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Finance-Inequality Nexus: the Long and the Short of It

By *Yousef Makhlouf, Neil Kellard, and Dmitri Vinogradov*

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Abstract

Although the existence of a link between financial development and income inequality is generally accepted, the relationship between the two is neither theoretically unambiguous, nor empirically uniform. We make a case for distinguishing between the short- and long-term effects of finance on inequality and investigate the nexus in 21 OECD countries over the period 1870-2011. Whilst in the short-run an improvement in financial development tends to reduce inequality, in the long-run, more finance contributes to more inequality. The short-run effect is in line with theories advocating that financial development increases accessibility and availability of financial services, primarily for the poor. The long-run effect suggests that any short-term financial gains of the poor turn are ultimately overwhelmed by the financial gains of the wealthy. We estimate that the short-run effect becomes nil within a few years of a positive innovation to the level of financial development. Strikingly, the only variable to reduce inequality over the short- and long-run is education, which may in part be proxying for financial literacy. Results suggest that policies aimed at reducing inequality through improving access of the poor to finance need to be carefully designed to ensure longevity of impact.

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1. Introduction

The finance and inequality nexus has been subject of extensive discussions for a long time (e.g. Kuznets, 1955; Greenwood and Jovanovic, 1990; Beck et al., 2007; De Haan and Sturm, 2017). Moreover, the apparent upward movement in income inequality over the last few decades, especially in developed countries, has increased academic interest in inequality and its potential determinants (Piketty, 2014; Xie and Zhou, 2014; Roser and Cuaresma, 2016; Tridico, 2017; Farias et al., 2018). A possible factor is financial development; however, both theoretical and empirical studies in the extant literature offer mixed views with regards to its impact on inequality. Theoretically, improved access to finance should reduce inequality, whilst improved quality of financial services to existing customers may contribute to more inequality. Empirical studies offer evidence of both positive and negative impact. In this paper we offer a new perspective by focusing on the time it takes to reap any gains from changes in financial opportunities brought by financial development. The speed of response to these opportunities may depend on the individual's income level and associated access to financial services, for which reason the finance-inequality relation may vary between the short- and the long-run. This is exactly what we examine in this paper.

Theoretical arguments in favour of the relationship between financial development and income distribution refer to the ability of the financial system to cover a larger number of people (the so-called extensive margin) and/or to its ability to absorb a larger amount of funds from each individual (the intensive margin).[1] Underdeveloped credit markets limit access to financial

[1] The terms "intensive and extensive margins" with regards to the financial industry have been in use since at least as early as Gurley and Shaw (1967), who, in particular, write: "Whatever the first choice may be, it is tilled intensively

services to the least risky segment of households and firms (Banerjee and Newman, 1993), hence, on the extensive margin, financial development alleviates entry barriers and expands the economic opportunities of poorer individuals, thus reducing income inequality (Becker and Tomes 1979, 1986; Galor and Moav, 2004; Paulson and Townsend, 2004).[2] On the intensive margin, financial development improves the quality of financial services for those who already have access to them, most likely relatively high-income individuals and well-established firms (Greenwood and Jovanovic, 1990; Antzoulatos et al., 2016)[3], thus contributing to more income inequality.[4] The overall impact of financial development is then the superposition of the two margins: some studies find a positive nexus (e.g., Gimet and Lagoarde-Segot, 2011; Jaumotte et al., 2013; Denk and Cournède, 2015; Jauch and Watzka, 2016; Haan and Sturm, 2017) whilst others show that financial development has a negative impact on inequality (e.g., Beck et al., 2007; Kappel, 2010; Hamori and Hashiguchi, 2012; Naceur and Zhang, 2016).

We differ from the above literature in that we stress the relative effects of the extensive and the intensive margin depend on the length of the time period considered. Extending financial services to those who had no access to them earlier, might require less time than, for example, accumulating more resources from those already involved in the financial system, through offering new and/or better quality services. After developing testable hypotheses in the subsequent section of the paper, to investigate our theoretical conjecture we require (i) data over a sufficiently long period of time and (b) a suitable econometric approach. For the former, recent

until there is obvious advantage in trying the extensive margin…" (p. 268). Below, we use the same argument to advocate that because intensive development may be too costly for banks in the short-run, they opt for the extensive strategy, until, in the longer-run, they return to the intensive path.

[2] For example, Paulson and Townsend (2004) note that wealthier people may start and expand businesses without the need for external finance, whilst the poor are financially constrained and, moreover for them, external finance may be unavailable. This is evidence in favour of a typical argument of why financial development works against inequality: it helps the poor to start businesses.

[3] Antzoulatos et al. (2016) suggest that as "financial development gathers pace", larger and more profitable firms with greater access to capital markets, tend to increase leverage more.

[4] See Demirgüç-Kunt and Levine, 2009 and Beck, 2012 for more details about these theoretical predictions.

research by Madsen et al. (2018) constructed annual data on income inequality for 21 OECD countries, over the period of 1870 to 2011[5], and showing that economic growth is constrained by inequality at lower levels of financial development. Taking advantage of this, we newly position these inequality series as the dependent variable. As to the latter requirement, most of the empirical studies cited above are based on panel data and use static models such as OLS and fixed and random effects models, or dynamic panel models, particularly employing the GMM estimator[6]. Unlike these approaches, we apply an autoregressive distributed lag (ARDL) model, which allows one to distinguish between the short- and long-run effects of financial development on inequality. We use two popular proxies for inequality – the Gini index and the 10 per cent income share. Whilst the former captures the overall distribution of income in the population, the latter isolates the rich cohort, helping us to judge whether, indeed, the short-term effect of financial development occurs primarily via the poor. A number of controls are employed including education, GDP per capita, financial volatility and trade union membership.

Over the 142-year sample period, our empirical findings show that a rise in financial development reduces the Gini index in the short-run, whilst increasing it over the longer-term. These results suggest that financial development may operate chiefly on the extensive margin in short-run by relaxing credit constraints and thus widening the availability of financial services for the poor, lessening inequality. In the long-run however, we observe the opposite effect. Strikingly, the results for the top 10 per cent income share indicate that growth in financial development does not significantly affect the rich in the short-run, only over the long-run. This provides further evidence that the observed short-run effect in the Gini data comes through the

[5] Our focus on OECD countries is also interesting as the current literature suggests that most developed countries experienced a sharp increase in inequality over the last few decades.

[6] Some studies use other methods such as panel Bayesian SVAR (Gimet and Lagoarde-Segot, 2011) or IV regression (Naceur and Zhang, 2016).

extensive margin and its effect on the relatively poor. In any case, in the long-run either the redistribution channel transfers financial gains to the rich, or the intensive margin takes over and reverses the impact of financial development on income distribution. This may explain the mixed findings of earlier studies as the employed empirical models conflate the short- and long-term effects. Notably the only control variable to reduce inequality over the short- and long-run is education, which may in part be proxying for financial literacy (see Kadoya and Khan, 2017; Gill and Prowse, 2015; Lusardi and Mitchell, 2014).

The organization of the paper is as follows: Section 2 presents the literature and theoretical underpinnings whilst Section 3 outlines the data used. Section 4 describes the empirical estimation methodology. Section 5 presents the findings and finally, Section 6 concludes.

2. Literature and theoretical underpinnings

Our central premise is that financial development will likely have differing intertemporal effects. For the banking sector, Burgess and Pande (2005) stress that banks themselves prefer expanding in rich areas, and the relationship banking literature emphasises that banks favour existing customers (Petersen and Rajan, 1994; Berger and Udell, 1995; Boot, 2000; Agarwal et al., 2018, to mention a few). From this supply-side perspective, a credit expansion along the financial development path should benefit the richer part of the population. However, in the short-run, financial institutions may be unable to follow their preferred strategy and may expand where the demand is more flexible, which is likely to be the poorer section of potential customers. For example, Burgess and Pande (2005) find, *inter alia*, that a state-led expansion of the banking sector into rural areas reduces poverty via accumulation of deposits and disbursement of credit

among the poor. In Ergungor (2010), opening new branches improves the ability of the poorer segment of the population to borrow, whilst branch presence is not correlated with mortgage availability in high income neighborhoods, in particular because the latter are more likely to qualify for credit scored mortgages.

Arguably, offering existing [simple] financial instruments to customers who had no or limited access to them, is a quicker solution than developing new financial instruments to meet the more sophisticated demand of existing customers. Similarly, the "keeping up with the Joneses" effect (e.g., Christen and Morgan, 2005; Coibion et al., 2014; Bazillier and Hericourt, 2017) assumes high demand of poorer households for credit, to help them "keep up" in consumption with richer households. It is this high demand that makes it easier for banks to extend credit to poorer households in the short run. As Coibion et al. (2014) note, the above "keeping up" effect only describes the demand side, yet the overall relationship between inequality and credit depends on the supply side, too, which is exactly what we take into account by allowing the expansion strategy of banks to vary over the short- and long-run.[7]

In a recent paper, Farias et al. (2018) theoretically[8] investigate the relationship between credit availability, adoption of new technologies and inequality. In particular, in a 'full liquidity' (no credit constraints) state, investment can lead to faster adoption of technology and, if the technology is 'skill-neutral', a reduction in income inequality. However, if the technology is 'skill-biased', in the sense that it requires skilled workers, and those workers are relatively few,

[7] In this discussion, we have focused on the banking sector because financial development is usually measured as the amount of credit issued by domestic financial intermediaries. Whilst the role of stock and bond markets is outside of this scope, there is some evidence that developed financial markets may contribute to a reduction in inequality (Kappel, 2010).

[8] Note that their theoretical derivation takes place in a small country setting. Here technological improvement is adopted from abroad and involves skill-bias. Additionally, note that by their Proposition 1, full liquidity corresponds to the case of complete markets, and insufficient liquidity – to the case of incomplete markets.

inequality can actually increase. Such an effect is exacerbated when financial markets are 'liquidity constrained.' This mechanism can, of course, be placed in intertemporal context. For example, assuming firms are credit constrained in the short-run, the Farias et al. (2018) result would support the view that credit expansion benefits the poor (as long as technology is skill-neutral) and reduces income inequality. In the long-run, with technology likely to be more skill-biased, credit expansion may raise the income gap between skilled and unskilled workers.

Parallels may be drawn between the inequality impact of financial development and that of monetary policy shocks that drive shorter-term credit expansions and contractions. Doepke and Schneider (2006) argue that expansionary monetary policies favour low income households, while at the same time low interest rates potentially work against higher income savers and investors. Note that, in line with our short- and long-term view, higher income households would need to readjust their portfolios to respond to low interest rates, which takes time, while availability of credit that favours lower income customers, benefits them more immediately. Conversely, Mumtaz and Theophilopoulou (2017) provide evidence that contractionary monetary policy in the UK harms low income households more than high-earners, who remain effectively unaffected. They suggest this result is explained by the higher reliance of the latter category on financial markets relative to financial intermediaries. The same directional effect of monetary contractions is reported in Furceri et al. (2018), who, on top of this, demonstrate that the mechanism works in the opposite direction as well, i.e., monetary easing reduces inequality, and both effects are stronger where the share of labour income is higher. Coibion et al. (2017) also stress the different income sources of the rich, who receive a disproportionate fraction of financial income, and of the poor, who obtain a large share of their income from transfers. Contractionary policy thus favours the rich as financial income sharply rises after a monetary

policy shock in the U.S. data of Coibion et al. (2017) and harms the poor as real wages rise faster than transfers.

From the above discussion it follows that the superposition of the extensive and intensive margins should generate different effects in the short- and the long-run. Importantly, the extensive margin works primarily through the poorest cohort of population, those previously excluded from finance. The intensive margin, to a larger extent, operates within the richer part of the population. Under this paradigm, understanding how financial development affects each of the cohorts in the short- and the long-run, will be crucial for policy design and leads us to two new hypotheses:

> H1: Over the short-run, the extensive margin is likely to dominate the intensive margin and increases in financial development will lead to decreases in inequality;
>
> H2: Over the long-run, the intensive margin will dominate, and therefore increases in financial development will lead to increases in inequality.

Of course, presuming the above dichotomy between the short- and long-run is appropriate, models that conflate the opposing effects, will underestimate the (long-run) effect of an innovation of financial development on inequality. This leads to our third hypothesis:

> H3: Static models will underestimate the (long-run) effect of financial development on inequality.

To examine the above hypotheses, we will employ a measure of the income inequality, such as the commonly employed Gini coefficient, which covers the whole income distribution. However, other measures of inequality exist that focus on the richest cohort, including the top 10 per cent

income share, which might not be so sensitive to the short-run effects of financial development given we theorise these affect mainly the relatively poor. Therefore, our final hypothesis follows:

> H4: Over the short-run, changes in financial development will not affect inequality measures that focus on the relatively wealthy.

3. Data

This study employs annual data for 21 OECD countries over the lengthy period of 1870 to 2011. Specifically, Table 1 presents the countries[9] included in our sample.

[INSERT TABLE 1 HERE]

The dependent variable is income inequality, proxied by the post-tax, post-transfer Gini coefficient, i.e. net Gini coefficient. A high value of this index indicates more unequal distribution of income. We use the Gini coefficient because it is the most widely used measure of inequality in the empirical literature (e.g., Beck et al., 2007; Delis et al., 2013; Jaumotte et al., 2013; Denk and Cournède, 2015). The main advantage of Gini index is that it covers the entire spectrum of the income distribution (Madsen et al., 2018). This is an important feature as it allows us to investigate the impact of financial development on income disparity across different cohorts[10].

[9] The source of much of the data is the excellent work of Madsen and Ang (2016) and Madsen et al. (2018).
[10] We use also the top 10 per cent income share to test the impact of financial development on the wealthy.

Next, we follow the literature by using private credit to GDP as a proxy of financial development (see for instance, Beck et al., 2007; Jaumotte et al., 2013; Madsen and Ang, 2016), allowing the comparison of our findings with other studies. Furthermore, this index has an advantage over alternative measures of financial development, such as M2 over GDP, as it captures the main function of financial intermediaries i.e., the channelling of the savings of society to private sector (Beck et al., 2007). However, to check the robustness of our results, we additionally follow work such as Ang and McKibben (2007), Gries et al. (2009) and Samargandi et al. (2015) by using the first principal component of several financial development indicators (i.e., the ratios of credit to GDP, bank assets to GDP, and monetary stock to GDP[11]) as a proxy of the aggregate financial development level.

Several control variables are also employed: GDP per capita, population, education level, inflation and the age dependency ratio. These variables are commonly used in the inequality literature (see, for example, Beck et al., 2007; Delis et al., 2013; Baiardi and Morana, 2018)[12]. Moreover, we check the robustness of our results to several other control variables such as technology (Galor and Moav, 2000 and Jaumotte, et al., 2013), stock market capitalization (Aggarwal and Goodell, 2009; Gimet and Lagoarde-Segot, 2011 and Denk and Cournède, 2015), financial stability (Jeanneney and Kpodar, 2011) and trade unions (Machin, 1997, and Checchi and Garcia-Peflalosa, 2010). We control also for GDP per capita squared to allow for nonlinear economic development (Delis et al., 2013). The annual data for GDP per capita and population is obtained from the Maddison Project Database, version 2018 (Bolt et al., 2018). The primary source of inflation series is Jordà et al. (2017), which offers data for 17 OECD countries since 1870, so we obtain inflation data for remaining countries from the Varieties of Democracy

[11] The source of the latter two variables is Madsen and Ang (2016).

[12] Some studies control for trade openness and Government expenditure, however this data is not available for our long sample period. In addition, the impact of these variables on income inequality is inconclusive (Delis et al., 2013).

(V-Dem) Institute at the University of Gothenburg (Coppedge et al., 2018). The source of all remaining variables is Madsen and Ang (2016).

4. Methodology

Several empirical studies use static panel models, such as pooled OLS, or fixed and random effects models, to examine the financial development and income inequality nexus (see for example, Kappel, 2010; Jaumotte et al., 2013; Denk and Cournède, 2015; Naceur and Zhang, 2016 and Haan and Sturm, 2017) whilst others employ dynamic GMM-type procedures (Beck et al., 2007; Jeanneney and Kpodar, 2011 and Hamori and Hashiguchi, 2012). Although we estimate static models for our preliminary analysis, and as a comparison with prior literature, they do not differentiate between short- and long-run effects (*inter alios*, see Loayza and Ranciere, 2006) and are therefore unsuitable to address our particular research question.[13] Dynamic GMM-type approaches only model the short-run, again rendering then unsuitable for our purposes, and can generate spurious results (see Roodman, 2006) when, for example, the number of countries *N* in the panel, is relatively small compared with the number of years *T*.

In this study, we primarily employ a panel ARDL model[14] given this allows us to distinguish between short- and long-run effects and use three estimators typically employed in the literature (e.g., see Pesaran et al., 1999; Asteriou and Monastiriotis, 2004; Samargandi et al., 2015); the mean group (MG), dynamic fixed effects (DFE), and pooled mean group (PMG). By

[13] See Samargandi et al. (2015) for a useful summary of the shortcomings of static models (i.e., pooled OLS, fixed and random effects) and GMM estimators, whilst covering the advantages of panel ARDL models. In particular, they note that ARDL models, such as those that use PMG estimation (see also Pesaran et al., 1999), mitigate endogeneity issues given the allowance for potential lags in the dependent and regressor variables.

[14] Samargandi et al. (2015) used an analogous panel ARDL model to assess the relationship between financial development and economic growth over the period 1980 to 2008.

employing an ARDL (p, q) approach, Pesaran and Smith (1995), Pesaran (1997) and Pesaran et al. (1999) introduce dynamic heterogeneous panel regressions in an error-correction form, where p and q are the lags of the dependent variable and the independent variables respectively. In our case, this can be written as follows:

$$\Delta Gini_{i,t} = \lambda_i\left[Gini_{i,t-1} - \left\{\beta_{i,0} + \beta_{i,1}X_{i,t-1}\right\}\right] + \sum_{j=1}^{p-1}\theta_{i,j}\,\Delta Gini_{i,t-j} + \sum_{j=0}^{q-1}\eta_{i,j}\,\Delta X_{i,t-j} + \varepsilon_{i,t} \quad (1)$$

where $Gini$ is the Gini index (in logs) for country i at year t and X is a group of potential income inequality determinants including financial development and other control variables. θ and η refer to the short-run coefficients of the lagged dependent variable and other regressors respectively, whilst β represents the long-run coefficients. λ is the coefficient of speed of adjustment to the long-run equilibrium and the first term on the right-hand side of Eq. (1) will capture any long-run relationship between financial development and inequality. As the system is expected to return to the long-run equilibrium, we expect $\lambda < 0$. Based on the theoretical discussion in the introduction, we also expect a negative short-run relationship between financial development and inequality, as given by the coefficient $\eta_j^{FD} < 0$ ("FD" for financial development). The same theoretical discussion implies the opposite long-term relationship, which is given by the coefficient $\beta_1^{FD} > 0$. By replacing $Gini_{i,t}$ with a measure for top 10 per cent share, we obtain an alternative model, where we expect $\eta_j^{FD} = 0$, as financial development is hypothesised to only affect the relatively poor in the short-run.

In terms of estimating (1), the MG approach of Pesaran and Smith (1995) initially estimates individual regressions for each country and subsequently, group coefficients are calculated by averaging country coefficients. Moreover, Pesaran and Smith (1995) show that this approach produces consistent estimates of the averages as long as *N* and *T* are reasonably large.

Of course, this method also allows all coefficients to be heterogeneous. A very different approach is taken by our second estimator (i.e., the DFE estimator), whereas aside from intercepts, other coefficients and error variances are homogenous across countries, which might be seen as a rather unrealistic assumption. Finally, the pooled mean group (PMG) estimator of Pesaran et al. (1999) assumes the long-run coefficients are homogenous across countries but allows for heterogeneity in the short-run coefficients, the intercepts, the speed of adjustment coefficients and error variances. Such an approach makes sense if we have grounds to believe the long-run association between financial development and inequality is the same across our OECD countries – which ex-ante appears plausible, particularly if we allow the short-run paths to differ. Given this long-run homogeneity assumption holds, which can be tested by a Hausman test (Ojede and Yamarik, 2012, Li et al., 2016), the PMG estimator will be more efficient than the MG estimator, reducing the magnitude of the long-run coefficient standard errors. Note that Pesaran et al. (1999) show the consistency and asymptotic distributions for the PMG estimators, under certain regularity conditions, in cases where the regressors are either I(0) or I(1).[15]

Analogously to Samargandi et al. (2015), we use the Hausman test to choose the most appropriate estimator. The null hypothesis of the Hausman test is that the difference between a pair of estimators is not significant and we employ a 5% level of significance. Finally, we impose an ARDL lag structure as follows; $p = 1$ and $q = 1$ (for all regressors) based on the Schwartz Bayesian criterion. In fact, this specification, $p = q = 1$, is not surprising as it has been widely used in previous studies that employ ARDL models to test a variety of economic issues (see for example, Ojede and Yamarik, 2012; Samargandi et al., 2015 and Li et al., 2016).

[15] Samargandi et al. (2015) suggests this obviates the requirement to pre-test variables for a unit root.

5. Empirical results and discussion

As a prelude to estimating the panel ARDL model, we employ three static estimators; the OLS, fixed effects and random effects models with cluster-robust standard errors at the country level to control for any potential autocorrelation and/or heteroskedasticity. Table 2 presents the results of these traditional estimators. The three estimators indicate that financial development has a positive and statistically significant impact on inequality. These preliminary results support the findings of other studies such as Gimet and Lagoarde-Segot (2011), Jaumotte et al. (2013), Denk and Cournède (2015) and Haan and Sturm (2017) that higher financial development leads to higher inequality. All these studies use static models, except Gimet and Lagoarde-Segot (2011) who employ a structural vector autoregressive model.

This result implies that the intensive margin dominates the extensive margin. Moreover, the impact of the included control variables is as expected. Increases in GDP per capita, for example, reduces inequality whilst a rise in the age dependence ratio increases the inequality. Although education has a negatively signed impact, this is not statistically significant. As we mentioned in the previous section, these estimators have some potential shortcomings. In particular, these models may generate misleading results, as they do not distinguish between potential short- and long-run relationships. To address these issues, we next estimate panel ARDL models.

[INSERT TABLE 2 HERE]

Table 3 shows the results of the PMG, MG and DFE estimators in columns [1], [2] and [3], respectively. The top part of the table displays the long-run coefficients whilst the bottom part presents the coefficients of the short-run. The Hausman test assesses whether the PMG estimator is significantly different from the MG or DFE alternatives. Given neither null is rejected, we might prefer the PMG given it is efficient. In any case, for all regressions the estimated error-correction coefficients, λ, are negative and highly significant in all regressions, thus the null hypothesis of no long-run relation is rejected. All estimators generate analogous results regarding the effect of financial development on inequality in both the short- and long-run.

From Table 3, in the short-run, it would appear that increases in financial development decrease income inequality and providing evidence for H1. This supports the extensive margin view that higher financial development tends to broaden the access to financial services, particularly for low-income individuals who had previously not been using such services. The long-run coefficients tell a different story; that financial development has positive and statistically significant effect in all regressions. This implies that higher financial development leads to higher inequality, supporting both the initial findings of the static models and H2. Of course, it's pertinent to note that the positively-signed long-run coefficient on financial development is larger, in the PMG and DFE cases, than its equivalent in the static regression – suggesting that a failure to distinguish between the intertemporal nature of the relationship, may lead to underestimating the positive effect of financial development on inequality over the long-run; a result that supports H3. Finally, note for policy purposes, that orthogonalized impulse response functions for a panel VAR with our controls from Table 3, suggest that the positive

effect of an innovation in financial development lasts approximately between 2 and 6 years.[16]

As discussed in the introduction, a possible explanation of these opposing effects in the short- and long-run is that extensive financial development (improving access to finance of the poorest segment) that dominates in the short run, is later dominated by the exploitation of the intensive margin (serving existing relationship customers) in the long-run. We further investigate this mechanism later on by testing the impact of financial development on the top 10 per cent income share, thus explicitly focusing on the richer cohort alone. In any case, the differential impact in the short- and long-run may explain the mixed evidence provided by previous studies, highlighting the importance of distinguishing between the intertemporal effects of financial development on inequality.

Turning to the control variables education is, as expected, negatively related to inequality in both short- and long-run. However, unlike the prior static regressions, education is now typically statistically significant, underlining the usefulness of using an ARDL-type model. Additionally, as noted in the introduction, education is positively associated with financial literacy (see Kadoya and Khan, 2017; Gill and Prowse, 2015; Lusardi and Mitchell, 2014), and it seems reasonable to suggest that part of education's reducing effect on income inequality relates to the increased ability to make competent financial decisions.

Interestingly, the impacts of other control variables are mixed. Inflation, for example, has a positive impact in the short-run whilst being negative in the long-run for both the PMG and MG approaches, however, the impact is significant only in the latter. A possible explanation is that higher inflation leads to a lower real wage in the short-run, which increases inequality but subsequently the unemployment rate decreases in long-run and thereby inequality diminishes. GDP growth also shows a positive impact in the short-run and a negative impact in the long-run

[16] Results available on request.

for both the PMG and DFE estimations, yet the impact is significant only in the latter. This implies that the wealthy mainly benefit from economic growth in short-run, whilst the distribution of this gain widens over the long-run, reducing inequality.

[INSERT TABLE 3 HERE]

For the next step, we check the robustness of our results by re-estimating Eq. (1) with several factors that may affect inequality using the PMG estimator[17]. In the first column of Table 4, we consider the Kuznets hypothesis relating to the nonlinear effect of economic development on inequality by including the square of GDP per capita (Delis et al., 2013). In the second column, we control for the impact of technology on inequality. Technology can increase inequality by raising the skill premium, which widens the wage gap between skilled and unskilled workers (Jaumotte et al., 2013). Furthermore, it may also lead to higher unemployment via enhancing the use of labour-saving capital. In the third column, we use trade unions to capture the impact of labour market institutions that can influence wage inequality and thereby income inequality (see Machin, 1997 and Checchi and Garcia-Peflalosa, 2010). In the fourth column, we examine the impact of financial stability given financial development may also indirectly affect the income distribution, as the development process is often associated with financial instability, leading to higher inequality as the poor are more vulnerable than the rich to unstable financial institutions (Jeanneney and Kpodar, 2011).

In the fifth column of Table 4, we control for the effect of financial markets. Similarly to private credit share, financial markets are also measure of financial development and its impact

[17] MG and DFE lead to similar results (see Appendix). The Hausman test suggests that DFE is a more efficient estimation than MG.

on income distribution is ambiguous. On the one hand, the development of the equity market can increase investment levels by providing additional financing sources to the real sector, which could reduce income inequality through transferring wealth from creditors to debtors (Aghion and Bolton, 1997). On the other hand, financial markets can also lead to higher inequality as large firms disproportionately benefit from stock market development (Aggarwal and Goodell, 2009). Finally, the in sixth column, we test the robustness of our findings by using an alternative measure of financial development. Specifically, we follow other studies such as Ang et al. (2007) and Gries et al. (2009) by using the first principal component of the ratios of credit to GDP, bank assets to GDP, and monetary stock to GDP as an aggregate proxy of financial development.

Overall, our financial development results seem robust to controlling for these additional factors with negatively-signed and significant financial development coefficients in the short-run and positively-signed coefficients and significant long-run coefficients, for all regressions in Table 4 and therefore providing further evidence for H1 and H2. Moreover, the results for education shown in Table 3, are carried over to Table 4. Turning to the newly added controls themselves, none show a significant impact on the short-run, whilst in the long-run, all the relevant coefficients are significant and in line with the theory suggested above. For instance, technology and financial instability have a positive and significant impact on inequality in the long-run. The impact of financial markets is also positive, which supports our previous finding about the long-run effect of financial development. Notably, our only additional control to reduce inequality significantly is Trade Unions. Finally, our results are also robust to the employment of the alternative measure of financial development.

The Gini index is the main measure of inequality used by previous studies as it covers the entire spectrum of the income distribution; however, it is important to examine the impact of the

financial development index on other measures of income distribution. Therefore, the next step in our analysis is to estimate the impact of financial development on the top 10 per cent income share, which allows us to capture the impact of financial development on the wealthy.

[INSERT TABLE 4 HERE]

Table 5 shows the results of these estimations. The negative and significant error correction coefficient across all estimators suggests that the null hypothesis of no long-run relation is rejected. Although the Hausman test suggests that the MG estimator is more appropriate than PMG, it also suggests that DFE is preferred to MG. Therefore, we will focus on DFE results, which are consistent with the financial development findings of the PMG estimator. In particular, the results show that financial development does not affect the top 10 per cent income share in the short-run, yet lead to higher top income share, thus higher inequality, in the long-run. These results provide further color to our previous findings presented in Tables 3 and 4. The increasing the availability of financial services for the relatively poor reduces inequality in general (as measured by Gini index) but this does not imply any effect on the rich in the short-run (as measured by the top 10 per cent income share) and supporting H4. However, the relaxation of credit constraints positively affects the rich in the long-run using both measures of inequality.

[INSERT TABLE 5 HERE]

6. Conclusion

This paper examines the impact of financial development on income inequality and in particular, develops new hypotheses which suggest a difference in the short- and long-run impacts. Using suitably lengthy data, that is a sample of OECD countries over the period 1870-2011, our main finding is that financial development has a negative impact on income inequality in the short-run but a positive impact over the long-run. The results suggest that, in the short-run, financial development operates on the extensive margin by relaxing the credit constraints and increasing the availability of financial services for the poor. As a result, an improvement in financial development leads to a reduction in income inequality in the short-run. In the long-run, however, the effect is the opposite - the rich appear to benefit more.

Our results emphasize the important of considering the intertemporal relationship between finance and the income distribution. This has a message for policy-makers: short-term inequality benefits from policies aimed at credit expansion may vanish or even become harmful in the long-run. To avoid this, complementary policies may be needed in the aftermath of credit expansion, such as, for example, fiscal redistribution through progressive income tax and regulation/financial education aimed at helping households not to take on excessive amounts of credit. In addition, as more data becomes available, more research needs to examine the long- versus short-run nexus advocated in this paper, in contexts such as developing countries, where the extensive margin can potentially take longer to work than the intensive margin. Similarly, more insight can be obtained by looking into bottom quantiles of income as an alternative measure of inequality, for which, unfortunately to date, data is scarce.

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TABLES

Table 1. Sample of countries

Australia	Japan
Austria	Netherlands
Belgium	New Zealand
Canada	Norway
Denmark	Portugal
Finland	Spain
France	Sweden
Germany	Switzerland
Greece	United Kingdom
Ireland	United States
Italy	

Table 2: Financial Development and Income Inequality (static models)

	[1] OLS	[2] FE	[3] RE
Financial development	0.087***	0.095***	0.083***
	(3.03)	(3.01)	(3.24)
Education (in log)	-0.131	-0.057	-0.110
	(-1.54)	(-0.55)	(-1.22)
GDP per capita (in log)	-0.109***	-0.078	-0.149***
	(-3.75)	(-0.98)	(-4.62)
Inflation	-0.000	-0.000	-0.000
	(-0.62)	(-0.64)	(-1.02)
Population (in log)	-0.020	0.131	-0.029
	(-1.09)	(1.60)	(-0.46)
Age dependency ratio (in log)	0.208*	0.138	0.097*
	(1.97)	(1.29)	(1.69)
Constant	4.039***	2.690*	4.875***
	(6.46)	(1.95)	(9.26)
Observations	2903	2903	2903

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01.

Table 3: Financial Development and Income Inequality (ARDL Models)

	[1] PMG	[2] MG	[3] DFE
Long-run coefficients			
Financial development	0.135***	0.059*	0.160***
	(8.02)	(1.79)	(2.75)
Education (in log)	-0.143***	-0.479*	-0.230**
	(-2.72)	(-1.95)	(-2.32)
GDP per capita (in log)	-0.032	0.142	-0.094*
	(-0.85)	(0.96)	(-1.77)
Inflation	-0.006	-0.623**	0.001
	(-1.64)	(-2.44)	(0.73)
Population (in log)	-0.027	-0.569	0.134
	(-0.66)	(-1.61)	(1.09)
Age dependency ratio (in log)	0.019	0.220	0.311
	(0.26)	(0.92)	(1.11)
Short run coefficients			
Error-correction coefficient	-0.051***	-0.148***	-0.027***
	(-4.81)	(-9.34)	(-4.95)
Δ Financial development	-0.015**	-0.029***	-0.013**
	(-1.99)	(-3.05)	(-2.08)
Δ Education	-0.168**	-0.131*	-0.060
	(-2.27)	(-1.88)	(-1.34)
Δ GDP per capita	0.035	0.018	0.040**
	(1.64)	(0.68)	(2.03)
Δ Inflation	0.022	0.045***	-0.000
	(1.64)	(3.26)	(-1.53)
Δ Population	0.136	-0.166	0.244
	(0.72)	(-0.56)	(1.47)
Δ Age dependency ratio	-0.037	0.019	0.002
	(-0.36)	(0.14)	(0.02)
Constant	0.204***	0.980***	0.053
	(4.74)	(5.74)	(1.15)
Observations	2881	2881	2881
Hausman test		11.29	6.04
p-Value		0.08	0.42

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01. The lag structure is $p = 1$ and $q = 1$ based on SBC. ·p-value represents the p-value of the Hausman test as to whether the MG or DFE is significantly different from the PMG estimation.

Table 4: Financial Development and Income Inequality, sensitivity analysis (PMG Model)

	[1] Nonlinear economic development	[2] Technology	[3] Trade union	[4] Financial volatility	[5] Stock market capitalization to GDP	[6] Aggregate Financial development[a]
Long-run coefficients						
Financial development	0.109***	0.160***	0.075***	0.128***	0.093***	0.100***[a]
	(7.20)	(8.39)	(3.94)	(7.22)	(5.42)	(8.63)
Education (in log)	-0.151***	-0.204***	-0.063	-0.136***	-0.161***	-0.112**
	(-3.05)	(-3.72)	(-1.17)	(-2.64)	(-3.50)	(-2.27)
GDP per capita (in log)	-2.798***	-0.041	0.027	-0.069*	0.0210	-0.116***
	(-8.82)	(-1.06)	(0.75)	(-1.84)	(0.63)	(-3.50)
Inflation	0.001	0.001	0.013	0.001	0.001	0.000
	(1.35)	(1.28)	(1.54)	(1.32)	(1.27)	(0.94)
Population (in log)	0.118**	-0.105**	0.165***	-0.017	-0.090**	0.024
	(2.24)	(-2.35)	(2.59)	(-0.40)	(-2.33)	(0.66)
Age dependency ratio (in log)	-0.125*	0.008	-0.195**	0.007	-0.062	0.084
	(-1.87)	(0.10)	(-2.53)	(0.09)	(-0.93)	(1.33)
GDP per capita (Sq)	0.141***					
	(8.65)					
R&D intensity (in log)		0.055***				
		(3.22)				
Union (in log)			-1.297***			
			(-14.62)			
Financial volatility (in log)				0.010**		
				(2.28)		
Stock market capitalization to GDP(in log)					0.001***	
					(4.22)	
Short run coefficients						
Error-correction coefficient	-0.059***	-0.053***	-0.062***	-0.054***	-0.057***	-0.058***

	(-5.94)	(-5.03)	(-4.45)	(-5.25)	(-4.69)	(-5.24)
Δ Financial development	-0.015**	-0.015*	-0.018***	-0.013*	-0.013*	-0.012* [a]
	(-1.97)	(-1.89)	(-2.64)	(-1.72)	(-1.66)	(-1.88)
Δ Education	-0.160**	-0.166**	-0.154**	-0.167**	-0.164**	-0.154**
	(-2.06)	(-2.05)	(-2.04)	(-2.31)	(-2.21)	(-2.04)
Δ GDP per capita	-0.276	0.036*	0.041*	0.037*	0.026	0.039*
	(-0.96)	(1.77)	(1.93)	(1.72)	(1.21)	(1.79)
Δ Inflation	0.021*	0.013	0.027*	0.022	0.022	0.023
	(1.65)	(0.90)	(1.84)	(1.63)	(1.62)	(1.59)
Δ Population	0.279	0.106	0.026	0.152	0.165	0.158
	(1.46)	(0.51)	(0.13)	(0.75)	(0.82)	(0.83)
Δ Age dependency ratio	-0.072	-0.012	-0.040	-0.043	-0.018	-0.088
	(-0.76)	(-0.13)	(-0.40)	(-0.42)	(-0.20)	(-0.92)
Δ GDP per capita (Sq)	0.019					
	(1.20)					
Δ R&D intensity		-0.014				
		(-1.30)				
Δ Union			-0.140			
			(-1.58)			
Δ Financial volatility				-0.000		
				(-0.47)		
Δ Stock market capitalization to GDP					0.000	
					(0.09)	
Constant	0.977***	0.263***	0.166***	0.231***	0.262***	0.255***
	(5.93)	(4.96)	(4.26)	(5.18)	(4.65)	(5.18)
Observations	2881	2881	2843	2843	2843	2843

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01. The lag structure is $p = 1$ and $q = 1$ based on SBC. [a] the aggregate measure of financial development is the first principle component of the following financial indicators; the ratios of credit to GDP, bank assets to GDP, and monetary stock to GDP.

Table 5: Financial Development and top 10 % income share (ARDL Models)

	[1] PMG	[2] MG	[3] DFE
Long-run coefficients			
Financial development	0.149***	0.037	0.140***
	(7.23)	(0.72)	(4.03)
Education (in log)	-0.156**	-0.774	-0.321***
	(-2.28)	(-1.24)	(-3.56)
GDP per capita (in log)	-0.031	0.474	-0.060
	(-0.82)	(0.98)	(-1.23)
Inflation	0.001	-1.661	0.001
	(1.16)	(-1.47)	(1.02)
Population (in log)	-0.160***	-1.043	0.083
	(-3.68)	(-1.22)	(0.88)
Age dependency ratio (in log)	-0.152*	0.689	0.003
	(-1.67)	(1.01)	(0.02)
Short-run coefficients			
Error-correction coefficient	-0.052***	-0.146***	-0.033***
	(-6.98)	(-8.55)	(-5.93)
Δ Financial development	0.007	-0.006	0.001
	(0.93)	(-0.71)	(0.25)
Δ Education	-0.025	-0.019	-0.015
	(-0.65)	(-0.49)	(-0.37)
Δ GDP per capita	-0.004	-0.009	0.011
	(-0.20)	(-0.32)	(0.64)
Δ Inflation	0.024	0.051***	-0.000**
	(1.35)	(3.35)	(-2.39)
Δ Population	0.094	0.161	0.218*
	(0.45)	(0.69)	(1.77)
Δ Age dependency ratio	0.041	0.033	0.070
	(0.52)	(0.44)	(1.22)
Constant	0.313***	0.959***	0.130***
	(6.75)	(3.77)	(2.60)
Observations	2881	2881	2881
Hausman test	20.16		0.01
p-Value	0.003		1.000

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01. The lag structure is $p = 1$ and $q = 1$ based on SBC. p-value represents the p-value of the Hausman test as to whether the MG or DFE is significantly different from the PMG estimation.

Appendix

Appendix 1: Financial Development and Income Inequality, sensitivity analysis (DFE Model)

	(1) Nonlinear economic development	(2) Technology	(3) Trade union	(4) Financial volatility	(5) Stock market capitalization to GDP	(6) Aggregate Financial development[a]
Long-run coefficients						
Financial development	0.181***	0.160***	0.089*	0.145***	0.144**	0.109**[a]
	(2.91)	(3.03)	(1.68)	(2.62)	(2.53)	(2.25)
Education (in log)	-0.130	-0.268***	-0.136	-0.201**	-0.220**	-0.189
	(-1.59)	(-3.19)	(-1.58)	(-2.11)	(-2.30)	(-1.63)
GDP per capita (in log)	-1.522*	-0.157***	-0.034	-0.155***	-0.106**	-0.064
	(-1.66)	(-3.41)	(-0.65)	(-3.06)	(-2.06)	(-0.88)
Inflation	0.000	0.000	0.000	0.000	0.000	0.000
	(0.70)	(0.72)	(0.71)	(0.58)	(0.74)	(0.77)
Population (in log)	0.135	0.010	0.144*	0.149	0.084	0.128
	(1.11)	(0.07)	(1.76)	(1.23)	(0.67)	(0.98)
Age dependency ratio (in log)	0.247	0.342	0.084	0.326	0.292	0.406
	(0.91)	(1.24)	(0.42)	(1.21)	(1.10)	(1.22)
GDP per capita Sq	0.072					
	(1.50)					
R&D intensity (in log)		0.126***				
		(3.77)				
Union membership(in log)			-0.897***			
			(-4.32)			
Financial volatility (in log)				0.023***		
				(2.64)		
Stock market capitalization to GDP(in log)					0.002**	

					(2.21)	
Short run coefficients						
Error-correction coefficient	-0.026***	-0.029***	-0.035***	-0.028***	-0.028***	-0.024***
	(-4.50)	(-5.07)	(-4.01)	(-4.90)	(-4.65)	(-4.16)
Δ Financial development	-0.015**	-0.012**	-0.014**	-0.013**	-0.013**	-0.017*** [a]
	(-2.30)	(-1.99)	(-2.21)	(-2.08)	(-2.04)	(-3.16)
Δ Education	-0.059	-0.062	-0.057	-0.059	-0.062	-0.061
	(-1.27)	(-1.33)	(-1.21)	(-1.28)	(-1.34)	(-1.32)
Δ GDP per capita	-0.474*	0.040**	0.043**	0.044**	0.041**	0.034*
	(-1.89)	(2.04)	(2.24)	(2.30)	(2.19)	(1.73)
Δ Inflation	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.62)	(-1.28)	(-1.23)	(-1.30)	(-1.54)	(-1.63)
Δ Population	0.261	0.221	0.233	0.253	0.237	0.264
	(1.63)	(1.31)	(1.47)	(1.52)	(1.41)	(1.59)
Δ Age dependency ratio	0.007	-0.023	-0.006	-0.014	-0.004	-0.029
	(0.10)	(-0.33)	(-0.09)	(-0.21)	(-0.06)	(-0.45)
Δ GDP per capita Sq	0.030**					
	(2.10)					
Δ R&D intensity		-0.017***				
		(-3.08)				
Δ Union membership			-0.146**			
			(-2.39)			
Δ Financial volatility				-0.000		
				(-1.57)		
Δ Stock market capitalization to GDP					-0.000	
					(-0.34)	
Constant	0.230*	0.110*	0.083*	0.064	0.073	0.043
	(1.86)	(1.94)	(1.83)	(1.36)	(1.50)	(0.92)
Observations	2881	2881	2843	2843	2843	2843

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01. The lag structure is $p = 1$ and $q = 1$ based on SBC. [a] the aggregate measure of financial development is the first principle component of the following financial indicators; the ratios of credit to GDP, bank assets to GDP, and monetary stock to GDP.

Appendix 2: Financial Development and Income Inequality, sensitivity analysis (MG Model)

	(1) Nonlinear economic development	(2) Technology	(3) Trade union	(4) Financial volatility	(5) Stock market capitalization to GDP	(6) Aggregate Financial development[a]
Long-run coefficients						
Financial development	0.065*	0.069**	0.024	0.057*	0.043	0.074***[a]
	(1.89)	(1.96)	(0.94)	(1.80)	(1.44)	(2.77)
Education (in log)	-0.583**	-0.381*	-0.369*	-0.489**	-0.596***	-0.452**
	(-2.16)	(-1.76)	(-1.91)	(-2.28)	(-2.76)	(-2.29)
GDP per capita (in log)	-0.728	0.106	0.0779	0.0325	0.0641	0.0530
	(-0.72)	(1.13)	(1.27)	(0.45)	(0.89)	(0.65)
Inflation	-0.405***	-0.410**	-0.232***	-0.380***	-0.328***	-0.562***
	(-3.68)	(-2.06)	(-3.65)	(-4.04)	(-4.68)	(-3.63)
Population (in log)	0.284	-0.566**	-0.161	-0.279*	-0.281**	-0.340
	(1.12)	(-2.20)	(-0.78)	(-1.85)	(-2.36)	(-1.36)
Age dependency ratio (in log)	0.062	0.072	-0.033	0.110	0.095	0.164
	(0.29)	(0.35)	(-0.26)	(0.66)	(0.52)	(1.02)
GDP per capita Sq	0.038					
	(0.69)					
R&D intensity (in log)		0.034				
		(0.80)				
Union membership(in log)			-0.900***			
			(-3.74)			
Financial volatility (in log)				0.009**		
				(2.22)		
Stock market capitalization to GDP(in log)					0.001**	
					(1.98)	
Short run coefficients						
Error-correction coefficient	-0.162***	-0.160***	-0.188***	-0.164***	-0.174***	-0.151***
	(-10.17)	(-10.43)	(-10.74)	(-10.81)	(-11.21)	(-9.50)

Δ Financial development	-0.030***	-0.025***	-0.024**	-0.029***	-0.026***	-0.028*** [a]
	(-2.92)	(-2.78)	(-2.47)	(-2.96)	(-2.69)	(-3.84)
Δ Education	-0.120*	-0.129*	-0.113	-0.117	-0.0915	-0.110*
	(-1.69)	(-1.70)	(-1.61)	(-1.62)	(-1.32)	(-1.66)
Δ GDP per capita	-0.538*	0.030	0.028	0.024	0.016	0.007
	(-1.71)	(1.06)	(1.15)	(1.02)	(0.63)	(0.30)
Δ Inflation	0.044***	0.031**	0.038***	0.045***	0.042***	0.047***
	(3.29)	(2.32)	(2.65)	(3.31)	(3.08)	(3.05)
Δ Population	-0.183	-0.174	-0.345	-0.260	-0.263	-0.176
	(-0.59)	(-0.61)	(-1.23)	(-0.80)	(-0.94)	(-0.62)
Δ Age dependency ratio	-0.013	0.043	0.033	0.008	0.031	0.032
	(-0.09)	(0.32)	(0.22)	(0.06)	(0.20)	(0.22)
Δ GDP per capita Sq	0.032*					
	(1.83)					
Δ R&D intensity		-0.019*				
		(-1.68)				
Δ Union membership			-0.110			
			(-1.50)			
Δ Financial volatility				-0.000*		
				(-1.88)		
Δ Stock market capitalization to GDP					-0.000	
					(-1.15)	
Constant	0.392	1.248***	0.982***	1.108***	1.245***	0.975***
	(0.47)	(6.09)	(3.67)	(5.59)	(6.88)	(5.92)
Observations	2881	2881	2843	2843	2843	2843

Notes: *t*-statistics in parentheses; * p<0.10, ** p<0.05, *** p<0.01. The lag structure is $p = 1$ and $q = 1$ based on SBC. [a] the aggregate measure of financial development is the first principle component of the following financial indicators; the ratios of credit to GDP, bank assets to GDP, and monetary stock to GDP.

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