International Review of Economics and Finance 92 (2024) 1172–1190

Contents lists available at ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

Stock market and inequality distributions – Evidence from the BRICS and G7 countries☆

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ARTICLE INFO

Keywords:
Mixed data sampling
Income inequality
Wealth inequality
Stock market
Autoregressive distributed lag
BRICS
G7

ABSTRACT

By examining the effects of three stock market indicators (market accessibility, efficiency, and stability) on income and wealth inequality in the BRICS and G7 countries, this study enriches lacking literature on income and wealth inequality, particularly for the BRICS countries. We apply the Autoregressive Distributed Lag–Mixed Data Sampling (ADL-MIDAS) model. We find that only enhancements in market stability reduce income inequality in the BRICS and G7 countries. Additionally, we find that while expansions of market accessibility contribute to narrowing wealth inequality, improvements in market stability widen the wealth disparity in the BRICS countries. Limited effects of the stock market indicators on wealth distribution are observed in the G7 countries.

1. Introduction

Using a mixed-frequency data approach, this paper aims to examine the effects of stock market developments on income and wealth inequality across the BRICS and G7 countries from 2004 to 2021. Income and wealth inequality distribution have become significant issues in modern societies due to their role in maintaining sustainable economic growth and prosperity.[1] Indeed, failures in equality distribution control lead to collapsing social cohesion (Wilkinson & Pickett, 2009). Furthermore, from an economic perspective, it adversely affects consumption demands (Castells-Quintana & Royuela, 2012), which directly impacts economic growth. Although there are positive improvements, income inequality distribution is still at alarming levels globally (OECD, 2016). Simultaneously, wealth disparity gaps are wider.[2] Moreover, literature has documented that income distribution tends to vary over time (Johansson & Wang, 2014) and across countries and regions (see, for example, Davies et al., 2017; Johansson & Wang, 2014), which suggests the country heterogeneity issues. Therefore, studying income and wealth inequality is as important as ever for policymakers to maintain the economy's and society's sustainable development.

In fact, numerous studies have been carried out to study the influences of various factors on income and wealth inequality

JEF classification: D31, D63; E21, G10.

☆ The authors are sincerely grateful for the constructive and valuable feedback from the editor Prof. Brian Lucey and the two anonymous reviewers in helping us to greatly improve quality of the manuscript.

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[1] According to OECD (2014), inequality distribution control is important in fostering sustainable and substantial economic growth.

[2] For instance, the top 1% population in the US account for almost 40% of national wealth, whereas the top 1% in France represents approximately 20% of national wealth (Zucman, 2019).

https://doi.org/10.1016/j.iref.2024.02.067
Received 2 August 2023; Received in revised form 17 February 2024; Accepted 21 February 2024
Available online 23 February 2024

distribution. For instance, the effects of monetary policies, (see, for example, Ghossoub & Reed, 2017; Devereux et al., 2019; Albert et al., 2020), economic complexity and policy (see, for example, Artuc et al., 2019; Chu & Hoang, 2020). In addition, due to the importance of finance in reducing income inequality (Clarke et al., 2006), linkages between finance and inequality have attracted further research attention. For instance, between finance and income inequality (see, for example, Greenwood & Jovanovic, 1990; Kanbur, 2000; Mookherjee & Ray, 2002; Iradian, 2005; Clarke et al., 2006) and wealth inequality (see, for example, Alvaredo et al., 2013; Davies et al., 2017; Piketty & Zucman, 2014). However, the empirical evidence of the linkages between finance and income inequality is not only ambiguous (see, for example, Beck et al., 2007; De Haan & Sturm, 2017), but they are also lacking empirical evidence regarding financial development's effects on wealth inequality due to either data limitation (Hasan et al., 2020) or complexity (Zucman, 2019). As a result, the literature on the study of finance-wealth inequality nexus is rather limited, especially in the emerging countries.

Given the significance of finance in equalising income and wealth distribution, our theoretical framework is built upon the inequality narrowing hypothesis, which can be regarded as the studies of Becker and Tomes (1979) and Galor and Zeira (1993). In essence, the inequality narrowing hypothesis posits that cross-dynasty discrepancies in income, wealth distributions and returns to investments are the results of the imperfect characteristics of the stock market, namely information and transaction costs. As a result, it could perpetuate the inequality in accessing capital accumulation due to starting point disparities. Indeed, in certain circumstances, the affluent household is more likely to access profitable investments due to minimum investment requirements (Banerjee & Newman, 1993). Consequently, wealth divergence between affluent and lower-income children may remain unchanged or even wider (Corak, 2016). However, according to Baiardi and Morana (2018), this could be alleviated by relaxing credit constraints and encouraging financial developments via investments. Therefore, it is worthy to study the linkages between stock markets and inequality (income and wealth).

Additionally, at least two additional factors motivate us to conduct this study. First, the previous scholars primarily consider the effects of financial institution's efficiency (see, for example, Altunbaş & Thornton, 2019; Christopoulos & McAdam, 2017; Hasan et al., 2020; Johansson & Wang, 2014; Zhang & Ben Naceur, 2019). However, in the current context, in which the stock market's influences are increasingly evident[3] and in a particular country such as the US, stock market fluctuations drive income inequality levels (Hungerford, 2013). Expanding deeper inquiry from financial developments to stock market development is essential. Following Zhang and Ben Naceur (2019) and Hasan et al. (2020), we capture stock market developments via three indicators: accessibility, efficiency, and stability. Specifically, total market capitalisation is a proxy for market accessibility, while the turnover ratio represents the efficiency of the market, and market stability is represented by conditional return volatility. We examine the effects of the stock market indicators on the Gini coefficient (Income inequality)[4] and net personal wealth distribution[5] by income groups[6] (Wealth inequality).

The second factor is the country heterogeneity. Because the stock market, income and wealth inequality distributions are complicated and likely to vary across countries, which renders further evidence of income and wealth inequality distribution predictability. Indeed, developed markets will likely have better, well-organised financial systems than emerging markets (Claessens & Yurtoglu, 2013), which results in more efficient income distributions. However, interestingly, the significant wealth disparities are documented primarily in developed countries (Zucman, 2019). As a result, we decided to examine the country heterogeneity effects on finance-inequality relationships by using the sample of the developing (BRICS) and developed (G7) countries. The BRICS countries have displayed a significant rise in global influences recently,[7] while the latter contains seven developed countries.[8] Additionally, studies on inequality in the BRICS countries are rather limited. Indeed, remarkably few studies on income and wealth inequality within the BRICS countries have ever existed. Therefore, understanding income and wealth inequality in the BRICS countries is urgently needed. We expect to enrich the literature in this regard by studying the stock market - inequality nexus in the BRICS countries.

Additionally, examining the effects of the stock markets on inequality distribution by parametric models is challenging due to mixed-frequency data. For instance, the stock market indicators data is high-frequency (monthly), while income and wealth inequality data are low-frequency (annually). Low-frequency data is widely believed to be less prone to changes and more likely to lead to information loss and inaccurate results. Indeed, the explanatory power of the regression models used in the previous studies is modest (see, for example, Altunbaş & Thornton, 2019; Zhang & Ben Naceur, 2019). Thus, to reduce the bias of the results and minimise the information loss, a non-parametric model might be considered as an alternative. For instance, Hasan et al. (2020) applied the Bayesian Averaging Model, which provides a tool for multiple regressor evaluations using averaging data sets and estimating posterior inclusion probability. However, the BMA heavily relies on the subjective prior assumptions, which is constant, but there are differences in the financial development across countries (Claessens & Yurtoglu, 2013). Therefore, considering priors unchanged causes biased results.

[3] Roine, Vlachos, and Waldenström (2009) and Liu et al. (2017) documented that the increasing stock market capitalisation leads to rising income inequality in emerging countries like China and OECD countries. According to Hungerford (2013), the stock market developments in capital gain and dividend yields significantly worsened income inequality distribution between 1991 and 2006.

[4] Gini coefficients are widely used as reliable indicators for studying inequality distribution (Solt, 2020).

[5] Net personal wealth is the value of total assets minus total liability.

[6] We consider the net personal wealth distribution of the two income groups, including the bottom 50% and the top 1% of the population.

[7] The BRICS countries include Brazil, Russia, India, China and South Africa. They account for over 40% of the world's population, they are projected to achieve 128 trillion USD in GDP by 2050 compared to G7 countries with 66 trillion USD (Hammoudeh et al., 2013).

[8] G7 comprises seven developed countries: Canada, France, Germany, Italy, Japan, UK and the USA.

Given the mixed-frequency nature of our data, we propose Autoregressive Distributed Lag-Mixed Data Sampling (ADL-MIDAS) model as our methodological framework.[9] Because the ADL-MIDAS model incorporates independent variables with high-frequency (the stock market data) and dependent low-frequency (inequality data) in distributed lags. Andreou et al. (2013) initially introduced the ADL-MIDAS model, constructed upon the MIDAS approach developed by Ghysels et al. (2004, 2005, 2007). The MIDAS approach has been shown to effectively exhibit the effects between economic variables in the context of the mixed-frequency (Salisu & Ogbonna, 2019; Weiguo & Yang, 2016). Hence, this model reduces missing information and improve the accuracy of the results. Therefore, we argue that the ADL-MIDAS model will be a perfect fit for our study.

Using the ADL-MIDAS model to examine the effects of three market indicators on income and wealth inequality in the BRICS and G7 nations from 2004 to 2021, we find that the effects of the market indicators on income and wealth inequality are more frequently observed in the BRICS than G7 countries. More specifically, the improvements in market stability reduce income inequality in the BRICS and G7 countries, while the remaining indicators have no effects on income inequality across countries. Furthermore, while improvements in market accessibility contribute to narrowing wealth inequality via improving wealth distribution of the bottom 50% of the population and reducing the wealth of the top earners, improvements in market stability widen the wealth disparities in the BRICS countries. Nonetheless, limited effects are observed in the G7 countries. Our results suggest that the stock market might not majorly affect wealth inequality in developed countries. Additionally, our findings suggest that the cross-country differences in income and wealth inequality responses may result from cumulative effects of the market discrepancies and differences in income and wealth structures.

Our study has three core contributions. Firstly, our paper enriches the current literature by differentiating the effects of the three stock market indicators on income and wealth inequality distributions in the BRICS and G7 countries. Because existing literature on the impact of the stock market developments on income and wealth inequality has been rather limited, especially in emerging nations. To the best of our knowledge, our study is the first to investigate the influences of the stock market indicators on income and wealth inequality distributions in the BRICS countries. Given that the BRICS countries have recently received global attention due to the substantial economic and political rises worldwide, our findings could be helpful in assessing whether the stock market developments in the BRICS and G7 countries are sustainable. Secondly, we adopt a different approach, using the ADL-MIDAS model. The ADL-MIDAS model provides a critical solution to address the challenges of the mixed-frequency data in examining effects of the stock market developments on income and wealth inequality[10]. The ADL-MIDAS model offers a noticeably better model fit and outperforms other parametric models utilised in the previous studies in this respect[11] (see, for example, Zhang & Ben Naceur, 2019; Altunbaş & Thornton, 2019). As a result, future studies on finance-inequality relationships may use this model to explore different aspects of the finance–inequality nexus, which enriches literature in this regard. Thirdly, our study offers valuable insights for policymakers in tailoring effective stock market environments and maintaining equitable distributions. In detail, we illuminate the diverse impacts of country heterogeneity among the distinct country categories. Simultaneously, we explicitly present the effects of three market indicators (market accessibility, stability and efficiency) on income and wealth inequality distributions. Such market indicators are pivotal and represent comprehensive components of the stock market's health. Therefore, given the distinctive differences in income and wealth inequality distribution characteristics, our findings are poised to offer substantial guidance for policymakers. This is particularly relevant for major emerging economies, such as the BRICS countries, where the stock markets exhibit high volatility and significant income and wealth disparities.

The paper is structured as follows: Section 2 discusses the Autoregressive Distributed Lag–Mixed Data Sampling (ADL-MIDAS) model. Section 3 provides the descriptive statistics. Section 4 discusses and analyses the empirical results. Section 5 concludes.

2. Methodology

We describe the Autoregressive Distributed Lag–Mixed Data Sampling (ADL-MIDAS) model in this section. One advantage of this model is the incorporation of the information with high-frequency data into lower-frequency regression in a simple fashion (Ghysels et al., 2004, 2005, 2007). Additionally, the predicting power of this model on economic and financial variables has been recognised widely with good forecasting results (see, for example, Salisu & Ogbonna, 2017; Weiguo & Yang, 2016). Therefore, empirical literature boosts our confidence that adopting ADL-MIDAS will enhance examinations of the linkages between stock market developments and inequality. The simple MIDAS model is described as below:

$$y_t = \beta_0 + \beta_1 B\left(L^{\frac{1}{m}};\ \theta\right) x_t^{(m)} + \varepsilon_t^m \tag{1}$$

Where.

$\left(L^{\frac{1}{m}};\ \theta\right) = \sum_{k=0}^{K} B(k;\ \theta) L^{k/m}$, and $L^{1/m}$ is a lag operator, so $L^{1/m} x_t^{(m)} = x_{t-1/m}^{(m)}$.

[9] According to Andreou et al. (2013), in the ADL-MIDAS model, the shape of the weights is determined by the data More information of the ADL-MIDAS model could in found in Appendix A.

[10] The frequency nature of income and wealth distribution data is in annually, which is less prone to the changes. Therefore, this can lead to biases in the result.

[11] Our estimations have noticeably high R-square and significantly low BIC in comparison to previous studies in this topic.

$B(k;\ \theta)$ is the lag coefficient of the corresponding lag operator $L^{k/m}$ as a small dimensional vector of parameter θ.
β_0 is a constant parameter.
β_1 is a parameter exhibiting the general effects of lagged $x_t^{(m)}$ on y_t.
ε_t^m is the error term, it represents other factors impact income inequality. In this study, error term is followed normal distribution.

In this study, while dependent variables are in annually frequency, the independent variables are in monthly frequency. Additionally, the number of dependent variable's lags are determined by the lags of independent variables (high-frequency). Consequently, a dependent variable y_t (annually), is between time t and t-1, and the independent variables x_t^m (monthly) are observed with m = 12 times in the similar period. As a result, capturing the potential effects of the persistence in the level of income/wealth inequality can be expressed by autoregressive augmented MIDAS as below:

$$y_{t+1} = \beta_0 + \gamma y_t + \beta_1 B\left(L_m^{\frac{1}{m}};\ \theta\right) x_t^{(m)} + \varepsilon_{t+1} \tag{2}$$

Where γ is the measure of persistence in the level of income/wealth inequality. Since we deal with various stock market indicators, therefore in order to deal with overparameterization, we deploy Almon Polynomial Distributed Lag weighting form. Consequently, an ADL-MIDAS model representing the relationship between the stock market development indicators and income/wealth inequality in this study will be described as:

$$Y_{t+1}^A = c + \sum_{i=1}^{p_Y^A - 1} \alpha_i Y_{t-i}^A + \sum_{j=0}^{k} \tau^j \theta_j \sum_{i=0}^{m_x^M - 1} X_{N_{M-j,t-i}}^M + \mu_{t+1,} \tag{3}$$

Where Y_{t+1}^A is the annual inequality level with low-frequency variable (A), X_N^M is the stock market indicators at monthly frequency data (M), X consists of three indicators such as market accessibility, stability and efficiency. p_Y^A and m_x^M are the distributed lag order of the low-and high-frequency variables.

μ is the stochastic disturbance term. Following the Karagoz and Ergün (2020) specification, $\sum_{j=0}^{k} \tau^j \theta_j$ is the coefficients of the lagged terms as polynomial varying weights β_1 in equation (2), displaying the effects of the stock market indicators on inequality.

c is the constant, and $\sum_{i=1}^{p_Y^A - 1} \alpha_i$ is equal to the persistence level of income/wealth inequality as γ in equation (2).

3. Data

Monthly time-series stock data contains a total of 216 observations from January 2004 to December 2021 is obtained from Bloomberg for the major stock exchanges in the BRICS countries, namely: Sao Paulo Stock Exchange Index, the Moscow Exchange Index, Shanghai Composite Stock Exchange Index, National Stock Exchange of India index, Johannesburg Stock Exchange index. The monthly stock data in the G7 countries includes the Toronto Stock Exchange, CAC 40, Deutsche Boerse AG German stock index, FTSE MIB index, FTSE all share, SP500 and Tokyo Stock Exchange. The log return employed is expressed as the following expression:

$$\pi_\tau = \log\left(\frac{\chi^\tau}{\chi^{\tau-1}}\right) \times 100$$

Where χ^τ represents the monthly price on the selected stock market's variables and π_τ is a monthly return.

The stability channel is proxied by conditional volatility, which is computed by using the GARCH (1,1) model. Specifically, the square root of conditional variance return (calculated by Equation (5)) is conditional volatility.[12] The GARCH model incorporates the actual context in estimating financial instruments. The conditional variances in the GARCH model are computed as below.

$$y_t = \mu + \varepsilon_t \tag{4}$$

Where: $\varepsilon_t = \sigma_t z_t$. ε_t is heteroscedastic error term, z_t is a random variable with a mean of zero, and μ is conditional mean. As a result, the conditional variance as follows:

$$\sigma_{ik}^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \tag{5}$$

Where : ω is constant and k > 0.

$$\alpha_i, \beta_j \geq 0 \text{ and } \alpha_i + \beta_j < 1, \text{thus volatility of the market (market stability) is } \sqrt{\sigma_{ik}^2}.$$

The annual inequality distribution data contains 18 observations from 2004 to 2021. Following Baiardi and Morana (2018), income inequality is captured by the mean of the Gini disposable coefficient, which is based on household post-tax or post-transfer income and the Gini market coefficient is based on pre-tax, pre-transfer, and financial incomes (Solt, 2020). The Gini coefficient is available at Solt

[12] The market volatility of the BRICS nations is shown in Fig. 1.

(2009), the Standardized World Income Inequality Database (SWIID), and the Gini coefficient ranges from 0 to 100. 0 implies perfect equality, and 100 describes perfect inequality.

Our wealth data selections are carefully considered from various reliable sources. Specifically, the Organisation for Co-operation and Development (OECD) has provided wealth distribution information of the top decile and top percentile since 2009. However, the country's coverage is limited to member countries, excluding five BRICS countries. Moreover, data is only available from 2009. Therefore, the wealth inequality data from the OECD does not fit our study's scope. Meanwhile, Credit Suisse Wealth Databook (CSWD) also provides a global annual dataset and distribution. Wealth distribution data is provided as Gini coefficients and top wealth shares. The wealth distributions from CSWD are computed using the methodology of Davies et al. (2017), and Hasan et al. (2020) employed the data set from CSWD to study wealth inequality. However, like OECD, CSWD data is only available from 2010 onwards, which does not allow us to conduct thorough studies at our desired period. Finally, the World Inequality Database (WID) offers comprehensive annual time-series data covering the BRICS and G7 countries from 2004 to 2021. The WID provides information about the wealth-income ratio, illustrating the net personal wealth by income groups. Therefore, data from WID will likely suit our study. Our wealth inequality is represented by the net personal wealth of the bottom 50% and the top 1% of the population, respectively.

3.1. World Inequality Database (WID)

By WID definition, wealth distribution is net household wealth containing the sum of non-financial and financial assets owned by households subtracting financial liabilities.[13] According to Zucman (2019), the definition of wealth by WID is comprehensive as it contains all types of marketable wealth. The methodology of WID is built upon the notion of the Distributional National Account (DINA).[14] In line with the pioneers in measuring wealth distribution, such as Atkinson and Harrison (1978), the method used in collecting wealth distribution data at the WID is Mixed Income Capitalisation Survey (MICS) method, which is a combination of income tax, national accounts and survey-based estimation. Therefore, this method avoids the issue of applying the different data sources and techniques, providing a homogenous measurement of inequality. Furthermore, the WID offers an additional advantage compared to other sources of wealth distribution data that they provide the net wealth distribution of the three main income groups: the bottom 50%, middle 40% and top 10%, which represents relatively well the lower, middle and upper class, respectively.

However, the wealth distribution data from the WID relies on tax information, but in some countries, wealth taxes are not popular, such as Brazil (Alvaredo et al., 2020a). Additionally, the WID does not consider tax evasion, but tax data is likely to change over time which cause biased estimation. For instance, Alstadsæter et al. (2019) found that the top richest Scandinavians evade one-fourth of their taxes. Therefore, in terms of policy, it might not be wise to neglect country-specific taxation characteristics.

3.2. Descriptive statistics

The descriptive statistics of all variables for the whole sample are illustrated in Table 1. Generally, the stock market developments in the panel BRICS countries during this period are relatively significant, with over 1.2 trillion USD in market capitalisation on average. Meanwhile, on average, the monthly returns are around 1% per month. However, the income inequality level is high (see Table 1), the average Income Gini Coefficient is 50.39 points. Additionally, the wealth distributions within BRICS countries are alarming. Simultaneously, G7 countries have a lower volume of shares traded and return, but their market capitalisation is significantly larger. In terms of inequality, G7 countries have better income and wealth distribution. It is an expected result as the developed countries are likely to have better systems, resulting in more equitable societies (Claessens & Yurtoglu, 2013). Overall, Table 1 shows distinctive differences between emerging and developed countries.

3.3. Correlations

Table 2 reports a correlation matrix between market variables. Differentiating the various perceptions between market variables is essential. As shown in Table 2, the correlations between variables are weak, except for the volume of shares traded and turnover ratio, showing a strong positive correlation in the BRICS countries. By contrast, in the G7 countries, market indicators have stronger correlations, but these correlations are likely to be negative, which means different market variables convey different information.

4. Empirical results

This section presents our empirical analysis and discussions on the effects of the stock market indicators on income and wealth inequality in the BRICS and G7 nations. Our Autoregressive Distributed Lag-Mixed Data Sampling results are demonstrated in Tables 3–8. As mentioned in Equation (3), the sums of polynomial weights present the effects of explanatory variables. The performance of the ADL-MIDAS model is evaluated by statistical tools such as R-square, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). Additionally, the heterogeneity between BRICS (developing) and G7 (developed) countries and non-linearity across countries will be discussed. Additionally, to enhance the robustness of our findings, we apply a robustness test

[13] Readers are referred to Alvaredo et al. (2020a) for specific components of financial and non-financial as well as liability.

[14] Readers are referred to Alvaredo et al. (2020a) to obtain the updated DINA Guidelines for specific documentation regarding measurements of wealth distribution.

Table 1
Descriptive statistics of the panel data.

Variables	Mean	Max	Min	Std.Dev
Panel A: BRICS countries				
Volume of shares traded (Millions of Shares)	215,057.521	668,066.601	44,319.600	119,312.310
Stock Market Capitalisation (Billions of USD)	1238.320	2653.100	206.600	574.882
Turnover ratio (%)	0.203	0.791	0.037	0.128
Return (%)	0.006	0.213	−0.345	0.069
Income Gini Coefficient	50.393	51.200	49.585	0.650
Wealth inequality by top 50% (%)	0.030	0.050	0.020	0.010
Wealth inequality by top 1% (%)	0.404	0.433	0.371	0.021
Panel B: G7 countries				
Volume of shares traded (Millions of Shares)	160,931.196	2,728,717.815	8891.966	3726.557
Stock Market Capitalisation (Billions of USD)	4756.026	7093.412	2369.510	1,3148.725
Turnover ratio (%)	0.379	0.997	0.129	0.168
Return (%)	0.002	0.182	−0.273	0.060
Income Gini Coefficient	40.967	42.185	39.771	0.756
Wealth inequality by top 50% (%)	0.041	0.050	0.036	0.005
Wealth inequality by top 1% (%)	0.254	0.267	0.244	0.006

Table 2
Market indicators correlations.

	Panel A: BRICS countries				Panel B: G7 countries			
Market capitalisation	1.000				1.000			
Volume of shares traded	0.139	1.000			−0.139	1.000		
Turnover rate of ratio	−0.105	0.970	1.000		−0.429	0.954	1.000	
Market Volatility	−0.027	−0.049	−0.042	1.000	−0.024	−0.221	−0.194	1.000

Table 3
Effects of the stock market indicators on income inequality in the panel BRICS and G7 countries.

Description	Accessibility		Efficiency		Stability	
	Lags	Coeff	Lags	Coeff	Lags	Coeff
Panel A: BRICS countries						
Constant		0.002**		0.001		−0.005
		(0.000)		*(0.001)*		*(0.004)*
Real income inequality (−1)	0.339		0.481		0.533***	
		(0.276)		*(0.385)*		*(-0.250)*
Market Indicators	−0.008		−0.002		**−0.357****	
	9	*(0.023)*	*13*	*(0.003)*	*7*	*(0.379)*
PDL01		−0.013		−0.002		−0.502
		(0.018)		*(0.003)*		*(0.292)*
PDL02		0.005		0.001		0.159**
		(0.005)		*(0.001)*		*(0.081)*
PDL03		−0.001		0.000		−0.014**
		(0.000)		*(0.000)*		*(0.006)*
R-Square		**0.423**		**0.217**		**0.512**
AIC		−190.833		−185.954		−193.51
BIC		−186.198		−181.319		−188.88
Panel B: G7 countries						
Constant		0.004***		0.003		0.004
		(0.001)		*(0.001)*		*(0.002)*
Real income inequality (−1)	−0.306		−0.207		−0.295	
		(0.272)		*(0.256)*		*(0.271)*
Market indicators	0.001		−0.003		**−0.344****	
	10	*(0.017)*	*8*	*(0.008)*	*7*	*(0.289)*
PDL01		0.011		−0.004		−0.469**
		(0.014)		*(0.007)*		*(0.221)*
PDL02		−0.002		0.001		0.136**
		(0.003)		*(0.001)*		*(0.063)*
PDL03		0.000		−0.000		−0.011**
		(0.000)		*(0.000)*		*(0.005)*
R-Square		**0.315**		**0.365**		**0.35**
AIC		−207.53		−208.83		−208.39
BIC		−202.53		−203.83		−203.39

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Table 4
Effects of the stock market indicators on the net wealth distribution of the bottom 50% of the population in the panel BRICS and G7 countries.

Description	Accessibility		Efficiency		Stability	
	Lags	Coeff	Lags	Coeff	Lags	Coeff
Panel A: BRICS countries						
Constant		−0.054		0.000		−0.133
		(0.035)		*(0.035)*		*(0.099)*
Real wealth distribution 50% (−1)		0.616		0.394		0.363**
	9	*(0.252)*	17	*(0.254)*	13	*(0.190)*
Market Indicators		**0.974***		−0.113		**−5.783*****
		(1.009)		*(0.114)*		*(2.457)*
PDL01		1.407		−0.137		−6.936***
		(0.786)		*(0.101)*		*(2.095)*
PDL02		−0.467**		0.025		1.211***
		(0.209)		*(0.013)*		*(0.346)*
PDL03		0.034**		−0.001**		−0.058***
		(0.014)		*(0.001)*		*(0.016)*
R-Square		**0.621**		**0.562**		**0.652**
AIC		−69.257		−61.031		−70.608
BIC		−64.622		−56783		−65.972
Panel B: G7 countries						
Constant		−0.005		0.003		−0.015
		(0.004)		*(0.006)*		*(0.028)*
Real wealth distribution 50% (−1)		0.346**		0.403**		0.409
	8	*(0.134)*	19	*(0.162)*	7	*(0.286)*
Market indicators		**−0.224****		0.001		3.072
		(0.179)		*(0.019)*		*(4.086)*
PDL01		−0.283**		0.001		4.118
		(0.141)		*(0.017)*		*(3.114)*
PDL02		0.064*		0.001		−1.137
		(0.035)		*(0.002)*		*(0.898)*
PDL03		−0.005*		0.000		0.091
		(0.003)		*(0.000)*		*(0.074)*
R-Square		**0.812**		**0.816**		**0.458**
AIC		−140.11		−130.63		−122.05
BIC		−135.11		−125.994		−117.05

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

using interpolation technique, widely used to convert low-frequency into high-frequency data.

Fig. 1 offers initial insights into the linkages between the stock market indicators and inequality distributions (income and wealth inequality) in the panel BRICS and G7 countries. We observed expected patterns. The graphs show that stock market accessibility negatively correlates to income inequality and net wealth distribution of the bottom 50% of the population. Simultaneously, it displays a positive correlation to the net wealth distribution of the top 1% of the population. In contrast, we observe that stock market efficiency and stability positively correlate to income inequality and net wealth distribution of the bottom 50% of the population in the panel BRICS countries. On the other hand, in the panel G7 countries, Fig. 1 suggests that decreases in the stock market accessibility and efficiency have negative correlations with income inequality. However, wealth distributions in the panel G7 countries do not correlate with the stock market indicators. Generally, Fig. 1 suggests the existence of intricate relationships between the stock market development indicators and inequality distributions. For example, a stock market indicator might increase (decrease) wealth (income) inequality distributions, whereas other indicators may exert opposite impacts. Also, there is heterogeneity between developing and developed countries.

4.1. The effects of stock market indicators on income inequality

Table 3 presents our ADL-MIDAS empirical results regarding the effects of the stock market indicators on income inequality in the panel BRICS and G7 nations from 2004 to 2021. We present effects of the three stock market indicators (market accessibility, efficiency, and volatility) in the three columns. We follow the result's interpretations by Ghysels et al. (2007), who developed a mixed data sampling method. As mentioned in Section 2, we apply the Almon Polynomial Distributed Lag weighting form for parsimony. Therefore, the coefficient effects of the market indicators are the sum of the Polynomial Distributed Lag (PDL). Moreover, the effects of the past value at lag (1) of the inequality distributions are also presented in the empirical results. The lag length used and displayed is the optimal lag of independent variables.[15]

According to the result, the model fits our data set remarkably well.[16] Compared to previous studies examining the effects of the

[15] Optimal lag is identified based on the AIC and BIC.
[16] R-squares are relatively high, and BIC and AIC are significantly low.

Table 5
Effects of the stock market indicators on the net wealth distribution of the top 1% of the population in the panel BRICS and G7 countries.

Description	Accessibility		Efficiency		Stability	
	Lags	Coeff	Lags	Coeff	Lags	Coeff
Panel A: BRICS countries						
Constant		0.004		−0.012		0.102***
		(0.008)		*(0.008)*		*(0.029)*
Real wealth distribution 1% (−1)		0.383		−0.168		−0.464
	8	*(0.401)*	11	*(0.274)*	8	*(0.231)*
Market Indicators		−0.091		0.011		**4.745*** **
		(0.257)		*(0.031)*		*(2.663)*
PDL01		−0.139		0.016		6.201***
		(0.198)		*(0.025)*		*(2.093)*
PDL02		0.051		−0.005		−1.570***
		(0.055)		*(0.005)*		*(0.531)*
PDL03		−0.003		0.000		0.114***
		(0.004)		*(0.000)*		*(0.039)*
R-Square		**0.554**		**0.493**		**0.745**
AIC		−118.693		−116.616		−127.631
BIC		−114.058		−111.981		−122.994
Panel B: G7 countries						
Constant		0.002		0.005		−0.031**
		(0.003)		*(0.005)*		*(0.015)*
Real wealth distribution 1% (−1)		−0.615*		−0.032		0.318**
	11	*(0.311)*	7	*(0.240)*	10	*(0.297)*
Market indicators		**0.088***		0.041		0.311
		(0.077)		*(0.110)*		*(0.467)*
PDL01		0.112		0.056		0.381
		(0.063)		*(0.081)*		*(0.381)*
PDL02		−0.026**		−0.018		−0.075
		(0.013)		*(0.023)*		*(0.081)*
PDL03		0.002**		0.002		0.004
		(0.001)		*(0.002)*		*(0.005)*
R-Square		**0.536**		**0.517**		**0.475**
AIC		−137.97		−147.4		−145.97
BIC		−133.33		−142.4		−140.97

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

stock market indicators on income inequality (see, for example, Altunbaş & Thornton, 2019; Zhang & Ben Naceur, 2019), our model offers a noticeably better well-fitted solution to data.[17] Our empirical results show that stock market volatility negatively impacts Gini coefficient in the panel BRICS nations. On average, at a 1% significance level, the Gini coefficient can be lowered by 0.357 units per 1 unit decrease in volatility monthly. Given the decrease in volatility (see Fig. 1), this result implies that a more stable market helps reduce income inequality. According to Baiardi and Morana (2018), significant linkages between financial stability and income distribution are undeniable, and financial stability might be considered an instrument to achieve even income distributions.

The other two indicators in columns 1 and 2 (market accessibility and efficiency) are not statistically significant with Gini coefficients. Our findings are consistent with Zhang and Ben Naceur (2019), who examined the effects of market access on income inequality on a global scale from 1961 to 2011. They found that expansions of the stock market do not contribute to alleviating income inequality. Furthermore, Panel B of Table 3 reports the effects of the stock market indicators on income inequality in the panel G7 countries. We find similar results to those of the panel BRICS countries, that market stability is statistically significant and negatively impacts income inequality. This finding is supported by Jeanneney and Kpodar (2011) and Zhang and Ben Naceur (2019) who confirmed the significance of financial stability in improving income distributions across countries. Besides, although using different financial and macroeconomic variables to understand the impact on income inequality within BRICS countries, our findings are consistent with Berisha et al. (2020). Specifically, he found positive relationships between income inequality, high inflation and interest rates in the BRICS countries. The high inflation will likely attach to volatility and uncertainty, lowering investor confidence. Our results suggest a stable market alleviates income inequality, while other stock market indicators have no effect on income inequality across the BRICS and G7 countries.

4.2. The effects of stock market indicators on wealth inequality

In this subsection, we discover the effects of stock market indicators on the net wealth distributions of the bottom 50% and top 1% of the population. The discussions on the net wealth distributions among income groups will be provided below in subsection 4.3.

Table 4 reports the influences of the stock market indicators on the net wealth distribution of the bottom 50% of the population in

[17] R-square of our model is 0.512, whereas R-squares in the model of Altunbaş and Thornton (2019); Zhang and Ben Naceur (2019) are around 0.2.

Table 6
Effects of the stock market indicators on income inequality across all countries.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Market accessibility	−0.022	0.061	0.049	0.033	−0.006	−0.044	**0.055*****	−0.037	−0.014	−0.057	0.042	0.072
	(0.038)	*(0.099)*	*(0.049)*	*(0.045)*	*(0.014)*	*(0.074)*	*(0.037)*	*(0.040)*	*(0.032)*	*(0.094)*	*(0.067)*	*(0.127)*
Lags	10	8	7	9	8	9	7	9	9	7	10	7
R-Square	**0.522**	**0.421**	**0.676**	**0.448**	**0.894**	**0.267**	**0.642**	**0.531**	**0.499**	**0.265**	**0.292**	**0.211**
Market Efficiency	0.012	0.012	**−0.023*****	**−0.024*****	0.002	0.030	−0.006	−0.002	0.006	−0.005	−0.017	−0.006
	(0.039)	*(0.011)*	*(0.011)*	*(0.020)*	*(0.004)*	*(0.040)*	*(0.008)*	*(0.026)*	*(0.011)*	*(0.041)*	*(0.064)*	*(0.016)*
Lags	7	9	10	7	10	9	9	9	10	7	7	10
R-square	**0.487**	**0.556**	**0.764**	**0.530**	**0.900**	**0.340**	**0.422**	**0.256**	**0.502**	**0.375**	**0.281**	**0.153**
Market stability	**0.872*****	**0.943****	−0.099	0.644	0.138	0.059	−0.184	0.659	−0.216	−0.552	**−2.079*****	0.675
	(0.591)	*(0.732)*	*(0.225)*	*(0.894)*	*(0.213)*	*(0.266)*	*(0.888)*	*(2.159)*	*(0.439)*	*(0.634)*	*(1.545)*	*(1.396)*
Lags	7	8	10	7	7	10	7	7	7	9	7	7
R-square	**0.611**	**0.586**	**0.723**	**0.458**	**0.896**	**0.254**	**0.360**	**0.103**	**0.712**	**0.504**	**0.448**	**0.414**

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Table 7
Effects of the stock market indicators on the net wealth distribution of the bottom 50% of the population across all countries.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Bottom 50%												
Market accessibility	**4.837*****	0.371	0.094	**0.355****	**1.852*****	−0.004	−0.288	**0.252*****	−0.014	0.848	−2.725	0.235
	(1.420)	*(0.319)*	*(0.141)*	*(0.326)*	*(0.883)*	*(0.109)*	*(0.275)*	*(0.170)*	*(0.022)*	*(1.535)*	*(2.943)*	*(1.409)*
Lags	9	*9*	*10*	10	9	7	10	8	10	9	7	8
R-Square	**0.575**	**0.325**	**0.771**	**0.826**	**0.501**	**0.784**	**0.693**	**0.918**	**0.391**	**0.358**	**0.480**	**0.578**
Market Efficiency	6.442	0.060	−0.166	**0.368****	−9.558	−0.030	0.052	0.006	−0.004	−0.050	−0.147	0.153
	(7.405)	*(0.082)*	*(0.192)*	*(0.320)*	*(27.385)*	*(0.060)*	*(0.092)*	*(0.065)*	*(0.013)*	*(0.513)*	*(0.273)*	*(0.303)*
Lags	10	*10*	*8*	*7*	*11*	*7*	*10*	*10*	*9*	*8*	*10*	8
R-square	**0.418**	**0.279**	**0.475**	**0.389**	**0.106**	**0.706**	**0.528**	**0.875**	**0.248**	**0.472**	**0.239**	**0.668**
Market stability	−51.761	−1.849	**−17.101*****	**−1.684***	126.848	−0.113	−1.104	**−4.489*****	−0.108	17.989	−7.441	35.235
	(57.405)	*(2.081)*	*(10.009)*	*(1.578)*	*(314.651)*	*(0.180)*	*(2.972)*	*(1.839)*	*(0.092)*	*(53.180)*	*(14.300)*	*(23.990)*
Lags	11	10	7	11	13	9	9	10	10	7	7	7
R-square	**0.575**	**0.316**	**0.677**	**0.750**	**0.006**	**0.624**	**0.552**	**0.837**	**0.490**	**0.466**	**0.776**	**0.745**

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Table 8
Effects of the stock market indicators on the net wealth distribution of the top 1% of the population across all countries.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Top 1%												
Market accessibility	−0.022	**−0.324***	−0.212	−0.704	**0.190*****	0.099	0.102	−0.072	−0.052	0.258	0.221	**−0.300****
	(0.195)	*(0.299)*	*(0.273)*	*(0.329)*	*(0.043)*	*(0.026)*	*(0.306)*	*(0.122)*	*(0.091)*	*(0.467)*	*(0.36)*	*(0.224)*
Lags	10	8	7	9	15	9	9	8	7	10	10	9
R-Square	**0.165**	**0.736**	**0.502**	**0.820**	**0.900**	**0.776**	**0.508**	**0.707**	**0.516**	**0.269**	**0.278**	**0.552**
Market Efficiency	−0.067	−0.075	**0.117*****	**−0.516*****	−0.082	−0.010	−0.017	0.028	0.009	0.124	0.010	0.091
	(0.052)	*(0.086)*	*(0.070)*	*(0.192)*	*(0.072)*	*(0.039)*	*(0.087)*	*(0.053)*	*(0.017)*	*(0.299)*	*(0.08)*	*(0.141)*
Lags	12	7	10	7	10	10	9	8	9	7	10	7
R-square	**0.580**	**0.749**	**0.484**	**0.686**	**0.620**	**0.769**	**0.485**	**0.763**	**0.396**	**0.354**	**0.263**	**0.281**
Market stability	−0.402	**−2.683***	9.802	**3.097*****	−1.567	0.208	0.255	**1.964****	**0.157*****	−14.434	−1.483	−0.424
	(1.078)	*(2.442)*	*(6.891)*	*(1.751)*	*(4.215)*	*(0.363)*	*(0.955)*	*(1.251)*	*(0.091)*	*(16.910)*	*(8.031)*	*(1.784)*
Lags	9	8	7	10	7	9	11	10	10	7	7	10
R-square	**0.277**	**0.797**	**0.624**	**0.685**	**0.617**	**0.676**	**0.707**	**0.482**	**0.711**	**0.437**	**0.294**	**0.232**

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

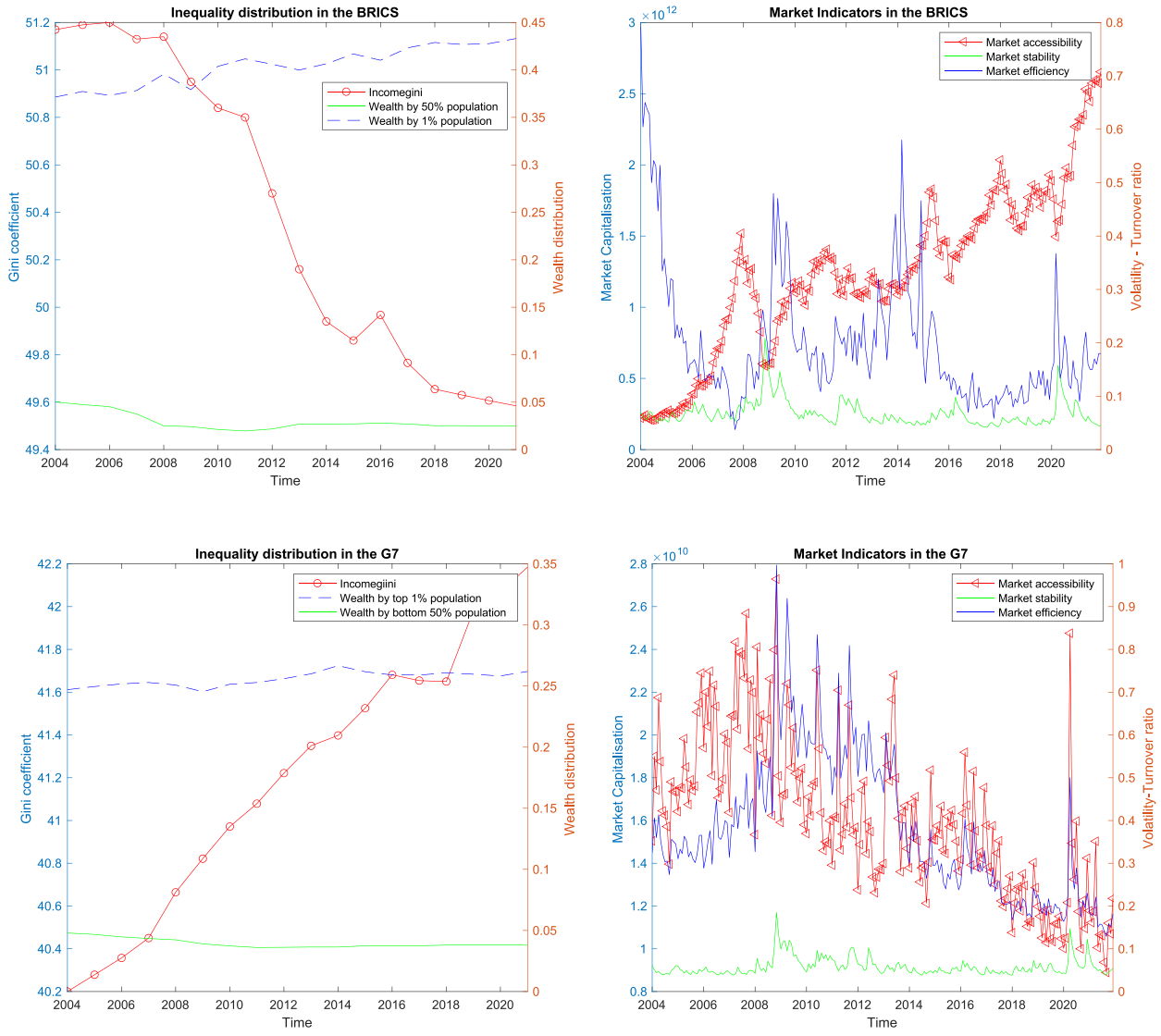

Fig. 1. Stock market indicators, Income and Wealth inequality.

the panel BRIC and G7 countries. Market volatility negatively impacts the net wealth distribution of the bottom 50% of the population in the panel BRICS countries. Our result implies that a more stable market could harm the net wealth distribution of the bottom 50% of the population at a 1% significance level (see Panel A, Table 4). The R-squares in Panel A in Table 4 are around 0.60, which suggests that the model fits the data remarkably well and can explain the linkages between market volatility and wealth distribution correctly approximately 60% of the time. This result is interesting since it seems controversial to a certain degree. However, we could argue that since it is broadly conceived that a stable market contributes to promoting stock prices and increases in the stock price likely lead to widening wealth disparity (Kuhn et al., 2020; Hansan et al., 2020).

In contrast, in column 1 of Panel A, Table 4, we find that expansions of market accessibility increase the net wealth distribution of the bottom 50% of the population (0.974). Meanwhile, market efficiency does not statistically impact the wealth distribution of the bottom 50% of the population in the panel BRICS countries. Our empirical findings on the effects of the two market indicators are relatively consistent with Hasan et al. (2020). Additionally, according to our results in the panel G7 countries (see Panel B, Table 4), only market accessibility is statistically significant and negatively impacts net wealth distributions of the bottom 50% of the population. Given the trend in Fig. 1, our result implies that reductions in market capitalisation erode the net wealth of the bottom 50% of the population in the G7 countries.

Furthermore, Panel A in Table 5 presents the effects of the stock market indicators on the net personal wealth of the top 1% of the population in the panel BRICS countries. According to the empirical results, market stability statistically increases the net wealth distribution of the top 1% of the population at a 1% significance level. Specifically, on average, every 1 unit decrease in market volatility increases 4.745 units of net personal wealth of the top 1% of the population. Given R-square is at 0.745. Thus, our result is

reliable, suggesting that a stable market will likely benefit the wealth of the top 1% of the population.

Conversely, market accessibility and efficiency do not statistically affect the net personal wealth of the top 1% of the population in the panel BRICS countries. In addition, Panel B of Table 5 reports the results in the panel G7 countries. We find that decreases in market capitalisation interestingly benefit the wealth distribution of the top 1%, while the other two indicators are not statistically significant with the wealth distribution of the top 1% of the population.

From our empirical findings, we illustrate the heterogeneities in the effects of the stock market indicators on wealth distributions between the panel BRICS and G7 countries. Our results indicate that among the BRICS nations, a more stable market will likely cause more significant wealth disparity by reducing the wealth of the lower-income people whilst increasing the wealth of the top earners. In contrast, market volatility does not affect wealth distribution in the panel G7 countries. In addition, while the development of accessibility contributes to alleviating the wealth disparity gaps by improving the wealth of the bottom 50% of the population in the panel BRICS countries, it shows contradictory effects in the panel G7 countries. Specifically, the top 1% benefits more than the bottom 50% of the population from expansions of market accessibility. This result is supported by Albert et al. (2020), which indicates that expansionary monetary policy disproportionately benefits top earners over the lower-income groups in the US.[18] Indeed, Domanski et al. (2016), using a sample of developed countries, they pointed out that expansionary monetary policy encourages investments, resulting in the rise of the stock and increasing wealth disparities. In addition, this finding is supported by Azmat et al. (2020), who found that rising market return increases wealth disparity in the US.

4.3. Country heterogeneity between developing (BRICS) and developed countries (G7) discussion

According to our results in subsections 4.1 and 4.2, we observed heterogeneities and similarities regarding the effects of stock market indicators on income and wealth inequality distribution across country groups. In detail, enhancements in market stability (low volatility) contribute to alleviating income inequality across countries. Market stabilisation implies improved governance quality (Sahay et al., 2015), which transmits into economic growth at all levels of financial development. Consequently, income gaps will gradually narrow. However, the differences in the responses of net wealth distribution to market stability between groups of countries could be explained by market discrepancies. These discrepancies may be from the factors, such as differences in governance and market quality (Narayan et al., 2015) or skills, technology and financial resources availability (Milanovic, 2016) between developed and developing countries.

In detail, Alvaredo et al. (2020b) have documented the significance of politic and institutional factors. For instance, since 1980, the differences in the magnitude of inequality in North America, India, China and Russia correlate with the changes in country-specific policies. Specifically, President Rogan's revolution in the USA, transition away of China and Russia from communist economies and economic deregulations in India. Another factor is the taxation system, which plays a pivotal role in income distribution.[19] However, wealth taxes are uncommon in certain, nations such as Brazil (Alvaredo et al., 2020a). Moreover, one of the reasons that causes the rise in wealth disparity in China is the unequal access to quoted and unquoted equity, particularly the top earners Alvaredo et al. (2020b).

Another reason might be wealth structure differences. According to Hasan et al. (2020), agriculture and economic factors significantly shape the wealth distribution in lower-income nations, while the wealth in developed countries is formulated from more diversified sources of income. Therefore, their wealth distributions are less prone to changes in the market. This finding might suggest additional investigations of the wealth components. Furthermore, we also argue that most of the population in emerging countries rarely participates in the stock market since stock market participants are likely affluent households (Kuhn et al.., 2020). Given the stock market manipulations in developing countries, improvements in market stabilisation will likely benefit the wealth distribution of certain groups of the population in the BRICS countries[20].

The heterogeneities in the effects of market accessibility on wealth inequality across countries are due to the contradictory market capitalisation trends.[21] The rising (falling) of market accessibility suggests increasing (decreasing) in capital investment in the market in the BRICS and G7 countries, respectively. As a group of emerging countries, there are substantial economic gains for further enhancements of the financial size, given that wealth distribution corresponds to economic developments (Hasan et al., 2020). Therefore, our findings suggest attracting market capitalisation could help narrow wealth inequality gaps in the BRICS countries. However, it is necessary to be aware of the velocity of financial development since dramatic financial deepening might trigger crises and instability (Sahay et al., 2015), which then translates into greater inequality. In fact, the market size of the BRICS countries increased approximately five times from 2004 to 2021 (see Fig. 1). Therefore, it could be a potential financial risk.

On the other hand, an explanation for the adverse effects of market accessibility on wealth inequality in the G7 countries is the capital withdrawal of investors (see Fig. 1), as investors may seek better return markets.[22] A failure in market capitalisation might

[18] This is because expansionary monetary policy encourages investments by lowering interest rate, which allows more people accessing to the funds. Therefore, it positively impacts stock market accessibility.

[19] In the USA, a third of national income distribution is via tax, transfer and public services (Piketty et al., 2018).

[20] Indeed, Narayan et al. (2015) found that in weak governance markets, investors are likely to employ classified information to tailor their profitable portfolio strategies.

[21] In Fig. 1, it shows that while market capitalisation in emerging countries rise strongly, we witness decreases in the G7 countries in the same period.

[22] See Table 1, an average return in the emerging markets is significantly higher than developed markets.

cause self-fulfilling effects, leading to financial crises and impeding economic growth. As a result, our findings suggest that improvements in capital attractions across the G7 countries will narrow wealth disparity. Nonetheless, avoiding "too much finance effects" across countries is necessary since it has been found empirically to harm wealth equality distribution (Arcand et al., 2015; Law & Singh, 2014).[23] Because misallocating financial resources into the financial market might decline the production activity investments as financial resources become unavailable for funding other investments (Checchetti & Kharroubi, 2012). And in the long run, resource misallocations could potentially result in financial crises (Baiardi & Morana, 2018).

Besides, we found no relationship between market accessibility and income inequality across the BRICS and G7 countries. Therefore, our analysis suggests that expansions of market accessibility may benefit economic and financial development, yet they do not essentially have effects on income inequality in the BRICS and G7 countries. Simultaneously, stock market efficiency does not significantly impact income and wealth inequality across countries. The diverse responses of income and wealth inequality to market indicators from our empirical results suggest that it is essential not to mix wealth and income distribution when examining inequality distributions. Previous scholars tend to substitute wealth distribution with income distribution due to data limitations (Hasan et al., 2020). Overall, the enhancements of the market accessibility and stability likely benefit income and wealth equality distributions in the BRICS countries. This finding aligns with Seven and Coskun (2016), who found that stock market developments reduce poverty in emerging countries.[24]

4.4. Non-linearity across individual countries

Given the differences between countries in terms of market quality, we argue that it might be wise to consider countries individually due to the differences in terms of culture, for instance, consumption habits and intergenerational wealth transfer.[25] Nolan et al. (2021) have discovered the complicated effects of intergenerational wealth transfer across developed countries. Therefore, it creates a need to explore the non-linearity of the estimated effects across countries individually. Furthermore, the estimations can be meaningful for validating our previous estimations.

We apply the ADL-MIDAS model with similar specifications to examine the effects of the monthly market indicators on annual inequality across 12 countries individually. The results are presented in Tables 6–8. Table 6 reports the effects of the stock market indicators on income inequality across 12 countries. The estimated coefficients of the explanatory variables display expected signs as we witness heterogeneities in terms of the effects of the market on inequality. Market accessibility has no relationship with income inequality across all countries except France. Surprisingly, while market efficiency negatively impacts income inequality in India and Russia at a 1% significance level, it has no effect in the rest of the countries in our study. The income inequality arising due to the effects of market stability is observed in a few countries, namely Brazil, China and the UK. Overall, stock market indicators likely impact income inequality in the countries in the BRICS countries, while it seems unlikely to have effects on income inequality in the G7 countries. In short, the results in Table 6 differ from our findings in Table 3 regarding the effects of the market on income inequality. Nonetheless, it confirms that the stock market will unlikely impact income inequality in the G7 countries.

Regarding effects of market indicators on wealth distribution across countries. Tables 7 and 8 show that improvements in stock market accessibility will narrow wealth disparity, while market stability likely triggers wealth disparity in the BRICS countries. Specifically, it reduces the net wealth of the bottom 50% of the population in Russia and India. On the other hand, it increases the net wealth of the top 1% of the population in Russia. However, only some effects of all market indicators are witnessed in the G7 countries (see Tables 7 and 8), which implies that wealth inequality in the developed countries will be unlikely to be impacted by their domestic stock markets. These results are consistent with our estimations in the previous subsections about the effects of the stock market indicators on wealth inequality.

In contrast, results in Tables 7 and 8 exhibit effects of market efficiency on wealth inequality in the BRICS countries, which suggests domestical effects within the BRICS countries. From our analysis, we could argue that the distinctive factors between individual nations could play an important role in measuring income and wealth inequality. Therefore, our results suggest that future studies could be wise to include cultural factors that might impact inequality distribution. Additionally, our results suggest that the stock market is not the primary component that affects income and wealth inequality in the G7 countries in our study.

4.5. Robustness test

To validate our findings, we apply an alternative technique for mixed-frequency data sampling, cubic spline interpolation. The

[23] Sahay et al. (2015). "How Much Finance Is Too Much: Stability, Growth and Emerging Markets". Online available at: https://www.imf.org/en/Blogs/Articles/2015/05/04/how-much-finance-is-too-much-stability-growth-emerging-markets#:~:text=The%20"too%20much%20finance"%20effect, loss%20of%20efficiency%20in%20investment.

[24] We argue that poverty alleviation means improving income of the lower-income group. Therefore, it contributes to narrow income inequality gap.

[25] In Asia, previous generations likely to spare their assets to their decedents, and they tend to save first and spend later, which is contradict to the western countries.

cubic spline interpolation converts annual income and wealth inequality data into monthly data. Compared to traditional interpolation techniques, namely linear interpolation, cubic spline interpolation provides better flexibility and accuracy (Sherif & Chen, 2019). Using monthly interpolated data to the Autoregressive Distributed Lag model (ADL),[26] the estimated results are shown in Appendix B.

Similar to our baseline estimation, Appendix Table 1 shows that improving market stability significantly reduces income inequality at a 1% significance level across the panel BRICS and G7 countries. Additionally, Appendix Table 1 shows that across the BRICS countries, improvements in market accessibility narrow the wealth inequality gaps across the BRICS countries, while limited influences of stock market indicators on wealth inequality in the G7 countries are observed (see Appendix Table 1). However, the robustness estimations show a slight difference, where market stability narrow the wealth inequality gaps across the BRICS countries.

According to the robustness estimations for country's heterogeneities, we robustly confirm that market accessibility has no linkages to income inequality (see Appendix Table 2). Nonetheless, we observe slight differences in the effects of the market stability on income inequality, with noticeably limited impacts on income inequality across 12 countries (see Appendix Table 2). In addition, based on the estimations in the Appendix Tables 3 and 4, effects of market accessibility and stability are solid to our baseline estimation (see Appendix Tables 3 and 4). Nonetheless, as opposed to our baseline estimation, market stability alleviates on wealth disparity in the G7 countries. It could be explained due to applying different approaches. Since the cubic spline interpolation approach obtains data from establishing linkages between known data points of low-frequency variables (Wolberg, 1988). Meanwhile, the MIDAS approach is more likely to comprehend the changes in the market as considering the lag distribution of high-frequency variable to disseminate movements of low-frequency data (Ghysel et al., 2004). Indeed, Muller et al. (2004) indicated that using interpolation techniques might lead to lower accuracy due to missing data issue.

4.6. Policy implication

Based on our findings, we delve into policy implication in this section. We found significant contributions of enhancements in market stability to narrowing income inequality across countries. However, these enhancements lead to wealth disparities in the BRICS countries, implying that stock market stability improvements benefit top earners. Therefore, policymakers should design sustainable policies that maintain the stock market's stability and regulate the market to alleviate disproportionate distributions among the top 1% and 50% of the population. For instance, policymakers in the BRICS countries may consider taxing incomes from dividends and capital gains separately.[27] However, it is essential to design this tax system as a progressive system. Moreover, our study identified that increasing market accessibility deteriorates wealth disparity in the BRICS countries by improving wealth distribution of the bottom 50% and reducing it among the top 1% of the population. As a result, policymakers should tailor an investor-friendly market to attract financial resources for expansions. The policies may contain relaxing procedures, credit constraints and control with international investors, simultaneously enhancing stock market supervision. Nonetheless, dramatic expansions may correspond to a greater crisis risk and economic instability (Sahay et al., 2015). Therefore, maintaining adequate stock market supervision is essential. Furthermore, it is imperative to develop a well-organised regulatory system to limit the risks of financial fraud, such as money laundering and to allocate financial resources effectively. Because capital misallocation persistence might lead to crisis (Baiardi & Morana, 2018).

5. Conclusion

Understanding the finance-income and wealth inequality nexus plays an important role in maintaining coherent society and economy. This paper examines the effects of three stock market indicators (market accessibility, efficiency, and stability) on income and wealth inequality in the BRICS and G7 countries, adding to the lacking literature on wealth inequality, especially for the BRICS countries. Using the Autoregressive Distributed Lag–Mixed Data Sampling (ADL-MIDAS) model, the findings are be outlined as follows.

Firstly, we found that while enhancements in market stability narrow income inequality across developing and developed countries, they widen wealth disparities in the BRICS countries, implying stock market stability improvements benefit top earners more significantly than the bottom lower-income group. Secondly, our study found that expansions of market accessibility reduce wealth disparity in the BRICS countries via improving wealth distribution of the population in the lower-income groups and reducing wealth distribution of the top earners. Finally, we found limited effects of the stock market indicators on wealth distribution in the G7 countries, which implies that the stock market is not a significant cause of the wealth disparity in the developed countries. Our findings robustly indicate that the effects of the stock market indicators on income and wealth inequality are more pronounced in the BRICS than in the G7 countries. This renders implications that the cross-country differences in the responses of income and wealth inequality may be due to accumulative effects of the market discrepancies and other, factors such as: differences in income and wealth structures, taxation, policy and institutions.

The limitation of this study is omitting variables in determining wealth and income structures between developed and developing countries, which might submerge certain links between the stock market and inequality, for example, taxation data. Specifically, since the Gini coefficient and net personal wealth are built upon the taxation data, which varies over time and across countries (Piketty et al., 2018). Nonetheless, in certain countries, there is no tax information, for example, Brazil (Alvaredo et al., 2020a). Additionally, Nolan

[26] By conducting this approach, it allows us to validate our results as well as compare differences of two approaches that can be employed for mixed-frequency data. In addition, our ADL model specifications remain unchanged, where income and wealth inequality are dependent variables; stock market indicators are independent variables.

[27] Denmark taxes dividend and income from capital gain separately, and they are one of the top countries with high score of equality globally.

et al. (2021) have documented that intergenerational wealth transfer plays a significant role in wealth inequality distribution in developed countries such as Germany and Italy. Therefore, the results may not reflect country-specific inequality distribution characteristics.

Our approach, MIDAS, provides significantly higher explanatory power (high R-square and lower BIC), and we have provided a critical avenue for future studies. We have provided an effective solution for the mixed-frequency data issue, which hinders studies regarding wealth inequality (Hasan et al., 2020). Therefore, future studies may benefit from employing this approach to consider the aforementioned omitted variables above to understand the effects of additional market factors on inequality distribution. These factors could be consumption habits between cultures, taxation or intergenerational transfer of wealth, which has been one of the hottest debate topics in recent years (Nolan et al., 2021). Therefore, future studies may apply the MIDAS approach to understand the effects of inheritance tax impact on income and wealth inequality across developing and developed countries. Hence, it provides insightful information for policymakers to assess the efficiency of the taxation systems in equalising income and wealth distribution by comparing the tax systems between developing and developed countries. Because in certain countries, such as the USA, a significant proportion of national incomes are distributed through tax (Piketty et al., 2018). Additionally, in this study, we use univariate ADL-MIDAS, which can effectively examine the relationships between variables with significantly better explanatory power (R-square and BIC). However, the future studies may apply multivariate ADL-MIDAS model to study similar topic with additional variables, which is helpful to compare the results between univariate and multivariate ADL-MIDAS model in this domain.

CRediT authorship contribution statement

Dong Quang Dang: Conceptualization, Software, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Weiou Wu:** Conceptualization, Supervision, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Ioannis Korkos:** Conceptualization, Supervision, Methodology, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

Acknowledgement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Autoregressive Distributed Lag-Mixed Data Sampling (ADL-MIDAS)

The ADL-MIDAS is an extended model building upon the MIDAS framework invented by Ghysel et al. (2004). Originally, the MIDAS models were considered a Distributed Lag polynomial, designed to measure the relationships of variables at different frequencies. The fundamental idea is to add the MIDAS model to auto-regressive distributed lag (ADL) model. In detail, the Autoregressive Distributed Lag regression model with dependent variable Y and independent variable X is presented as ADL (p_Y^A, m_x^A) below:

$$Y_{t+1}^A = c + \sum_{i=1}^{p_Y^A - 1} \alpha_i Y_{t-i}^A + \sum_{i=0}^{m_x^A - 1} \beta_i X_{t-i}^A + \mu_{t+1},$$

Where:

p_Y^A is lag of Y_t^A and m_x^A is lag of X_t^A.

However, assuming Y and X are at different frequencies (low-frequency and high-frequency respectively), then depending on the polynomial specifications, the ADL model with mixed-frequency data will be different. There are a few polynomial specification options, such as beta polynomial, Almon lag polynomial and step functions. In this study, we choose the Almon lag polynomial. Therefore, the ADL-MIDAS model becomes as Eq. (3). In practice, the MIDAS model has been developed into numerous new models such as unrestricted MIDAS (U-MIDAS), autoregressive structure MIDAS (AR-MIDAS). Additionally, the MIDAS model can be incorporated into the GARCH model (GARCH-MIDAS) for modelling the volatility of financial mixed-frequency time series data.

Appendix B. Robustness test results

Appendix Table 1: Effects of the stock market indicators on income and wealth inequality in the panel BRICS and G7 countries using monthly interpolated data.

	Panel BRICS			Panel G7		
	Market accessibility	Market efficiency	Market stability	Market accessibility	Market efficiency	Market stability
Income inequality	0.002	**0.002*****	**−0.012***	−0.004	−0.002	**−0.049****
	(0.003)	*(0.001)*	*(0.008)*	*(0.004)*	(0.001)	*(0.013)*
Lags	*1*	*5*	*7*	*1*	2	*13*
Wealth distribution bottom 50%	**0.226*****	0.009	0.246	−0.014	0.002	**−0.176*****
	(0.078)	*(0.018)*	*(0.273)*	*(0.019)*	*(0.006)*	*(0.060)*
Lags	*5*	*1*	*1*	*1*	*1*	*5*
Wealth distribution top 1%	**−0.071*****	**0.010***	**−0.132****	−0.020	0.002	0.055
	(0.021)	*(0.005)*	*(0.063)*	*(0.015)*	*(0.004)*	*(0.035)*
Lags	*5*	*3*	*1*	*1*	*1*	*1*

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Appendix Table 2: Effects of the stock market indicators on income inequality across all countries using monthly interpolated data.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Market accessibility	0.003	−0.001	0.001	0.000	−0.001	0.002	−0.001	−0.001	0.006	−0.002	0.003	0.005
	(0.004)	*(0.003)*	*(0.002)*	*(0.002)*	*(0.001)*	*(0.005)*	*(0.002)*	*(0.009)*	*(0.002)*	*(0.004)*	*(0.007)*	*(0.007)*
Lags	*2*	*4*	*1*	*1*	*1*	*1*	*1*	*1*	*6*	*1*	*1*	*1*
Market Efficiency	0.000	0.000	0.000	**−0.002*****	**−0.001*****	**−0.014*****	−0.004	0.000	**0.002*****	−0.001	−0.001	0.000
	(0.001)	*(0.001)*	*(0.001)*	*(0.001)*	*(0.000)*	*(0.004)*	*(0.004)*	*(0.002)*	*(0.001)*	*(0.001)*	*(0.002)*	*(0.001)*
Lags	*1*	*1*	*1*	*4*	*3*	*13*	*1*	*1*	*4*	*1*	*1*	*1*
Market stability	0.010	−0.006	**0.010***	0.040	0.010	0.009	**−0.010***	0.011	−0.011	−0.044	−0.012	**0.000*****
	(0.010)	*(0.008)*	*(0.009)*	*(0.020)*	*(0.006)*	*(0.040)*	*(0.005)*	*(0.026)*	*(0.001)*	*(0.036)*	*(0.020)*	*(0.054)*
Lags	*1*	*2*	*1*	*7*	*7*	*1*	*1*	*1*	*1*	*1*	*1*	*8*

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Appendix Table 3: Effects of the stock market indicators on the net wealth distribution of the bottom 50% of the population across all countries using monthly interpolated data.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Market accessibility	0.004	−0.031	**−0.060*****	**0.099***	**2.341*****	**−0.043*****	0.012	0.028	**0.005****	0.140	−0.061	**0.151****
	(1.920)	*(0.027)*	*(0.025)*	*(0.058)*	*(0.732)*	*(0.009)*	*(0.050)*	*(0.026)*	*(0.003)*	*(0.099)*	*(0.125)*	*(0.069)*
Lags	*1*	*1*	*4*	*1*	*1*	*13*	*1*	*1*	*1*	*1*	*1*	*2*
Market Efficiency	0.067	−0.009	0.004	**0.035*****	3.508	**0.011*****	**−0.029****	0.002	0.000	**0.073****	0.008	0.009
	(0.590)	*(0.007)*	*(0.013)*	*(0.015)*	*(2.702)*	*(0.004)*	*(0.011)*	*(0.006)*	*(0.001)*	*(0.031)*	*(0.029)*	*(0.018)*
Lags	*1*	*2*	*1*	*3*	*1*	*5*	*2*	*1*	*1*	*1*	*1*	*1*
Market stability	0.197	0.085	0.485	**−0.878*****	**−1.839*****	**0.071****	**0.485***	**−0.614*****	−0.004	0.165	**−1.391***	**0.455****
	(6.583)	*(0.088)*	*(0.324)*	*(0.391)*	*(0.751)*	*(0.031)*	*(0.267)*	*(0.167)*	*(0.008)*	*(0.750)*	*(0.782)*	*(0.225)*
Lags	*1*	*1*	*2*	*3*	*1*	*7*	*5*	*8*	*1*	*1*	*11*	*1*

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

Appendix Table 4: Effects of the stock market indicators on the net wealth distribution of the top 1% population across all countries using monthly interpolated data.

	Brazil	China	India	Russia	South Africa	Canada	France	Germany	Italy	Japan	UK	USA
Market accessibility	−0.005	0.018	**0.034*****	**−0.138*****	0.016	**0.096*****	**−0.118****	**−0.031****	−0.005	−0.025	0.006	**−0.062****
	(0.023)	*(0.014)*	*(0.012)*	*(0.050)*	*(0.021)*	*(0.021)*	*(0.043)*	*(0.014)*	*(0.003)*	*(0.046)*	*(0.023)*	*(0.024)*
Lags	*1*	*1*	*4*	*2*	*1*	*13*	*5*	*3*	*1*	*1*	*1*	*7*
Market Efficiency	0.004	−0.005	**−0.016*****	**−0.044*****	**0.011***	**−0.024*****	−0.023	−0.003	0.001	0.006	0.001	**−0.018*****
	(0.007)	*(0.003)*	*(0.007)*	*(0.012)*	*(0.006)*	*(0.008)*	*(0.014)*	*(0.004)*	*(0.001)*	*(0.014)*	*(0.006)*	*(0.006)*
Lags	*1*	*1*	*3*	*3*	*2*	*5*	*5*	*1*	*1*	*1*	*1*	*7*
Market stability	**0.239*****	−0.018	**−0.371*****	0.046	**0.436*****	**−0.165****	**−0.781****	−0.080	**−0.037****	0.341	0.036	0.081
	(0.080)	*(0.045)*	*(0.153)*	*(0.224)*	*(0.176)*	*(0.067)*	*(0.334)*	*(0.060)*	*(0.011)*	*(0.365)*	*(0.071)*	*(0.061)*
Lags	*1*	*1*	*11*	*1*	*12*	*7*	*9*	*1*	*5*	*1*	*1*	*1*

Note: ***, ** and * indicate statistical significance at 1%,5% and 10% level, respectively. Parentheses report standard errors.

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