Finance and Inequality - panel BMA approach*

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Abstract

We investigate the impact of financial development on income inequality differentiating between depth, efficiency and access to financial markets and institutions. We apply panel Bayesian model averaging framework to address model uncertainty to reveal that financial development has complex relationship with the income distribution within countries. The access to and efficiency of banking decrease income inequality. The size of the markets has no relevance for overall income inequality, but relates to the higher top income shares. Moreover, unemployment along with investment into non-tangible assets increase income inequality while more redistribution imply lower levels of inequality.

Keywords: Finance, Inequality, Bayesian Model Averaging

1. Introduction

Financial development alters how much the economic opportunities depend on the individual skills, family endowments, social status or political connections as individual may depend on financial system to provide loans to start new business, attain education, or temporarily fund their consumption. The research in the area of financial development and income inequality is well established. Demirgüç-Kunt and Levine (2009), Claessens and Perotti (2007), and more recently de Haan and Sturm, 2017 provide extensive reviews of the topic. A similar theme emerges in all three papers. The implications from theoretical contributions provide conflicting predictions about the relationship and empirical results bring evidence for both positive and negative effect. Although majority of the papers point towards finance tightening the distribution of income this results is not universal with some papers suggesting the opposite while other stress potential non-linearities.

A key divide appears between the effect of financial development on extensive and intensive margin. The extensive margin captures the extend to which individuals, who had not been using financial services before, gain access. On the other hand, the intensive margin describes growing use of finance by the

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agents who had already been using it before (Demirgüç-Kunt & Levine, 2009). Financial development on the extensive margin might lead to more equal opportunities and outcomes. Access to credit by previously disadvantaged groups allows human capital accumulation (Braun et al., 2019; Galor & Moav, 2004; Galor & Zeira, 1993), formation and growth of new firms (Banerjee & Newman, 1993; Evans & Jovanovic, 1989), with more evenly distributed economic opportunities as a result[1].

On the contrary, intensive margin of financial development might disproportionately benefit the rich who may leverage financial services for their further benefit or to protect their existing rents. Greenwood and Jovanovic (1990) present a model where the finance is the key driver of inequality and the welfare gains accrued by the incumbents - primarily the rich - in the initial development stage. With time, more agents meet the fixed costs of joining the financial intermediaries and they enjoy higher returns. Consequently, the efficiency of resource allocation also increases, which enhances growth and reduces inequality. Perotti and Volpin (2007) present a framework based on political economy. They argument depends on a lobby for lower investor protection to prevent entrance of the new competitors. The politicians require higher bribe from the lobbyist the greater is their accountability for policy decisions. Thus, with increasing accountability, investor protection strengthens and spurs market entry and competition. The authors examine their prediction in a cross-section and show that better investor protection correlates with larger entry rates and higher firm density in more financially intensive sectors[2].

Financial development may also have indirect effect on income inequality through economic growth. Townsend and Ueda (2006) model how finance interacts with production and allocation of credit. If increased use of finance increases the demand for low- relatively to the high-skilled workers, then it may have equalizing consequences for income distribution. Empirical evidence by Beck et al. (2010) show that bank deregulation and increased competition in loan provision in the United States (US) primarily benefited the workers with income below the median. Similarly, Delis et al. (2014) provide evidence of bank deregulation and liberalization tightening the income distribution, although this effect is only present in countries with high-quality institutions. They attribute the effect to the changes in labour market conditions and relatively higher wages and working hours of the low-skilled workers following the reforms.

A set of distinct papers explores the relationship between inequality and growth while stressing financial markets imperfections driving the outcomes. Income inequality and growth may intersect through varying channels. Accu-

[1]Having similar economic opportunities might decrease the cross-generational inequality, by diminishing the effect of e.g. parental wealth. Depending on the innate abilities and talents of the individuals, however, it may increase the inequality of income within every generation at the same time.

[2]In addition, they show that the most important factor of accountability is not the formal measure of democratic institutions, but newspaper readership which they interpret as broad awareness of policy choices and their outcomes.

mulation of savings, unobservable effort, and investment project size favor the prediction of growth inducing inequality. Negative impact of inequality on human capital accumulation, entrepreneurial activity provide argument for the opposing view. Van der Weide and Milanovic (2018) report how income inequality in the US has different implications for the future income growth of the rich and the poor. High inequality seems to hurt the prospects of the poor while the top of the distribution is unaffected. The rich thus disproportionately benefit from higher inequality as their subsequent income exhibit faster growth. The authors attribute this effect to the political channel the rich use to lobby in favor of the policies which support their economic interests. Preferences of the rich are ultimately more likely to determine public policy than the preferences of the majority (Gilens & Page, 2014). High inequality together with a credit constraint and rich driving the political process results in low government spending and lasting inequality.

The literature does not converge on the conclusions even in the empirical cross-country and panel data studies. The papers link higher levels of financial development with lower levels of inequality (Beck et al., 2007; Gimet & Lagoarde-Segot, 2011; Hamori & Hashiguchi, 2012; Kunieda et al., 2014)[3]. On the other hand, several other estimate a inequality inducing effect of finance (de Haan & Sturm, 2017; Jauch & Watzka, 2016; Jaumotte et al., 2013). Finally, some authors claim there the relationship might be non-linear, conditional on a threshold value of financial development (Kim & Lin, 2011; Tan & Law, 2012) or institutional quality (Delis et al., 2014; Law & Singh, 2014).

Three papers are the closest to ours, each in a different respect. First, de Haan and Sturm (2017) examine different dimensions of finance on income inequality. Their results suggest that financial development, financial liberalization, and banking crises all increase pre-tax income inequality within countries. Additionally, they show that the effect of financial liberalization is conditional on democratic accountability. Higher accountability mitigates the impact of liberalization on inequality. On the contrary, the financial development, proxied by the credit to GDP ratio, has inequality increasing effect irrespective of the institutional background. Second, Naceur and Zhang (2016) take similar approach in considering multiple dimensions — the access, efficiency, and stability of the financial sector, although not examining the indicators simultaneously. Third, Furceri and Ostry (2019) apply Weighted-average Least Squares (WALS) to identify robust determinants of income inequality. Their approach mirrors ours in accounting for model uncertainty in the estimation. Their focus is more general rather than focused primarily on finance. We provide synthesis and extension to these papers in providing more detailed view on the link between finance in shaping income inequality and examining multiple measures of inequality while specifically identifying the determinants of top income shares along with the determinants of the overall income distribution[4].

[3]For an extended list, we refer to de Haan and Sturm (2017).

[4]Captured by income Gini index.

2. Data and methodology

The key variable in the paper is the measure of income inequality. We want to examine how financial development affects income inequality and whether the effect might by different at the top quantiles of income distribution. As the overall measure of income inequality, we rely the after-tax Gini coefficient from Standardized World Income Inequality Database (SWIID) by Solt (2019), which is a standard resource in the literature[5]. Its critical advantage lies in the widespread coverage across countries and time and a unified methodology which provides a reasonable level of comparability. It typically takes values in the interval between 0 and 100 where the former suggests perfect equality (everyone in the economy enjoys the same income) and the latter perfect inequality (all the income goes to only a single unit). We depart from existing papers slightly in considering the after-tax rather than the before-tax income distribution as a dependent variable.

To explore the relationship in the top part of the distribution, we choose top income share from World Inequality Database (WID)[6]. The surveys suffer from well-known issues of underrepresentation of the top income earners and the distortions resulting from self-reported character of the data. This can influence not only the top income shares resulting from survey data, but also distortions in the overall measures of inequality. The data in WID make use of income tax records in individual countries and the derived shares obtained using consistent methodology of Distributional National Accounts (DINA) are arguably more reliable relative to the survey-based measures which are the primary source of majority estimates of income distributions.

The data spans from 2000 to 2014. We follow the literature (Dabla-Norris et al., 2015; de Haan & Sturm, 2017) and average both the inequality measure (dependent variable) and the potential determinants (independent variables) across three year intervals. There are important reasons for looking at the averages than observation in individual years. Annual macroeconomic data are subject to fluctuations and the data on income inequality is noisy Delis et al. (2014). Averaging should diminish the level of noise. On the top of that, the variables at the center of our analysis, e.g. stock market capitalization or credit to Gross Domestic Product (GDP), are likely to be affected by the business cycles and volatile on the yearly basis. Similar argument holds for top income shares, as they depend, among other things, on the bonuses paid out each year and capital income. We want to explore the long-term rather than the short-term relationship and that guides the choice of averaged data. Faced against the trade-off between length of the averaging periods and available observations in the time dimension, we take a compromise of three years in contrast to the literature, where generally the 5-year intervals apply. The availability of finan-

[5]There are alternative sources of for Gini coefficient, e.g. World Income Inequality Database (WIID) or Luxembourg Income Study (LIS), but each of them brings limitations in terms of comparability or coverage.

[6]The methodology and guidelines to database are provided by Alvaredo et al. (2016).

cial development indicators limits the analysis to a period from 2000 onward and we prefer to keep at least 5 unique time periods to just three under the case of 5-year average[7].

Table 1 report the summary statistics of the income inequality variables and financial development indicators.

Table 1: Summary statistics of selected variables

Variable	Mean	St. Dev.	Min	Max
After-tax Gini index	36.38	8.12	22.88	61.16
Top 10% income share	0.42	0.12	0.24	0.71
Top 1% income share	0.14	0.06	0.05	0.38
FIA	0.42	0.32	0.01	1.00
FIE	0.60	0.13	0.11	0.81
FID	0.37	0.30	0.01	1.00
FMD	0.33	0.32	0.00	0.99

Table 2: Correlation matrix of selected variables

After-tax Gini index	.						
Top 10% income share	0.47	.					
Top 1% income share	0.39	0.84	.				
FIA	-0.14	-0.09	-0.12	.			
FIE	-0.14	-0.10	-0.06	0.28	.		
FID	-0.07	0.12	0.06	0.60	0.24	.	
FMD	0.03	0.2	0.13	0.36	0.1	0.40	.

We obtain the financial development indicators from Global Financial Development Database (GFDD). The database offers detailed indicators along four dimensions of financial systems and allows to estimate the affect of changes in access, size, efficiency, and stability of financial markets. Furthermore, we can distinguish between banking sector and financial markets in all these dimensions. The data in for access and stability of stock markets remains sparse in the concerned period we must leave them out of analysis. We use the version of financial indicators from Svirydzenka, 2016. The authors make use of principal component analysis in order to construct aggregate indicators in each characteristic of financial sector. In summary, we have indicators of financial institutions depth (FID), financial markets depth (FMD), access to financial institutions (FIA), efficiency of financial markets (FME), and institutions (FIE)[8]. We report the composition of each indicator in Table A1.

[7]Nevertheless, we run the estimation with 5-year averages of data as a robustness check and find no critical qualitative differences compared to the baseline.

[8]Svirydzenka (2016) extrapolate the indicators from top to bottom if the original variables are unavailable, we make sure that that at least one variable is available for the construction of the index and no artificial correlation introduced to the data.

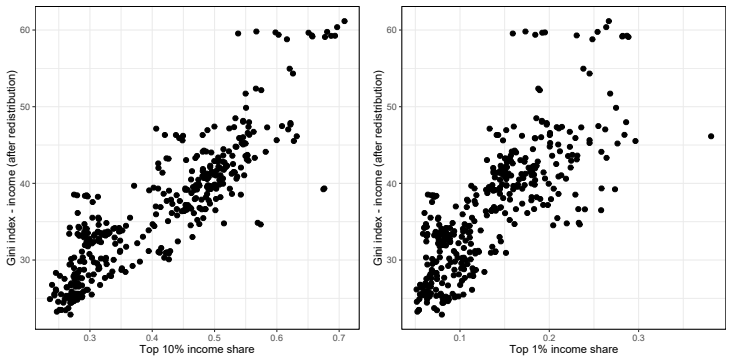

Figure 1: Gini Coefficient and top shares

We build the choice of other explanatory variables on a reviews of income inequality drivers (Nolan et al., 2019; Roine et al., 2009), related study of finance-inequality nexus (de Haan & Sturm, 2017), and a more general inquiry into the robust determinants of income inequality (Furceri & Ostry, 2019). The potential regressors could be categorized in several groups. They control for economic and financial development, demographics, globalization, and institutional background. Table A2 reports all the control variables and their sources.

Methodologically, we rely on the Bayesian Model Averaging (BMA) approach which conveniently addresses the issue of model uncertainty with a large number of potential regressors. The advantages are statistical properties of the BMA have been sketched in Koop (2003). In application to the panel data, we make use of Frisch-Waugh-Lovell theorem and demean all the variables using time averages for individual observations. Using the time-demeaned observations in the estimation is equivalent to the estimate using the dummy variables for individual cross-sectional units. The key assumptions in BMA are on parameter and model priors. For the parameter prior, we turn to so-called hyper-g prior. The prior provides more robust results than some other traditionally applied g priors such as Unit Information Prior (UIP), Bayesian Risk Inflation Criterion (BRIC) (Feldkircher & Zeugner, 2012). As for the model priors, the baseline estimate relies on the uniform model prior. We choose the model prior to remain agnostic about the prior probability of each examined model. While uniform prior assigns the same prior probability to each model, the distribution of the prior model space is concentrated around $k/2$, where k is the number of potential covariates, and it may consequentially gravitate towards larger model sizes and higher number of covariates[9].

[9]See Ley and Steel (2009) for details.

3. Results

We examine the determinants of inequality in the panel BMA framework and present the results in the following sections. We start with a model where we capture the overall inequality by Gini index in subsection 3.1. We then continue to estimations where we consider the shares of income going to the top 10% and top 1% of the income distribution as our dependent variable. We check the robustness of our estimates by employing alternative model and parameter priors throughout the analysis.

3.1. Gini index of income distribution

We focus the analysis on the relationship between the indicators representing various aspects of financial development and income inequality. Figure 2 outlines the expected link after we have demeaned the variables using the cross-sectional averages. The relationship is not particularly strong, but we observe negative correlation between Gini index and indicators of access and efficiency of financial institutions, as suggested by a linear estimate. For size indicators of financial market and institutions, the link appears much weaker.

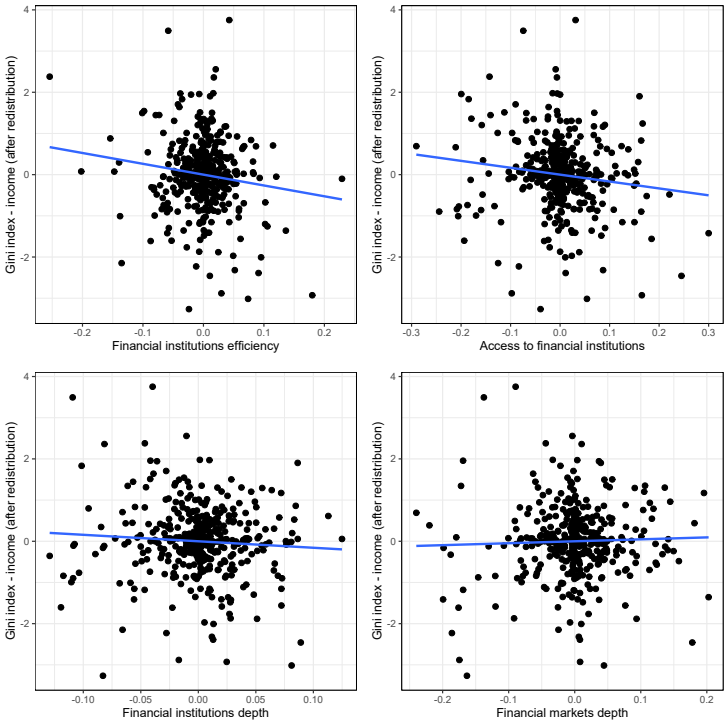

Figure 2: Gini Coefficient and Financial Development Indicators

Table 3 reports the baseline results. Overall, we have 16 variables with Posterior Inclusion Probability (PIP) above 0.8. The number of unique relevant

regressors effectively shrinks by two if we abstract from the quadratic terms of the GDP per capita and the education index. Most of the estimated posterior means exhibit expected signs.

The only financial indicators which occur among the top regressors are access and efficiency of financial institutions with PIPs of 1 and 0.88, respectively. The posterior mean on the coefficients in both dimension is negative so higher levels of access and efficiency are associated with lower levels of income inequality. The inequality decreasing effect of access to finance on inequality mirrors Hasan et al. (2020) for wealth inequality, and partially also Furceri and Ostry (2019), Naceur and Zhang (2016) who document similar effect. The observation on inequality decreasing effect of access to finance supports also Claessens and Perotti (2007) who suggest that access may equalize economic opportunities and lead to more evenly distributed income as well as theoretical predictions (Banerjee & Newman, 1993; Braun et al., 2019; Galor & Moav, 2004). The efficiency of financial intermediation putting downward pressure on income inequality also has a precedent in Gimet and Lagoarde-Segot (2011)[10]. We fail to confirm that the efficiency of financial institutions is a robust determinant of inequality, however, as the PIP markedly decreases under alternative model priors. None of the size indicators of financial institutions or markets has high probability of inclusion.

Education expenditures (% share of GDP) along with the education index calculated using mean and expected years of schooling show inequality decreasing effect. This is in line with prediction of Deaton (2013), Goldin and Katz (2009) who claim that the skill-biased technological change should be mitigated by education. OECD (2011) finds similar evidence for a panel of advanced countries while Furceri and Ostry (2019) also suggest a negative relationship, although it is not fully robust to variable and sample selection. The effect of education diminishes at the higher levels of schooling as the quadratic term has also high PIP and positive posterior mean.

We find evidence for the Kuznets' hypothesis about the inequality and economic development. We include three regressors which primarily capture the level of development - GDP per capita along with a square term, share of value added in agriculture, and share of value added in industry. Exploring the results of the baseline, We find evidence for an inverted-U curve for GDP per capita and baseline PIPs for linear and square component. This suggests that the inequality tends to be higher at the lower stages of economic development and only starts decreasing after reaching a threshold. The PIP of 0.97 for value added in agriculture along with a negative posterior mean for its coefficient supports this idea further. The economies at lower stages of development generally report higher shares of agricultural sector which is also more labour intensive,

[10]The authors measure efficiency of banking sector by the difference between lending rate and the deposit rate (spread). They argue higher spread reflects low competition and high transaction costs. The imperfections in the credit market can skew the credit to high-income, rich households who can provide significant collateral, reinforcing the existing inequality.

Table 3: BMA, baseline results. Dependent variable after-tax Gini index, 394 observations.

	PIP	Post Mean	Post SD
Education expenditures	1.00	-0.14506	0.05042
GDP per capita	1.00	1.62811	0.56870
Unemployment	1.00	0.23629	0.05907
Non-equipment investment	1.00	0.14977	0.05285
Access to financial institutions	1.00	-0.24629	0.06342
Education index (UN)	1.00	-0.58853	0.23865
Redistribution	1.00	-0.22055	0.05051
Education index sq.	1.00	0.82252	0.22008
GDP per capita sq.	1.00	-1.44906	0.57565
Life expectancy	0.99	-0.22879	0.09750
Economic freedom	0.99	0.18518	0.06941
Value added in agriculture	0.97	-0.12361	0.05947
Government expenditures	0.95	0.12259	0.05743
Total population	0.95	-0.15378	0.08478
Financial institutions efficiency	0.88	-0.08374	0.05599
Inflation	0.86	0.16879	0.12487
Inflation sq.	0.66	-0.11127	0.11201
Value added in industry	0.62	-0.05825	0.06407
Equipment investment	0.44	-0.03383	0.05359
Financial markets depth	0.27	0.01554	0.03673
Gross domestic savings	0.27	-0.02022	0.04597
Social globalization	0.23	0.02365	0.06279
Restrictions on globalization	0.15	0.00874	0.03214
Trade openness	0.13	0.00615	0.02589
Left-wing orientation	0.11	0.00339	0.01720
Rule of law	0.10	-0.00333	0.01812
Net FDI (% GDP)	0.10	-0.00283	0.01575
Natural resources rents	0.08	-0.00223	0.01583
Chinn-Ito index	0.07	-0.00205	0.01780
Financial globalization	0.06	-0.00134	0.01466
Civil liberties & political rights	0.06	0.00075	0.01131
Financial institutions depth	0.05	0.00060	0.01316
GDP growth	0.05	0.00016	0.01255
Population growth	0.05	0.00055	0.01052
Political globalization	0.05	0.00000	0.01432

i.e. not exacerbating the inequalities that stem from unequal distribution of capital. The level of unemployment is associated with elevated income inequality. The mechanism is direct through the lower share of income going to labour in case of high unemployment rates. The effect of unemployment is also documented on cross-section by Furceri and Ostry (2019). We also explore the effect of non-equipment investment[11], which we believe could proxy for the technological progress and skill-biased technological change. The PIP suggests positive

[11] We construct the indicator using the detail on capital investment prom Penn World Table (PWT) and split the overall investment into non-equipment (structures, transportation, and other assets - software / intellectual property products) and equipment investment (machinery, computers + communication equipment).

correlation with income inequality as Dabla-Norris et al. (2015), Goldin and Katz (2009).

We rely on redistribution to capture the effect of taxes and social expenditure on income inequality. Our measure is the the difference between before-tax and after-tax Gini coefficient from the SWIID database. Therefore, we concentrate on the direct effects of policies on the household income. Given the global nature of our data and its limitations, we cannot estimate the potential indirect effects on the pre-tax distribution of income using, for example, top marginal tax rates (Alvaredo et al., 2013), corporate tax rates (Fuest et al., 2018). Nevertheless, the PIP of our indicator is very high and it it negatively relates to inequality as expected. The government expenditures, an often used regressors in the literature also has a perfect inclusion probability, but with positive posterior mean. The intuitive first-order effect of government expenditure should be through reduction of inequality through general social spending on transfers, education, and health. We account for these explicitly with redistribution and education expenditures of the government. Anderson et al. (2017) introduce a meta-analysis where they show how the examined relationship depends on the type of spending considered and how it depends on the measure of income inequality. Additionally, they suggest that the redistributive impact has not extended over the entire distribution, but has mostly centered towards middle-income groups. In line with their conclusions, our results suggest the effect of government spending might run in the positive direction when the key equalizing function have been accounted for or perhaps point towards reverse causality.

Life expectancy should proxy for changing demographics. We find a negative link between life expectancy and income inequality. Goldstein and Lee (2014) examine the channels between population ageing and inequality. Stretching the economic life-cycle are associated with larger within-group variance as a cohort ages. They argue this should pronounce inequality in older populations. On the other hand, if we consider retirement age, pension structure in many countries equalize income flows and therefore the older populations may report lower levels of inequality. The posterior mean of our estimated coefficient indicates the latter scenario.

Inflation is the only variable which could proxy for monetary policy and its influence on income inequality. It is among the relevant regressors with PIP of 0.86 and shows inequality inducing association. The interest in the effects of monetary policy, and macroprudential tools in particular, on inequality is relatively recent, following the introduction of unconventional measures following the Great Recession (Frost & van Stralen, 2018). Theoretically, the effect is ambiguous as high inflation of asset prices might benefit high-income households than the low income as they receive higher shares of financial income. Also, the assets held by low-income households tend to be much more liquid, thus inflation hurts them more relatively to the high-income ones. On the contrary, cut in rates usually benefits the borrowers and increased economic activity benefits the bottom-part of income distribution (Furceri & Ostry, 2019). Our evidence supports the view of inflation enhancing income inequality, at least at moderate

levels, as its square term is borderline on the inclusion, but negative in terms of posterior mean of its coefficient. This would suggest that the above mentioned theoretical effects interact and manifest differently at different inflation levels.

The index of the economic freedom of the world describes the overall business conditions by considering regulatory and legal environment. More economic freedom to trade and run daily business makes it easier to exploit economic opportunities and the high PIP with positive posterior mean of the coefficient point to economic freedom making the distribution of income less equal. We consider many other potential explanatory variables, but in case of Gini index, they show low PIPs. We do not find any measure of globalization, institutions, or trade openness relevant for the overall distribution of income. In the next section, we concentrate on the top income share and whether the top part of the distribution is perhaps associated with different regressors.

3.2. Top income shares

Financial development may influence various part of the income distribution differently. We therefore follow with baseline estimates with the top income shares as dependent variables. Table 4 reports the results for top 10% share and Table 5 for the top 1% share. There is large overlap of the most important determinants for the top 10% income share and Gini coefficient. GDP per capita, life expectancy, government expenditures, education index (but not expenditures), and inflation remain among the relevant regressors and their posterior means are consistent with the estimation for the overall income distribution. However, PIPs of some of the variables decline significantly and some other become relevant. Figure 3 provides a visual comparison of the inclusion probabilities.

In the case of the Top 10% share, education expenditures, non-equipment investment, unemployment, redistribution, and an index of economic freedom drop out. With the exception of the economic freedom, there are good reasons to believe these factors mainly drive lower and middle-part of the income distribution, rather than the very top. While education expenditures may support public education system and allow for human capital accumulation in the low-income households, such effect might not be as relevant for the concentration at the top. We have discussed previously how redistribution policies mostly affect the middle quantiles of the distribution and high unemployment rates traditionally do not concern the well educated high-income households and individuals. Also share of value added in agriculture now has a low PIP. The inclusion of non-equipment investment also decreases, while it retains the positive posterior mean. Most importantly, depth of financial markets and financial institutions now exhibit perfect PIPs and they seem to be associated with income distributions more concentrated at the top. The access to financial institutions remains relevant and negatively correlated with inequality. Among other variables with higher PIPs, we have natural resources rents, rule of law, equipment investment, and trade openness. For the natural resources rents, we get a negative posterior mean. The evidence is in line with Goderis and Malone (2011), who describe a mechanism of income equalizing natural resource booms through the

Table 4: BMA, baseline results. Dependent variable Top 10% share, 394 observations.

	PIP	Post Mean	Post SD
Natural resources rents	1.00	-0.15595	0.04773
GDP per capita	1.00	2.13915	0.54791
Life expectancy	1.00	-0.53327	0.09806
Financial institutions depth	1.00	0.20288	0.05638
Access to financial institutions	1.00	-0.25218	0.06712
Financial markets depth	1.00	0.19376	0.04976
GDP per capita sq.	1.00	-1.80042	0.55408
Government expenditures	1.00	0.15638	0.05565
Rule of law	1.00	-0.12607	0.04665
Education index (UN)	1.00	-0.49573	0.22152
Education index sq.	1.00	0.58180	0.20423
Equipment investment	1.00	-0.13953	0.05578
Trade openness	0.98	0.12632	0.05604
Inflation	0.80	0.06758	0.05407
Gross domestic savings	0.65	0.06566	0.06764
Left-wing orientation	0.63	0.04567	0.04858
Total population	0.57	0.07224	0.08621
Financial institutions efficiency	0.55	-0.04309	0.05278
Non-equipment investment	0.49	0.03864	0.05320
Value added in industry	0.31	-0.02652	0.05253
Financial globalization	0.22	-0.01390	0.03673
Value added in agriculture	0.18	-0.01163	0.03405
Unemployment	0.18	-0.01019	0.03113
Restrictions on globalization	0.13	0.00637	0.02398
Civil liberties & political rights	0.12	0.00529	0.02137
GDP growth	0.12	0.00608	0.02464
Net FDI (% GDP)	0.07	-0.00217	0.01377
Redistribution	0.07	-0.00243	0.01571
Chinn-Ito index	0.06	0.00170	0.01373
Population growth	0.05	0.00097	0.01043
Economic freedom	0.04	0.00055	0.01416
Education expenditures	0.04	-0.00062	0.01030
Social globalization	0.04	-0.00004	0.01918
Political globalization	0.04	0.00060	0.01279
Inflation sq.	0.03	-0.00045	0.01581

benefits for unskilled workers in labour intensive sector. A positive link between inequality and trade openness has been suggested by Dabla-Norris et al. (2015), Jaumotte et al. (2013) for the cross-sectional datasets and by Van der Weide and Milanovic (2018) in the case of US. The negative posterior coefficient on the rule of law is in line with the prediction by Perotti and Volpin (2007) and is sole variable indicating the importance of institutions posited in Acemoglu (2003), Acemoglu and Robinson (2015). Equipment investment (machinery) may channel the resources to the bottom part of the income distribution through increase long-term growth rates and upward pressure on wages.

The results using the Top 1% share for top regressors differs in the drop of PIPs for natural resource rents, and education attainment. We hypothesize that natural resource rents might redistribute the share of income from the

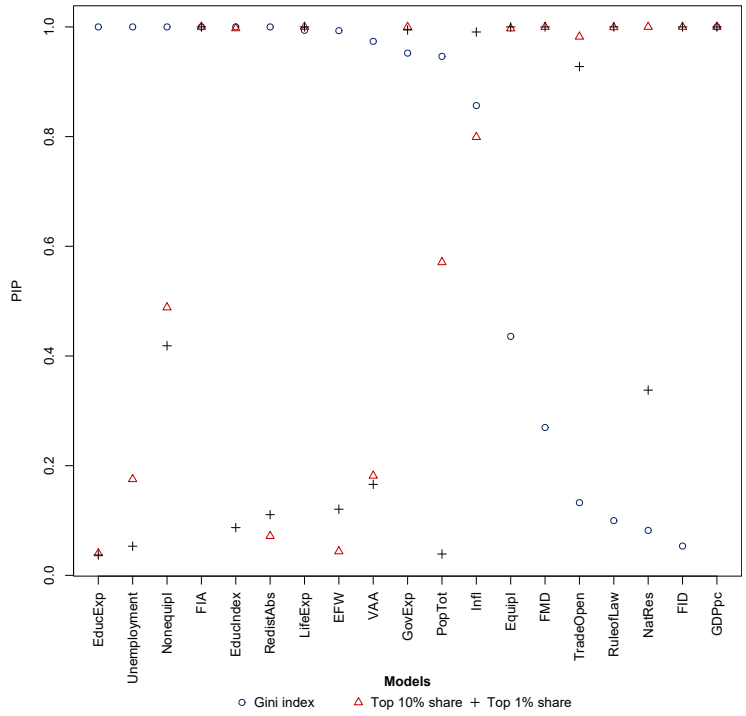

Figure 3: PIPs with different inequality measures
Note: The comparison only shows variables which show PIP > 0.9 *in at least one of the models.*

top decile to the rest of the distribution without actually affecting the share of the income going to the very top. The top 1% income earners might well be among the ones enjoying capital rents from the country resources. While education appears to have equalizing income effect for the lower part of the distribution, it is reasonable that it wears out for the very top income earners in the distribution. Figure 4 depicts comparison of inclusion probabilities of all variables considered in the estimation for the Top 10% share and Top 1% share.

3.3. Robustness checks

We perform robustness checks for all three specifications employing alternative model priors[12]. We choose random and dilution priors to address prior model size concentrated around the mean number of potential regressors and correlation among them by each of the model priors, respectively.

[12]We also perform robustness checks using alternative hyperparameter g and Markov-chain samplers, but these do not affect our results.

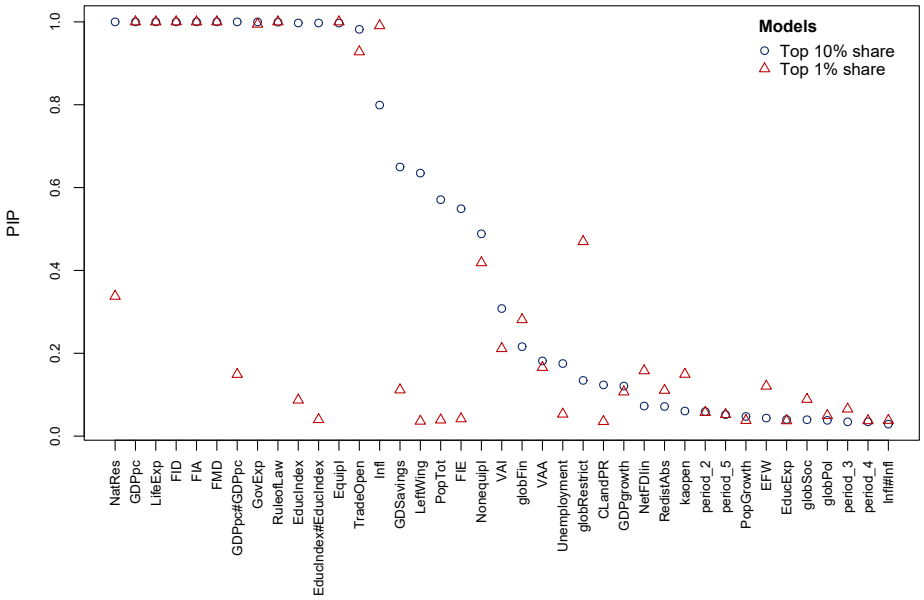

Figure 4: PIPs for different top income shares with baseline priors

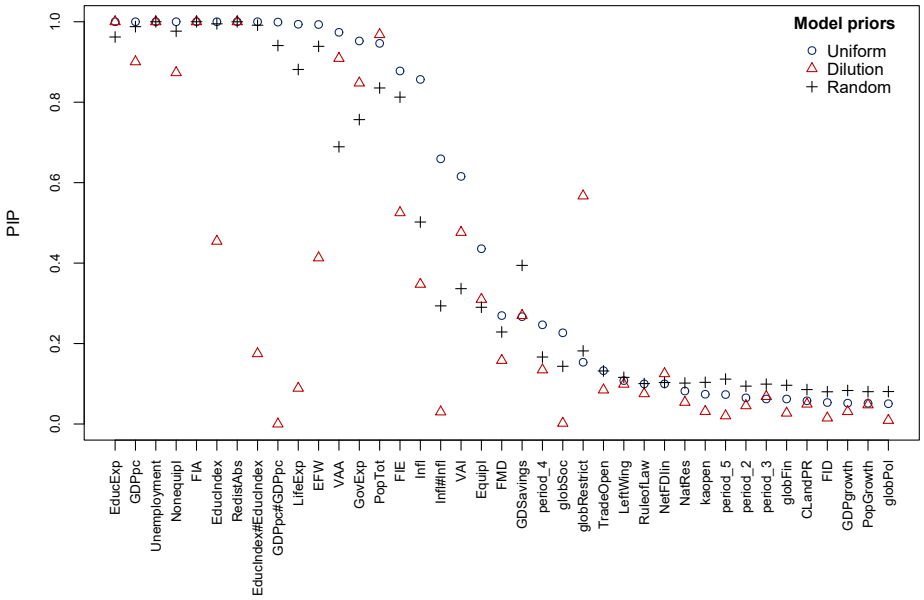

Figure 5: Robustness checks with alternative model priors, Gini coefficient

Table 5: BMA, baseline results. Dependent variable Top 1% share, 394 observations.

	PIP	Post Mean	Post SD
Rule of law	1.00	-0.17039	0.04688
GDP per capita	1.00	0.48163	0.29090
Life expectancy	1.00	-0.45605	0.06980
Equipment investment	1.00	-0.19727	0.05526
Financial institutions depth	1.00	0.16380	0.05689
Access to financial institutions	1.00	-0.25945	0.06419
Financial markets depth	1.00	0.15454	0.04989
Government expenditures	0.99	0.11633	0.04718
Inflation	0.99	0.11773	0.04922
Trade openness	0.93	0.10374	0.05711
Restrictions on globalization	0.47	0.03804	0.05418
Non-equipment investment	0.42	0.03197	0.05001
Natural resources rents	0.34	-0.02182	0.04037
Financial globalization	0.28	-0.02001	0.04269
Value added in industry	0.21	-0.01389	0.03634
Value added in agriculture	0.17	-0.00969	0.03053
Net FDI (% GDP)	0.16	-0.00730	0.02401
Chinn-Ito index	0.15	0.00828	0.02797
GDP per capita sq.	0.15	-0.08401	0.28484
Economic freedom	0.12	-0.00945	0.03762
Gross domestic savings	0.11	0.00634	0.02688
Redistribution	0.11	0.00495	0.02085
GDP growth	0.11	-0.00504	0.02208
Social globalization	0.09	-0.00626	0.03233
Education index (UN)	0.09	-0.01003	0.07309
Unemployment	0.05	0.00131	0.01287
Political globalization	0.05	0.00137	0.01473
Financial institutions efficiency	0.04	-0.00070	0.01024
Education index sq.	0.04	0.01380	0.07857
Total population	0.04	-0.00060	0.01484
Inflation sq.	0.04	0.00053	0.01828
Population growth	0.04	0.00020	0.00844
Education expenditures	0.04	-0.00002	0.00935
Left-wing orientation	0.04	-0.00028	0.00843
Civil liberties & political rights	0.04	0.00009	0.00846

The alternative priors influence the results similarly in all three specifications. The random mode prior decreases PIPs for the regressors as it generally prefers smaller models. Nevertheless, the results are only marginally effected for Gini coefficient as well as the top income shares with a few exception of education index in the case of Top 10% share and trade openness for both top income shares. The use of dilution model prior which penalizes the models with highly correlated regressors, we see more significant differences. Above all, the quadratic terms show very low inclusion probabilities. That is not surprising since they are correlated with their original values. This irrelevance of quadratic terms is universal across inequality measures and we may argue that it is due to the construction of the concerned variables. While the PIPs for other regressors remain similar to the baseline in the case of top income shares, for the Gini

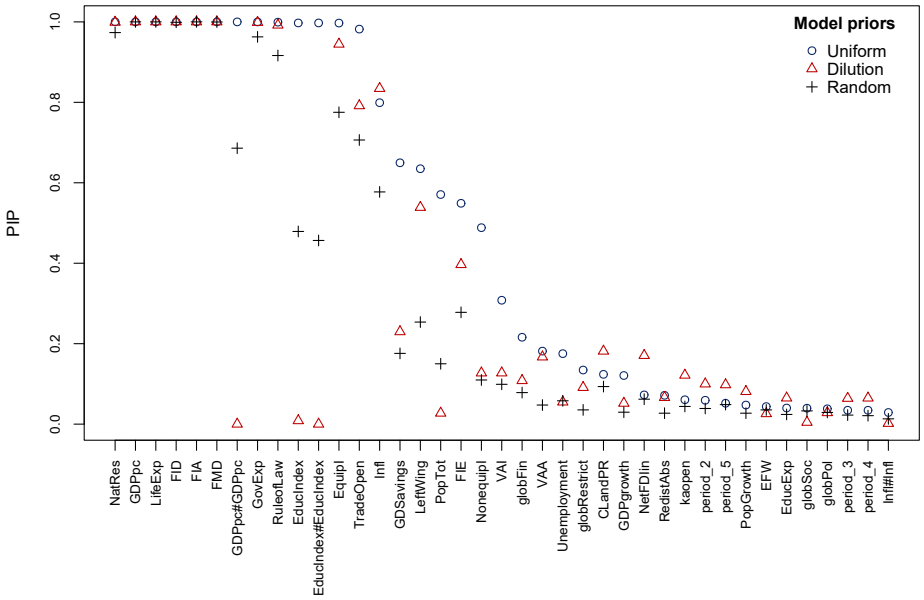

Figure 6: Robustness checks with alternative model priors, Top 10% share

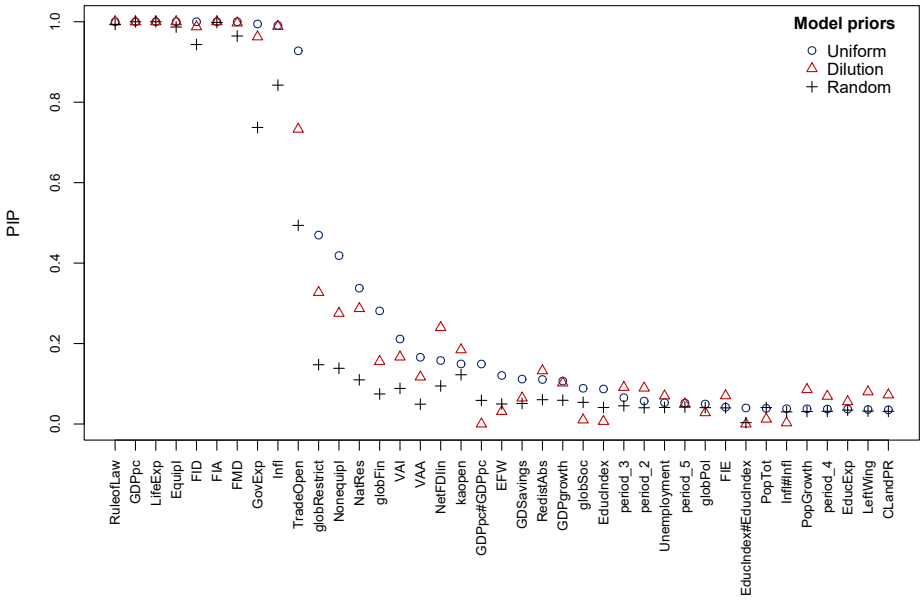

Figure 7: Robustness checks with alternative model priors, Top 1% share

index of overall income inequality, we observe some regressors which are now penalized by the dilution prior. Taking the set of the important regressors in the baseline specification, we observe drop in the inclusion probability for education index, life expectancy, and economic freedom. Given high correlations among the set of regressors, this is not surprising and allows to narrow down the number of regressors robustly associated with income inequality.

4. Conclusion

In the paper, we explore the robust determinants of income inequality with a special attention given to indicators of financial development. We choose financial indicators that reflect the access, efficiency, and size of financial markets and institutions. We believe that the detailed indicators provide better proxies for the functions of finance - screen investment opportunities, monitor the debtors who were provided funding, as well as pooling and management of risk. We allow for model uncertainty by employing BMA and examine a number of other potential determinants of income inequality.

We show that financial development has complex relationship on income distribution. While access to finance has a universally inequality decreasing effect, the larger size of financial markets and financial institutions associates with higher top income shares, irrelevant for the Gini coefficient of the income distribution. This finding suggests that the size of financial markets also equalizes the income among the first 9 deciles.

We find a few other important covariates for income inequality. Education, redistribution, and changing demographic structure seem to be linked with lower income inequality. On the contrary, unemployment, investment other than machinery, economic freedom - ease of pursuing economic opportunities, and inflation all positively relate to income inequality. As in the case of financial indicators, we find that the link could be more complex. When looking at the top income shares, some of the covariates (education, unemployment, redistribution, and economic freedom) cease to be relevant, while some other (trade openness, rule of law, and machinery investment) seem to matter.

The results we present warrant caution in drawing quick conclusions on the matter of income inequality determinants. While finance, technology, and trade likely affect the distributional outcomes, it can have varying influence on different parts of the income distribution.

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A1. Appendix

The composition of financial indicators

Table A1: Underlying Components of Financial Development Indicators

Indicator	Measure
Financial institutions	
Access	Bank branches per 100,000 adults ATMs per 100,000 adults
Efficiency	Net interest margin Lending-deposits spread Noninterest income to total income Overhead costs to total assets Return on assets Return on equity
Depth	Domestic private credit to the real sector to the GDP Pension fund assets/GDP Mutual fund assets/GDP Insurance premiums life and nonlife/GDP
Financial markets	
Depth	Stock market capitalization/GDP Stocks traded/GDP International debt securities of government/GDP Total debt securities of financial corporations/GDP Total debt securities of nonfinancial corporations/GDP

Dataset description

Table A2: List of variables

Variable	Definition (+ optional comments)	Source
GiniNet	Aftertax Gini index based on distribution of income (The Standardized World Income Inequality Database).	Solt (2019)
GiniMarket	Before-tax Gini index based on distribution of income (The Standardized World Income Inequality Database).	Solt (2019)
Top10share	Share of income going top decile of the distribution.	WID
Top1share	Share of income going top percentile of the distribution.	WID
FIA	Access to financial institutions	Svirydzenka (2016)
FID	Financial institutions depth	Svirydzenka (2016)
FIE	Financial institutions efficiency	Svirydzenka (2016)
FMD	Financial markets depth	Svirydzenka (2016)
FME	Financial markets efficiency	Svirydzenka (2016)
GDPpc	Level of GDP per capita	WB
NatRes	Total natural resource rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	WB
PopGrowth	Annual population growth 1980-2009	WB
GovExp	General government final consumption expenditure (formerly general government consumption).	WB
NNSavings	Net national savings (gross national savings less the value of consumption of fixed capital, % GNI).	WB
EducExp	Education expenditure refers to the current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment..	WB
Infl	Inflation as measured by the consumer price index.	WB
VAA	Agriculture, forestry, and fishing value added (% GDP).	WB
VAI	Industry value added (% GDP).	WB
GFCF	Gross fixed capital formation (% of GDP).	WB
NetFDI	Foreign direct investment, net inflows (% of GDP).	WB
GDPgrowth	Annual growth of GDP.	WB
LifeExp	Life expectancy at birth.	WB
LabForce	Total labor force comprises people ages 15 and older who meet the International Labor Organization definition of the economically active population: all people who supply labor for the production of goods and services during a specified period. Labor force total.	WB
RuleOfLaw	Rule of law estimate	WB
CLandPR	Average of index for civil liberties and political rights	Freedom House
ChinnIto	Chinn-Ito index of financial openness.	Chinn-Ito
LeftWing	Dummy equal to 1 when left oriented party lead the country.	DPI

ActivRestrict	Activity restrictions. Regulatory restrictions on bank activities and the mixing of banking and commerce.	Barth et al. (2013)
CapitalReg	Capital Regulatory index.	Barth et al. (2013)
DiversIndex	Whether there are explicit, verifiable, quantifiable guidelines for asset diversification and banks are allowed to make loans abroad.	Barth et al. (2013)
EducIndex	Calculated using mean years of schooling and expected years of schooling	UN
NetInterestMargin	Accounting value of banks' net interest revenue as a share of average interest-bearing assets; a measure of the efficiency of the banking sector.	GFDD
BankZScore	return on banks' assets plus the ratio of banks' equity and assets, divided by the standard deviation of the return on assets (ROA+equity/assets)/sd(ROA); a measure of stability of the banking sector	GFDD
Privatecredit	Domestic private credit to the real sector to GDP; a measure of the depth of the banking sector	GFDD
MarketCap	Value of listed shares to GDP; a measure of the depth of stock markets.	GFDD
MarketTurn	Stock market value traded to total market capitalization; a measure of the efficiency of stock markets.	GFDD
BankBranches	Number of bank branches per 100,000 adults	GFDD
Loan2Deposits	Loan-to-deposit ratio.	GFDD
Redist	Difference between market (pre-tax) and net (after-tax0 Gini index based on distribution of income (The Standardized World Income Inequality Database).	Solt (2016)
FinLib	Averaged components of Economic Freedom of the World index 3D (freedom to own foreign currency accounts), 4C (black-market exchange rates), 4D (controls of the movement of capital and people), and 5A (credit market regulations).	Gwartney et al. (2017)