationship between Tax Policy and Economic Growth

We assume that the tax rate on income remains constant over time and reproduce (16) below.

$$\gamma = \frac{1}{\theta}\left[\alpha(1-\tau)\tau^{(\frac{1-\alpha}{\alpha})}\sigma_i^{\alpha-1}B - \rho\right]$$

where, for convenience, we let $A^{\frac{1}{\alpha}}\varphi^{\frac{1-\alpha}{\alpha}}$ be a constant equal to B. The effect of government's flat rate tax on economic growth is computed with the first derivative of γ with respect to τ, and is determined to be

$$\frac{d\gamma}{d\tau} = \sigma_i^{\alpha-1}\frac{1}{\theta}B\tau^{\frac{1-2\alpha}{\alpha}}(1-\alpha-\tau) \tag{20}$$

According to (20), the effect of the government's flat rate tax on economic growth is positive if $\tau < 1 - \alpha$ and negative for $\tau > 1 - \alpha$, with the long-run growth maximizing tax at $\tau^* = 1 - \alpha$. This implies that the relationship between the tax rate on income τ and economic growth γ is represented by an inverted-U curve. This implies that when τ is increasing but is less than $\tau^* = 1 - \alpha$, the economy will experience a higher level of productive services, g_p, and therefore a higher output-capital ratio. This entails a higher growth potential. On the other hand, a τ higher than $\tau^* = 1 - \alpha$ leads to a low after-tax rate of return on saving. This results in low aggregate saving and investment and thereby in low growth. If τ starts low, and subsequently increases, the initial effect dominates until $\tau = \tau^*$ while a continued increase in τ lowers growth. This relationship between tax policy and economic growth was confirmed by calibration of (20) using the standard parameters which are $\alpha = \frac{1}{3}$, $A = 2$, $\rho = 0.025$, $\sigma_i = 0.5$ and $\varphi = 0.5$, while τ and γ were allowed to vary.

4.2 Relationship between Tax Policy and Wealth Distribution

This is the case of a benevolent government that chooses to levy a constant tax rate on income in order to finance public spending on consumption and production services. In doing so, the government aims to maximize the discounted utility of individual i, given by (1). The relationship between an individual's preferred tax rate (τ_i^*) and their initial share of capital stock (σ_i) is derived by substituting (18) into (1) as follows:

$$\cup^i = \int_0^\infty \left[\frac{\left(\frac{\rho - (\alpha-\theta)(1-\tau)\tau^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta} \sigma_i k(0) e^{\frac{\alpha(1-\tau)\tau^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B - \rho}{\theta} t} \right)^{1-\theta} - 1}{1-\theta} + \ln g_c \right] e^{-\rho t} dt \quad (21)$$

We then solve (21) and obtain the objective function for individual i:

$$\cup^i = \left[\frac{\rho - (\alpha-\theta)(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta} \right]^{1-\theta} \frac{[\sigma_i k(0)]^{1-\theta}}{1-\theta} \left[\frac{\rho - \alpha(1-\theta)(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta} \right]^{-1}$$
$$+ \frac{\ln \tau_i^*}{\alpha\rho} + \left[\frac{\alpha(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{-1} B - \rho}{\theta\rho^2} \right] - \frac{\ln \sigma_i}{\rho} + C \quad (22)$$

Maximization of the objective function of individual i with respect to τ_i, we have $\frac{du^i}{d\tau_i^*}$ being equal to

$$= (\sigma_i k(0))^{1-\theta} \frac{B\sigma_i^{\alpha-1}{\tau_i^*}^{\frac{1-2\alpha}{\alpha}}}{\theta}(1-\alpha-\tau_i^*)[(\frac{\rho - \alpha(1-\alpha)(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta})^{-2}$$
$$(\frac{\rho - (\alpha-\theta)(1-\tau_i^*){\tau_i^*}^{(\frac{1-\alpha}{\alpha})} \sigma_i^{\alpha-1} B}{\theta})^{1-\theta} - \frac{(\alpha-\theta)}{\alpha}(\frac{\rho - \alpha(1-\alpha)(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta})^{-1}$$
$$(\frac{\rho - (\alpha-\theta)(1-\tau_i^*){\tau_i^*}^{\frac{1-\alpha}{\alpha}} \sigma_i^{\alpha-1} B}{\theta})^{-\theta})] + (\frac{B\sigma_i^{\alpha-1}\tau_i^{\frac{1-2\alpha}{\alpha}}}{\theta\rho^2})(1-\theta)(1-\alpha-\tau_i^*) + \frac{1}{\alpha\rho\tau_i^*} = 0 \quad (23)$$

We then use (23) to compute $\frac{d\tau_i^*}{d\sigma_i}$. To compute this derivative, we appeal to the implicit function theorem (see Wainwright et al. (2005)). Specifically, since we are concerned with the relationship between τ_i^* and σ_i, we may regard $\frac{d\tau_i^*}{d\sigma_i}$ as a function of τ_i^* and σ_i only and take other variables as fixed. For this reason we may write $\frac{dU^i}{d\tau_i^*} = f(\tau_i^*, \sigma_i)$. Now, according to the implicit function theorem, the equation $f(\tau_i^*, \sigma_i) = 0$ defines τ_i^* as a function of σ_i and

$$\frac{d\tau_i^*}{d\sigma_i} = -\frac{f\sigma_i}{f\tau_i^*}$$

where $f\sigma_i$ denotes the partial derivative of f with respect to σ_i and similarly for $f\tau_i^*$. By letting $\frac{dU^i}{d\tau_i^*} = A[Z]+C+D = 0$, we can let the first part of $\frac{dU^i}{d\tau_i^*}$ be $A = (k(0))^{1-\theta}(\frac{B\sigma_i^{\alpha-1}\tau_i^{(\frac{1-2\alpha}{\alpha})}}{\theta})(1-\alpha-\tau_i^*)$ and let $f(\tau_i^*, \sigma_i) = (k(0))^{1-\theta}(\frac{B\sigma_i^{\alpha-1}\tau_i^{(\frac{1-2\alpha}{\alpha})}}{\theta})(1-\alpha-\tau_i^*) = 0$ then we have

$$f\sigma_i = \frac{\partial A}{\partial \sigma_1}Z + \frac{\partial Z}{\partial \sigma_1}A + \frac{\partial C}{\partial \sigma_1}$$

$$= (k(0))^{1-\theta}) \left[\frac{(\alpha-\theta)(1-\alpha-\tau_i^*)\tau^{*(\frac{1-2\alpha}{\alpha})}B\sigma_i^{\alpha-\theta-1}}{\theta}\right] Z$$

$$+(2[(\frac{\alpha(\alpha-1)(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\theta})(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-3}(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{1-\theta}$$
$$-\frac{(1-\theta)(\alpha-1)(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\theta})(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta}-(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-2}]$$
$$-\frac{(\alpha-\theta)}{\alpha}[(\frac{\alpha(\alpha-1)(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\theta})(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-2}(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta}$$
$$+(\frac{\theta(\alpha-1)(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\theta})(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta-1}(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-1}])A$$

$$+\frac{B(1-\theta)}{\alpha\theta\rho^2}(2\alpha^2-3\alpha+1-(1-\alpha)\tau_i^*)\tau_i^{*(\frac{1-3\alpha}{\alpha})}\sigma_i^{\alpha-1}$$

and

$$f\tau_i^* = \frac{\partial A}{\partial \tau_i^*}Z + \frac{\partial Z}{\partial \tau_i^*}A + \frac{\partial C}{\partial \tau_i^*} + \frac{\partial D}{\partial \tau_i^*}$$

$$= (k(0))^{1-\theta}) \left[\frac{(1-\alpha-\tau_i^*)(\frac{1-2\alpha}{\alpha})\tau^{*(\frac{1-3\alpha}{\alpha})}B\sigma_i^{\alpha-\theta}}{\theta}\right] Z$$

$$+([(\frac{2(1-\theta)(1-\alpha-\tau_i^*)\tau_i^{*(\frac{1-2\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-3}(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{1-\theta}$$
$$-\frac{(1-\theta)(\alpha-1)(1-\tau_i^*)\tau_i^{*(\frac{1-2\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\alpha\theta})(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta}-(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-2}]$$
$$-\frac{(\alpha-\theta)}{\alpha}[(\frac{(1-\theta)(1-\alpha-\tau_i^*)\tau_i^{*(\frac{1-2\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\theta})(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-2}(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta}$$
$$+(\frac{\theta(\alpha-\theta)(1-\alpha-\tau_i^*)\tau_i^{*(\frac{1-2\alpha}{\alpha})}B\sigma_i^{\alpha-2}}{\alpha\theta})(\frac{\rho-(\alpha-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-\theta-1}(\frac{\rho-\alpha(1-\theta)(1-\tau_i^*)\tau_i^{*(\frac{1-\alpha}{\alpha})}B\sigma_i^{\alpha-1}}{\theta})^{-1}])A$$

$$+\frac{B(1-\theta)}{\theta\rho^2}(\alpha-1)(1-\alpha-\tau_i^*)\tau_i^{*(\frac{1-2\alpha}{\alpha})}\sigma_i^{\alpha-2}$$

Therefore,

$$\frac{\partial\tau_i^*}{\partial\sigma_i} = -\frac{f\sigma_i}{f\tau_i^*} \tag{24}$$

The capital/income share of the median voter is denoted by σ_m while the tax rate chosen by majority rule is τ_m. According to (24), the relationship between tax policy and wealth distribution is ambiguous in that the effect of a change in an individual's preferred tax rate with respect to changes in wealth distribution can be negative, zero or positive. These possible outcomes can be explained in three parts. First, when income inequality is low, it implies that the median voter income is relatively high, such that $\sigma_i \leq \sigma_m$. In this case, there will be a negative relationship between τ_i^* and σ_i, such that (24) will be negative. Second, the income tax rate is lowest at τ_m, which coincides with $\sigma_i = \sigma_m$. At this point, the effect of σ_i on τ_i^* is zero and hence (24) will be zero. Third, $\sigma_i \geq \sigma_m$ implies that income inequality is high. In this case, the relationship between τ_i^* and σ_i is positive, such that (24) will be positive.

4.3 Relationship between Economic Growth and Wealth Distribution

Since the choice of income taxation is by majority voting, the median-voter theorem applies. Therefore the tax rate chosen by majority rule is the median voter's preferred choice, τ_m, which is defined implicitly in

$$(\sigma_m k(0))^{1-\theta}(\frac{B\sigma_m^{\alpha-\theta}\tau_m^{\frac{1-2\alpha}{\alpha}}}{\theta})(1-\alpha-\tau_m^*)[(\frac{\rho-\alpha(1-\alpha)(1-\tau_m^*)\tau_m^{*\frac{1-\alpha}{\alpha}}\sigma_m^{\alpha-1}B}{\theta})^{-2}$$
$$(\frac{\rho-(\alpha-\theta)(1-\tau_m^*)\tau_m^{*\frac{1-\alpha}{\alpha}}\sigma_m^{\alpha-1}B}{\theta})^{1-\theta}-(\frac{(\alpha-\theta)}{\alpha}(\frac{\rho-\alpha(1-\alpha)(1-\tau_m^*)\tau_m^{*(\frac{1-\alpha}{\alpha})}\sigma_m^{\alpha-1}B}{\theta})^{-1}$$
$$(\frac{\rho-(\alpha-\theta)(1-\tau_m^*)\tau_m^{*(\frac{1-\alpha}{\alpha})}\sigma_m^{\alpha-1}B}{\theta})^{-\theta})]+(\frac{B\sigma_m^{\alpha-1}\tau_m^{\frac{1-2\alpha}{\alpha}}}{\theta\rho^2})(1-\theta)(1-\alpha-\tau_m^*)+\frac{1}{\alpha\rho\tau_m^*}=0 \quad (25)$$

where σ_m denotes the capital endowment share of the median voter. Using the relationship between economic growth and tax policy as given by (20), the relationship between tax policy and wealth distribution as given by (24) and the chain rule leads to the following relationship between economic growth and wealth distribution (income inequality) in a political equilibrium:

$$\frac{\partial\gamma}{\partial\sigma_m} = \frac{\partial\gamma}{\partial\tau_m} * \frac{\partial\tau_m}{\partial\sigma_m} \quad (26)$$

As detailed above, $\frac{\partial\gamma}{\partial\tau_m}$ is an inverted U-shaped relationship between growth and the tax rate, and that $\frac{\partial\tau_m}{\partial\sigma_m}$ can be negative, zero or positive, such that $\frac{\partial\gamma}{\partial\sigma_m}$ is ambiguous. In summary, we show that in an endogenous growth model with a flat tax on income, distributive conflicts among agents and median voter dynamics and in which government spends tax revenue on the provision of public goods in the form of both production and consumption services, the theoretical relationship between inequality and economic growth is neither strictly positive nor strictly negative but that it is ambiguous. In the next section, we empirically test this theoretical relationship between inequality and growth.

5 Variables, Data Sources and Empirical Analysis

We use per adult national income (purchasing power parity (PPP) at constant 2016 prices) from the World Inequality Database (WID.world), instead of the commonly used gross domestic product (GDP), to compare levels of economic welfare across countries. This is because comparing income and wealth in different countries using GDP is not convincing (Alvaredo et al., 2017). WID.world combines fiscal, survey and national accounts data to compile per adult national income in a systematic manner that is novel. It considers national income as being more meaningful than GDP since it nets out, from GDP, depreciation of capital stock as well as the fraction of domestic output attributable to foreign capital owners. This net national income is the one distributable to a country's population. In addition, the idea of Distributional National Accounts (DINA), as detailed in WID.world, takes into account the evolution of the distribution of national income and wealth, unlike GDP (total and per capita) that focuses exclusively on aggregates and averages and hence does indicate the extent to which the different social groups benefit - or not - from economic growth.

Income inequality data for countries, expressed as Gini coefficients, is sourced from the Standardized World Income Inequality Database (SWIID)[2]. The SWIID 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 data set is thus better suited for broad cross-country analysis on income inequality than other available sources. While there are four ways of expressing income inequality, as detailed in Solt (2016), we focus on inequality in disposable (post-tax, post-transfer) income.

The unbalanced panel data sample contains 4,926 observations on per adult national income and inequality in disposable (post-tax, post-transfer) income for 169 countries (26 Low-Income, 49 Lower Middle-Income, 47 Upper Middle-Income and 47 High Income countries based on World Bank classification) from 1960 to 2016. A balanced sub-sample was constructed from the unbalanced panel data sample for the period 1980-2010. 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). The two variables, per adult national income and the Gini coefficient were transformed to logs. Table 1 shows the annual growth rate of per adult national income and the Gini coefficient (in natural logs), controlled for different lags of the two variables, giving us a sample of 1,430 observations per each variable.

Table 1: Descriptive Statistics

	Growth of per adult national income	Gini (Log)
N	1,430	1,430
Mean	0.0158	3.6110
S.D.	0.0605	0.2497
Min	-0.6228	3.0316
Max.	0.6255	4.0702
Skewness	-0.4740	-0.2783
Kurtosis	21.9871	-0.9891
JB	28,949.7990***	76.4520***

Notes: In addition to the mean, the table reports the standard deviation (S.D.), minimum (min), maximum (max), skewness, and kurtosis statistics, and the Jarque-Bera normality test (JB). The asterisks ***, ** and * represent significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

5.1 Semi-parametric Model

We employ a semi-parametric model to empirically examine the relationship between income inequality and per adult national income growth.[3] Our analysis builds on the theoretical argument outlined earlier that the relationship between economic growth and income inequality is

[2] The Gini coefficient can theoretically range from 0 (complete equality) to 100 (complete inequality)

[3] Dickey-Fuller type panel unit root tests confirmed the stationarity of the natural log-levels of income inequality. Complete details of these results are available upon request from the authors.

non-linear and that the relationship runs from inequality to growth. A semi-parametric approach is convenient as it can account for the non-linearity in panel data by relaxing functional form assumptions and hence letting data to speak for themselves. In particular, we use an instrumental variable (IV) approach to control for potential endogeneity of the Gini coefficient. The sample size we use is relatively large enough to minimize the possibility of misspecification bias. The appropriate IV models are chosen on the basis of the Wu-Hausman and the Sargan J-test results. The Hausman-Wu tests the null that the regressors are not correlated with the disturbance term while the J statistic tests the null hypothesis that all instruments are exogenous.

The first stage regressions of the two stage least squares (2SLS) involves auxiliary IV regression estimation. Auxiliary regression measures the instrument relevance and are based on the following

$$q_{it} = \mu + \theta' z_{it} + \varepsilon_{it} \tag{27}$$

where q_{it} is the Gini coefficient (in logs), $z_{it} = [g_{it-1}, g_{it-2}, ..., g_{it-p}, q_{it-1}, q_{it-2}, ..., q_{it-p}]'$ are instrumental variables and g_{it} is the growth rate of per adult national income. $\varepsilon_{it} \sim iid\left(0, \sigma^2\right)$ is the error term. The subscript i is for the cross-sections and t is for the time series. We then estimate the ordinary least squares (OLS) and IV regression models of the following form:

$$g_{it} = \alpha + \beta q_{it} + \varepsilon_{it} \tag{28}$$

and the model for the OLS-lagged estimates is given by

$$g_{it} = \alpha + \beta q_{it-1} + \varepsilon_{it} \tag{29}$$

with OLS. Non-parametric (NP) estimates are for the specification

$$g_{it} = f(q_{it}) + \varepsilon_{it} \tag{30}$$

This is estimated with instruments or without instruments. Non-instrumental NP estimates corresponds to estimation of $g_{it} = f(q_{it}) + \varepsilon_{it}$ and $g_{it} = f(q_{it-1}) + \varepsilon_{it}$. The semi-parametric model is then expressed as follows:

$$g_{it} = \Phi x_{it} + f(q_{it}) + \varepsilon_{it} \tag{31}$$

where $f(q_{it})$ is a non-linear function and x_{it} is a set of exogenous variables. The possibility that $E[\varepsilon_{it}|q_{it}] \neq 0$ is accounted for by estimating (31) using those models for which instrument validity is not rejected by the Sargan J-test or the Wu-Hausman test does not indicate endogeneity. We follow Vaona and Schiavo (2007) to estimate the model in equation (31) by employing the semi-parametric IV estimation approach of Park (2003). The optimal bandwidth selection is data driven and is determined using the least-square cross validation method of Li et al. (2013). In this paper, we use a Gaussian kernel for all non-parametric and semi-parametric models. Table 2 reports estimates of nine auxiliary regressions, each with a different instrument specification. Results indicate that all the instruments are adequate, as the F-test is rejected in all the nine specifications.

Table 2: Estimates of the IV Auxiliary Regressions

	Instruments	R^2	Adjusted R^2	$\hat{\sigma}$	F
Model 1	g_{t-1}	0.9982	0.9982	0.0105	806,647.9775***
Model 2	g_{t-1},g_{t-2}	0.9993	0.9993	0.0067	979,626.1523***
Model 3	g_{t-1},...,g_{t-3}	0.9993	0.9993	0.0067	654,427.2841***
Model 4	g_{t-1},...,g_{t-4}	0.9993	0.9993	0.0067	491,500.2306***
Model 5	g_{t-1},q_{t-1}	0.9982	0.9982	0.0105	404,264.3685***
Model 6	g_{t-1}, g_{t-2},q_{t-1}	0.9993	0.9993	0.0067	652,978.9590***
Model 7	g_{t-1}, g_{t-2}, q_{t-1},,q_{t-1}	0.9993	0.9993	0.0067	489,986.4458***
Model 8	g_{t-1},...,g_{t-3}, q_{t-1},...,q_{t-3}	0.9993	0.9993	0.0067	327,146.8131***
Model 9	g_{t-1},...,g_{t-4}, q_{t-1},...,q_{t-4}	0.9993	0.9993	0.0067	245,573.7617***

Notes: R^2 is the coefficient of determination; Adjusted R^2 is the adjusted coefficient of determination; $\hat{\sigma}$ is the standard error of the regression; F is the regression F statistic. ***, **, and * denote significance at 1 percent, 5 percent, and 10 percent, respectively.

The next stage involves estimating the relationship between linear growth of per adult income and Gini by means of OLS and IV. The NP-IV estimates we are interested in are those models for which instrument validity is not rejected by the Sargan J-test or the Wu-Hausman test does not indicate endogeneity. As shown in Table 3, these include IV Model 1, IV Model 2, IV Model 3, IV Model 7, IV Model 8 and IV Model 9.

Table 3: OLS and IV Estimates of the Linear Growth and Gini Relationship

	Instruments	Intercept[α]	Gini[β]	Wu-Hausman F-test	Sargan J-Test
OLS		0.0210	-0.0014		
		(0.0232)	(0.0064)		
OLS lagged		0.0227	-0.0019		
		(0.0230)	(0.0064)		
IV Model 1	g_{t-1}	8.2720	-2.2860	17.8290***	
		(18.6510)	(5.1650)		
IV Model 2	g_{t-1},g_{t-2}	2.0670	-0.5680	10.1180***	1.7280
		(1.6430)	(0.4550)		
IV Model 3	g_{t-1},...,g_{t-3}	1.3250**	-0.363*	12.1190***	4.0910
		(0.6770)	(0.187)		
IV Model 4	g_{t-1},...,g_{t-4}	0.0210	-0.0010	0.0000	41.7330***
		(0.2870)	(0.0790)		
IV Model 5	g_{t-1},q_{t-1}	0.0220	-0.0020	2.3140	17.6400***
		(0.0230)	(0.0060)		
IV Model 6	g_{t-1}, g_{t-2},q_{t-1}	0.0220	-0.0020	2.0320	21.2390***
		(0.0230)	(0.0060)		
IV Model 7	g_{t-1}, g_{t-2}	0.0230	-0.0020	6.6760***	21.3310***
	q_{t-1},,q_{t-1}	(0.0230)	(0.0060)		
IV Model 8	g_{t-1},...,g_{t-3}	0.0230	-0.0020	6.5230**	25.3800***
	q_{t-1},...,q_{t-3}	(0.0230)	(0.0060)		
IV Model 9	g_{t-1},...,g_{t-4},	0.0230	-0.0020	6.4650**	44.0150***
	q_{t-1},...,q_{t-4}	(0.0230)	(0.0060)		

Notes: OLS model is the estimate of $g_{it} = \alpha + \beta q_{it} + \varepsilon_{it}$, while OLS-lagged estimates $g_{it} = \alpha + \beta q_{it-1} + \varepsilon_{it}$ using non-instrumental OLS estimation. IV models are estimated by two stage least squares using the corresponding instruments given in the second column. Wu-Hausman F statistic tests for the endogeneity of the Gini in (28) given the instruments. Sargan J statistic tests for the over-identifying restrictions. ***, **, and * denote significance at 1 percent, 5 percent, and 10 percent, respectively.

The estimated parameters for Gini and lagged Gini on per adult income growth are both negative, implying that income inequality reduces income growth in a linear model. The β coefficients for all the 9 IV Models are also negative. However, only the coefficient of the Gini for IV Model 3 is statistically significant. IV Model 1, IV Model 2 and IV Model 3 regressions appear to overestimate the effects of income inequality on income growth, while the Gini coefficient estimates for the rest are all more or less similar, ranging from -0.0020 to 0.0010. The estimated thresholds (where the slope of the curve turns from positive to negative and stays negative afterwards) are outlined in Table 4 below.

Table 4: Estimated Thresholds for the Gini Coefficient

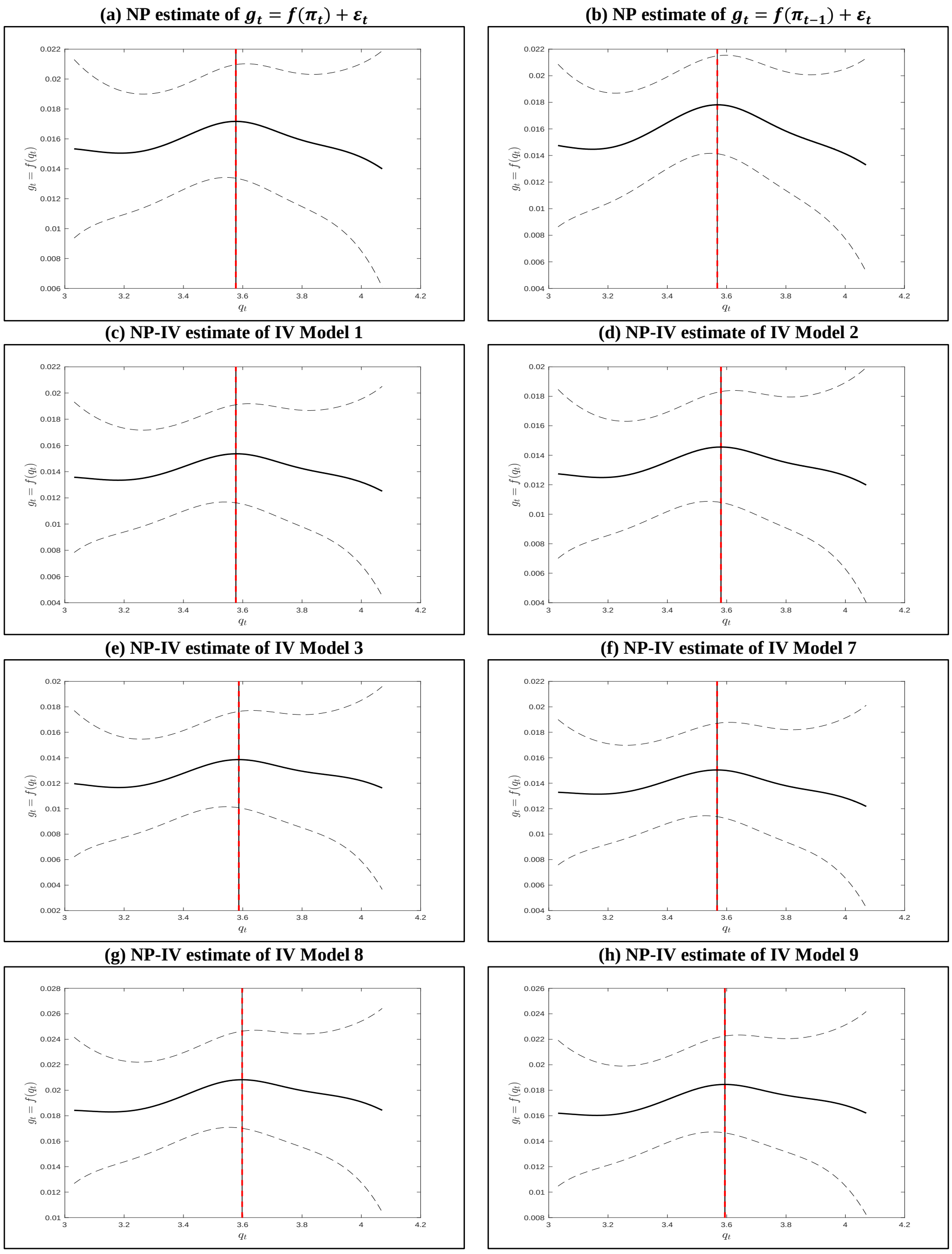
Model	Threshold Gini Coefficient
OLS	35.7589
OLS lagged	35.4705
IV Model 1	35.7589
IV Model 2	35.8987
IV Model 3	36.1183
IV Model 7	35.4315
IV Model 8	36.5215
IV Model 9	36.3793
Average	35.9172
Min	35.4315
Max	36.5215

Notes: We determined the optimal bandwidth using least squares cross-validation methods of Li et al. (2013).

Our findings are that on average, income inequality, as measured by the Gini coefficient, impacts positively on growth of per adult national income for coefficients below 35.92, whereas a negative relation is likely for income inequality higher than 35.92 (see Table 4). Figure 1 plots the relationship between income inequality and per adult national income growth. The continuous line traces $f(q_t)$; the dotted lines mark the confidence interval whereas a vertical dashed line is drawn at the estimated threshold. This relationship is non-linear and exhibits an inverted-U shape for all the eight specifications, as shown in Figure 1.[4]

[4] We also employed Wang et al. (2015)'s fixed-effect panel threshold model, developed following Hansen (1999)'s panel threshold model to examine the relationship between income inequality and growth of per adult income, using the same data set. Appendix A shows results for a single-threshold model. The F-statistic for a linear model is rejected implying that we fail to reject the presence of a single-threshold. In summary, the result suggests a single-threshold model, with a Gini coefficient threshold value of 42.60, as shown in Appendix A, Panel B. According to threshold effects and fixed-effect panel threshold model results, income inequality is found to impact growth positively when the Gini coefficient is less than 42.6000, beyond which it negatively impacts on growth. For the first regime, parameter β_1 was found to be 0.0895 and statistically significant, while β_1 for the second regime was found to be -2.2566 and statistically significant. A positive β_1 for the first regime and a negative β_1 for the second regime confirmed the inverted-U shaped relationship between income inequality and economic growth.

Figure 1: NP and NP-IV Estimates



This inverted-U shaped relationship between income inequality and growth can be explained by our theoretical model discussed in Section 3 and 4. In the model, an individual derives utility from both private and public consumption and would want to match marginal utilities of the two. The individual, however, does not have direct influence on the provision of public consumption goods or services. As such, initial preferences will be for a high income tax in order to allocate more resources to the provision of public consumption goods or services so as to equalize the marginal utilities. The result will be that a higher tax on income lowers aggregate saving and investment, leading to low growth. As income inequality increases, the individual's willingness to vote for a higher tax on income diminishes. As such, the individual progressively votes for a lower tax on income. This encourages savings and investment and as a result, higher economic growth is realized. This view is supported by the classical argument that as income inequality increases and income tax falls, resources are channelled towards the rich, whose marginal propensity to save is higher than for the poor. This increases an economy's total savings, accumulation of physical capital and ultimately higher economic growth. The income tax rate will fall to its lowest point, τ_m, which coincides with $\sigma_i = \sigma_m$. At this point, the effect of σ_i on τ_i^* will be zero and the growth rate of the economy, γ, is maximized. As income inequality continues to increase to a point where $\sigma_i \geq \sigma_m$, there will be strong pressure, by the majority, for redistribution in the form of transfer payments funded by taxation on income. As such, there will be an increase in the tax rate, necessitated by the increase in σ_i. This leads to lower aggregate savings and investment, and ultimately low growth. These three channels explain why the relationship between inequality and growth turns out to assume an inverted-U shape estimated empirically and is shown in Figure 1.

There is a general consensus that inequality matters for growth and that the relationship has important policy implications. As such, countries with inequality levels below a Gini coefficient of 35.92 are more likely to experience a positive relationship between inequality and growth, above which the inequality-growth nexus turns negative. Understanding the channels through which this may occur is crucial for policy makers as they seek to strike a balance between the need to reduce inequality while at the same time promoting growth. This paper proffered an outline of the various channels through which income inequality affects growth in a political economy set up (majority rule) with income taxation and in which government spending is used for the provision of both production and consumption services. These channels can inform policy makers to better understand the inequality-growth relationship in their own economies.

6 Conclusion

This paper re-examines the theoretical and empirical relationship between income inequality and growth in an endogenous growth model with a flat tax on income, distributive conflicts among agents and median voter dynamics. It provides important insights for the ongoing debate relating to the impact of income inequality on economic growth. Our paper makes a crucial and interesting contribution to this theoretical literature by apportioning government spending to the provision of public goods in the form of both production and consumption services. When this is the case, the theoretical relationship between inequality and economic growth found to be neither positive nor negative but ambiguous. We empirically evaluate this finding by applying the semi-parametric and fixed-effect panel threshold models 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 1980 to 2010. The semi-parametric model estimation shows that on average, income inequality, as measured by the Gini coefficient, appear to impact positively on growth of per adult national income for Gini coefficients below 35.92, whereas a negative relation appears for income inequality higher than 35.92. This empirical finding provide cross country evidence and confirms the validity of our model.

Based on both the theoretical and empirical findings, we argue that the relationship between income inequality and growth is complicated. In a political economy set up with distributive conflicts, greater inequality implies higher taxation. But since a fixed share of tax revenues are spent on government-provided capital good, there is a trade-off between the distortion from taxation, which leads to less private capital accumulation; and the benefit, from additional accumulation of capital. The benefit of higher taxation on private income meant to finance the provision of a public capital good can outweigh the negative impact of taxation on private savings and investment. If this effect dominate, the result is that positive economic growth is realized. A point at which economic growth plateaus is when capital/income share is at the level of the median voter and the tax rate is at level chosen by the median voter. An increase in inequality beyond median voter income calls for redistribution through a tax on private income. This discourages investment and if this effect dominates, it leads to lower economic growth.

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A Appendix

Threshold Effects Tests and Fixed-Effect Panel Threshold Model Results

Panel A: Tests for Threshold Effects		
Test	F-Statistic	p-value
Test for Single Threshold	24.79	0.0220
Panel B: Fixed-Effect Panel Threshold Model Results		
Sample	Estimate (Gini Coef.)	95 percent Confidence Interval
55 I, UMI, LMI and LI) countries	42.6000	[42.4000, 42.7000]