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Financial development and income inequality: a panel data approach

Sebastian Jauch[1] · **Sebastian Watzka**[1]

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Abstract We analyzed the link between financial development and income inequality for a broad unbalanced dataset of up to 138 developed and developing countries over the years 1960–2008. Using credit to GDP as a measure of financial development, our results reject theoretical models predicting a negative impact of financial development on income inequality measured by the Gini coefficient. Controlling for country fixed effects, possible endogeneity problems, GDP per capita and other control variables, we find that financial development increases income inequality. These results are robust to different measures of financial development, econometric specifications and control variables.

Keywords Financial development · Income inequality · Kuznets curve

JEL Classification O15 · O16

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✉ Sebastian Watzka
sebastian.watzka@econ.lmu.de

Sebastian Jauch
sebastian.jauch@gmx.net

[1] Seminar for Macroeconomics, Ludwig-Maximilians-Universität Munich, Ludwigstr. 28 Rgb, 80539 Munich, Germany

1 Introduction

In the aftermath of the economic crisis of 2008–2009, many public debates were concerned with the benefits and harms of the financial sector for the rest of society. The privatization of banks' profits and the socialization of their losses is a common argument made in political debates in many developed countries. Together with widening income gaps and social inequality in the USA, the UK, Germany and many other countries, this crisis has led to question the contribution of the financial system to the economy and, more generally, to society. The merits of efficient financial systems fall short in being acknowledged by the public as bankers are recognized as highly paid individuals who serve only their own interest. In the view of many economists, there exists a more benign view of the financial sector: Financial markets boost economic growth, enable wealthy as well as poor people to borrow and finance investments and thereby ensure that capital is distributed most efficiently—and, in particular, in a manner unrelated to inherited wealth. Generally speaking, the story goes: When financial markets are more efficient and better developed, a specific borrower can borrow more with a given amount of collateral. This then reduces dependency on inherited wealth. The success of microcredits for the poor in developing countries is just one example of what banks are able to do for society.[1] There are parts of society that were previously unable to borrow and now can build their own businesses, increase income and climb the social ladder. The remaining income inequality would then be optimal or justified in the sense of being independent of inherited wealth.

However, there are also critical voices that have recently been raised. In particular, banks and financial markets are highly criticized for being ruthless in developed countries where almost everybody is supposed to already have access to finance and where rising income inequality has recently become an important problem and issue in the political debate.[2] There is by now increasing evidence that excessive finance is associated with lower economic growth. In fact, Beck et al. (2014) find that too much finance reduces economic growth after some threshold level. This is also supported by Arcand et al. (2012) who find that finance starts having a negative effect on output growth when credit to the private sector reaches 100 % of GDP.

Our study aims to go beyond the finance–growth nexus and empirically assess the link between financial development and the distribution of income in a society. Does financial development always reduce income inequality in a society? Are there important differences across and within countries based on their stage of economic development, or is the influence the same around the world, independent of country characteristics and the time we live in? We analyze the link of financial development and income inequality using standard proxies in the financial development literature, the ratio of private credit over GDP and the Gini coefficient of income distribution within countries.

[1] Demirgüç-Kunt et al. (2009) provide a brief overview of the relation between microfinance and income inequality and also cite studies that do not confirm that microfinance lowers inequality.

[2] See, e.g., the monograph of Wilkinson and Pickett (2011) for an extensive discussion of the problems posed by high and rising inequality for modern economies and societies.

We extend the existing literature by using a larger database covering a longer time horizon and more countries with a measure for gross and net Gini coefficients that are consistent across the entire dataset. We further control for year effects, time-invariant country characteristics and potential endogeneity problems. Finally, we conduct various robustness checks for our benchmark specification. These include a sample split of the dataset into subsamples according to income levels. In contrast to previous empirical work on this topic, we reject theories that predict an income inequality-reducing effect of financial development. This finding is robust over most specifications. Due to these more general and robust findings, we believe that our work is of importance to the literature and the profession.

While investigating the link of financial development and income inequality, we do not judge or examine whether there exists an optimal or fair level of inequality. On the one hand, higher levels of inequality may have boosting effects on an economy from an incentive point of view. On the other hand, excessive inequality may also lead to inefficient outcomes as social mobility might be reduced and eventually might lead to social unrest and political instability.

The remainder of this study is structured as follows: Sect. 2 presents an overview of related literature and what we contribute to the literature. Section 3 describes the data used in our work. In Sect. 4, we conduct the econometric analysis, Sect. 5 presents our robustness tests, and Sect. 6 concludes.

2 Overview of related literature

Our work adds to the literature on financial development, income inequality and economic development. There is an extensive literature on the link between financial development and growth. A good overview of theoretical as well as empirical work on this issue has been provided by Levine (2005). In general, financial development is expected to enhance growth by enabling the efficient allocation of capital and reducing borrowing and financing constraints. While this is still the mainstream view within the economics profession, there is by now some empirical evidence that there might be some optimal threshold level of financial development, in the sense that excessively large financial sectors can reduce economic growth because of inefficient rent-seeking activities that are in fact distracting resources from other more productive activities (Arcand et al. 2012).

However, this literature does not address the issue of which part of society benefits from the growth enabled by financial development. Growth may benefit the poor by creating more employment opportunities, but it may also favor entrepreneurs and their profit margin. The relationship between the distribution of income and economic development was initially investigated by Kuznets (1955), who established the inverted U-shaped path of income inequality along economic development—the well-known Kuznets curve. Kuznets' argument was that rural areas are more equal and have a lower average income compared with urban areas in the beginning of industrialization and thus that through urbanization a society becomes more unequal. When a new generation of former poor rural people who moved to cities is born, they are able to profit from the urban possibilities. Wages of lower-income groups rise, and overall income inequality narrows. One factor backing Kuznets' argument of urban possibilities is

financial development, which enables formerly poor migrants to choose the education they desire and to build their own businesses—regardless of their inherited wealth. This is the basic reasoning why economic theories predict a negative impact of financial development on income inequality. Financial development fosters the free choice regarding education and the founding of businesses. Because both lead to growth and growth is associated with more jobs, average income will rise and inequality will fall.

The three major theoretical papers explaining the financial development and income inequality nexus are by Banerjee and Newman (1993), Galor and Zeira (1993) and Greenwood and Jovanovic (1990). Whereas the first two predict that better-developed financial markets lead to a reduction in income inequality, the latter predicts an inverted U-shaped relationship between financial development and income inequality. In other words, in the early stages of financial development—during which only a small part of society benefits—income inequality increases. However, after a certain stage of financial and economic development is reached, more financial development begins to reduce income inequality.

Whereas the specific economic mechanisms behind these predictions differ, the key reason why better-developed financial markets—at least after some stage—reduce income inequality is always that better credit availability allows household choices and decisions to be made based more on economic optimality and less on inherited wealth. The relevant choices differ according to each study, but they all concern the individual's future income possibilities and whether these are optimal for the individual. To that end, Banerjee and Newman (1993) model households' occupational choice dependent on credit availability. Alternatively, Galor and Zeira (1993) model human capital investment, which again depends on credit. Finally, Greenwood and Jovanovic (1990) model household portfolio selection where the use of financial intermediaries generally improves household capital incomes but comes at a small fixed cost. Initially, poor households cannot afford using banks for their savings, leading inequality to increase with financial development, as only wealthy-born households are able to use bank finance. However, as the economy develops and grows over time, poorer households become richer and can also begin using bank finance. Therefore, inequality after some point decreases with financial and economic development.

These models theoretically motivate the use of the ratio of private credit over GDP as a proxy for financial development. On the one hand, better-developed financial markets lead to either more investment in occupational choice or human capital, which requires financing by credit. Consequently, financial development and private credit growth should go hand in hand. On the other hand, better-developed financial markets allow more households in a society to benefit from improved use of investment possibilities through the financial sector. This should thus increase bank deposits and overall savings in the economy, which are then funneled into more credit in the economy.

Empirical tests of these theories have yielded mixed results. We summarize the basic datasets, empirical approaches and results of those studies in Table 1.[3]

In addition to cross-country studies, a large body of literature is focusing on single country analysis, but a detailed overview of these papers is beyond the scope of this

[3] A more detailed discussion of these papers is available in an extended version of this research online.

Table 1 Overview of empirical multi-country studies

Effect of FD on income inequality	Empirical studies	Scope of investigation # = Number of countries; D = Developed; E = Emerging and developing	Empirical approach FE = Fixed effects; RE = Random effects LHS/RHS = Left/right hand side; LD = Lagged dependent	Inequality data
Linear—positive	Jauch and Watzka (this study)	# 138 (D and E), 1960–2008	Panel FE, time dummies	SWIID
	Jaumotte et al. (2008)	# 51 (D and E), 1981–2003	Panel demeaned, time dummies	Povcal, LIS
Linear—negative	Kappel (2010)	# 78 (D and E), 1960–2006	Cross-country, Panel RE, 2SLS	WIDER
	Clarke et al. (2006)	# 83 (D and E), 1960–1995	Cross-country, OLS and 2SLS Panel RE	Lundberg and Squire
	Beck et al. (2004)	# 52 (D and E), 1960–1999	Cross-country, OLS and IV	Dollar and Kray
	Li et al. (1998)	# 49 (D and E), 1947–1994	Pooled OLS, AR(1), IV	Deininger and Squire
	Hamori and Hashiguchi (2012)	# 126 (D and E), 1963–2002	Panel FE and GMM, LD	UTIP
Nonlinear—U-shape	Tan and Law (2012)	# 35 (E)		UTIP, SWIID
Nonlinear—inverted U-shape	Nikoloski (2012)	# 52 (D and E), 1962–2006	GMM, LD and Panel FE, LD	WIDER
	Jauch and Watzka (this study)	# 138 (D and E), 1960–2008	GMM	SWIID

study. These single country studies also come to different conclusions. Beck et al. (2010) find that lower income shares benefited from financial development in the USA. Instead, Giné and Townsend (2004), studying inequality in Thailand, find that less expansion in the financial sector would have led to lower inequality.

Finally, there is a new and growing strand of literature emphasizing the political dimension in the inequality and finance nexus. Rajan (2010), a leading proponent of this view, argues that the increased credit given to American households was a direct consequence of the rising inequality trend over the last two decades. Together with the political inability to use traditional forms of redistributive taxation, it seemed better and by far easier for politicians to improve access to credit for poorer American households. In this way, credit to GDP, the literature's traditional measure of financial development, is influenced largely by politics and depends on increased inequality. Kumhof and Ranciere (2010) construct a theoretical model that endogenously explains how high credit growth and financial crises may result as a consequence of rising income inequality. The two argue that the periods 1920–1929 and 1983–2008 exhibited this type of pattern. However, the hypothesis that rising inequality generally leads to a credit boom is empirically rejected in a recent study by Bordo and Meissner (2012), who use a much larger dataset than Kumhof and Ranciere (2010) and conclude that there is no evidence that rising inequality leads to credit booms. This finding is naturally very important for our study because we ideally wish to treat financial development as a variable that is reasonably independent from income inequality. Therefore, we confirm our benchmark results by adding several robustness tests that specifically allow for the endogeneity of financial development.

Our research adds value to the aforementioned literature, especially in the scope of the analysis. The basic sample consists of 138 countries with observations covering the years 1960–2008. In total, we use 3228 country-year observations and 802 observations for the estimation with five-year averages. The large sample also allows us to distinguish between the effect of financial development in different country groups regarding income and region. This is to the best of our knowledge the largest dataset for an analysis of financial development and income inequality in terms of years as well as countries. This paper further uses various econometric model specifications and controls for year effects with year dummies and country characteristics through fixed effects to isolate the effect of financial development and to reduce omitted variable bias. Further, we make use of the Arellano–Bond estimator for dynamic panel models. Finally, we conduct various robustness checks that support our key result that the data generally rejects the theoretical models.

3 Data

3.1 Description of dataset

We combine different datasets to derive what is to the best of our knowledge the largest dataset concerning financial development and income inequality. Income inequality is measured using the Gini coefficient for both gross income before redistribution and net income after redistribution. Redistributive policies may blur the theoretical

relationship between financial development and income inequality, which is modeled without an explicit role for redistribution. Therefore, we use both gross and net Gini coefficients in our empirical analysis. The underlying source is Solt's Standardized World Income Inequality Database (SWIID) (2009), which "is the most comprehensive attempt at developing a cross-nationally comparable database of Gini indices across time" [Ortiz and Cummins (2011), p. 17].[4] The SWIID combines and standardizes the World Income Inequality Database by the United Nations University, which is the successor of Deininger and Squire's (1996) database, data from the Luxembourg Income Studies (LIS), Branko Milanovic's World Income Distribution data, the Socio-Economic Database for Latin America and the ILO's Household Income and Expenditure Statistics. The total coverage is at 171 countries with 4,285 country-year observations for the gross Gini and 4,340 country-year observations for the net Gini.

The other important source for our research is the updated 2010 version of the Financial Structure Database by Beck et al. (2010), who collected data on our measure for financial development—private credit divided by GDP. Private credit is calculated based on the IMF's International Financial Statistics and consists of credit provided by deposit money banks and other financial institutions to the private sector. It does not include credit provided to the state or by central banks. This variable is the standard measure of financial development and is also used in the empirical literature described above.

Finally, we control for a host of other variables that have traditionally been used to explain inequality. GDP per capita is used in constant USD and taken from the World Development Indicators of the World Bank. Table 2 provides an overview of the definitions and sources of all variables used in this paper.[5]

3.2 Financial development over time and around the world

Private credit over GDP can be used as a proxy for financial development. It reflects the ease with which households and corporations may obtain credit. It is the standard measure of financial development in the empirical literature using panel data analysis (see, e.g., Clarke et al. 2006; Nikoloski 2012). If private institutions find it easier to signal their creditworthiness at the respective lending rate and private individuals find credit markets to be more accessible, more credit can be provided to the private sector indicating a higher level of financial development. That this line of reasoning does not always hold, can be observed with the subprime crisis in the USA in 2007–2008 and with many other banking crises where the problems were arguably related to "excessive" finance. Still, given the large dataset we use, it is reasonably safe

[4] Other datasets that claim to have a broad coverage and that are widely used in cross-country studies include different measures of the Gini, e.g., household consumption or income, household or per person levels and gross or net income. The Solt database is in that sense the most comprehensive *standardized* dataset on income inequality to our knowledge.

[5] Table A.3 in the Online Appendix provides an overview of our measures for financial development and income inequality for all countries in our sample. Figure A.1 in the same Appendix provides a 3D chart of income inequality against GDP p.c. and financial development.

Table 2 Overview of variables and sources

Variable	Definition	Source
Gini (gross) and Gini (net)	Gini coefficient of gross and net income	Solt (2009)
Financial development—Private credit/GDP	Private credit divided by GDP; claims on the private sector by deposit money banks and other financial institutions	Beck et al. (2010)
GDP per capita	Constant 2000 USD; country groups based on four income categories (high, upper middle, lower middle and low income)	World Development Indicators, World Bank (2011)
Inflation	Consumer price index; change on previous year	World Development Indicators, World Bank (2011)
Agricultural sector	Value added by the agricultural sector as a share of GDP	World Development Indicators, World Bank (2011)
Government consumption	Government share of total expenditure	World Development Indicators, World Bank (2011)
Access to finance	Different measures for the access to finance, e.g., number of ATMs per 100,000 inhabitants, minimum amount required to borrow as ratio over GDP p.c.	Financial Access Survey, International Monetary Fund (2011)
Ethnolingusitic fractionalization (ELF)	Degree of the fractionalization of the population in 1985 with lower values indicating lower fractionalization	Roeder (2001)

to say our measure captures financial development well and that the bulk of observations dominate those countries and episodes specifically related to financial excesses.[6] Furthermore, we do not have microlevel data regarding the distribution of credit in the population and among businesses and thus cannot asses how different groups in the population benefit from increasing credit provision and how this credit is used. Nonetheless, we believe that it is a good proxy for financial development, as there is a high correlation between private credit over GDP and access to finance as measured by other proxies for financial development.

Financial development, measured as private credit over GDP, is shown in Fig. 1 for a selection of developed countries. It is generally increasing over time, with some noticeable short- and long-run country differences. The mean for the entire sample is .45 with a standard deviation of .39. Figure A.2 in the Online Appendix shows the stage of financial development for the countries in our sample for the years 2000–

[6] We have done various robustness checks using a limited dataset that excludes credit booms and financial centers. These checks confirmed our results. Please see our robustness section below.

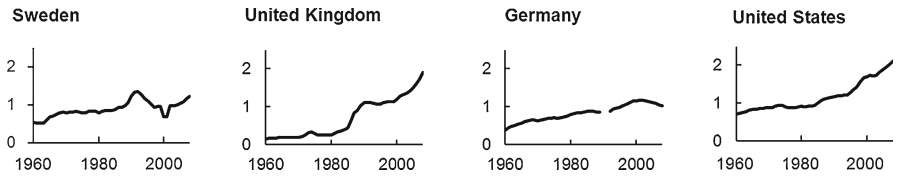

Fig. 1 Financial development over time

2004. As expected, financial development is especially high in OECD countries, with the highest levels found in countries of Anglo-Saxon origin. The countries with the highest values are Iceland, Luxembourg and the USA.[7]

3.3 Income inequality over time and around the world

Income inequality may be measured on a gross and on a net basis. Gross income excludes all income from nonprivate sources, i.e., it excludes pensions provided by the state to pensioners, all types of social transfers to economically poor people and abstains from subtracting taxes as well as social contributions. Net income, in contrast, includes all types of public transfers and deductions. Net income measures the amount an individual has at hand and may use for consumption and saving. Neither gross nor net income is the ideal instrument to measure the market outcome when individuals determine whether to follow a career opportunity. Gross income does not reflect what amount an individual can spend and save today, and net income does not consider individuals' earning entitlements on pensions and other social benefits. This paper consequently uses both measures of income inequality and investigates how gross and net income inequalities are affected by financial development and other explanatory factors.

Figures A.3.1 and A.3.2 in the Online Appendix show the distribution of gross and net inequality around the world, measured as the average over the years 2000–2004. Inequality is highest in Latin America and sub-Saharan Africa.

High and in increasing levels of gross income inequality can also be observed in developed countries, such as Germany, the UK and the USA, as shown in Fig. 2. However, the level of net income inequality, i.e., after redistribution, is much lower than gross income inequality in developed countries. Even countries that are considered as being very equal, such as Sweden, have a high level of gross income inequality. These examples show that in discussing equality aspects, one must be explicit whether equality before or after redistribution is considered. In Germany and Sweden, net inequality is relatively constant compared with gross inequality, unlike the UK and the USA, where net and gross inequality move in parallel. Redistribution in these countries does not change when gross inequality increases or decreases. This is a very

[7] We do acknowledge that these countries have shown excessive provision of private credit or serve as financial hubs. Excluding the 5 year term 2005–2009 does, however, not change the sign of the coefficients and has no substantial effect on the significance of our results.

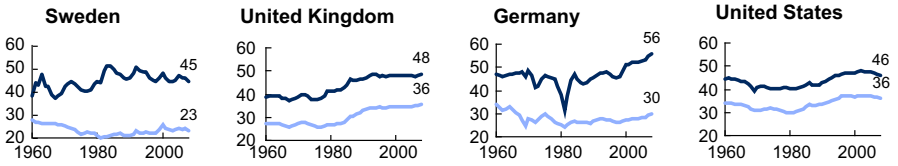

Fig. 2 Inequality over time. The *dark blue* (*light blue*) *line* shows the Gini for gross income inequality (net income inequality). (Color figure online)

interesting result on its own, as it demonstrates how different societies address the issue of unequal income distribution.

A simple correlation analysis of gross and net Gini coefficients with the other explanatory variables shows that net income inequality has higher correlations with most variables compared with gross income inequality.[8] From a theoretical point of view and with respect to the economic theories, we outlined above, we note that it is not clear whether the theoretical case for financial development decreasing gross inequality is weaker or stronger than the case for financial development decreasing net inequality. Financial development may encourage risk taking, which may increase the gross Gini; meanwhile, financial development may allow households and countries to share their risks, thus reducing net Ginis. For all these reasons, we will focus on describing and interpreting the results of the estimations with net income inequality, but we will nevertheless also report all results for gross income inequality throughout this paper.

3.4 Control variables

We use various control variables to account for other important factors that might possibly have an effect on income inequality. These are first and foremost the share of the agricultural sector in the economy, as well as GDP per capita following the Kuznets hypothesis. The Kuznets hypothesis itself suggests the economic and statistical model explaining income inequality might be nonlinear. Early and late phases of economic development might see lower income inequalities, but income inequality should be particularly high during the high phase of economic development associated with urbanization and industrialization. Hence, we will be careful to also include squared terms of the various variables in our empirical analysis.

Finally, we control for inflation and the share of government consumption in the economy. Though there are some theories predicting that the rich can hedge better against inflation because of better access to financial markets, it is also true that debtors will in general benefit from unexpectedly high inflation because this reduces the real debt burden when most contracts are written in nominal terms. The effects on inequality are thus somewhat unclear. The same holds for the government share in the economy. A large government share might indicate a strong determination to redistribute income, in which case it should have a particularly strong effect in reducing net income inequality.

[8] See Tables A.1 and A.2 in the Online Appendix.

But a large government share might also be the result of rent-seeking activities by a small but powerful elite in government which would then lead to increased inequality.

4 Econometric estimation

4.1 Pooled regression estimation: comparison with previous research

For transparency and to facilitate comparison with results from the earlier literature, we first run pooled regression estimations. We test the hypotheses of Galor and Zeira (1993) and Banerjee and Newman (1993), namely that financial development has a negative impact on income inequality, and the hypothesis of Greenwood and Jovanovic (1990) that this influence follows an inverted U-shape. In the following, we label these hypotheses as GZ, BN and GJ. Our basic estimation thus allows for nonlinearities due to the Kuznets curve as well as the initial increasing and then decreasing influence of financial development. Equation (1) enables a comparison of our dataset with Gini coefficients that are suited for cross-country research with the results from other research.

$$\begin{aligned} \text{Gini}_{i,t} = \alpha + \beta_1 \text{FD}_{i,t} + \beta_2 \text{FD}_{i,t}^2 + \beta_3 \text{GDP } p.c._{i,t} + \beta_4 \text{GDP } p.c._{i,t}^2 \\ + \beta_j X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

Following the hypothesis of a linear negative influence, β_1 should be negative and significant and β_2 should be insignificant. According to the inverted U-shape hypothesis, β_1 should be significant and positive and β_2 should be significant and negative. We add *GDP per capita* and its squared term to control for the Kuznets curve. Therefore, β_3 should be positive and significant and β_4 should be negative and significant.

We follow the approach of Nikoloski (2012) by using a levels-log specification and also test the approach of Clarke et al. (2003, 2006) with different control variables and OLS. Our comprehensive dataset confirms the results for the effect of GDP but supports the theoretical and empirical effects of financial development from those other studies only to a certain degree.[9]

4.2 Econometric hurdles

Because of the large number of countries in our sample—of which some are very diverse—it seems possible that omitted variables are biasing our estimates of the slope parameters of interest. We account for this endogeneity problem due to omitted variables by a fixed effects panel estimation, including time dummies, which is also the main difference separating our econometric approach from previous research. The fixed effect estimator controls for country-specific characteristics that do not change over time but are potentially influential with regard to income inequality. These can be

[9] Detailed results are available in an extended Working Paper version of this research online at http://www.cesifo-group.de/de/ifoHome/publications/working-papers/CESifoWP/CESifoWPdetails?wp_id=17407941.

cultural factors, religion, colonial background and others. Time dummies are included to control for common shocks for all countries such as major international political events or large business cycle fluctuations as well as trends in GDP p.c. and financial development.

Two further potential problems might arise when estimating Eq. (1). First, financial development might itself be an endogenous variable and hence must be instrumented to obtain consistent estimates. As discussed above in the literature review, there is an important recent view that growing inequality—at least in the USA—was in fact the driving cause of the recent credit boom and subsequent financial crisis (cf., e.g., Rajan 2010 or Kumhof and Ranciere 2010). Former research considered endogeneity and used an instrumental variable approach to estimate the impact of financial development, allowing for the possibility that inequality influences financial development or for an omitted variable bias. The results usually did not differ much from the OLS approach. Instruments for financial development were similar to those in the literature on the financial development–growth nexus, usually the origin of a country's legal system. However, legal origin may not be a good instrument for financial development when investigating the inequality nexus.[10] Hence, to deal with the endogeneity problem of financial development, we instead use the Arellano–Bond difference GMM estimator as discussed below.

Second, because income inequality is typically only slowly changing over time with a large degree of persistence, we include income inequality as a lagged dependent variable in our fixed effects panel model, thus essentially making this a dynamic panel model which we estimate using the Arellano–Bond estimator. The Arellano–Bond estimator should be well suited to deal with the endogeneity problems arising from these two considerations. Still, to make the presentation transparent, we also discuss results from a static fixed effect panel estimation.

4.3 Benchmark models: fixed effects estimation and dynamic panel model

The estimation results answer the question how financial development in the countries included in this broad dataset influences the income distribution. To estimate this influence, we use the fixed effects estimator, also known as a within estimator. The within estimator has the advantage of controlling for country characteristics and, in contrast to the between estimator, uses all observations of the dataset and developments over time. Amending the pooled regression estimation by time dummies γ_t and country-specific time-invariant effects α_i leads to the fixed effects panel estimation in Eq. (2).

$$\begin{aligned} \text{Gini}_{i,t} = \; & \beta_1 \text{FD}_{i,t} + \beta_2 \text{FD}_{i,t}^2 + \beta_3 \text{GDP } p.c._{i,t} + \beta_4 \text{GDP} p.c._{i,t}^2 \\ & + \beta_j X_{i,t} + \gamma_t + \alpha_i + \varepsilon_{i,t} \end{aligned} \tag{2}$$

[10] This is best shown by the French motto "liberté, egalité, fraternité" which of course includes equality. This motto shows that the origin of the legal system is not independent of inequality and that the legal system is therefore not a good instrument because it directly influences inequality. Legal origin may be a good instrument for financial development when studying growth, but it is not suitable for an investigation of the influence of financial development on inequality.

The fixed effects estimator subtracts the country-specific mean from each variable so that all time-invariant factors drop out.

To account for the time persistence in income inequality and the potential endogeneity problem of financial development we use the Arellano–Bond difference GMM estimator to estimate a dynamic version of the fixed effects panel model given in its level form in Eq. (3).

$$\begin{aligned} \text{Gini}_{i,t} = {} & \rho \text{Gini}_{i,t-1} + \beta_1 \text{FD}_{i,t} + \beta_2 \text{FD}_{i,t}^2 + \beta_3 \text{GDP}p.c._{i,t} + \beta_4 \text{GDP}p.c._{i,t}^2 \\ & + \beta_j X_{i,t} + \gamma_t + \alpha_i + \varepsilon_{i,t} \end{aligned} \tag{3}$$

We use lagged values of the Gini, financial development and GDP per capita as instruments in the difference GMM Arellano–Bond estimator. Results are discussed in the next section.

4.4 Results

Table 3 shows the results of the fixed effects static and dynamic GMM estimations.[11]

We proceed in several steps, starting with the static fixed effects estimation first and then dealing with the dynamic panel model. Independent of the inclusion of control variables, and of the investigation of gross or net income, the static fixed effects estimation suggests financial development to significantly increase income inequality. The effect is somewhat larger for the gross Gini coefficient than for the net. Our findings thus reject economic theories predicting an income inequality-reducing effect of financial development.

Turning to the findings from the dynamic panel model, we find this result supported in general. Financial development here enters with a significantly positive coefficient. Interestingly, for the gross Gini we find the squared term of financial development now estimated significantly negative. In other words, the results from the dynamic panel model for the gross Gini suggest there is a financial Kuznets curve as in Nikoloski (2012). Gross income inequality initially increases with financial development and only falls after some threshold value of credit of GDP, which in our case is estimated to be 82 %. This empirical finding then supports the GJ hypothesis. The same is not true, however, for the net Gini as shown in the last column.

Overall, our results suggest that economic theories predicting an income inequality-reducing effect of financial development should be rejected. Instead it seems that increased financial development—possibly because of excessive finance that fosters rent extraction—leads to increased income inequalities in countries around the world.

[11] There are different approaches on how to proceed with yearly data. Yearly data may represent cyclical movements, whereas using a five-year average yields a more balanced panel, but at the same time means a loss in the number of observations. To compare the results of this larger and more suitable dataset with previous work, we focus on five-year averages. Most variables move slowly over time. Therefore, differences between five-year averages show more variation than yearly data and smooth the effect of business cycles. Yearly data and five-year averages lead to similar coefficients, and we therefore report five-year averages only.

Table 3 Fixed effects and dynamic panel model

	Model					
	Gini (gross)			Gini (net)		
	3a	3b	3c	4a	4b	4c
	FE	FE	GMM	FE	FE	GMM
Gini(−1)			0.41***			0.31**
FD	2.57***	2.75***	12.96**	1.76***	1.89***	3.01**
FD^2	Dropped, as not significant		−1.47*	Dropped, as not significant		
GDP p.c.	−24.10***	−21.90***	−43.76***	−6.88	−9.04**	−17.46**
GDP $p.c.^2$	1.56***	1.40***	2.25***	0.43	0.56*	0.82
Inflation		−0.53*	0.27		−0.35*	−0.03
Govern. exp.		1.38	−2.05		0.84	−3.84
Agriculture		0.13	−2.22		−0.05	−0.91
Constant	133.95***	123.39***		61.15***	64.00***	
N	802	668	476	802	668	476
R^2 (within)	0.25	0.26		0.08	0.12	
Sargan test (*p* val.)			0.65			0.51
AB test for AR(1)			0.02			0.23
AB test for AR(2)			0.48			0.00
AB test for AR(3)			0.60			0.87
(*p* values)						
Threshold/marginal effect of						
FD (priv. credit)	Positive	Positive	82.12 %	Positive	Positive	Positive
GDP (USD)	2,240	2,547	16,721	Not signif.	3,090	Negative

***, **, * denote statistical significance levels at 1, 5 and 10 %

Model 3 is estimated with Gini coefficients of gross income as the dependent variable, and model 4 uses Gini coefficients of net income. Model a is a fixed effects estimation without further control variables, model b is a fixed effects estimation with control variables and model c are the results from the Arellano–Bond difference GMM two-step estimator with Windmeijer correction (using xtabond2 in Stata) with Gini, financial development and GDP per capita being instrumented by lags (precisely with lags 3 and 4). All models use data averaged over five-year periods and are estimated with heteroskedasticity-robust standard errors. The threshold/marginal effect of FD and GDP give the values of FD and GDP at which the Gini is at its max or min, or the sign of the significant marginal effect on the Gini. All estimations include time dummies

Differentiating between gross and net Gini in the fixed effects specification, we find that the impact of financial development is approximately 45 % larger on the gross Gini. The influence is statistically highly significant, but its economic consequences are of a small magnitude. An increase in financial development by 10 increases the net Gini by approximately 0.2 points. The different magnitudes of the effect of financial development on net versus gross Gini are less obvious in the dynamic panel specification. However, we plot marginal effects for all specifications in Appendix Figure A.4.

This confirms the finding that the effect of financial development is somewhat larger for gross income inequality than for net income.

Somewhat surprising are our results for the effects of GDP per capita or economic growth on inequality. In contrast to Kuznets' inverted U-shaped hypothesis, income inequality first decreases with the process of development and increases after surpassing a threshold of roughly 2,500 USD for gross income and over 3000 USD for net income. A possible explanation for this behavior is that Kuznets was focusing on the time of industrialization over the 19th and early 20th centuries. The time period covered in this paper begins much later. The earliest observations in our dataset are from the 1960s, enabling an initial decreasing inequality to remain in line with Kuznets. However, when a country reaches a certain development level—which was not yet reached when Kuznets wrote his work—a small fraction of the population may be better able to extract rents from using their abilities or inherited wealth, thereby increasing inequality again.[12] Nevertheless, this fact does of course not exclude the possibility that the absolute income level of the poor also increases and that the poor benefit from economic and financial development.

Inflation is the only control variable that is constantly significant in the static fixed effects model. Considering inflation as an indicator of macroeconomic stability, the estimation results indicate that higher levels of uncertainty tighten the income distribution. Nonetheless, the small coefficient of inflation signals that the effect is economically minor. The statistical significance is not that strong and it is not at all significant in the dynamic panel model.

The explanatory power of the fixed effects estimation differs between gross and net income. The within-R^2 for gross income is over twice the size of that for net income, and thus, the estimation is more effective in explaining the development of gross income inequality over time. The main reason for the differences in explanatory power may reflect that gross income is closer related to the market outcome than net income which is also determined by redistributive policy.

To summarize, private credit over GDP as measure of financial development rejects theories predicting better-developed financial markets will always reduce income inequality. In other words, our empirical results reject the predictions of BN and GZ. In contrast, our results—in line with those of Nikoloski (2012)—indicate that financial development increases income inequality. Whether poor people will actually see their incomes decline in levels is not clear. But income inequality itself is found to rise. Thus, our empirical results are more in line with the theoretical predictions of GJ. Because our results contradict some key economic theories, some earlier empirical work, and some widely held beliefs among economists, the next section will provide several robustness checks.

5 Robustness checks

The robustness checks include estimations for subsamples of countries (cf. Tables 4, 5), additional estimations with a lagged dependent variable and lagged explanatory

[12] See in particular the recent debate on long-term trends in inequality as initiated, e.g., by Piketty (2014). Please see also the discussion by Milanovic and Alvaredo in Finance and Development, IMF, Sept 2011.

Table 4 Financial development and the Kuznets curve in different income groups

Low inc.		Lower middle income			Upper middle income			High income			Rational/theory
GDP	Positive	Positive	Or	Positive	Negative	Or	Positive	Negative			Kuznets
GDP^2	Insig.	Insig.		Negative	Insig.		Negative	Insig.			
FD	Positive	Positive	Or	Positive	Positive	Or	Positive	Positive	Or	Negative	Greenw. and Jovan.
FD^2	Insig.	Insig.		Negative	Insig.		Negative	Negative		Insig.	

variables (cf. Table 6), estimation using a levels-levels specification (cf. Table 7) and some robustness checks on the dataset being used.

First, we investigate whether the effects on income inequality hold for different country groups. This estimation requires the use of yearly data, as five-year averages would not provide us with enough observations. We split the sample into four groups according to the income categories defined by the World Bank. The high-income group consists of 1035 country-year observations, the upper-middle-income group consists of 633, the lower-middle-income group consists of 637, and the low-income group consists of 349. All estimations are performed with fixed effects estimators and yearly data, including time dummies, to identify the influence of financial and economic development on the variation of income inequality independent of a time factor and country-specific characteristics. We include the same control variables as before. Robust standard errors are used to adjust for heteroskedasticity in the errors. Splitting the sample into country groups, we expect the signs of the coefficients for economic and financial development as follows:

Depending on the exact turning point in the models of Kuznets and Greenwood and Jovanovic, the squared terms of GDP per capita and financial development in the lower-, upper-middle- and high-income group may be insignificant, and we expect different signs of the linear terms for the high- and low-income groups. Table 5 shows that splitting the countries into subsamples supports the results of the previous section.

The estimation by country sample reveals that financial development has a positive effect on net income inequality for all country groups, which leads to the rejection of BN and GZ and confirms the part of GJ that explains rising inequality. For gross income inequality, we do find an inverted U-shaped influence. The threshold level after which financial development starts reducing gross income inequality is found to be 107 % of private credit to GDP. Up to that level financial development increases gross income inequality.

For the influence of GDP, we only observe significant effects on gross income inequality in high-income countries, where increasing income leads to a reduction in income discrepancy. For net income inequality, there are only significant effects in the two lower-income groups. For very low incomes, i.e., below 200 USD, inequality is decreased before it rises. In the lower-middle-income group, inequality first increases and is reduced after reaching 457 USD. This finding indicates that a Kuznets curve may be observed for the lower-middle-income countries, but the p values are close to 0.1. Furthermore, GDP is of no significant influence for upper-middle-income and high-income countries. As before, the control variables are mostly without a significant influence, except for agriculture which highlights income disparities between rural, agricultural regions and industrialized urban areas.

Second, we adjust the fixed effects estimations in various ways to deal with the time series properties of income inequality and to provide an alternative way to deal with the endogeneity or reverse causality problem. Table 6 shows the results.

As a first step, we include a lagged dependent variable to capture the fact that income inequality is changing very slowly over time. The variable is highly significant and shows that ceteris paribus approximately half of gross income inequality is determined by its level of the previous five-year term. The coefficient for net income inequality is smaller, at approximately one-third. Net income inequality thus reacts more to short-

Table 5 Fixed effects estimation by income group

Income level	Model							
	Gini (gross)				Gini (net)			
	Low	Lower middle	Upper middle	High	Low	Lower middle	Upper middle	High
FD	4.80**	2.81***	5.89*	15.87***	2.72**	2.26**	1.77***	1.75*
FD^2	Not significant[a]		−0.72	−1.70**	Not significant[a]			
GDP p.c.	−0.18	18.39	34.41	−36.69*	−99.39*	23.38*	8.94	−16.46
GDP $p.c.^2$	−0.16	−1.51	−2.43	1.67	9.32*	−1.90*	−0.55	0.61
Inflation	0.17	0.22	0.04	0.08	0.62*	−0.04	−0.04	−0.02
Govern. exp	−2.44	0.76	0.13	1.39	−0.56	−0.41	0.61	−0.64
Agriculture	−3.48	0.63	1.91***	−2.21*	−0.88	0.27	2.60***	−1.42
Constant	58.46	−15.69	−77.04	202.37**	302.04**	−32.74	−13.73	126.93**
N	349	633	637	1035	349	633	637	1035
R^2 (within)	0.39	0.27	0.45	0.29	0.29	0.15	0.24	0.29
Threshold/marginal effect of FD (credit)	Positive	Positive	Positive	107 %	Positive	Positive	Positive	Positive
GDP (USD)	Not signif.	Not signif.	Not signif.	Negative	200	457	Not signif.	Not signif.

***, **, * denote statistical significance levels at 1, 5 and 10 %

[a] Both terms for FD are insignificant in a quadratic estimation so that FD only enters linearly in the model

All estimations are fixed effects estimations with time dummies and robust standard errors. The threshold/marginal effect of FD and GDP give the values of FD and GDP at which the Gini is at its max or min, or the sign of the significant marginal effect on the Gini. All data are yearly data, as there are too few observations for this robustness check using five-year averages. The correlation coefficients for income inequality, financial development and GDP per capita by subgroup are provided in Table A.1 in the Online Appendix

Table 6 Results from alternative Fixed Effects Estimators

	Model					
	Gini (gross)			Gini (net)		
	(1) Lagged dependent	(2) Lagged explanatory	(3) First difference	(1) Lagged dependent	(2) Lagged explanatory	(3) First difference
Gini lagged	0.48***			0.35***		
FD	4.35**	5.69**	1.39***	3.61**	3.22**	1.34***
FD^2	−0.34	−0.61	0.43	−0.28	−0.30	0.56
GDP p.c.	−15.05***	−25.40***	−0.96	−8.40**	−7.89*	−2.86**
GDP $p.c.^2$	0.85**	1.62***	4.43	0.45*	0.48	10.33**
Inflation	−0.12	−0.15	−0.37*	−1.50	−0.44	−0.04
Gov. exp	0.83	1.35	0.48	1.44	1.57	1.53
Agriculture	−0.06	−0.21	−1.18	0.24	−0.10	−018
Constant	76.64***	130.08***	−3.14	49.44***	60.62***	−0.64
N	605	532	524	605	532	524
R^2(within)	0.45	0.18		0.30	0.14	
Threshold/marginal effect of FD (credit)	Positive	Positive	Positive	Positive	Positive	Positive
GDP (USD)	6,836	2,530	Not sig.	10,500	Negative	1,148

***, **, * denote statistical significance levels at 1, 5 and 10 %

All estimations are performed for gross and net income inequality. The first model includes the lagged Gini coefficient and is estimated as a fixed effects model. The second model uses the first lag of all explanatory variables and is estimated as a fixed effects model. The third model is a model in first differences and estimates the effect of changes in the explanatory variables on changes of the dependent variable

term factors and policy action compared with gross income inequality. Governments are consequently possibly not as active (or as influential) on gross income inequality than they are on redistributing income and influencing the distribution of net incomes. Regarding the influence of financial development, the results are in line with our benchmark estimation: Higher financial development is associated with a more unequal income distribution, which is more pronounced for gross than for net income. For economic development, there is again an inverted Kuznets curve. Including the lagged dependent variable substantially increases the explanatory power of the estimations; the within-R^2 for the net Gini triples.

As a second step, we control for potential reverse causality by taking lags of the explanatory variables. Addressing the arguments that the explanatory factors need time to influence income inequality and that there could be a simultaneity bias; this estimation measures the influence of financial and economic development on the income distribution in five years. The explanatory power on gross income inequality is reduced but remains approximately the same for net income inequality. The sign of financial development remains positive, and the coefficient increases by 107 % for the gross Gini and 70 % for the net Gini. The medium-term influence of financial development on income inequality is substantially more profound than the short-term influence. Furthermore, there is again the inverted Kuznets curve for gross income at the same GDP per capita level as without lagged variables. The influence of GDP per capita on net income inequality becomes negative. Higher levels of income, combined with increasing gross income inequality, therefore lead to higher redistribution and lower net income inequality. However, GDP per capita is significant only at the 10 % level, with a p value of 0.094.

As a third step, we estimate the model in first differences which estimates the effect of changes in the explanatory variables on changes of the dependent variable. Results are given in Table 6 and indicate that larger increases in financial development lead to larger increases in income inequality.

To further validate the results of the methodology in Sect. 4, we estimate models 1–3 in levels. Table 7 shows the results from a levels–levels specification for the pooled, FE and GMM models. The link of financial development and income inequality broadly holds. Financial development is significantly positive for gross and net income inequality in a pooled OLS estimation. The positive effect also holds for the fixed effects model up to a certain threshold. The level of this threshold is at 128 and 138 % and thus above values observed for all countries, except for financial centers prior to the financial crisis. The GMM estimations in levels lead to less significant outcomes. Financial development is negatively linked at the 10 % confidence interval to gross income inequality and is not significant for net income inequality.

Finally, we carried out various robustness tests checking the sensitivity of our results to specific country groups or time periods or our large dataset. In particular, we estimated Eqs. (2) and (3) for reduced datasets by excluding (i) financial centers which we defined as those countries or observations with credit-to-GDP ratio above 150 %, (ii) periods of credit booms for which we took the most recent 2005–2008 period, (iii) small financially opaque islands such as the Bahamas or Mauritius and (iv) small countries in terms of population by imposing a minimum population requirement which we took as 500,000. All these robustness tests confirmed our benchmark results

Table 7 Results from a levels–levels specification

	Model					
	Gini (gross)			Gini (net)		
	3a	3b	3c	4a	4b	4c
	Pooled OLS	FE	GMM	Pooled OLS	FE	GMM
Gini(−1)			0.37***			0.21*
FD	4.12***	11.61***	7.68	3.45***	7.15***	1.37
FD^2	Dropped, as not significant	−4.53***	−4.77*	Dropped, as not significant	−2.61**	Dropped, as not significant
GDP p.c.	−0.0008***	0.00	0.0006***	−0.002***	0.00	0.0002*
GDP $p.c.^2$	1.4e−8***	0.00	Dropped due to collinearity	2.6e−8***	0.00	Dropped due to collinearity
Inflation	−0.00	−0.00***	−0.01	−0.00	−0.00***	−0.01
Govern. exp.	0.11	0.22**	−0.06	−0.13**	0.13	−0.32**
Agriculture	−0.11***	0.19**	−0.45***	−0.14***	0.11*	0.09
Constant	57.51***	42.34***			30.77***	
N	677	677	483	677	677	483
R^2 (within)	0.13	0.29		0.39	0.12	
Hansen test			0.46			0.55
Threshold/marginal effect of FD (priv. credit)	Positive	128 %	Negative	Positive	137 %	Not significant
GDP (USD)	27,931	Not significant	Positive	30,033	Not significant	Positive

***, **, * denote statistical significance levels at 1, 5 and 10 %

Model 3 is estimated with Gini coefficients of gross income as the dependent variable, and model 4 uses Gini coefficients of net income. Model a is the pooled OLS regression model, model b is the fixed effects estimation, model c the Arellano–Bond difference GMM two-step estimator with Windmeijer correction (using xtabond2 in Stata) with Gini, financial development and GDP per capita being instrumented by lags (precisely with lags 3 and 4). All models use data averaged over five-year periods and are estimated with heteroskedasticity-robust standard errors. The threshold/marginal effect of FD and GDP give the values of FD and GDP at which the Gini is at its max or min, or the sign of the significant marginal effect on the Gini. All estimations include time dummies

of Table 3. Neither of the tests led to qualitatively different results and there were only small quantitative differences in the estimates.[13]

6 Conclusion

Two phenomena can be observed over the last five decades around the world—increasing financial development and increasing gross income inequality in many countries, especially in the developed world. We test theoretical models, which explain the link between financial development and income inequality and which predict that better-developed financial markets lead to decreasing levels of income inequality regarding labor and entrepreneurial income and first increasing and then decreasing levels regarding capital income. Earlier empirical research focusing on this financial development income inequality nexus broadly confirms the decreasing effect of financial development. This research either is built upon a pure cross-country perspective that cannot account for the many country-specific characteristics or uses panel data approaches but, again, often neglects country-specific characteristics.

Using a broader and more comprehensive dataset and time-invariant country specifics and time dynamics in our panel estimation, we reach a different conclusion in the analysis of this nexus and reject those earlier theories and previous empirical research. Integrating time-invariant country characteristics, we find a positive relationship between financial development and income inequality within countries. Further developed financial markets lead to higher gross and net income inequality. This finding holds for several robustness checks, e.g., for subsamples by different income groups, neglecting country characteristics and including further control variables. The positive relationship is highly significant but is only of a small magnitude. An increase in the provision of credit by ten percent leads to an average increase in the Gini coefficient by 0.22 for the within estimation.[14]

We do not exclude the possibility that all income groups within a country benefit from more financial development, but we do find that those who are already better off benefit more because income inequality is increasing. These results add to the existing literature on financial development and income inequality by using different estimation techniques and a larger and more comprehensive dataset with more countries over a longer time horizon compared with previous research. Our results should, at the very least, allow researchers to remain skeptical when confronted with the supposedly beneficial effects of financial development. It appears instead to be very important to target financial development toward the poorest in society. At the same time, excessive and possibly inefficiently much finance—such as the recent buildup of financial excesses before the subprime crisis—should be avoided and possibly limited through appropriate regulation. Only then can we hope for inefficient and excessive inequality to decline. Nonetheless, the relationship between finance, financial development and income inequality offers more research opportunities and merits more resources and effort.

[13] We would like to thank a referee for pointing these robustness tests out to us. Results are available from the authors upon request.

[14] This value ranges from 0.176 to 0.275 depending on the subsample and specification (see Table 3).

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