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How does income inequality affects economic growth at different income levels?

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ABSTRACT

To address the slowdown in growth from an inequality perspective, this study applies a comprehensive dataset with strong comparability and a dynamic panel threshold model to explore the effect of income inequality on economic growth, its channels of influence, and differences in channels due to country differences, considering income level differences and country differences. The study finds that whilst inequality impedes growth in the general growth framework, this impediment becomes insignificant when the fertility rate or country differences are controlled for. Second, the impeding effect of inequality on growth occurs at low-income levels rather than at high-income levels. Finally, in the low-income stage, inequality tends to impede growth through channels that reduce the level of human capital and political stability and increase fertility, rather than through channels that affect investment, and the channels vary slightly by the country's economic systems, religious beliefs, and saving habits. This study suggests that at the low-income stage, the government should appropriately increase the proportion of labour compensation, improve the redistribution system, encourage the development of charity, and establish a sound social donation system.

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1. Introduction

Global economic growth has entered a period of significant slowdown. According to the World Economic Outlook, global economic growth has shown a gradual downward trend since 2017. Compared to the 3.8% growth in 2017, the growth in 2018 dropped by 1%, and in 2019, it dropped to 3.2%. Despite a strong rebound of 5.5% in 2020, the World Economic Outlook notes that subdued external demand in emerging markets and developing economies, the impact of inflation on monetary policy, a severe blow to low-income groups, and rising debt and income inequality could lead to a further slowdown in global economic growth in the future. There are many factors affecting the slowdown in growth; we focus on income inequality as 'the most

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visible challenge of our time'. According to the World Inequality Database (WIID), from the early 20th century to the 1980s, the degree of inequality in most of the world's economies experienced a Kuznets curve process from increasing to improving. However, in the 1980s, it broke the rules and deteriorated again. The share of income held by the top 1% of the global income level increased from 16% in 1981 to 19% in 2020. Although inequality is a product of rapid growth, it can also be used as an independent variable in further growth, and whether and how this variable affects growth is explored in this study. Therefore, this study aims to uncover the role of inequality in growth to examine and achieve growth from an inequality perspective. This is important because uncovering the relationship patterns between inequality and growth can not only help to avoid the negative impact of rising inequality on growth, and to develop more precise income distribution policies but also to contribute to the transition of middle-income countries to high-income countries, as inequality is one of the main manifestations of growth stagnation in some Latin American countries.

The topic of the inequality–growth relationship has been around for a long time, and both the conclusion that inequality promotes or impedes growth and that inequality has a weak relationship with growth focus on only two economic variables, inequality and growth. However, our research considers different income levels. Based on the empirical data for most economies, we find that the relationship between inequality and growth is complex. At low-income levels, inequality tends to boost economic growth by increasing physical capital investment. As income levels increase, human capital becomes more important than physical capital, and inequality tends to impede economic growth by affecting human capital accumulation. When credit markets continue to weaken, the impact of inequality on economic growth becomes negligible (Galor & Moav, 2004). This means that the effect of inequality on economic growth is not simply promoting or inhibiting, and the key to complicating the relationship seems to lie in changes in income levels because the dynamics of growth change as income levels rise.

Prior to this, we recognised that inequality appears to affect economic growth primarily by affecting investment, human capital accumulation, fertility rate, and sociopolitical stability (Madsen et al., 2018; Seo et al., 2020). We have become increasingly suspicious of the accuracy and completeness of these findings from full time samples and full characteristic country samples. Based on empirical data for most economies, we find that the relationship between inequality and growth may vary with income level, which leads us to believe that there may be sample differences in the channel of inequality's impact on growth caused by differences in income levels. In addition, we also pay attention to institutional and cultural differences between countries because some conclusions may differ between countries with different development characteristics. Therefore, instead of using a full sample, we believe that we should discuss the channel of the impact of inequality on growth after clarifying the relationship between inequality and growth.

To explore the pattern of the relationship between inequality and growth, this study first analyses the relationship between inequality and growth in a growth framework using a comparable dataset of 167 economies from 1950 to 2020, and

finds that there is no overall relationship between inequality and growth. Second, we find that this result may be generated by income level differences, so we build a dynamic panel threshold model to test the role of income level in the inequality–-growth relationship and find that inequality impedes growth when a country is at a low-income level and has almost no relationship with growth when it is in the high-income stage. This differential result leads us to doubt the findings of previous literature on the channels through which inequality affects growth since their conclusions are based on the analysis of the overall sample. Therefore, we further test the main channels through which inequality affects growth when a country is in the low-income stage, as well as the heterogeneity of the channels of impact due to differences in economic institutions, religious beliefs, and saving habits of the country.

The marginal contributions of this study are as follows. First, we conclude that there is no overall relationship between inequality and growth when multiple channel factors and country differences are considered, which can avoid the phenomenon of a country making incorrect decisions based on averages. We further find that the relationship between inequality and growth varies with income level, with inequality impeding growth in the low-income stage and having a negligible effect in the high-income stage. Second, we reject the channels through which inequality affects growth estimated by the previous literature using the full sample, because we find that the negative growth effect of inequality tends to occur more in the low-income level stage of a country. Therefore, we test the channels through which inequality affects growth when the country is at a low-income level to correct or complement existing studies. Third, we analyse the heterogeneity of the channels through which inequality affects growth in different types of countries at the same low-income level to explore the general pattern of inequality affecting growth in depth.

2. Literature review

2.1. Inequality and growth

The study of the relationship between inequality and growth can be divided into three stages: The first stage was when Kuznets (1955) pointed out that growth caused inequality to increase, and then improve. However, after some countries experienced growth stagnation, attention was paid to the negative impact of inequality on growth, as it is one of the main manifestations of growth stagnation in Latin American countries, and the second stage of research began to examine the role of inequality on growth. Alesina and Rodrik (1994), Clarke (1995), and Perotti (1996) apply multi-country cross-sectional data methods and find that inequality impedes growth. However, omitted variables in these methods may lead to biased estimation results. As the panel data approach has matured, scholars have reached different conclusions, which may be due to differences in study data and estimation methods. Some studies argue that inequality has a positive effect on growth. Based on theoretical and empirical studies, Li and Zou (1998), Forbes (2000), and Acemoglu et al. (2012) found that inequality promotes growth. Most recent studies that apply country panel data and GMM methods have found that inequality impedes growth. Berg et al., (2018) found that higher inequality appears to be associated with slower economic growth, after

excluding the effects of redistribution. Seo et al. (2020) used a cumulative growth model to confirm that rising inequality has a negative impact on growth. Anyanwu et al. (2021) applied a national panel dataset for 1988-2012 and a system GMM method, and found that inequality has a negative effect on growth. Gutiérrez-Romero (2021) used multi-country manufacturing panel data and found that inequality has a negative effect on growth.

The third stage came after Barro (2000) found that the relationship between inequality and growth was different for countries at different levels of development, and attention was drawn to the heterogeneity of the inequality–growth relationship. The focus of research at this stage shifted to analysing heterogeneity due to different factors by applying WIID data and split-sample regression or interaction term methods. Barro (2000) and Gründler and Scheuermeyer, (2015) analysed the differences in the relationship between inequality and growth in developed and developing countries. Barro (2000) concluded that the promoting effect of inequality on economic growth tends to occur in developed economies and the hindering effect tends to occur in developing countries. However, Gründler and Scheuermeyer, (2015) believe that inequality has no significant impact on growth in developed economies, whilst inequality tends to hinder growth in developing countries. Castelló-Climent (2010) and Brueckner and Lederman (2018) analysed the differences in the relationship between inequality and growth in low-income and high-income countries Castelló-Climent (2010) found that inequality promotes growth in high-income countries and impedes economic growth in low-income countries. Brueckner and Lederman (2018) conclude that inequality impedes growth in high-income countries and promotes growth in low-income countries. Shin (2012), Madsen et al. (2018), and Hailemariam and Dzhumashev (2020) analysed the differences in the relationship between inequality and growth at different stages of development. Shin (2012) applied a stochastic optimal growth model and found that greater inequality may impede growth in the early stages of economic development and encourage growth in near-steady states. Madsen et al. (2018) constructed 142 years of panel data for 21 OECD countries and found that inequality impedes growth at low to moderate levels of financial development but has little effect on growth at high levels of financial development. Hailemariam and Dzhumashev (2020) studied the relationship between income inequality and economic growth from 1965 to 2014 and found that moderate levels of inequality may have a positive effect on growth, whereas higher levels of inequality may have a negative effect on growth. In fact, the classification of countries' level of development, the classification of countries' income levels, and the classification of countries' stages of development give us the insight that the relationship between inequality and growth varies with income levels, but there is no uniform conclusion on the pattern of change.

2.2. Influence mechanism

Analysis of impact mechanisms is also the focus of the third stage of research on the relationship between inequality and growth. Gründler and Scheuermeyer, (2015) found that societies with high levels of inequality tend to have a smaller educated

population and higher fertility rates but not necessarily a lower share of investment. Berg et al. (2018) found that inequality appears to impede growth, primarily through its effects on education, life expectancy, and fertility rate. Madsen et al. (2018) found that inequality impedes growth through savings, investment, education, and idea production for most countries in the world or OECD countries until about 2000. Seo et al. (2020) concluded through a cumulative growth model that inequality has a negative effect on investment only, but no correlation is found between technological innovation and income inequality or between human capital accumulation and income inequality. Hailemariam and Dzhumashev (2020) stated that high levels of inequality can have a negative impact on investment and growth, which may be due to costly redistributive policies, rent-seeking behaviour, insecurity in property rights, and a tendency toward social unrest and conflict caused by inequality. The above studies show that inequality may affect growth, mainly through investment, human capital accumulation, fertility, and socio-political stability.

2.3. Research space

Although the relationship between inequality and growth has been studied for a long time, it still suffers from the following problems: First, the World Inequality Database (WIID) is the most widely used database; however, it contains a variety of inequality calculations from different survey agencies, which leaves a very limited range of data under each calculation method. We applied the standardised world inequality database (SWID) with strong comparability. Second, to estimate the heterogeneity of the inequality–growth relationship, previous studies have mainly used split-sample regression methods or estimation methods that introduce interaction terms in the model. However, the artificially set classification criteria in split-sample regression may have large deviations from the actual situation, and both methods that introduce interaction terms in the model and simple threshold regression methods have endogenous problems. We adopt a dynamic panel threshold regression method to overcome these two problems. Third, although the current research on the cross-country relationship between inequality and growth applies a validated research framework, it does not consider country heterogeneity. Hailemariam and Dzhumashev (2020) pointed out the importance of addressing country heterogeneity when testing the impact of inequality on economic growth using cross-country data, because of the large differences in political structures and economic policies across countries. Fourth, the channels through which inequality affects growth are not defined. The current research on the inequality impact channel is in the literature that concludes that inequality positively or negatively affects growth, and hardly in the differential studies. Since the relationship between inequality and growth is not clear, the study of the inequality impact channel is questionable.

Based on the background of previous literature, we find our research space, that is, to study the role and influence channels of inequality's impact on growth, taking into account the differences in income levels and national cultural and economic policies. Specifically, based on SWID's Gini coefficient and a common growth framework that takes into account country differences, this study estimates the relationship between

inequality and growth using a dynamic panel model, and the differences in the inequality–growth relationship by income level using a dynamic panel threshold model, further analysing the channels through which inequality affects growth according to explicit findings on the inequality–growth relationship, as well as the channel differences due to country differences.

3. Theoretical analysis

3.1. Economic growth theory

The theoretical support for this study comes from the production function, which is a common method in macroeconomics to study the sources of economic growth. The results show that the sources of growth are mainly physical capital accumulation, employment, human capital accumulation, innovation, and technological progress, which leads us to discover the mechanisms by which inequality affects growth. First, high inequality can affect capital accumulation by inhibiting investments. Second, inequality may hinder the accumulation of human capital by increasing the fertility rate of the poor and lowering their average level of education. Third, the increase in inequality may also affect innovation and technological progress because the relationship between education and innovation is something that needs to be considered. In addition, high inequality can lead to the redistribution of income and turmoil in the socio-political environment, affecting investment and hindering capital accumulation. In summary, we find that the possible channels through which inequality affects growth are investment, fertility, education level, redistributive policies, and socio-political order and proceed to analyse the mechanisms through which inequality affects growth from these perspectives. In addition, we supplement the analysis of income level and cross-country differences.

3.2. Mechanism analysis

3.2.1. Investment and savings

On the one hand, models of credit market imperfections suggest that investment is limited by income levels, with high-income earners free to allocate their investments and savings, whilst low-income earners tend to forego high-risk and high-return investment opportunities. Thus, rising inequality impedes economic growth by reducing the average amount of physical capital investment and human capital accumulation. On the other hand, high-income groups are a major part of society's wealth, and if they invest in it primarily, it will promote economic growth (Bourguignon, 1981). Offsetting forces may arise when the returns on investment are widespread over a range; for example, beyond secondary education, where the level of education may be useful, and if these types of set-up costs are compared to median income, then increases in inequality tend to increase overall investment (Barro, 2000).

3.2.2. Fertility rate and human Capital

In some countries, inequality tends to increase the fertility rate of the poor and reduce the fertility of the rich, because the reproductive choices of the poor are less

constrained by the cost of education, and having more children can bring more future possibilities, whilst the rich have higher investment costs in human capital and a heavier reproductive burden; in this case, the average level of human capital decreases (De La Croix & Doepke, 2003). Another possibility is that the poor and the rich think the same way about human capital investment, but the poor cannot afford the cost of education and choose to have fewer children. Middle-income families can only maintain the status quo and choose to have fewer children, and the rich have enough free money and enjoy family happiness; they will choose to have more children and provide higher human capital investment, thus increasing the average human capital level.

3.2.3. Fiscal policy

Two mechanisms exist in the endogenous fiscal policy approach (Perotti, 1996). When initial inequality reaches a certain level, it tends to promote redistribution from the rich to the poor, which may promote economic growth through increased opportunity effects (Aghion et al., 1999). However, redistribution resulting from high inequality may reduce the returns that can be transferred from investments. Instead of incentivising the poor, such unearned rewards may make them more slack. Increases in taxes may also reduce the incentives of the rich to work and affect labour productivity and investment (Alesina & Rodrik, 1994). Redistributive policies can also lead to corruption because the rich prevent redistribution to protect their interests (Meltzer & Richard, 1981), which can impede economic growth.

3.2.4. Socio-political unrest

On the one hand, high inequality may increase social crime rates and cause social unrest. The involvement of the poor in crime and unrest due to their own interests will not only reduce the labour production of crime participants and waste social resources but also threaten the interests of others and affect investment (Barro, 2000). On the other hand, high inequality may affect political stability and even lead to a change in government, increase economic uncertainty, affect savings and investment, and cause capital outflows and a decrease in foreign-to-inward investment (Alesina & Perotti, 1996). In addition, to prevent unrest, the government may implement redistributive policies to stabilise society in advance, which is beneficial for growth.

3.2.5. Income level differences

Galor and Moav (2004) explained the dynamic impact of inequality in the development process based on unified growth theory, which shows that the impact of inequality on growth is not the same under different stages of development. In the early stages of industrialisation, when the main source of economic growth was physical capital accumulation, inequality promoted growth by directing resources to capital owners with a higher marginal propensity to save. However, as the economy develops, human capital increasingly becomes the main source of economic growth. In the presence of credit constraints, inequality impedes growth by reducing investment in human capital. As income increases further and credit constraints weaken, the effect of inequality on growth becomes negligible.

3.2.6. Country differences

Differences in political systems, economic systems, resources, and cultural differences across countries are also factors that must be considered because the theories discussed above are all relevant to political and economic decision-making. First, compared to one-party countries, multiparty countries have their own mechanisms for regulating income distribution through party negotiation or party rotation (Chang, 1998). However, there are fewer one-party states and we ignore this difference. Second, the degree of government regulation of markets is an important factor that influences investment and decision-making. Economic freedom may promote economic growth and equity with an appropriate but relatively small trade-off between growth and income inequality (Scully, 2002). Third, religious differences may affect firms' investment decisions (Hilary & Hui, 2009) and may also affect households' economic decisions through individual savings rates, and there are significant differences between Christians and non-Christians regarding savings decisions (Klaubert, 2010). This implies that findings may differ between Christian and non-Christian countries. Fourth, since religiosity influences household economic decisions through savings rates, we also hypothesised that differences in savings rates would also produce differences in the study results. In fact, the Chinese have a strong culture of saving, whereas Western countries are better at consumption and investment.

Based on the theoretical analysis, the following conclusions were drawn. First, inequality affects growth, mainly through physical capital investment, human capital accumulation, fertility, and social unrest. Second, the impact of inequality on growth is likely to vary with the income level. Third, country heterogeneity should be considered when studying the overall relationship between inequality and growth.

4. Empirical model and data

4.1. Model construction

From the long-term perspective of growth theory, the need to smooth short-term fluctuations, and the constraints of data availability, we take five years as a unit of growth and take the 5-year average of all other variables. We draw on the model structure applied by Gründler and Scheuermeyer (2015) as:

$$y_{it}-y_{it-1} = \alpha y_{it-1} + \beta h_{it} + \lambda \phi_{it} + \theta X_{it} + \eta_i + \zeta_t + \upsilon_{it} \quad (1)$$

where the term $(y_{it}-y_{it-1})$ represents the per capita GDP growth in five years, h_t represents the level of human capital per capita, ϕ_t represents income inequality, and X_t represents other control variables. η_i represents the country individual effect, ζ_t represents the time effect, υ_{it} is an idiosyncratic error term, i represents a country individual, and t represents time.

4.2. Estimation of benchmark model

If the standard panel model estimation method is used to estimate the model in Equation (1), the lag term may result in inconsistent estimation results (Bond et al.,

2001). If the first-order difference method is used for model estimation, the result will be biased because of the loss of a large amount of cross-sectional information. Therefore, we rewrite Equation (1) as

$$y_{it} = (\alpha + 1)y_{it-1} + \beta h_{it} + \lambda\phi_{it} + \theta X_{it} + \eta_i + \zeta_t + \upsilon_{it} \tag{2}$$

The generalised moment estimation method can be applied to estimate Equation (2). Commonly used generalised moment estimation methods include difference GMM and system GMM, in which difference GMM can solve the problem of lagging variables, as well as unobserved heterogeneity and endogeneity, but it may not be suitable for our paper requirements, because the difference GMM will lose cross-sectional information, and the difference in inequality is often mainly manifested among countries.

Because the system GMM is not only applicable to the case of a large number of individuals and a small amount of time but also considers the difference and level equations and uses appropriate lagged differences as an instrument, it can avoid the bias of the difference GMM. System GMM can be divided into one-step and two-step GMM, with the difference being whether a weight matrix independent of the estimated parameters is used. Because the two-step system GMM weighs the moment conditions by the consistent estimation of their covariance matrices, we apply the two-step system GMM. However, it has strict restrictions; that is, only when the requirements indicated in Blundell and Bond (1998, p. 124) are met, the additional moment conditions for the GMM regression of each system are valid. Therefore, we first conducted difference-in-Hansen tests to check for violations of these requirements.

4.3. Estimation of dynamic panel threshold model

This study uses the initial per capita income level as the threshold variable and the income inequality variable as the regime-dependent variable to build a dynamic panel threshold model. Rewrite Equation (2) into the following threshold form:

$$y_{it} = (\alpha + 1)y_{it-1} + \beta h_{it} + \lambda_1\phi_{it}1(y_{it-1} \le \gamma) + \lambda_2\phi_{it}1(y_{it-1}>\gamma) + \theta X_{it} + \eta_i + \zeta_t + \varepsilon_{it} \tag{3}$$

Among them, y_{t-1} is the threshold variable, γ is the threshold to be estimated, ϕ_t is the regime-dependent variable, ε_{it} independent and identically distributed, and not related to ϕ_{it}. $1(\cdot)$ is an indicative function, specifically

$$\begin{aligned} 1(y_{it-1} \le \gamma) &= \begin{cases} 1 & if\ y_{it-1} \le \gamma \\ 0 & if\ y_{it-1}>\gamma, \end{cases} \\ 1(y_{it-1}>\gamma) &= \begin{cases} 1 & if\ y_{it-1}>\gamma \\ 0 & if\ y_{it-1} \le \gamma. \end{cases} \end{aligned} \tag{4}$$

We assume that the threshold γ is unknown and its value should not exceed the value range of y_{t-1}, so $\gamma \in \{y_{it-1} : \quad i = 1, 2, 3, \cdots, N,\ t = 1, 2, 3, \cdots, T\}$. The estimation strategy is to select $\hat{\gamma}$, which minimises the estimated value of the coefficient

of the residual sum of squares. In addition, we used the LR statistic calculated using the bootstrap method to perform the threshold effect and threshold tests.

Our estimation strategy follows the theory of Kremer et al. (2013), which applies the forward orthogonal deviations transformation proposed by Arellano and Bover (1995) to combines Caner and Hansen (2004) instrumental variable estimation of the cross-sectional threshold model with Hansen's (1999) panel threshold model to construct an estimation method for dynamic panel threshold models to address the endogenous problems of the main variables, and the threshold γ of this estimation method is also endogenously determined.

4.4. Variable selection and description

4.4.1. Variable selection

We selected the growth framework proposed by Barro (2000, 2003) because Gründler and Scheuermeyer (2015) pointed out that it has been proven to explain empirical growth patterns quite accurately in a number of studies.

In our model, output per capita was measured by real GDP per capita at the 2017-dollar level, denoted by log(GDPpc), and income inequality was measured by the Gini coefficient of income (GINI). Following Barro's (2003) hypothesis that y_{it-1} and h_t are used to represent the stock of capital, we use y_{it-1} to represent physical capital, which is measured by the initial real GDP per capita. Let h_t represent human capital, including average years of education (EDU) and life expectancy, denoted by log(LIFEEX). In addition, our variables also include the investment share to measure physical capital investment (INVS), government expenditures to measure the size of the government (GOVC), the proportion of total imports and exports to GDP that measures the degree of openness (OPEN), political rights to measure political stability and legal index (POLRIGHT), and inflation rate (INFL), which measures economic uncertainty. These variables were derived from Barro's (2003) growth framework. We also consider total fertility rate (FERT), economic freedom (ECFR) differences, religious differences, and savings differences in the model.

4.4.2. Data description

The World Inequality Database (WIID) provided by the Luxembourg Income Study (LIS) is the most widely used and contains all available Gini coefficient data for most countries in the world from 1867 to 2020, but these Gini coefficient data come from different survey agencies and different calculation methods, which makes the data incomparable. If WIID is collected according to the same survey agency and calculation method, which enhances cross-country comparability, the amount of data is significantly reduced. Therefore, we considered the standardised world inequality database provided by Solt (2009, 2016), which uses a large amount of source data from survey institutions and is standardised to enhance the comparability and coverage of the data. All other data were obtained from PWT 10.0, World Bank, Freedom House (2018), EFW database, and Barro and Lee (2013). As a result, we obtained all data for 167 economies from 1950 to 2020. Specific data are presented in Table 1.

Table 1. Descriptive statistics of data.

Variable	Obs	Mean	Std. Dev.	Min	Max
Log(GDP pc)	1927	8.703	1.172	5.605	11.861
GROWTH	1927	0.077	0.207	−3.052	1.019
GINI	1177	0.384	0.088	0.178	0.672
INVS	1947	0.214	0.112	0.014	1.457
EDU	1876	5.34	3.258	0.0319	13.086
log (LIFEEX)	1958	4.145	0.196	3.047	4.438
GOVC	1947	0.189	0.097	0.007	0.929
OPEN	1947	−0.059	0.224	−6.529	0.800
INFL	1627	34.886	262.645	−6.628	6945.242
POLRIGHT	1520	3.666	1.855	1.000	7.000
FERT	1962	3.951	2.024	00.891	8.811
ECFR	1671	5.885	1.339	2.430	9.060

Source: self-created.

5. Regression results

First, we use a two-step system GMM method to analyse the impact of income inequality on economic growth. Second, we use dynamic panel threshold regressions to test how the impact of inequality on growth varies with the income level. Third, we explore the channels through which inequality affects growth and the differences in channels due to country differences to delve deeper into the regular features of inequality.

5.1. Benchmark regression results

The estimation results of the six models, from simple to complex, are provided in Table 2, which shows that there is no overall relationship between inequality and growth. Model 1 is a simple growth model framework. We consider the lagging level of per capita GDP in this model, as well as the time fixed effects. Although this model has the problem of missing variables, it provides us with an overall growth effect of income inequality. The estimation results of Model 1 show that the increase in inequality impedes growth under the condition of controlling for the time fixed effect (at a significance level of 10%), and when inequality increases by one unit, the growth rate drops by 1.419 percentage points. We introduce the investment share, average years of schooling, and life expectancy variables representing capital levels in Model 2 based on the empirical growth model, at which point the effect of income inequality on growth is reduced by about half, possibly because the newly introduced variables are part of the transmission process of inequality to growth. In addition, investment share and life expectancy significantly contribute to growth, whilst the contribution of average years of schooling is insignificant. We again introduce government consumption expenditure, openness, inflation rate, and political power variables from the growth framework in Model 3. The estimation results show that inequality has a negative impact on growth, with growth rates falling by 0.687 percentage points when inequality increases by one unit. In addition, investment, life expectancy, and openness have shown a significant boost in growth, whilst government spending and inflation have shown an impeding effect.

The estimation of Model 4 with the introduction of fertility shows that the effect of income inequality on growth is reduced and no longer significant, as in Barro

Table 2. Benchmark regression results.

Log(GDP pc)	(1)	(2)	(3)	(4)	(5)	(6)
L.Log(GDP pc)	0.960***	0.896***	0.892***	0.905*	0.867***	0.885*
	(0.033)	(0.045)	(0.038)	(0.520)	(0.033)	(0.515)
GINI	−1.419*	−0.529*	−0.687***	−0.417	−0.280	−0.053
	(0.753)	(0.320)	(0.261)	(4.704)	(0.292)	(1.826)
INVS		1.400***	1.164***	0.994	0.583**	0.444
		(0.204)	(0.227)	(0.756)	(0.237)	(0.459)
EDU		0.005	0.003	0.003	0.008	0.004
		(0.012)	(0.011)	(0.087)	(0.012)	(0.068)
log (LIFEEX)		0.378**	0.455***	0.428	0.265	0.265
		(0.151)	(0.161)	(2.313)	(0.221)	(0.567)
GOVC			−1.329***	−1.249	−0.684**	−0.628
			(0.320)	(3.663)	(0.304)	(1.622)
OPEN			0.356**	0.370	0.486***	0.474***
			(0.152)	(0.585)	(0.134)	(0.145)
INFL			−0.0001***	−0.0002*	−0.0001	0.0001
			(0.00003)	(0.0001)	(0.0001)	(0.0001)
POLRIGHT			0.018	0.020	0.025**	0.029
			(0.012)	(0.174)	(0.012)	(0.196)
FERT				−0.022		−0.023
				(0.221)		(0.057)
ECFR					0.126***	0.108
					(0.022)	(0.150)
Constant	−0.004	−0.664	−0.603	−0.634	−0.568	−0.555
	(0.117)	(0.794)	(0.714)	(16.963)	(1.043)	(8.511)
Observations	1128	976	874	874	796	796
Countries	165	132	129	129	124	124
Hansen p-val	0.115	0.981	0.984	0.991	0.999	1.000
Diff-Hansen	0.893	1.000	1.000	1.000	1.000	1.000
AR(1) p-val	0.0001	0.000	0.000	0.000	0.000	0.000
AR(2) p-val	0.0592	0.100	0.2450	0.2316	0.1965	0.1755
Instruments	77	136	141	161	143	163

Note: This table provides two-step system GMM estimation results. All models were controlled for time fixed effects. The instrumental variable is the second lag value of the level explanatory variable of the difference equation, and the first lag value of the difference in the level equation.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.
Source: self-created.

(2000), De La Croix and Doepke (2003), and Gründler and Scheuermeyer, (2015), possibly because of the introduction of fertility, which eliminates another transmission channel from inequality to growth. We further consider economic system differences[1], religious differences,[2] and savings differences[3] in Models 5 and 6, and the estimation results show that the effect of income inequality on economic growth is further reduced and no longer significant when controlling for differences between countries. Models 4, 5, and 6 show that there is no uniform pattern between inequality and growth.

5.2. Robustness test

Although the two-step system GMM estimation provides the best estimation of our model, we also provide the one-step system GMM and difference GMM estimation results to test the robustness of the benchmark estimation results.

The left half of Table 3 shows the partial estimation results of the one-step system GMM, of which six correspond to the models in Table 2. Although the estimated results differ slightly, they still illustrate the impeding effect of income inequality on

Table 3. The estimation results of one-step system GMM and difference GMM.

	One-step system GMM			Difference GMM		
Log(GDP pc)	(3)	(4)	(6)	(3)	(4)	(6)
L.Log(GDP pc)	0.901***	0.902***	0.876***	0.500***	0.617***	0.609***
	(0.038)	(0.035)	(0.029)	(0.092)	(0.076)	(0.071)
GINI	−0.645**	−0.437*	−0.081	−0.507	−0.419	−1.028
	(0.267)	(0.244)	(0.281)	(0.635)	(0.726)	(0.64)
FERT		−0.017	−0.020		0.040	0.046
		(0.026)	(0.024)		(0.033)	(0.028)
ECFR			0.117***			0.104***
			(0.021)			(0.027)
Constant	−0.587	−0.637	−0.903	1.349	−0.580	0.299
	(0.668)	(0.748)	(0.929)	(1.691)	(1.815)	(1.510)
Observations	880	880	796	745	745	796
Countries	129	129	124	128	128	124
Hansen p-val	0.811	0.998	0.998	0.292	0.526	0.839
Diff-Hansen	1.000	1.000	1.000			
AR(1) p-val	0.0000	0.000	0.000	0.0280	0.0013	0.000
AR(2) p-val	0.2408	0.2171	0.1875	0.5286	0.4725	0.1875
Instruments	141	161	144	81	91	93

Note: Same as Table 2. In addition, we did estimates for the six models, but listed only the important ones. The control variables are the same as those in Table 2, but are not listed.
Source: self-created.

growth. With the introduction of control variables, the growth effect of income inequality gradually weakens, and the introduction of fertility still makes the estimated coefficient no longer significant, as does the introduction of cross-country differences. The right half of Table 3 shows the partial estimated results of the difference GMM, which still supports the impeding effect of income inequality on growth; however, the results are not significant. When we control for other variables, the growth effect of inequality gradually strengthens and the introduction of fertility weakens the growth effect of inequality. The only inconsistency is that the introduction of cross-country differences greatly enhances the effect of uneven growth.

5.3. Income level differences

Table 4 shows the estimation results of the dynamic panel threshold model with income level as the threshold variable, which confirms that the relationship between inequality and economic growth varies with income level. The impeding effect of inequality on growth is significant when an economy's GDP per capita is below 5,263.442 USD (2017 price level), and the impeding effect of inequality decreases and is insignificant when an economy's GDP per capita is higher than 5,263.442 USD. The introduction of the fertility variable reduces the significance of the growth-dampening effect of inequality in both the stages. The threshold of 5,263.442 USD is slightly higher than the World Bank's national income classification criteria for upper-middle-income countries and approximates the cut-off between low- and high-income countries, which strengthens the credibility of our threshold.

Our findings are distinct from Shin's (2012) finding that inequality impedes growth in the early stages of development and encourages growth in the near-steady state, and Brueckner and Lederman (2018) finding that inequality promotes growth in poor countries and impedes growth in rich countries, similar to Gründler and

Table 4. Dynamic panel threshold model estimation results.

Log(GDP pc)	(3)	(4)
Threshold	5263.442	5263.442
Inequality (below the threshold)	−2.062***	−1.485**
	(0.746)	(0.637)
Inequality (above the threshold)	−0.987	−0.048
	(0.743)	(0.639)
L.Log(GDP pc)	0.623***	0.554***
	(0.027)	0.029
GINI	0.012	0.322**
	(0.128)	(0.146)
INVS	−0.040***	0.008
	(0.017)	(0.018)
EDU	1.753***	2.101***
	(0.339)	(0.285)
log (LIFEEX)	−2.653***	−2.495***
	(0.115)	(0.132)
GOVC	−0.690***	−0.185
	(0.164)	(0.151)
OPEN	−0.0007**	−0.0007***
	(0.0002)	(0.0002)
INFL	−0.048***	−0.039**
	(0.016)	(0.015)
POLRIGHT		0.120***
		(0.027)
Constant	−2.484*	−4.449***
	(1.288)	(1.092)
Number of obs	874	874
Number of groups	129	129
Wald chi2	4176.48	6269.83
p-Value	0.000	0.000
instruments	73	79

Note: This table provides the estimated results for the panel threshold model. The models with insignificant estimation results are not shown here. All the models use robust standard errors.
$^{*}p < 0.1$. $^{**}p < 0.05$. $^{***}p < 0.01$.
Source: self-created.

Scheuermeyer, (2015). Their conclusions are obtained using the World Bank income grouping approach and the introduction of interaction terms in the empirical model with thresholds of $12,746 and $8,000 (2005 price level, PWT 8.0), which differs from our thresholds. The reasons for these differences may lie in differences in study data and differences in the study method, with our advantage of better comparability of data and a study method that reduces endogeneity problems.

5.4. Influence channel

Based on the estimation results of the dynamic panel threshold model, this study further analyses the main channels through which inequality affects economic growth when a country has a low level of income (GDP per capita less than 5,263.442 USD), as well as the differences in channels due to country differences.

5.4.1. Influence channels

Drawing on Berg et al. (2018) approach, we first analyse the effect of inequality on candidate channel variables and then present the effect of inequality on growth through channel variables. Table 5 shows the results of estimating the effect of

Table 5. Results of estimating the impact channel of inequality in low-income countries.

	INVS	EDU	POLRIGHT	FERT
GINI	0.093	−3.139***	−6.739*	8.248**
	(0.202)	(1.101)	(3.942)	(3.275)
Log(GDP pc)	0.066	2.742***	−0.450	−1.866***
	(0.025)	(0.136)	(0.322)	(0.374)
Constant	−0.378*	−15.765***	10.581***	15.755***
	(0.204)	(1.259)	(2.749)	(3.518)
Observations	419	343	385	417
Countries	88	70	84	87
Hansen p-val	0.247	0.523	0.203	0.341
AR(1) p-val	0.000	0.000	0.507	0.000
AR(2) p-val	0.971	0.814	0.781	0.707
Instruments	67	67	39	46

Note: Same as Table 2. In addition, the AR(1) tests in the Table are all larger than expected, a phenomenon that also appears in Berg et al. (2018) estimation results on political stability, which is explained by the fact that some of the estimated channels may have little time-series variation, or the model does not include lagged dependent variables.
Source: self-created.

inequality on the four candidate channels, indicating that at low levels of income in a country, inequality has a significant negative effect on human capital accumulation and socio-political stability, a significant positive effect on total fertility, and no significant effect on investment. Since lower levels of human capital, unstable politics, and high total fertility have a negative effect on growth (Temple, 1999; Bashir & Xu, 2014; Ashraf et al., 2013), we consider human capital accumulation, political stability, and fertility to be the main transmission channels of inequality.

These findings are similar to those of Gründler and Scheuermeyer, (2015) and Berg et al. (2018), in which the unsatisfactory investment channel contradicts the findings of Madsen et al. (2018), Seo et al. (2020), and Berg et al. (2018). Although we provide a comparison with the findings of recent related literature, their conclusions come from the estimation of the overall sample, whilst our conclusions are dependent on the precondition that the country is at the low-income level stage.

5.4.2. Country differences

Table 6 shows the differences in the channels of unequal human capital accumulation in different types of low-income countries. First, inequality in countries with low ECFR can significantly reduce human capital levels but not in countries with high degrees of ECFR. Second, inequality can significantly reduce the level of human capital in both countries by saving habits and without saving habits, but even more so in countries with saving rate habits. Finally, inequality reduces the level of human capital in Christian countries, whilst inequality in other countries tends to increase the level of human capital.

Table 7 shows the differences between the different types of countries in the channels of political stability of inequality in the low-income stage. First, inequality in countries with low ECFR has little effect on political stability, whilst inequality in countries with high ECFR significantly reduces political stability. Second, countries without a saving habit are more likely to highlight the negative effect of inequality on political stability than are countries with a saving habit. Finally, inequality in Christian countries can significantly and negatively affect political stability.

Table 6. Differences in impact channels due to country differences (Education).

	Economic freedom		Savings share		Religious beliefs	
EDU	Low	High	Low	High	Christianity	no
GINI	−15.183*	3.511	−1.582	−8.798***	−23.319*	5.147*
	(7.764)	(8.335)	(1.784)	(1.249)	(13.256)	(2.992)
Log(GDP pc)	3.525***	4.822***	3.433***	1.219***	3.047***	2.265***
	(0.865)	(1.001)	(0.207)	(0.106)	(0.681)	(0.549)
Constant	−16.821**	−34.610***	−21.742***	−1.590	−9.808	−15.007***
	(7.903)	(8.536)	(1.531)	(1.056)	(7.749)	(4.375)
OBS	168	157	222	417	229	114
Countries	55	49	55	87	47	23
Hansen p	0.386	0.635	0.203	0.341	0.654	1.000
AR(1) p-val	0.003	0.042	0.000	0.000	0.022	0.024
AR(2) p-val	0.147	0.359	0.632	0.707	0.498	0.122
Instruments	42	40	44	46	44	63

Note: Same as Table 2. In addition, high or low ECFR is defined by the mean value; since inequality does not affect growth through investment in the low-income stage, we do not consider this investment in our analysis of heterogeneity.
Source: self-created.

Table 7. Differences in impact channels due to country differences (political stability).

	Economic freedom		Savings share		Religious beliefs	
POLRIGHT	Low	High	Low	High	Christianity	no
GINI	−1.308	−9.958**	−5.063***	−0.195	−7.683*	−2.982
	(6.143)	(4.758)	(1.609)	(6.084)	(4.532)	(5.065)
Log(GDP pc)	0.698	−0.468*	0.365**	−0.493	−0.118	−0.244
	(0.574)	(0.268)	(0.169)	(0.371)	(0.270)	(0.439)
Constant	−0.115	12.051***	3.458**	8.401*	8.543**	7.103*
	(3.939)	(2.954)	(1.455)	(4.637)	(3.323)	(4.091)
OBS	96	289	236	149	267	118
Countries	37	82	64	48	60	24
Hansen p	0.820	0.485	0.583	0.261	0.922	1.000
AR(1) p-val	0.327	0.724	0.899	0.334	0.471	0.056
AR(2) p-val	0.458	0.553	0.263	0.116	0.799	0.298
Instruments	42	57	39	39	75	57

Note: Same as Table 6.
Source: self-created.

Table 8 shows the differences in the fertility channel of inequality in the low-income stage across different types of countries. First, inequality increases fertility in countries with high levels of ECFR but not in countries with low levels of ECFR. Second, inequality in high-saving-rate countries is more likely to affect growth through higher fertility channels than that in low-saving-rate countries. Finally, there is no difference in the fertility channels between Christian and non-Christian countries, and both can significantly increase fertility.

In summary, we find that in the low-income stage, countries with low ECFR impede growth mainly by lowering the level of human capital, whilst countries with high ECFR impede growth mainly by lowering political stability and raising fertility. Countries without saving habits hinder growth by primarily lowering political stability, whilst countries with saving habits hinder growth by primarily lowering the level of human capital and raising fertility. Countries with Christian faith hinder growth by primarily reducing the level of human capital and political stability and by increasing fertility, whilst other countries prefer to hinder growth by reducing the level of human capital and increasing fertility channels.

Table 8. Differences in impact channels due to country differences (fertility rate).

	Economic freedom		Savings share		Religious beliefs	
FERT	Low	High	Low	High	Christianity	no
GINI	6.764	12.482***	9.844	10.950**	14.088***	7.798*
	(6.698)	(3.636)	(5.513)	(4.705)	(4.968)	(4.374)
Log(GDP pc)	−0.774	−2.001***	−2.019***	1.520***	−1.540***	−2.363
	(0.475)	(0.331)	(0.586)	(0.381)	(0.416)	(0.231)
Constant	8.571**	14.891***	16.306***	11.870***	10.996***	19.008***
	(4.001)	(3.138)	(5.156)	(3.225)	(4.142)	(2.260)
OBS	101	316	258	159	294	123
Countries	38	86	68	49	62	25
Hansen p	0.829	0.173	0.308	0.530	0.289	0.990
AR(1) p-val	0.006	0.004	0.004	0.021	0.000	0.025
AR(2) p-val	0.124	0.301	0.882	0.607	0.932	0.623
Instruments	46	44	44	44	44	43

Note: Same as Table 6.
Source: self-created.

6. Conclusion

This study applies a comprehensive dataset with strong comparability and a dynamic panel threshold model to explore the effect of income inequality on economic growth, its impact channels, and the channel differences due to country differences, considering income level differences and country differences.

Several important conclusions were drawn from this study. First, we find a negative effect of inequality on growth in the growth framework, but the negative effect of inequality on growth becomes less significant when fertility rate and country differences are introduced, implying that there is no overall relationship between inequality and growth. The theoretical analysis and previous literature give us an important idea that income level may be an important factor affecting the absence of an overall relationship between inequality and growth. Therefore, we test the heterogeneity due to income level by applying a dynamic panel threshold model and find that inequality has a significant negative effect of inequality on growth when income level is low, but the negative effect of inequality is not significant when income levels are high. This heterogeneous result leads us to doubt the findings of previous literature on the channels through which inequality affects growth since their conclusions are derived based on the overall sample. We further examine several main channels through which inequality affects growth when a country is in the low-income stage. It is found that inequality tends to hinder growth at the low-income stage by reducing the level of human capital and political stability and by increasing the fertility channel, whilst investment is not an effective channel of influence. Finally, we note that countries that are also in low-income countries but belong to different types of countries may exhibit different channels of impact and test for channel heterogeneity due to ECFR, saving habits, and religiosity and find that in the low-income stage, countries with low ECFR tend to impede growth through the channel of lower human capital levels, whilst countries with high ECFR tend to impede growth through the channel of lower political stability and higher fertility. Countries without saving habits tend to impede growth through the channel of lower political stability, whilst countries with saving habits tend to impede growth through the channel of lower levels of human capital

and higher fertility. Christian countries tend to hinder growth by reducing the level of human capital and political stability, and by increasing fertility, whilst other countries prefer to hinder growth by reducing the level of human capital and by increasing fertility channels.

The conclusions of this study have several theoretical and practical implications. On the theoretical side, we first clarify that there is no overall relationship between inequality and growth. Second, we find that inequality tends to impede growth in the low-income stage and has a negligible effect in the high-income stage. Again, we reject the channels through which inequality affects growth estimated in the literature using the full sample and argue that inequality affects growth through different channels in countries with different characteristics. On the practical side, our findings suggest that governments should deal with the relationship between inequality and growth according to their own characteristics and level of development and avoid making wrong decisions based on averages.

Several effective suggestions have been made by the government. Although we believe that there is no overall relationship between inequality and growth, there is a certain pattern in the relationship between inequality and growth when we are specific to a certain income stage. Therefore, we suggest a differentiated view of the relationship between inequality and growth. When a country has a low-income level, in terms of initial distribution, the government should increase the proportion of labour compensation, strengthen legislation on wage protection, and implement a minimum wage system. Laws can be enacted to uphold the right to be paid for overtime work, recognise the right of workers to bargain collectively for wages, and intervene directly in wages by wage controls for as long as necessary. In terms of the secondary distribution, the government should establish a comprehensive set of tax policies. In addition to the main personal income tax, redistribution can be implemented through the introduction of property and inheritance taxes on the holding and inheritance aspects of property and the introduction of digital service tax to redistribute the dividends of the digital economy era. Second, transfer payments for low-income groups can be increased and certain social security can be provided to low-income groups, including medical services, disability insurance, housing subsidies, unemployment assistance, and social security benefits. In terms of third distribution, the government should encourage the development of charity and establish a sound social donation system. In addition, the government should strengthen investment in education and implement education subsidy policies, such as education–mortgage-free loans. When a country is at a high-income level, the role of income inequality in impeding growth diminishes, and the government can maintain growth by encouraging investment.

This study has several limitations and future research directions. Although we have made many efforts to select the data source of the Gini coefficient, the accuracy and comparability of the Gini coefficient are still difficult to overcome in the future. Second, the dynamic panel threshold model can only obtain a threshold value, which limits our research. Finally, future research will exclude the effects of redistribution and further explore the internal mechanism of the relationship between inequality and growth.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. Economic system differences are measured by the degree of economic freedom.
2. Religious differences refer to Christian versus non-Christian countries.
3. Countries with or without a savings culture are defined by the mean.

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