

The Effect of Financial Derivatives on Wealth Inequality

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Abstract

This paper explores the relationship between financial derivatives and wealth inequality. While previous studies have acknowledged a connection between finance and inequality, the precise nature of this relationship remains uncertain. Our study aims to contribute to this discourse by isolating the impact of financial derivatives on wealth distribution, independently of other financial factors.

Using data for 16 countries from 2001-2021, we examine exchange-traded derivatives from the Bank of International Settlements and pre-income tax wealth Gini coefficients for adults from the World Inequality Database. Employing unbalanced panel econometric techniques and controlling for country fixed effects, we analyze the dynamic relationship between these variables.

Contrary to conventional financial theory, which often views derivatives as redundant assets, our findings reveal a positive, significant and robust association between wealth inequality and the use of derivatives. This challenges prevailing assumptions and underscores the importance of derivatives in shaping global wealth distribution dynamics.

Keywords: Derivatives, Wealth Inequality, Income Inequality, Gini, Financial Development, Financial Liberalization

1. Introduction

Wealth inequality has emerged as a prominent topic in economic discourse over the past few decades. The sharp increase in wealth inequality not only poses economic challenges but also necessitates a keen examination of its socio-political dimensions (Qureshi, 2023). However, comprehending the sources of wealth inequality is a complex task.

Finance, broadly understood, is exerting influence on income inequality through the channels of financial inclusion, development, and liberalization. These factors have their own distinct processes of shaping the distribution of income and each one requires careful examination. Abiad et al. (2010) differentiate between financial liberalization and financial development, emphasizing the need to distinguish the two. Financial liberalization involves reducing credit controls, bank entry barriers, and regulations, while financial development is often measured by the ratio of private sector credit to GDP (Beck et al., 2007), reflecting access to capital for entrepreneurs and households. While financial liberalization can pave the way for economic opportunities, it does not necessarily translate to high levels of financial development (Abiad et al. 2010; De Haan and Sturm 2017; Fraser Institute).

Concurrently, a gap persists in translating these findings to wealth inequality. Hasan et al. (2020) highlight the key variables influencing wealth inequality, underscoring the urgent need for more comprehensive research and varied methodologies to enhance the literature and advance our understanding of this area. While Osakwe and Solleder (2023) provide support and evidence suggesting that income inequality influences wealth distribution (although with some subsamples exhibiting less robust results), Smith (2001) argues against such a relationship. Smith contends that the impact of income dispersion on savings is unclear, and the permanence or temporariness of income inequality between households further complicates the matter.

Given the lack of a solid theoretical foundation regarding the variables affecting wealth inequality, we adopt a similar approach to empirical research as the one in the income inequality literature. This strategy, as seen in studies by de Haan, Jaruch, and Watzka, Buck et al. (2014), and Brie, Ferri, and Gambacorta (2023), will be elaborated upon in Section 3.

Meanwhile, despite the comprehensive analysis of finance and its relationship to inequality from various angles, the role of derivatives and derivatives markets has been notably

underexplored in the literature. This is surprising given that the derivatives market has a notional value of approximately \$750 trillion dollars (BIS, 2023). The extreme dollar value of derivatives together with the high leverage properties and speculative aspect that derivatives possess, should be considered when wealth outcomes and the distribution of wealth are discussed.

In our analysis, we are quantifying the relationship between financial derivatives and inequality controlling for other finance and macroeconomic variables that influence the distribution of wealth across countries. On the one hand we have the Gini coefficient for Wealth Inequality from the World Inequality Database (WID), and on the other side we account for finance (Financial Development and Financial Liberalization), control variables associated with inequality and the variable of interest which is the use of derivatives. We approximate derivatives by the notional amount of exchange traded derivatives in 16 organized markets around the world from 2001-2021. Given the dual nature of derivatives as both speculative instruments and hedging tools, we incorporate variables such as Trade as a percentage of GDP, Foreign Direct Investments as a percentage of GDP, and Stock Market capitalization as percentage of GDP into our model. These variables help capture both the speculative aspects and the broader economic context in which derivatives operate.

We employ a panel fixed effects estimator to account for unobservable country-specific characteristics and time-invariant factors that may influence our variables but are not included in the model. Additionally, recognizing the dynamic nature of derivatives and financial phenomena, we use a dynamic model. This accounts for the fact that the outcomes of derivatives transactions are realized in the future rather than at the time of purchase. Similarly, the effects of financial liberalization and financial development policies may take time to materialize (de Haan, 2017). By incorporating lagged variables, we address potential endogeneity issues and enhance the robustness of our analysis.

Our contribution to the literature, consists of three main aspects. Firstly, we examine the previously unexplored in the inequality literature relationship between financial derivatives and wealth inequality. Secondly, we utilize a more recent dataset compared to many existing studies on inequality. Our dataset spans from 2001 to 2021, providing a more contemporary perspective compared to the prevalent samples covering the period from 1975 to 2012. Although these earlier samples include more countries, they often exclude recent years, potentially overlooking significant structural changes in the relationship between finance and real economic variables.

Lastly, we decompose the Liberalization Fraser Institute Index, following de Haan's (2017) definition, to investigate specific liberalization characteristics and their impact on wealth inequality.

Our findings indicate a significant positive association between the value of derivatives and wealth inequality. However, financial development, as measured by the percentage of private credit to GDP and the Liberalization Index (for most of our results), appears to be statistically insignificant in its impact on wealth inequality, in contrast to many studies about the effect of finance on income inequality. Conversely, our analysis of the financial liberalization index decomposition reveals that accounts held in foreign currency lead to an increase in wealth inequality. Additionally, variables such as Trade, Foreign Direct Investment (FDI), and Stock Market Capitalization exhibit statistically significant positive effects on wealth inequality, aligning with recent literature on the topic (Brie et al., 2023, Adao et al., 2022).

The remainder of the paper follows a structured approach, with Section 2 delving into an extensive review of the existing literature. Section 3 outlines the methodology employed and provides details on the dataset used for analysis. Subsequently, Section 4 presents and discusses the main results derived from the analysis. In Section 5, we conduct robustness checks and explore alternative models to validate the robustness of our findings. Finally, Section 6 offers concluding remarks summarizing the key insights drawn from the study.

2. Literature Review

2.1 Finance and Income Inequality

The empirical relationship between finance and inequality has been thoroughly examined in economic literature, yielding valuable insights into their interconnectedness. Jaruch and Watzka (2013) estimate a positive relationship between financial development and income inequality using a dataset including 138 countries from 1960-2008 while de Haan et al. (2017) by conducting a comprehensive panel study encompassing 121 countries spanning from 1975 to 2005 support these findings. Their study suggests a positive association between income inequality and finance as measured by financial development, liberalization, and banking crises. Essentially, the more developed the financial sector, the higher the observed levels of inequality.

Additionally, Brie et al. (2023) offer a fresh perspective on this relationship. Analyzing data from 97 countries over the period of 1989 to 2012, they explore the impact of financial development on income inequality employing a more detailed methodology. Their analysis, utilizing Svirydenka's (2016) aggregate financial development index, distinguishes between financial depth, access to finance, efficiency of finance, and financial structure (bank credit vs market finance). Interestingly, their study reveals a non-linear relationship between financial development and inequality, with financial markets exerting a greater impact on inequality compared to bank credit. Moreover, they find a U-shaped curve, indicating that while increased financial development initially reduces inequality, beyond a certain threshold, it starts to exacerbate it, further enriching the literature on this complex relationship.

Furthermore, Kunieda, Okada, and Shibata, utilizing dynamic panel analysis, shed light on the global dimension of financial markets' influence on inequality. They observe that countries more closely integrated into the global financial markets, experience higher levels of income inequality, while those with less connectivity exhibit lower inequality levels—a crucial insight into the globalization's impact on income distribution.

Law et al. (2014) further contribute to the literature by employing threshold regression analysis. Their study highlights that income inequality tends to decrease only after financial institutions have achieved a certain threshold of institutional quality, adding another layer of complexity to the relationship between financial development and inequality.

On the contrary, a plethora of literature is supporting the notion that financial development contributes to income inequality reduction. Beck et al. (2007), in their study spanning 27 countries from 1960 to 2005, find a negative association between financial development and inequality.

Galor and Zeira (1993), as well as Banerjee and Newman (1993) and Beck et al. (2014) show that income inequality is reduced when financial development as measured by the Private Credit as percentage of GDP is estimated. To control for possible endogeneity the use of origin of country's legal system also provides consistent results with their previous estimations.

The varying results align with the observations of Demircüç-Kunt and Levine (2009), who highlight the ambiguity in theoretical predictions regarding the impact of financial development on income inequality.

There is also a considerable body of literature addressing the second dimension of finance, namely financial liberalization. According to Bumann and Lensink (2015), financial liberalization encompasses measures such as reductions in reserve requirements and limits on foreign funds that can be borrowed by domestic banks. The researchers find that financial liberalization is connected to financial development. If financial development is above 25%, financial liberalization reduces income inequality. Similar results are reported by Agnello et al. (2012) and Abiad (2010). They find that financial liberalization reduces income inequality, although the extent of this effect depends on the specific definition of liberalization policy. They observe that policies such as privatization and increasing international capital flows, do not significantly impact the distribution of income. Additionally, Beck, Demircüç-Kunt, and Levine (2009) find, based on data from 1960 to 2005 and several developed and emerging economies, that financial development decreases income inequality, especially benefiting the poorest segments of the population.

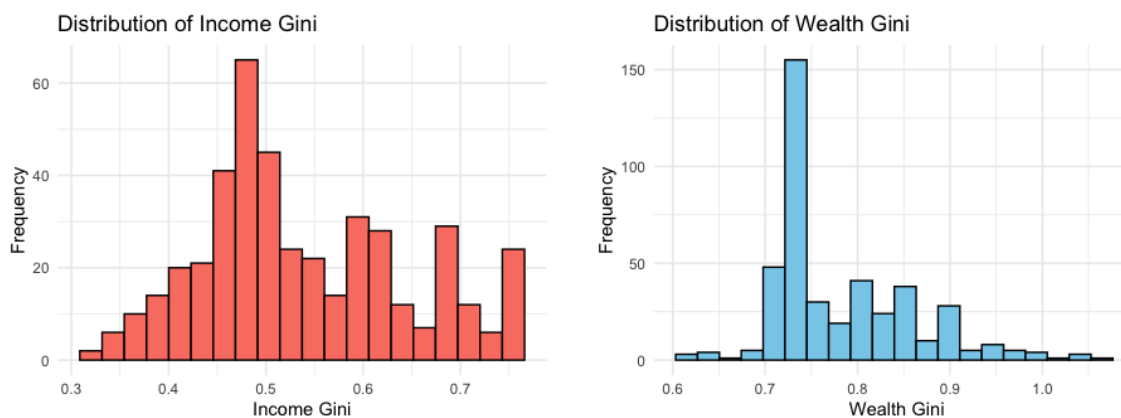
On the other hand, Korinek et al. (2014) by specifically examine financial deregulation as a subset of financial liberalization, identifying a positive association between financial deregulation and income inequality.

2.2 Relationship Between Income and Wealth Inequality

Intuition would suggest that income and wealth inequality should be related to each other. However, it's essential to define what constitutes wealth. According to the System of National Accounts (UN, 2009), as well as research by Piketty and Zucman (2014) household wealth comprises all non-financial assets (such as real estate, land, and buildings) and financial assets (including equities, bonds, bank deposits, life insurance, and pension funds) over which households can assert ownership rights that yield economic benefits, minus any debts. Essentially, wealth encompasses all assets and liabilities measured at current prices.

While the theoretical relationship between income inequality and wealth inequality lacks extensive exploration in the literature, a closer examination of micro-level data suggests that these variables may not closely related, and their distributions may be driven by distinct processes.

Figure 1: Income Gini and Wealth Gini Distributions



Income inequality can often be explained by factors such as financial development, financial liberalization (as discussed in the previous section of the literature), GDP per capita, education, occupation, and other socioeconomic factors. However, wealth distribution, according to current literature, appears to be less dependent on these characteristics. One notable difference between the distributions lies in their concentration levels. Wealth distribution tends to be much more concentrated than income distribution. This disparity arises from the types of assets individuals possess, with only the upper segment of the population, as measured by total income terms, typically having access to the assets that constitute wealth.

Using a sample spanning from 1984 to 1994, Smith (2001) argues that increasing income inequality may not significantly impact wealth distribution. This argument stems from the observation that income changes occurring below the median income level are unlikely to affect wealth distribution, as individuals in this segment typically do not hold any assets. Moreover, even if individuals in the upper median income range experience an increase in income, it is uncertain whether they will save or invest the additional income, as saving behavior is not always linear. Additionally, income disparities are often temporary rather than permanent. Smith's data suggests that despite income increases, individuals may not necessarily increase their savings. Furthermore, wealth inequality is expected to rise less than income inequality (given a change in income), as only a portion of the additional income is likely to be invested. Examining percentiles, Smith notes a much greater dispersion in wealth compared to the dispersion associated with any change in income, suggesting that factors beyond income

contribute to wealth inequality, particularly in the tail of the distributions. Additionally, Durand and Martin (2015) analyze data from the OECD's wealth inequality database, focusing on 18 OECD countries. They discover that while countries with high income inequality tend to exhibit high levels of wealth inequality, the statistical relationship between the two tends to be weak. This observation is further reinforced by Benhabib, Bisin, and Luo (2017), who provide both theoretical insights and empirical evidence to support this notion. Similarly, Osakwe and Solleder (2023) do not find robust evidence supporting a relationship between wealth and income inequality.

Contrary to this view, our preliminary regression analysis of the data, examining the relationship between wealth inequality, as measured by the Gini coefficient, and income inequality, suggests a potential correlation between the two indicators. While this does not constitute a definitive exploration of their relationship, the observed trend points to a possible connection worthy of further investigation. A comprehensive examination would require additional variables to fully understand the underlying factors shaping these distributions. Our model has the form:

$$WealthGini_{i,t} = \delta IncomeGini_{i,t} + u_{i,t}$$

Where

$$u_{i,t} = \mu_i + \varepsilon_{i,t}$$

Table 1: Wealth Inequality and Income Inequality

Variables	(1)	(2)	(3)
	Pooling	Fixed Effects	Random Effects
Income Gini	0.5*** (0.26)	0.21*** (0.09)	0.23*** (0.08)
Observations	433	433	433
R-squared	0.45	0.45	0.45

Robust standard errors in parentheses. Standard errors clustered at the country level.

*p<0.1, **p<0.05, ***p<0.01

Figure 2: Wealth Gini vs Income Gini, source: World Inequality Database



2.3 Financial Assets and Wealth Distribution

According to Smith, the factor that seems to be of central importance in shaping wealth distribution rather than income inequality, is the ownership of financial assets which can experience substantial fluctuations in value. This idea is further supported by Kuhn, Schularick, and Steins (2017), who not only provide evidence supporting the main driving factors of wealth inequality but also advance the understanding of the process.

By examining microdata from the US spanning from 1949 to 2013, they find that financial assets not only influence the distribution through their returns, but they also highlight the importance of individual portfolios and the heterogeneity of investors in shaping the distribution. Individuals in the upper 10% of the wealth distribution tend to allocate a larger portion of their investments to equity and other financial assets (as discussed further in the next section and the analysis of derivatives). These individuals are more financially sophisticated, diversifying their investments and maintaining lower levels of leverage compared to their counterparts in the middle of the distribution. On the other hand, the middle class, as characterized by the interquartile range (between the 25% and 75% of the population), often invests in equity through housing.

However, they lack diversification, typically holding only one asset—their home—and they are highly leveraged. This lack of diversification and high leverage can lead to significant fluctuations, particularly during financial crises. Based on the previous analysis, and despite the inconclusive literature on the relationship between income inequality and wealth inequality, the factor that emerges as a significant influence on the observed dispersion of wealth is the performance of equity markets and the returns they generate. Equity market performance plays a pivotal role in shaping wealth distribution, as individuals' investment returns can greatly impact their accumulation of wealth. This connection suggests that fluctuations in equity market performance may directly translate into variations in wealth inequality, emphasizing the importance of understanding market dynamics in the broader context of economic disparities.

2.4 Derivatives, Financial Markets and Real Economic Variables

Exchange-traded and Over-the-Counter derivatives have undergone significant expansion in the past decade. Their nominal value is estimated to be approximately \$715 trillion dollars (BIS, June 2023). They have gained increasing popularity among investors, driven by their diverse range of advantages. However, derivatives also carry inherent risks, as they allow investors to assume highly leveraged positions, leading to potentially substantial gains or losses, if market conditions move unfavorably.

This illustrates the dual nature of these instruments. On one hand, the hedging aspect enables the transfer of risk to less risk-averse agents, thereby enhancing financial sector stability and promoting growth (King and Levine, 1993). On the other hand, the potential for high rewards also encourages speculation in both derivatives and the underlying asset market, potentially leading to disruptions and inefficient allocation of resources (Tobin, 1984).

Economic liberalization, as described in the previous section, also fosters the use of derivatives by giving rise to new investment and insurance vehicles, such as pension funds, insurance companies, and hedge funds (Haiss and Summer, 2010). They note that the traditional finance sector, particularly the banking system, appears to be declining in relative value. At the same time, Rousseau and Wachtel (2009) demonstrate that the link between economic growth and finance is weakening. Although the relationship between macroeconomic variables and

economic growth remains unclear, Vo et al. (2019) suggest that there may be a connection between derivatives and macroeconomic variables, particularly for advanced economies.

Derivatives appear to exert influence on a range of real variables, as the establishment of a derivatives exchange (exchange-traded derivatives) introduces three crucial properties affecting real variables (Rodrigues, Schwarz, and Seeger, 2012). Following the arguments of Merton and Bodie (1995), derivatives impact the real economy through the individual firm channel, by facilitating efficient capital allocation and by reducing volatility in macroeconomic variables.

Additionally, Stulz (2004) supports the perspective that derivatives are not redundant assets, contrary to the common view in finance literature. The notion that derivatives are redundant assets stems from the theoretical possibility of replicating the payoff of a derivative product with a portfolio of other financial products. However, in practice, individuals and non-financial firms encounter significant transaction costs. Replicating portfolios often require a considerable number of trades to achieve cash-flow replication, and designing such portfolios is not as straightforward as depicted in financial literature. Many products demand highly sophisticated designs based on the accurate definition of underlying price dynamics, information, and knowledge that may not be readily available to every investor in the market.

Furthermore, we have ample evidence of the effects that derivatives can have when they are not used appropriately, as demonstrated by examples such as Long-Term Capital Management, Enron, and Barron's, as well as the systemic effects witnessed in the most recent financial crisis. Drawing from this literature and the key ideas described, it is undeniable that derivatives, given their significant role in the economy through both hedging and speculative activities, are likely to have distributional effects as well.

3. Data and methodology

3.1 Wealth Inequality

For the measurement of wealth inequality, we rely on the Wealth Gini as measured by the World Inequality Database (WID). The wealth distribution is constructed by the researchers at WID as an extension of their comprehensive database of income inequality data. This distribution is derived from tax data and inheritance data, following the methodology outlined by

Atkinson and Harrison (1974). The result is a panel dataset covering data for most countries spanning from 1800 to 2022, providing a wide range of observations to inform our methodological approach. Although we considered using the Credit Suisse Wealth reports, as utilized by Hasan et al. (2020), we opted for the WID database due to its broader coverage of years. The Credit Suisse reports, while comprehensive, do not span as many years as the WID database. Utilizing the WID database ensures that we have access to a more extensive dataset, which is particularly advantageous given the relatively limited availability of derivatives data.

We utilize the Gini coefficient as a measure ranging from 0 to 1, with 0 indicating full equality and 1 representing complete inequality. It's important to note that there are several other methods to measure wealth inequality, each with its own benefits and drawbacks that we must consider when analyzing our results. One significant limitation of the Gini coefficient is that it does not provide insight into changes in wealth within different quartiles of the population. However, it serves as a useful summary measure that can be easily applied in our econometric modeling, effectively capturing the concept of wealth dispersion across the entire population.

3.2 Derivatives

Our variable of interest is the nominal value of derivatives, and we approximate their effect using data from the exchange-traded derivatives provided by the Bank for International Settlements (BIS). Derivatives can be classified into two categories: exchange-traded derivatives and over-the-counter (OTC) derivatives.

According to the BIS report from 2023, the notional amount of over-the-counter (OTC) derivatives stands at approximately \$650 trillion, significantly exceeding the comparatively lower value of exchange-traded derivatives, estimated to be in the range of \$100-150 trillion. However, one of the challenges we encountered was selecting the appropriate variable for derivatives. While OTC derivatives are often associated with destabilizing, leveraging, and speculative roles in the economy, given their low degree of regulation and poor reporting, obtaining data posed a significant challenge. Only banks in G10 countries are required to report their derivatives holdings to the Bank for International Settlements, and this reporting occurs only every three years. Additionally, the accounting techniques and reporting methods for derivatives are often unclear (Borio et al., 2022). On the contrary, exchange-traded derivatives

are reported to the Bank for International Settlements (BIS), and since the contracts are standardized and publicly available through exchanges, they serve as a better proxy for the use of derivatives in an economy. Despite the limited availability of longitudinal data, the estimated correlation between exchange-traded derivatives and over the counter (OTC) derivatives yields a coefficient of 0.51, providing a reasonable basis for employing this proxy. Furthermore, when considering only interest-rate derivatives, for which the OTC dataset offers a richer (but still limited) set of observations, we observe a higher correlation of 0.71. This strong relationship underscores the potential utility of using exchange traded derivatives as a reliable indicator in our analysis.

Another benefit of this choice is the categorization per currency, which we matched to the appropriate country. While many market participants may seek exposure to different countries and markets through the derivatives market, we find this choice reasonable, as we will control for capital inflows, financial openness, and capital liberalization in our model. The variable we are using is the turnover notional amount of exchange-traded derivatives expressed in US dollars for all interest-rate and foreign exchange derivatives, as reported in the Bank for International Settlements from 2001 to 2021.

3.3 Explanatory Variables

As for the financial development index, we follow the main literature suggesting that financial development can be measured by private credit divided by GDP. This measure excludes factors that could influence the approximation, such as credit to the central bank or development banks. Another advantage of this measure is that, unlike M2 divided by GDP, for example, it specifically measures the channel of society's savings to private sector projects (Beck et al., 2007; de Haan, 2017).

For financial liberalization, we utilize data from the Fraser Institute, an independent research institute that collects data on various dimensions of financial liberalization. While many studies on financial liberalization and income inequality use the Abiad et al. (2005) index, we have opted to use a different index proposed by de Haan (2017). This decision is taken since the Abiad index covers values for the period from 1973 to 2005, which excludes a significant portion

of our dataset. Additionally, the significant growth of derivatives occurred after this period. De Haan constructs an index using four variables from the Fraser Institute. We will employ the same index but will also decompose it into its four parts to ascertain which individual aspects of financial liberalization are more influential.

The index comprises four variables: freedom to own foreign currency bank accounts, black market exchange rates, financial openness (foreign ownership/investment restrictions), and credit market regulations (ownership of banks, private sector credit, and interest rate controls). Each variable is getting values from 0 to 10, with 10 indicating complete freedom and 0 indicating the opposite. The total financial liberalization index proposed by de Haan (2017) has a maximum score of 40, with each dimension equally weighted. It's important to note that a high score in one dimension does not necessarily imply a high score in all others.

For our control variables, we use the stock market divided by GDP as a measure of stock market size and returns, which as we discussed in the previous section is a significant factor of wealth inequality. We also include foreign direct investments (as a percentage of GDP) and trade (net exports as a percentage of GDP) to control international capital movements that may influence the derivatives market behavior. Also, according to literature, (Brie et al., 2023, Adao et al., 2022) they are important determinants of inequality. Data for these variables are obtained from the World Development Indicators (WDI) database of the World Bank.

Table 2: Correlation matrix

	Der	FD	FL	FO	CMR	BM	FCBA	SM	Trade	FDI
Der	-									
FD	0.43	-								
FL	0.21	0.55	-							
FO	0.22	0.42	0.88	-						
CMR	0.05	0.35	0.58	0.39	-					
BM	0.05	0.21	0.16	-0.07	0.33	-				
FCBA	0.20	0.53	0.88	0.65	0.32	0.21	-			
SM	0.008	0.46	0.17	0.10	0.24	0.06	0.13	-		
Trade	-0.18	0.04	0.24	0.16	0.28	0.12	0.14	0.76	-	
FDI	-0.08	0.12	0.17	0.20	0.13	0.03	0.17	0.43	0.57	-

Table 3: Variable Statistics

Variable		Mean	Std.dev.	Min.	Max.	Observations
Wealth Gini	overall	0.79	0.082	0.62	1.06	N=304
	within		0.078			n=16
	between		0.022			T=19
Income Gini	overall	0.55	0.11	0.32	0.75	N=304
	within		0.1			n=16
	between		0.02			T=19
Derivatives	overall	328961.8	1037812	1	6817889	N=304
	within		757178.9			n=16
	between		583398.1			T=19
Financial Liberalization	overall	34.81315	5.79	13.94861	40	N=304
	within		5.83			n=16
	between		1.96			T=19
Financial Development	overall	106.134	57.32	12.24098	258.9028	N=304
	within		53.84			n=16
	between		20.88			T=19

3.4 Econometric Modelling

Given the panel nature of our data, we are modelling the wealth inequality index as a dynamic panel model. The model that we are implementing is:

$$WealthGini_{i,t} = \delta Derivatives_{i,t-1} + \beta_1 FinancialDevelopment_{i,t-1} + \beta_2 FinancialLiberalization_{i,t-1} + \beta_3 X_{i,t} + u_{i,t}$$

Where $u_{i,t} = \mu_i + \varepsilon_{i,t}$

We're employing an unbalanced panel because derivatives exchanges became available in different years across countries. Some countries got earlier access to financial derivatives markets than others. The development of the markets is also accounted for in the Financial Development variable. Our dependent variable is the wealth Gini index. Derivatives represent the nominal value of exchange-traded interest-rate and foreign exchange derivatives, while Financial Development is measured by Private Credit to GDP. Financial Liberalization is quantified as the sum of the four variables described earlier. Additionally, our controls encompass Stock Market values as a percentage of GDP, FDI as a percentage of GDP, and Trade. There are three main reasons that we are using lagged independent variables for the study of wealth inequality. Firstly, derivatives typically redistribute wealth in the future. Market participants often gain access to derivatives to acquire monetary outcomes or physical assets at a later date. Secondly, the effects of Financial Development and Financial Liberalization, as defined earlier, take time to materialize in the economy. The third reason is about the econometric modelling. Many of our variables may be endogenous in nature. We contemplated using an Arellano-Bond (1992) or a Blundell-Bond estimator (1998), which would involve including the wealth Gini of the previous period as a dependent variable. However, the highly persistent nature of the dependent variable, coupled with the small sample size at our disposal, could lead to biased estimates. While there is no consistent theory to define which variables are endogenous, we cannot entirely exclude this possibility empirically. By employing the lagged dependent variables, we expect to deal with endogeneity up to a particular degree but is still a potential issue. Therefore, we opt to implement the dynamic within-estimator fixed effects model, controlling for country fixed-effects. This approach accounts for the influence of a country's social, economic, and financial conditions on the development of wealth inequality and access to financial and derivatives markets.

For robustness, we will also implement the random effects estimator and we will add an additional Housing Price Index control variable. We will also explore alternative dependent variables to assess wealth inequality. This approach aims to provide a more nuanced understanding of wealth distribution by capturing different dimensions of inequality. By incorporating a variety of measures, we can gain deeper insights into the factors influencing wealth disparities and improve the robustness of our analysis. The errors that are reported in the parentheses are the corrected for heteroscedasticity and autocorrelation robust standard errors.

4. Main results

Our results tables are set as it follows. For table 4 we show the estimations without the control variables except for the last column that all variables are included. First, we show the effects that each individual variable has on wealth inequality, starting with the derivatives value, then financial development and then financial liberalization as defined by de Haan (2017), (Fraser institute index). In the last column the complete model estimation is presented. In the last column of table 4, we include the control variables. For table 5 we decompose the financial liberalization index into four parts, financial openness, credit market regulation, black market exchange rate, and foreign currency bank accounts. The way that we present the results is similar to our prior analysis.

The results indicate that the effect of financial derivatives is in the vast majority of cases statistically significant and positive on wealth inequality, amplifying the large effect that the stock market valuation has according to theory. Contrary to observations on income inequality, financial development does not appear to influence wealth inequality positively, as indicated by de Haan (2007), or negatively, as suggested by Bumann and Lensik (2016); rather, it seems to have no discernible effect on wealth inequality. The primary determining factors appear to lie within the realm of financial instruments rather than the depth of the market or to the private credit provided from the banking sector, highlighting the importance of financial market dynamics. On the contrary, our analysis indicates that financial liberalization, when measured as an index, seem to align with the findings of Bumann and Lensink (2015) in the main model, and it emerges as a determining factor of wealth inequality. It is essential to consider the fundamental distinctions between income inequality and wealth inequality, along with the tenuous link that connects them, as outlined in section 2.

Another significant finding is that upon decomposing financial liberalization, we discover that only holding bank accounts in foreign currency is statistically significant in every case, exerting a positive effect on wealth distribution. Additionally, it's crucial to examine our control variables. Stock market valuation relative to GDP, trade as a proportion of GDP, and FDI as a percentage of GDP positively influence wealth inequality and also account for a significant

portion of wealth variation. This aligns with the theoretical analysis in section 2, where the stock market is shown to increase wealth inequality (Smith), FDI is considered to be a statistically significant measure of capital flow (Brie et al., 2023), and trade having a positive effect on inequality (Adao et al., 2022).

Table 4: Derivatives and Wealth Inequality: fixed effects panel estimates (dependent variable Wealth Gini), Frazer Liberalization Index

Variables	(1)	(2)	(3)	(4)	(5)
Derivatives	5.92e-09*** (1.71e-09)			2.49e-09 (1.59e-09)	2.76e-09** (1.02e-09)
Financial Development		3.89e-04 (2.51e-04)		3.63e-04 (2.61e-04)	1.43e-04 (1.72e-04)
Financial Liberalization			1.95e-03*** (6.14e-04)	1.66e-03*** (5.19e-04)	1.66e-03*** (7.52e-04)
Stock market					5.85e-05*** (1.25e-05)
Trade					5.18e-04*** (9.12e-05)
FDI					1.4e-04*** (2.9e-05)
Observations	410	271	271	271	254
R-squared	0.037	0.08	0.02	0.1	0.36

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *p<0.1, **p<0.05, ***p<0.01

Table 5: Derivatives and wealth inequality: fixed effects panel estimates (dependent variable wealth Gini), decomposed liberalization index

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Derivatives	2.00e-09 (1.44e-09)	3.72e-09*** (5.41e-10)	2.53e-09** (1.03e-09)	2.1e-09* (9.81e-010)	2.51e-09** (1.04e-09)	2.59e-09** (1.00e-09)	2.24e-09** (1.02e-09)
Financial Development	3.4e-04 (3.1e-04)		1.5e-04 (1.8e-04)	1.14e-04 (1.95e-04)	1.57e-04 (1.8e-04)	1.3e-04 (1.7e-04)	9.25e-05 (2.1e-04)
Financial Openness	9.09e-04 (1.8e-03)	2.4e-03* (1.1e-03)	5.6e-04 (9.7e-04)				1.23e-04 (1.8e-03)
Credit Market Regulation	-2.5e-03 (3.7e-03)	-4.1e-03 (2.9e-03)		-4.4e-03 (2.8e-03)			-3.6e-03 (3.1e-03)
Black Market Exchange rate	-8.2e-03 (0.01)	3.9e-03 (4.4e-03)			-1.2e-03 (4.2e-03)		(-4.5e-03) (0.01)
Foreign Currency Bank Account	3.1e-03*** 4.3e-04	3.1e-03*** (4.4e-03)				3.5e-03*** (2.77e-04)	3.3e-03 (3.6e-04)
Stock market			5.8e-05*** (1.27e-05)	6.1e-05*** (1.3e-05)	5.78e-05*** (1.26e-05)	5.79e-05*** (1.16e-05)	6.1e-05*** (1.4e-05)
Trade			5.2e-04*** (8.3e-05)	5.2e-04*** (8.53e-05)	5.25e-04*** (8.63e-05)	5.4e-04*** (8.6e-05)	5.2e-04*** (8.26e-05)
FDI			1.47e-04*** (2.8e-05)	1.43e-04*** (2.6e-05)	1.48e-04*** (2.73e-05)	1.33e-04*** (2.9e-05)	1.29e-04*** (2.8e-05)
Observations	271	271	254	254	254	254	254
R-squared	0.11	0.07	0.35	0.37	0.35	0.39	0.39

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, ** p<0.05, *p<0.01

5. Sensitivity analysis

5.1 Random effects estimation

All our analyses up to this point have been conducted using a dynamic panel fixed effects model, controlling for country fixed effects. In this section, we adopt a similar approach as Clarke et al. (2006), who argue that fixed effects may remove a significant amount of cross-country variation, and thus advocate for the use of random effects. Since the Hausman test

sometimes fails to clearly indicate which model should be used, we also apply the random effects model to assess the sensitivity of our results to the estimation methodology. We present our results in a manner consistent with the previous section. Interestingly, the results obtained using the random effects model align closely with those obtained using the fixed effects model. This suggests that our estimation and interpretation of the results is robust and not dependent on the choice of estimation method.

Table 6: Derivatives and wealth inequality: random effects estimation (dependent variable wealth Gini)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Derivatives	2.85e-09*** (1.06e-09)	2.39e-09** (1.00e-09)	2.89e-09*** (1.03e-09)	2.35e-09** (1.00e-09)	2.5e-09** (1.00e-09)	3.00e-09*** (1.00e-09)
Financial Development	1.28e-04 (1.74e-04)	8.76e-05 (1.85e-04)	1.07e-04 (1.65e-04)	7.78e-05 (1.97e-05)	7.75e-05 (1.81e-04)	1.19e-04 (1.68e-04)
Financial Openness	2.46e-04 (1.04e-03)			9.93e-04 (1.45e-03)		
Credit Market Regulation		-4.94e-03* (2.73e-03)		-5.25e-03* (3.1e-03)	-3.88e-03 (2.87e-03)	
Black Market Exchange rate						
Foreign Currency Bank Account			3.15e-03*** (4.89e-04)		2.82e-03*** (4.82e-04)	
Financial Liberalization (Fraser)						1.16e-03 (8.74e-04)
Stock market	6.24e-05*** (1.06e-05)	6.56e-05*** (1.09e-05)	6.22e-05*** (9.86e-06)	6.64e-05*** (1.21e-05)	6.46e-05*** (1.06e-05)	6.26e-05*** (1.05e-06)
Trade	4.22e-04*** (7.84e-05)	4.21e-04*** (8.1e-05)	4.37e-04*** (8.46e-05)	4.22e-04*** (7.68e-05)	4.42e-04*** (8.22e-05)	4.2e-04*** (8.38e-05)
FDI	1.52e-04*** (3.57e-05)	1.48e-04*** (3.7e-05)	1.39e-04*** (8.46e-05)	1.45e-04*** (3.86e-05)	1.36e-04*** (3.19e-05)	1.47e-04*** (3.43e-05)
constant	7.3e-01*** (2.6e-02)	7.7e-01*** (3.86e-02)	7.05e-01*** (2.68e-02)	7.72e-01*** (3.7e-02)	7.44e-01*** (3.96e-02)	6.9e-01*** 3.37e-02
Observations	254	254	254	254	254	254
R-squared	0.35	0.36	0.38	0.37	0.39	0.36

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, **p<0.05, *p<0.01

5.2 Housing Index and Inequality

In our analysis, we included the Housing Price Index as a potential determinant of wealth inequality, given the importance of housing as an asset for middle-class households, particularly those within the interquartile range. For many households, housing is their primary or sole asset, and fluctuations in housing prices could significantly impact middle-class wealth. However, our results indicate that fluctuations in housing prices do not significantly affect wealth inequality, as measured by the Wealth Gini coefficient. This could be due to offsetting effects between housing price fluctuations for middle-class households and fluctuations in business equity—the main asset of wealthy households. These competing dynamics may neutralize each other, leading to minimal net impact on wealth distribution.

Table 7: Derivatives and wealth inequality: estimations including Housing Price Index (dependent variable wealth Gini)

Variables	(1) Fixed Effects	(2) Fixed effects	(3) Random Effects	(4) Fixed effects	(5) Random Effects	(6) Fixed Effects
Derivatives		3.24e-09* (1.6e-09)	3.60e-09* (1.98e-09)	2.99e-09* (1.56e-09)	3.66e-09* (2.09e-09)	3.01e-09* (1.46e-09)
Financial Development		-1.22e-04 (1.8e-04)	-1.7e-04 (1.65e-04)	-1.61e-04 (1.98e-04)	-2.13e-04 (2.39e-04)	-1.64e-04 (1.88e-04)
Financial Openness				-4.35e-04 (3.2e-03)	-2.99e-03 (4.81e-03)	
Credit Market Regulation				-2.7e-03 (4.05e-03)	-3.38e-03 (4.53e-03)	-2.77e-03 (3.37e-03)
Black Market Exchange rate				-4.2e-03 (1.8e-02)	-1.56e-02 (2.69e-02)	
Foreign Currency Bank Account				2.41e-03*** (7.26e-04)	6.21e-04 (1.21e-03)	2.42e-03 (8.83e-04)
Financial Liberalization (Fraser)		4.58e-04 (1.14e-03)	-7.73e-04 (1.36e-03)			
Stock market		6.51e-05* (3.52e-05)	7.73e-05 ** (3.63e-05)	4.86e-05 (3.08e-05)	7.33e-05** (3.48e-05)	5.02e-05 (2.89e-05)
Trade		5.44e-04 (3.97e-04)	3.74e-04 (2.6e-04)	5.15e-04 (4.63e-04)	2.86e-04 (3.51e-04)	5.05e-04 (4.22e-04)
FDI		1.18e-04* (6.68e-05)	9.4e-05 (6.02e-05)	8.93e-05 (5.83e-05)	5.69e-05 (5.3e-05)	8.95e-05* (4.68e-05)
Housing Price Index	1.6e-04 (1.39e-04)	1.69e-04 (2.08e-04)	1.96e-04 (1.74e-04)	2.06e-04 (2.47e-04)	2.43e-04 (2.12e-04)	2.02e-04 (1.84e-04)
constant			7.81e-01*** (4.76e-02)		9.75e-01*** (2.52e-02)	
Observations	258	215	215	215	215	215
R-squared	0.03	0.08	0.07	0.12	0.09	0.11

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, ** p<0.05, *p<0.1

5.3 Effect of Foreign Exchange and Interest-Rate derivatives on Wealth Inequality Individually

Next, we analyze the individual impacts of different types of derivatives on wealth inequality. The derivative proxy utilized in our analysis encompasses two primary categories of derivatives, sourced from the Bank for International Settlements database: foreign exchange derivatives and interest-rate derivatives. These types are among the most prevalent derivatives in the global market. In Table 8, we examine the effects of these two categories on wealth inequality while controlling for key factors such as financial development, financial liberalization, stock market returns, trade, foreign direct investment (FDI) and country fixed-effects. Our findings reveal that both foreign exchange and interest-rate derivatives exert a positive influence on wealth inequality, aligning with our main results. These outcomes suggest that the use of these derivatives can exacerbate disparities in wealth distribution. For robustness, we also employed a random effects model, which supports the consistency of our results.

Interestingly, in this analysis, financial liberalization emerges as a significant factor in shaping wealth distribution. However, the varying outcomes observed in the initial phase of our study, combined with mixed findings in the literature, leave the precise impact of financial liberalization on wealth inequality ambiguous. Further investigation is required to determine the specific mechanisms and conditions under which financial liberalization influences wealth inequality.

5.4 Effect of Futures and Options on Wealth Inequality Individually

We investigate the impact of various types of derivatives on wealth inequality, focusing on the distinct mechanisms and accessibility of futures and options. Options grant the buyer the right, but not the obligation, to buy or sell a specific asset in the future at a predetermined price, contingent upon paying a premium. Conversely, futures contracts obligate the buyer or seller to purchase or sell a specific asset on a future date at a predetermined price, requiring the investor to provide a margin.

The decision to choose one instrument over the other depends on various factors, highlighting the unique characteristics of each derivative. Our results reveal that futures contracts

significantly influence wealth inequality, irrespective of whether we examine forex or interest rate instruments. In contrast, only forex options appear to be affecting the distribution while the total options, regardless of the asset class, do not show statistical significance.

Futures emerge as the primary driver of wealth inequality, with their substantial volume in our dataset compared to options, which are less prevalent across many exchanges and currencies. Despite these differences, statistical significance of derivatives, particularly futures, in our estimation persists.

Table 8: Foreign Exchange, Interest-rate derivatives and Wealth Inequality (dependent variable Wealth Gini)

Variables	(1) Fixed Effects	(2) Random Effects	(3) Fixed Effects	(4) Random Effects
Foreign Exchange Derivatives	2.25e-07*** (4.46e-08)	2.37e-07*** (5.25e-08)		
Interest Rate Derivatives			2.63e-09** (1.04e-09)	2.87e-09*** (1.1e-09)
Financial Development	1.21e-04 (1.71e-04)	9.81e-05 (1.67e-04)	1.44e-04 (1.72e-04)	1.21e-04 (1.68e-04)
Financial Liberalization (Fraser)	1.64e-03** (6.46e-04)	1.16e-03 (7.64e-04)	1.65e-03** (7.54e-04)	1.16e-03 (8.76e-04)
Stock market	5.99e-05*** (1.24e-05)	6.38e-05*** (1.05e-05)	5.84e-05*** (1.25e-05)	6.26e-05*** (1.05e-05)
Trade	5.08e-04*** (8.95e-05)	4.16e-04*** (8.14e-05)	5.18e-04*** (9.12e-05)	4.2e-04*** (8.38e-05)
FDI	1.39e-04*** (2.87e-05)	1.46e-04*** (3.41e-05)	1.4e-04*** (2.9e-05)	1.47e-04*** (3.43e-05)
constant		6.91e-01*** (3.13e-02)		6.9e-01*** (3.38e-02)
Observations	254	254	254	254
R-squared	0.38	0.38	0.36	0.36

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, ** p<0.05, *p<0.1

Table 9: Derivatives and wealth inequality: Futures and Options

Variables	(1) (Forex Futures)	(2) (Forex Options)	(3) (Interest Rate Futures)	(4) (Interest Rate Options)	(5) (Total Futures)	(6) (Total Options)
Derivatives	2.36e-07*** (5.96e-08)	1.09e-06*** (1.00e-09)	3.9e-09*** (1.33e-09)	3.02e-09 (4.72e-09)	3.81e-09*** (1.33e-09)	3.69e-09 (4.59e-09)
Financial Development	1.61e-04 (1.84e-04)	1.19e-04 (1.71e-04)	1.5e-04 (1.79e-04)	1.6e-04 (1.8e-04)	1.86e-04 (1.85e-04)	1.59e-04 (1.8e-04)
Financial Liberalization (Fraser)	3.33e-04 (9.69e-04)	7.53e-06 (9.76e-04)	5.6e-04 (9.7e-04)	5.6e-04 (9.7e-04)	1.78e-04 (9.53e-04)	5.6e-03 (9.73e-04)
Stock market	5.64e-05*** (1.25e-05)	5.95e-05*** (1.22e-05)	5.84e-05*** (1.25e-05)	5.83e-05*** (1.28e-05)	5.46e-05*** (1.23e-05)	5.83e-05*** (1.28e-05)
Trade	5.32e-04*** (8.42e-05)	5.31e-04*** (8.29e-05)	5.21e-04*** (8.4e-05)	5.19e-04*** (8.35e-05)	5.46e-04*** (8.53e-05)	5.19e-04*** (8.35e-05)
FDI	1.46e-04*** (2.78e-05)	1.41e-04*** (2.81e-05)	1.47e-04*** (2.79e-05)	1.48e-04*** (2.78e-05)	1.47e-04*** (2.78e-05)	1.48e-04*** (2.78e-05)
Observations	234	254	254	254	234	254
R-squared	0.38	0.37	0.35	0.35	0.36	0.35

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, **p<0.05, *p<0.1

5.5 Different measures of wealth inequality

In the final part of our sensitivity analysis, we examine alternative measures of wealth inequality beyond the Gini coefficient. We explore three measures: the share of total wealth held by the top 1% of the distribution, the share held by the bottom 50%, and the share held by the top 10%. Using data from the World Inequality Database, we analyze how financial derivatives affect these different portions of the wealth distribution, controlling for country fixed effects.

First, financial derivatives significantly influence the wealth distribution across all parts of the spectrum. In particular, derivatives play a substantial role in shaping the trajectory of wealth ownership for the top 1%, with a stronger impact observed in this segment of our analysis. Interestingly, financial liberalization gains statistical significance in this context, while the size of the stock market no longer has a notable effect. This may suggest that once

individuals reach a certain level of wealth, such as the top 20%, access to stock market equity becomes ubiquitous, and financial sophistication through derivatives becomes a key differentiator.

Similar trends are observed for the top 10%, where derivatives uniquely contribute to the accumulation of wealth in this decile. For the bottom 50% of wealth holders, the effects are inversely related: the use of derivatives reduces the share of wealth they possess. Additionally, stock market activity appears insignificant for this group, while trade and foreign direct investment further diminish their wealth share. These findings suggest that derivatives may serve as a mechanism for wealth transfer from the lower to upper segments of the distribution.

While the findings seem align with economic intuition, the theoretical underpinnings of these behaviors require a deeper examination of the role of derivatives within the modern economy and financial system. The development of complex derivatives markets over the last few decades has reshaped the landscape of finance, offering sophisticated instruments for risk management, hedging, and speculation. These markets have become integral to the financial system, providing liquidity and facilitating transactions across borders.

However, the expansive growth and complexity of derivatives markets have also contributed to increased financialization and interconnectedness. This may amplify systemic risks and create channels for wealth concentration and transfer, particularly favoring the upper tiers of the wealth distribution. Such dynamics could reinforce existing disparities and alter the traditional functions of finance in ways that impact wealth inequality.

Given these complexities, a comprehensive analysis of derivatives' influence on wealth distribution should consider how these instruments interact with other facets of the financial system, including regulation and global financial flows. By deepening our understanding of these relationships, we can better grasp the broader economic and social implications of derivatives and their role in shaping wealth distribution.

Table 10: Derivatives and Wealth Inequality (alternative wealth inequality measures)

Variables	(1) Fixed Effects P99	(2) Fixed Effects P50	(3) Fixed Effects P90
Derivatives	7.65e-09*** (8.96e-10)	-5.66e-09*** (3.28e-10)	7.7e-09*** (7.29e-10)
Financial Development	-5.1e-06 (1.45e-04)	-3.67e-05 (5.4e-05)	-2.49e-05 (1.05e-04)
Financial Liberalization (Fraser)	3.09e-03*** (9.49e-04)	-6.35e-05 (7.68e-04)	4.53e-04 (9.86e-04)
Stock market	1.7e-05 (1.3e-05)	7.44e-07 (1.35e-05)	2.2e-05 (2.54e-05)
Trade	5.26e-04** (2.04e-04)	-1.75e-04*** (1.34e-04)	2.19e-04 (1.97e-04)
FDI	2.19e-04*** (5.66e-05)	-1.87e-04*** (1.94e-05)	1.49e-06 (4.63e-05)
Observations	254	254	254
R-squared	0.27	0.13	0.1

Notes: Country fixed effects included. Robust standard errors in parentheses. Standard errors clustered at the country level. *** p<0.01, **p<0.05, *p<0.1

6. Conclusion

Our findings indicate that financial derivatives exert a positive influence on wealth inequality, as measured by the Gini coefficient. However, factors that were previously significant in explaining income inequality, such as financial development, does not appear to have any effect on the distribution of wealth.

While there is no consistent theoretical framework to explain these results, our analysis suggests that a significant portion of wealth inequality variation is attributable to financial markets, particularly financial derivatives and the stock market. By looking in several dimensions of derivatives such as the underlying asset or the type of the instrument, we obtain consistent results. Additionally, trade and foreign direct investments appear to contribute to the increase of

wealth inequality. These findings align with existing literature on wealth inequality, although the precise mechanisms driving wealth distribution remain unclear.

Foreign currency bank accounts, appear to have a positive impact on wealth inequality. Surprisingly, the housing price, despite being a primary asset held by the middle class, does not seem to influence wealth distribution. This finding challenges the common belief that housing prices play a significant role in wealth inequality, particularly considering their lack of diversification for many middle-class households.

A drawback of using the Gini coefficient is its inability to assess wealth distribution across different deciles. By using alternative measures, we start to discern the specific impact of derivatives on wealth distribution in key segments, such as the top 1%, top 10%, and bottom 50%. These findings offer a valuable foundation for further research to explore the underlying mechanisms behind our results.

Another important consideration to note is that our estimation of the Gini coefficient does not account for any distribution policies implemented by governments, as it is calculated before taxes. This approach allows us to isolate the direct impact of derivatives on wealth inequality, independent of government interventions. However, it also highlights the need for future research to explore the relationship between wealth distribution and government policies. As debates surrounding the concentration of wealth at the upper end of the distribution intensify, investigating the role of government interventions in shaping wealth distribution is becoming increasingly pertinent.

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