CENTRO DE ECONOMÍA APLICADA

INGENIERÍA INDUSTRIAL · UNIVERSIDAD DE CHILE

DOCUMENTOS DE TRABAJO

Serie Economía

Nº 329 **INEQUALITY, FINANCE, AND GROWTH**

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Inequality, Finance, and Growth*

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June 2017

Abstract

This paper investigates the relationship between income inequality, financial development and economic growth from both a theoretical and an empirical perspective. This paper introduces a simple model in which the effect of inequality on growth depends on the degree of development of the domestic financial market. The model predicts that greater inequality reduces growth in economies with low levels of financial development but that this effect is attenuated in economies with more developed systems. Using a panel dataset that covers a large number of countries over the past four decades, this paper shows empirical evidence that is consistent with the main prediction of the model. The model also predicts that individuals in economies with developed financial markets have a higher tolerance to inequality; we also provide evidence for this through value surveys. Overall, this paper's major findings highlight that some of the pernicious effects of inequality can be attenuated by improving access to credit.

Keywords: financial development; growth; inequality; income distribution; private credit

JEL Classification: D3; E6; P1; O4; I2

*We thank all participants at the Twenty-First Annual Meeting of the Latin American and Caribbean Economic Association, the Annual Meeting of the Chilean Economic Society, as well as participants at the Universidad Torcuato Di Tella and the Universidad Adolfo Ibáñez workshops for their useful suggestions.

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1 Introduction

A fundamental question in development economics is whether inequality retards or accelerates economic growth. At the theoretical level, arguments in both directions can be found in the literature. Saving rates modeled as an increasing function of wealth generates a positive relationship between inequality and economic growth (Smith 1776; Keynes 1920; Lewis 1954; Kaldor 1957; Bourguignon 1981). On the other hand, credit constraints on investment in human capital trigger a mechanism through which equality could enhance economic growth (Galor and Zeira 1993; Durlauf 1996; Fernandez and Rogerson 1996; Benabou 2000; Mookherjee and Ray 2003). Empirically, the answer also remains elusive. While a number of empirical studies suggest that more inequality reduces economic growth (Alesina and Rodrick 1994; Persson and Tabellini 1994; Perotti 1996; Deininger and Square 1998; Panizza 2002; Easterly 2007), others studies support a positive effect of inequality on the process of development (Li and Zou 1998; Forbes 2000; among others). More recent papers aim to conciliate the previous findings by exploring potential non-linear effects in the relationship between inequality and economic growth (e.g., Barro 2000, Castello-Climent 2010, and Brueckner and Lederman 2015).

Our paper contributes to the literature on the effects of inequality on growth by examining, from both a theoretical and an empirical perspective, whether the effect of inequality on growth depends on the country's level of domestic financial development. We build a simple model that predicts that greater inequality reduces growth in countries with less developed financial markets but that this effect vanishes in countries with higher financial development. In the model, inequality negatively affects growth because poor agents do not have enough capital to invest in the optimal level of ideas (intangible assets). This effect is attenuated in countries with developed financial markets because credit allows higher investment by poor agents, thus increasing the output of the economy. We use a large panel of countries over the past four decades to test the main predictions of the model. Consistent with our theoretical results, the empirical findings show that the negative effect of inequality on growth is mitigated in economies with more developed domestic financial systems. We also document evidence of the relationship between: (i) tolerance to income inequality and financial market development, and (ii) patents applications and financial market development. We show that more developed domestic financial markets increase the tolerance to income inequality. In addition, we show

that inequality negatively impacts patent applications but that the effect is attenuated in economies with a more developed financial market. This latter evidence sheds light on the underlying mechanism behind our reduced-form results and is consistent with the theoretical channels that are emphasized by our model.

Overall, our findings help to reconcile the mixed and non-linear effects of inequality on growth as reported in the literature. Moreover, we provide a theoretical foundation and suggest empirical evidence of the channels through which non-linearities in the relationship between inequality and growth could arise. Lastly, our results are relevant in terms of policy. Some of the lessons that can be extracted from our analysis are: (i) the financial markets constitute a powerful instrument to generate a path of inclusive economic growth, (ii) some of the pernicious effects of initial inequality in endowments can be attenuated by improving access to credit, and (iii) financial development not only has effects on economic outcomes but also has an effect on beliefs.

Our model consists of an economy where each agent has an investment project at hand. Agents are individual producers and the aggregate production of the economy is, therefore, the sum of the output generated by each of those projects. In this environment, more inequality implies that few agents concentrate much of the resources of the economy and, therefore, experience low marginal returns of investment as individual producers. On the other hand, poorly-endowed agents face high marginal returns on their investment opportunities. Then, a redistribution of resources from high- to low- endowed agents increases aggregate output and, in an endogenous growth model, the rate of growth of the economy. A more developed financial market provides a mechanism through which resources can be channelled towards investment projects that exhibit high marginal returns (i.e., those in the hands of poorly-endowed agents).[1] In that type of environment, a deepening of the financial market allows a greater number of agents to capitalize on good ideas, which attenuates the negative effects of inequality on growth. In addition, the model predicts that there will be a negative relationship between financial development and income inequality, which is in line with the results documented in Beck et al. (2007), and a positive relationship between financial development and growth, which is

[1] This mechanism is highlighted in the survey discussed by Aghion et al. (1999) as one of the possible channels that would explain a negative relationship between inequality and growth. However, we theoretically emphasize in this paper that the mechanism described can be a candidate to explain the non-linear relationship between inequality and growth found in the literature discussed above. We test this hypothesis in Section 4.

consistent with the evidence documented by Calderon and Liu (2003).[2]

Our model economy captures two aspects of the framework, which were originally proposed by Galor and Moav (2004) to understand the relationship between inequality and growth. First, the existence of an asymmetry between different types of capital. Physical capital is, in general, not embodied in humans and, thus, its aggregate productivity is independent of the distribution of its ownership in society. On the other hand, the individual accumulation of other types of capital is subject to diminishing returns. Galor and Moav (2004) place human capital in this second type. In this paper, we use a broader term: ideas. By ideas we mean opportunities that flourish in the economy to develop projects that present high returns. That type of investment, as does investment in human capital, experiences diminishing returns because an individual capitalist agent is constrained to develop all the potential good ideas that could be carried out in an economy. In other words, ideas are not easily transferable to other humans. Second, our model captures the fact that ideas are an important component in the production process in modern economies and financial development is particularly relevant for investment in intangible assets.

To explore the empirical relationship between income inequality, financial development, and growth, we rely on panel data for a large number of countries observed for almost four decades. Consistent with the model's predictions, this paper shows that greater income inequality is associated with lower economic growth. We also find that there is a positive effect of financial development on economic growth, which is consistent with the results reported in Rajan and Zingales (1998), Beck et al. (2000), Levine et al. (2000), among others. However, in addition, we find that the negative effect of inequality on economic growth is significantly smaller (and in some cases even reversed) in economies with more developed financial markets; that is, a development of the domestic financial markets plays an attenuating effects on the negative relationship between inequality and growth. Additionally, we show that this effect is not simply an artifact arising from: (i) the nonlinear effect of inequality on growth along the per capita GDP path, as documented in Brueckner and Lederman (2015), or (ii) the positive correlation of financial development with per capita income.

The results from our pooled OLS regressions show that, when comparing countries with

[2]Rioja and Naval (2004) provide evidence suggesting that financial development exerts a strong positive effect on economic growth only once it has reached a certain size threshold.

high and low financial development (in the 75th and the 25th percentiles of private credit to GDP), a one standard deviation increase in the Gini index is associated with 65 basis points lower per capita GDP growth in the latter but with only 7 basis points lower growth in economies with more developed systems. Furthermore, it is important to highlight that a causal interpretation of the correlation between inequality and growth is not trivial due to endogeneity biases, which generally stem from potential omitted variables and reverse causality. We attenuate potential endogeneity concerns by estimating dynamic panel models with country and time fixed effects, and by using instrumental variable estimations.

We extend the model to analyze the relationship between finance and tolerance to inequality. The model predicts that individuals have a higher tolerance to inequality in countries with more developed financial markets. That prediction is consistent with the concept of financial deepening promoting economic growth by enhancing greater opportunities to initially low-endowed agents. When financial systems are more developed, agents with a low endowment but good ideas have a chance of undoing the unequal initial distribution of resources. Given that they foresee this possibility, poor agents, who are the median voter of the economy, are less reluctant to support future redistributive policies. Thus, society is more tolerant to current inequality.[3] Relying on data from the World Values Survey (WVS), we document that individuals in countries with more developed financial markets are significantly more likely to disagree with the statement that "Incomes should be made more equal" and agree with the statement "We need larger income differences as incentives for individual effort."

Lastly, we analyze the empirical relationship between patent applications, inequality, and financial development. In our model, inequality harms economic growth by preventing poorly-endowed agents from investing in some types of intangible assets, which we call ideas. On the other hand, a developed financial market facilitates these individuals' access to credit, which allows them to carry out investments in these types of assets. Therefore, the negative effect that inequality exerts on investments in intangible assets should be less severe in economies with more developed financial markets. We test this theoretical prediction by estimating the relationship between patent applications, inequality, and financial development. Data on patent

[3] Our model suggests that a lower inequality level prevents the use of distorting redistributive policy, which would be the political economy mechanism through which lower inequality enhances economic growth. In addition, Benabou (1996) highlights the presence of political instability and social conflicts as an important mechanism through which inequality harms economic growth.

applications was collected from the World Bank's World Development Indicators. Consistent with the model, we find that inequality reduces patent applications, financial development enhances it, and the negative effect of inequality on patents is attenuated in economies with a more developed financial market.

This paper contributes to the literature by presenting a novel mechanism through which the pernicious effects of inequality can be attenuated (i.e., the development of the domestic financial market). To our knowledge, this is the first empirical paper to directly explore the inequality-finance-growth nexus. Additionally, this paper contributes to the literature by showing how more developed financial markets make people more tolerant of inequality. Thus, this paper demonstrates that financial development not only has effects on economic outcomes but also has effects beliefs and, potentially, on political outcomes.

The remainder of this paper is organized as follows. Section 2 discusses the related literature. Section 3 describes our theoretical model. Section 4 presents our econometric framework and it gives the main results. Section 5 concludes this paper.

2 Related Literature

Our paper relates to the theoretical and empirical literature exploring the relationship between economic inequality and growth. An early strand of the literature originated by Smith (1776), and was further developed by Keynes (1920), Lewis (1954), Kaldor (1957), and Bourguignon (1981) and suggests that there is a positive relationship between inequality and economic growth. These articles model the savings rate as an increasing function of wealth and, thus, inequality plays a role in channelling resources towards individuals whose marginal propensity to save is higher. Therefore, inequality increases aggregate savings and capital accumulation and, through that channel, promotes economic growth. An alternative approach suggests that equality in sufficiently wealthy economies alleviates the adverse effect of credit constraints on investment in human capital, which increases the average stock of human capital of the economy and enhances economic growth (Galor and Zeira 1993; Durlauf 1996; Fernandez and Rogerson 1996; Benabou 2000; Mookherjee and Ray 2003). Galor and Moav (2004) propose a unified theory that reconciliates the conflicting viewpoints about the effect of inequality on economic

growth. The theory developed by Galor and Moav (2004) proposes a positive effect of inequality on the process of development in early stages of industrialization when physical capital accumulation was the prime engine of economic growth but it proposes a negative effect in later stages of development when human capital accumulation becomes a prime engine of economic growth and credit constraints are largely binding. Banerjee and Newman (1993) and Aghion and Bolton (1997) suggest that equality positively affects the investment opportunities of individuals not only in human capital but also in physical capital.[4] A third approach provides an alternative socio-political mechanism through which inequality affects economic growth. According to this literature, as surveyed by Benabou(1996), equality diminishes the tendency for socio-political instability and distortionary redistribution, in this way stimulating investment and economic growth. Therefore, even though the existing theoretical models shed some light on the channels through which inequality impacts economic growth, robust conclusions remain elusive. Whether or not inequality retards growth ultimately seems to be an empirical question.

The empirical literature is not yet conclusive. A number of empirical studies suggest that more inequality reduces economic growth (Alesina and Rodrick 1994; Persson and Tabellini 1994; Perotti 1996; Deininger and Square 1998[5]; Panizza 2002; Easterly 2007; among other). On the other hand, other studies have documented a positive effect of inequality on growth (Li and Zou, 1998; Forbes, 2000). In addition, recent papers suggest the existence of non-linear effects in the relationship between inequality and growth. For example, Barro (2000), Castello-Climent (2010) and Bruckner and Lederman (2015) explore whether the effect of inequality on growth depends on a country's level of economic development. Barro (2000) and Castelló-Climent (2010) find that there is a positive relationship between inequality and growth in developed economies and a negative one in less developed economies. Bruckner and Lederman (2015) show that, on average, increases in income inequality reduce GDP per capita but that

[4]Aghion et al. (1999) provide a survey of the relationship between inequality and economic growth. The authors start by exploring the channels through which the early theoretical literature generates a positive relationship between inequality and growth. They then discuss new theoretical insights by analyzing the effect of inequality on growth in economies in which wealth or human capital are heterogeneous across individuals and capital markets are imperfect. The authors argue that there are at least three reasons why inequality may have a direct negative effect on growth: (i) inequality reduces investment opportunities, (ii) inequality worsens the borrowers' incentives, and (iii) inequality generates macroeconomic volatility.

[5]These authors utilize data on the distribution of land as a proxy for the distribution of assets rather than measures of income distribution to explore the relationship between inequality and growth. They find a strong negative relationship between initial inequality in the asset distribution and long-term growth. However, the authors report that initial income inequality is not a robust determinant of future growth.

this effect varies with a country's initial level of income. Specifically, their panel data results and instrumental variable estimations suggest that in poor economies more inequality increases GDP per capita while the opposite is true in middle and high income economies.

The literature has also explored non-linear relationships between inequality and growth that are unrelated to the degree of economic development. Banerjee and Duflo (2003) find that a change in inequality in any direction appears to discourage economic growth in the next period. Voitchovsky (2005) employs data on disposable income from the Luxembourg Income Study to show that inequality at the top end of the distribution accelerates growth, while inequality lower down the distribution retards growth. Halter et al. (2014) explore the time dimension and find that the short-term impact of inequality on growth is positive while the long-term effect is negative.

According to Bazillier and Hericourt (2017), the next step in the literature is to bring the theories to the data in order to understand the finance and inequality relationship and, therefore, assess the relevance of each theoretical argument. Our paper contributes to the literature by examining, from both a theoretical and an empirical perspective, whether the effect of inequality on growth depends on the country's level of domestic financial development. We also present evidence that sheds light on the channels through which a potential non-linear relationship between inequality and economic growth could be triggered.

3 The Model

In this section, we develop a model to motivate the empirical analysis that will be carried out in Section 4. In our model economy, a representative firm produces the unique good of the economy using ideas and capital. Agents spend their endowment of resources by either producing ideas or investing in the capital market. By ideas we mean opportunities that flourish in the economy to develop projects that present high returns. Individual accumulation of ideas is subject to diminishing marginal returns since agents are constrained to develop all of the potential good ideas that could be carried out in an economy. A broader access to the financial market allows poor agents to invest in ideas which, in turn, impacts output and inequality. All of these

interrelationships will be formalized in the following sections.[6] We first describe the agent's problem and we will then describe the production technology of this economy.

3.1 Agents

The economy is populated by a mass of N^r rich agents and $N^p > N^r$ poor agents. Each agent is endowed by one unit of time, which is inelastically supplied to the labor market. Therefore, labor equals population: $N^r + N^p = N = L$. In addition to the endowment of time, agents are born with an endowment of resources, which is different for poor and rich agents. Rich agents are endowed with y_0^r units of the unique good produced in the economy, whereas poor agents are born with $y_0^p < y_0^r$ units of that good. Agents spend their endowment of resources by either producing ideas or investing in the capital market. We assume a small open economy and, thus, the gross return of the unique international assets is given and denoted by R^*. Poor agents must borrow in the capital market to produce more ideas since they are born with only a few resources. Thus, the degree of development of the financial market constrains the production of ideas carried out by those agents. The production technology of ideas is described by a function $g(h) : \mathbb{R}_+ \to \mathbb{R}_+$ which is strictly increasing, strictly concave in h, twice continuously differentiable, with $g(0) = 0$, and $\lim_{h\to\infty} g(h) = 0$ and $\lim_{h\to 0} g(h) = \infty$. h is the amount of resources that are used in the production of new ideas. Additionally, we denote by I^i the number of ideas produced by a type-i agent with the technology described by g.

Agents are risk neutral and they maximize income, denoted by y^i, taking the rental price of the efficiency units of labor, the rate of return of the international asset, and the tax structure of the economy as given. We assume that taxes are proportional to the flow of income generated by the ideas produced in the economy, redistribution takes the form of a flat transfer, and the government maintains a balanced budget. Additionally, redistribution is costly in our economy model: a fraction c of the collected resources are destroyed when distributed back to the population. This is a type of iceberg cost of redistribution whose magnitude depends on the efficiency levels of the incumbent government. The efficiency of the government is an

[6] We have to remark that, due to the static nature of the model developed in this section, the comparative static that follows is performed in terms of output levels but not in terms of growth rates. However, the conclusions derived in this section have a direct implication on the effects that financial development would have on growth once we recognize the accumulation of ideas as a mechanism of endogenous growth.

unobservable parameter for the agents. However, they know that c is drawn from a cumulative distribution function Γ whose support is over the interval $(0, 1)$. Then, the after-tax income earned by a type-i agent is

$$y^i = (1 - \tau\mathbb{D})wI^i + \tau\mathbb{D}w\overline{I}(1 - c) + R^*b^i, \tag{1}$$

where $\mathbb{D} = 1$ if a redistributive tax policy is implemented and zero otherwise, b^i is the individual holdings of the international asset, and w is the rental price of each efficiency units of labor. The maximization problem for the agents of this economy is

$$\underset{h^i, b^i}{max}\{y^i\} \text{ subject to } \; y_0^i = h^i + b^i$$

3.2 Financial Market

We model the financial market by a single policy parameter $\alpha \in [0, 1]$, which reflects the fraction of the optimal debt at which agents have access to finance their ideas. For instance, $\alpha = 0$ implies that agents have no access to indebtedness in the financial market and, therefore, they must finance their ideas with their endowment of resources. In contrast, when $\alpha = 1$, agents have perfect access to the financial market, which allows them to get the desired level of indebtedness. Therefore, a rise in the parameter α reflects a policy that deepens the financial market. Taking into account this structure for the financial market, we have that the optimal investment in the production of ideas can be described as

$$h^i = \begin{cases} h^* & \text{if } \; h^* \leq y_0^i \\ \\ \alpha(h^* - y_0^i) + y_0^i & \text{if } \; h^* > y_0^i \end{cases} \tag{2}$$

where h^* is the optimal investment in ideas for each agent. At that level h^*, the marginal return on the investment in ideas is equal to the gross return on the international asset: $h^* = g_h^{-1}\left(\frac{R^*}{w(1-\tau)}\right)$. A deepening of the financial market allows resource-constrained agents to reach that optimal level of investment in ideas.

3.3 Tolerance to the Income Inequality Level of the Economy

Consider the following definition:

Definition 1. *Define the degree of tolerance to the income inequality level of the economy as the probability that the median voter supports the current distribution of resources.*

Definition 1 contains the intuitive idea that agents who are more tolerant to the current inequality level of the economy are, in turn, less prone to support a redistributive policy that changes the allocation of resources across agents. Therefore, by assessing the probability with which the median voter would support a redistributive policy, we can figure out how tolerant the economy is to the current allocation of resources. And vice versa, by directly asking the agents how tolerant they are to the income inequality level of the economy, we can assess their probability to vote in favor of a redistributive policy.

Assume that a traditional one-person one-vote democracy rules this economy. In this democracy, the decisive voter is the representative poor agent because $N^p > N^r$. The game is as follows. First, given their endowment of goods, the agents decide their optimal investment in ideas and international assets; taking as given the rental price of each efficiency unit of labor, the return on the international asset, and the tax structure of the economy. Then, taking into account the investment in ideas carried out in the economy, the median voter is asked about the probability that she would vote not to change the allocation of resources through a redistributive policy. According to Definition 1, the answer to this question reflects the tolerance to the current income inequality level. Denoting the degree of tolerance to the inequality level of the economy by $TI \in [0, 1]$, we have

$$TI(\phi^r, \phi^p, I^r, I^p) = \mathbb{P}(\mathbb{D} = 0 | \phi^r, \phi^p, I^r, I^p) = \mathbb{P}\left(c > 1 - \frac{1}{\phi^r I^r / I^p + \phi^p}\right), \tag{3}$$

where ϕ^r and ϕ^p are the fraction of rich and poor agents in the population, respectively.

3.4 Technology

The unique good of the economy is produced by a representative firm that uses efficiency units of labor ($\widehat{L}$) and physical capital (K) as inputs. The efficiency of each unit of labor depends on

the average number of ideas in the hands of the workers. Denoting by $\overline{I}$ the number of ideas per worker, the efficiency units of labor can be expressed as $\widehat{L} = \overline{I}L$. The production technology of the unique good of the economy is described by a function $F(\widehat{L}, K) : \mathbb{R}_+ \times \mathbb{R}_+ \to \mathbb{R}_+$, which is homogenous of degree one in $(\widehat{L}, K)$, strictly increasing in $\widehat{L}$ and K, weakly concave in $(\widehat{L}, K)$ jointly, strictly concave in each argument individually, twice continuously differentiable, with $F(0, K) = F(\widehat{L}, 0) = 0$, and which satisfies the Inada conditions $\lim_{K\to\infty} F(\widehat{L}, K) = 0$ and $\lim_{K\to 0} F(\widehat{L}, K) = \infty$ for all $\widehat{L} > 0$, and $\lim_{\widehat{L}\to\infty} F(\widehat{L}, K) = 0$ and $\lim_{\widehat{L}\to 0} F(\widehat{L}, K) = \infty$ for all $K > 0$. The representative competitive firm takes the unitary rental price of both the efficiency units of labor and capital as given and it maximizes profits:

$$\max_{\{K,L\}} F(K, \widehat{L}) - w\widehat{L} - R^*K$$

where R^* denotes the rental price of capital.[7]

3.5 Equilibrium

A competitive equilibrium consists of a set of allocations $\{I^r, I^p, b^r, b^p\}$ for the agents, a set of allocations $\{K^d, \widehat{L}\}$ for the representative firm, a set of prices $\{R^*, w\}$, and a government policy $\{\mathbb{D}\}$, such that: (i) taking the prices and the policy as given, the agents' allocations solve their maximizing problem, (ii) taking the prices, the government policy, and the state of development of the financial market α as given, the firm's allocations solve its profit maximizing problem, (iii) the government budget is balanced in each period, and (iv) the market for ideas and capital is clear, so that $N^r I^r + N^p I^p = \widehat{L}$ and $K^d = N^r b^r + N^p b^p + B^*$, with B^* denoting the total international holdings of the asset.

The equilibrium in this model economy works as follows. The gross return R^* of the international asset (which is given for this small open) determines the optimal capital labor ratio, $K/\widehat{L}$, demanded by firms. The demand for capital per efficiency unit of labor, in turn, determines the price of the efficiency units of labor, w. Both prices R^* and w determine the optimal individual investment in ideas and in the international asset. Then, the aggregate stock of ideas determines the aggregate demand for capital by firms. The net domestic supply

[7] We assume a depreciation rate equals to one.

of capital is given by the amount of resources that are not invested in ideas by highly-endowed agents less the resources demanded in the capital markets by less-endowed agents (to invest in ideas). The capital market is cleared by the infinitely elastic supply of funds from the rest of the world (denoted by B^*). Production is exhausted by the payment to the producers of ideas, the net payment to the domestic holders of the international asset, and the payment to the foreign suppliers of funds.

Notice that, in this environment, financial development reflects how easy it is for the economy to transfer resources from rich agents and international suppliers of funds towards poor agents, who are constrained in their optimal investment of ideas. When $\alpha = 1$, a supply of $h^* - y^p$ resources flow to each poor constrained agent at a cost of R^*. Some of those resources are supplied by highly-endowed agents whereas the remaining resources flow from the international capital market (i.e., from foreign rich agents). When $\alpha = 0$, unconstrained agents can invest in the international capital markets but those resources do not flow to poor agents. Therefore, we relate an underdeveloped financial market to the existence of frictions that prevent the flow of resources at a gross cost R^* from highly-endowed agents (both domestic and foreign agents) towards poorly-endowed agents.[8]

3.6 Comparative Statics

We will now perform some comparative statistics regarding the effect of a financial market deepening on inequality, output level, and the tolerance to income inequality. Consider the following assumptions:

Assumption 1. $h^* \leq y_0^r$

Assumption 2. $h^* > y_0^p$

Assumption 1 implies that the endowment of resources of rich agents allows those agents to invest optimally in ideas. Assumption 2 imposes that poor agents are credit-constrained to invest optimally in ideas. Notice that in our model economy the policy parameter α reflects how frictional is the financial market in channeling the savings of highly-endowed agents to poorly-endowed agents. Rich agents save $y_0^r - h^*$ resources in the capital market. Net domestic supply

[8] Appendix A formally derives the competitive equilibrium of this economy.

of funds equals those resources saved by rich agents net of those borrowed by the poor agents, $\alpha(h^* - y_0^p)$. The net domestic supply of funds and the completely elastic supply of foreign funds finance the demand for aggregate capital and clear the market. A higher α means, therefore, that a greater amount of the savings by rich people are channeled towards poor agents, which reduces the net domestic supply of funds.

Consider the following alternative definitions of inequality measures. First, we define *ex-post* total income inequality as the ratio between the before-tax income level earned by rich and poor agents after the production of the economy has been carried out. Denoting the *ex-post* total income inequality measure by G_{ep} , we have

$$G_{ep} = \frac{y^r}{y^p} \tag{4}$$

We also define an *ex-post* inequality measure that only considers the income derived from the investment in ideas (which is the income that we assume is taxed by redistributive policies). By defining this inequality measure by G_{id}, we have

$$G_{id} = \frac{I^r}{I^p} \tag{5}$$

Finally, we define *ex-ante* total income inequality as the ratio between the total endowment of rich and poor agents. We denote this inequality measure by G_{ea}:

$$G_{ea} = \frac{y_0^r}{y_0^p} \tag{6}$$

We will now discuss a series of propositions that characterize the interrelationships between the financial market, the output level of the economy, inequality, and the tolerance for income inequality. The formal proofs of each proposition are presented in Appendix B. To avoid a cumbersome notation, we have suppressed the arguments of the functions in the statements that follow.

Proposition 1. *A financial market deepening reduces the ex-post income inequality level:* $\frac{\partial G_{ep}}{\partial \alpha} < 0$

Assumption 1 implies that rich agents are not financially constrained to optimally invest

in ideas. These agents have an endowment of resources that is high enough to reach the optimal investment in ideas, supplying the remaining resources in the capital market. On the other hand, Assumption 2 implies that poor agents are not endowed with enough resources to reach the investment level $h^*$and, therefore, they demand extra resources from both domestic and foreign highly-endowed agents. The financial market is the institution that channels those resources from rich to poor agents. Specifically, a more developed financial market (i.e., a rise in α) allows poorly-endowed agents to fund a greater production of ideas. Equivalently, a financial market deepening unlocks the flow of resources towards poor agents. In turn, for poor agents, the cost of those resources borrowed from the financial market is R^* but the return of investing them in ideas is much higher since they bear a high marginal productivity in the production of new ideas. Then, a financial market development increases the total income earned by poor agents but keeps constant the one earned by highly-endowed agents. The latter conclusion results from the fact that, with an underdeveloped domestic financial market, rich agents can still supply their excess of resources in the international capital market at a gross return of R^*. The final result is a fall in the *ex-post* income inequality level (the formal proof of this proposition is developed in Appendix B.1).

The first theoretical prediction of the model is in line with the results documented in Beck et al. (2007). The authors emphasize the importance of the financial system for the poor. They document that about 40% of the long-run impact of financial development on the income growth of the poorest quintile is the result of reductions in income inequality, while 60% is due to the impact of financial development on aggregate economic growth. Beck et al. (2007) conclude that "financial development disproportionately boosts incomes of the poorest quintile and reduces income inequality". Our first theoretical proposition points in that direction.

Proposition 2. *A financial market deepening increases output:* $\frac{\partial Q}{\partial \alpha} > 0$

A more developed financial market allows poorly-endowed agents to borrow resources from rich agents to increase their production of ideas.[9] Additionally, the greater stock of ideas increases the demand for capital by firms; both of these effects imply that output rises (see Appendix B.2 for a formal proof). Notice that the aggregate demand for capital increases but poor agents also demand resources to finance a greater production of ideas. Foreign suppliers of

[9]Since rich agents do not need the financial market to materialize their projects or ideas, a development in the financial market does not increase the investment in ideas carried out by rich agents.

capital clear the market. As a result, the greater output produced in the economy is exhausted by the rise in the net income of poor agents who increase their production of ideas by demanding resources from the capital market (with a net increase in their income being positive) and the income flowing to the foreign suppliers of capital who clear the market.

Proposition 3. *A higher level of ex-ante inequality reduces output* $\frac{\partial Q}{\partial G_{ea}} < 0$

Assume a mean preserving increase in inequality; that is, a fall in y_0^p and a rise in y_0^r such that $\phi^r \Delta y_0^r + \phi^p \Delta y_0^p = 0$. The fall in the endowment of poor people reduces their investment in ideas and, for a given positive α (financial market development), it increases their level of indebtedness in the financial market. On the other hand, a rise in the endowment of rich agents, who are already investing optimally in ideas, only increases their supply of funds in the capital market. Therefore, the stock of ideas decreases as a consequence of the reduced investment carried out by poor agents. In turn, the lower stock of ideas available in the economy reduces the aggregate demand for capital by firms. Both a lower stock of ideas and physical capital reduce aggregate output (see Appendix B.3 for a formal proof). In this case, the aggregate demand for capital falls whereas the net domestic supply of funds stayed roughly constant. The latter effect is a consequence of a net fall in the supply of funds by poor agents (because of their higher level of indebtedness) and the greater supply by rich agents because of their greater endowment. Foreign suppliers of capital clear the market by supplying smaller amounts of capital to the domestic economy. Then, the fall in aggregate output is exhausted by a fall in both the income of poor agents who reduce their production of ideas and in the income earned by foreign suppliers of capital in the domestic market.

Proposition 4. *The negative effect of a higher level of ex-ante inequality on output is smaller in economies with a more developed financial market:* $\frac{\partial^2 Q}{\partial G_{ea} \partial \alpha} > 0$

Assume first $\alpha = 0$. Then, a mean preserving increase in inequality, such as the one described in Proposition 3, reduces the endowment of poor agents who cannot rely on the financial market to optimally invest in ideas. Therefore, they invest smaller amounts in ideas. On the other hand, highly-endowed agents do not use the financial market to invest in ideas. Then, the effect of a rise in *ex-ante* inequality is a fall in the production of ideas which, in turn, reduces the demand for capital and the aggregate output. However, when $\alpha = 1$, both poor and rich agents are always optimally investing in ideas. Therefore, a rise in inequality does not

impact aggregate output. The only effect is an increase in the indebtedness by poor agents, which is partially compensated by a higher supply of funds by rich agents. Therefore, the negative effect of inequality on aggregate output vanishes in economies with a more developed financial market. We prove this proposition in Appendix B.4.

Proposition 5. *A financial market deepening increases the tolerance to the income inequality level of the economy:* $\frac{\partial TI}{\partial \alpha} > 0$

This proposition is a direct consequence of the fact that a more developed financial market allows poor agents to invest more in ideas and, therefore, allows them to increase their future income. These low-endowed agents (which are the median voter) anticipate lower levels of inequality in the future and, therefore, become less prone to support redistributive policies. Therefore, they are more tolerant to the current level of income inequality (see Appendix B.5).

In the next section we will present the empirical evidence related to the propositions that were previously established.

4 Empirical Analysis

In this section, we test the main predictions of the model that was developed in Section 3. Specifically, we quantify the effect of financial development and inequality on growth, and see whether the negative effect of inequality on growth is attenuated in countries with a more developed domestic financial market. We also empirically study some political economy aspects that are related to the development of the domestic financial market. The theoretical model developed in Section 3 suggests that a more developed domestic financial market provides more opportunities for financially constrained agents to invest in some types of capital whose individual accumulation is subject to diminishing returns. The channel through which financial development enhances economic growth, say opportunities, suggests that there is a direct relationship between the financial development of the economy and the tolerance those agents have to inequality. This political economy implication of a financial market development is also tested in this section. In addition, since in our model the central channel through which financial development attenuates the negative effect of inequality on growth is the investment in

intangible assets (ideas), we also empirically study the relationship between patent applications, economic inequality, and financial development.

We first conduct growth panel data regressions. We assemble a panel dataset of 134 countries. Data were averaged over each of the seven 5-year intervals during the period between 1978 and 2012 for which we have more extensive data for our income inequality measure. The dependent variable is the growth rate of real per capita gross domestic product (GDP). As covariates, we include the level of domestic financial development, income inequality, the interaction between those variables, and a broad set of control variables that, according to the literature, directly impact economic growth. Specifically, we include as control variables the previous level of income per capita to take convergence into account, government size, openness to trade, inflation, and average years of secondary schooling (see, e.g., Levine, Loayza, and Beck, 2000). We also include as covariate an interaction between the fraction of the income per capita that is not explained by financial development and our inequality measure. This interaction term controls for any non-linearity in the effect of inequality on growth that comes from forces that are inherent to economic development but orthogonal to financial development.

We measure domestic financial development using domestic credit to the private sector by banks normalized by GDP. This measure, which is taken from the the World Bank's World Development Indicators (WDI), has traditionally been used as a continuous proxy for the degree of development of the financial system and, more generally, of the extent to which agents have access to financing. Our proxy for income inequality is the Gini index, which measures the extent to which the distribution of income within an economy deviates from perfect equality, taking value from 0 (perfect equality) to 100 (perfect inequality).[10] The World Bank estimates the index for a number countries since 1981 based on primary household survey data from government statistical agencies and World Bank country departments. Tables 1 and 2 report the description of our data and summary statistics for each variable included in the empirical analysis, respectively.

Our empirical model consists of pooled OLS regressions, GMM dynamic panel and instrumental variables regressions. GMM dynamic panel data models and instrumental variables

[10]In countries with missing values of the Gini index in particular years, we replace it with a lag of this variable (up to the fifth yearly lag). The same treatment was given to the alternative inequality measure, which we will discuss in the following.

regressions allow us to reduce potential endogeneity biases associated with simultaneity and omitted variables. By estimating dynamic models that include both unobserved country fixed effects and lagged dependent variables, we mitigate endogeneity biases associated with both time-invariant and time-variant omitted variables, respectively.[11]

Our baseline empirical model is close to that estimated by Levine et al. (2000). However, we augment their cross-sectional and GMM dynamic panel models to explore the effect of inequality on growth and whether this effect depends on the private credit to GDP ratio. Columns 1 to 3 of Table 3 report the results from estimating various specifications of our pooled OLS regressions and columns 4 to 6 report the results from the GMM dynamic panel models. Table 3 also reports the p-values for the Sargan-test. For the case of the GMM dynamic panel regressions, we cannot reject the null hypothesis that we have valid instruments. Consistent with the propositions derived from the model developed in Section 3, the results show that, on average, higher financial development has a positive and significant effect on economic growth (column 1). This result is in agreement with those documented in Rajan and Zingales (1998), Beck et al. (2000), Levine et al. (2000), among others. Additionally, our results show a statistically significant negative effect of income inequality on growth. Importantly, we find that this negative effect of inequality on growth is attenuated (in some specifications even reversed) in economies with more developed domestic financial systems. This effect is not simply an artifact of the facts that, on the one hand, the effect of inequality on growth is non linear along the per capita GDP levels, as documented in Bruckner and Lederman (2015) and, on the order hand, financial development is positively correlated with per capita income. We show in columns 3 and 6 that, even controlling by the per capita GDP component that is orthogonal to our financial development measures, the attenuating effect that financial markets eject on the negative effect of inequality on growth persists.

The economic magnitude of the heterogeneity in the inequality-finance relationship is important. The results from our pooled OLS regressions suggest that an increase of one standard deviation in the Gini index reduces real per capita GDP growth by 65 and 7 basis points in economies with private credit to GDP ratios in the 25th and 75th percentiles, respectively.

[11] Huber-White robust standard errors are used in all of the models and the specifications are explored in the following. The resulting standard error estimates are consistent in the presence of any pattern of heteroskedasticity and autocorrelation within panels.

That is, the reduction of growth associated with inequality is negligible when the financial system is sufficiently developed. According to our dynamic panel regressions, an increase of one standard deviation in the Gini index for economies with a private credit to GDP ratio in the 25th percentile reduces real per capita GDP growth by 86 basis points, while an increase of one standard deviation in the Gini index for economies with a private credit to GDP ratio in the 75th percentile increases per capita GDP growth by 56 basis points.

Table 4 presents a robustness check of our previous results. A potential concern with our financial development measure arises from the fact that the private credit to GDP ratio may reflect financial depth but does not necessarily reflect financial inclusion (i.e., greater access of low-endowed agents to the financial markets). This is problematic because, such as the theoretical model developed in Section 3 suggests, only an inclusive deepening of the financial market is able to trigger the attenuating effect that financial development has on the negative impact of inequality on growth. To address this concern, we estimate in columns 1 to 3 of Table 4 the growth regressions using the number of loan accounts per 1,000 adults as an alternative measure of financial development. This measure is more closely related to financial inclusion and, therefore, to the channel through which financial development undoes the negative effect of inequality on growth, as suggested by the model developed in Section 3. Data on the number of loan accounts from commercial banks is available for a few countries from 2001 and for a large number of countries since 2004. Given that we can rely only on two 5-year periods with little time variation in our dependent variable, we conduct this robustness analysis by estimating growth cross-sectional regressions.[12] We observe a positive and statistically significant effect of the interaction term between the alternative financial development measure and the Gini coefficient. Therefore, using this alternative measure of financial development, we confirm that financial development attenuates the negative effect of inequality on growth.

As an additional robustness check, we estimate the growth panel data regressions using the 10% top income share as an alternative measure of inequality. Although there is a strong and significant relationship between top income shares and the Gini coefficient (Leigh, 2007), the 10% top income share allow us to explore whether medium and upper medium income individuals also face financial constraints that prevent them from financing their optimal level of ideas. Columns 4 to 6 report the results for the pooled OLS specification and columns 7

[12]Therefore, we cannot present this robustness check for the dynamic panel regressions.

to 9 report the dynamic panel regressions. We observe that the main conclusions regarding the effect of inequality on growth and how that effect is attenuated in economies with more developed financial markets remains; the coefficient of the 10% top income share is negative and the coefficient for the interaction between inequality and financial development is positive, which are both statistically significant at conventional levels. Moreover, the effects found using this alternative measure of inequality are of a similar magnitude to those when we used the Gini coefficient. Therefore, our results are robust to this alternative measure of inequality.

Although country and time fixed effects attenuate potential endogeneity concerns associated to time-invariant omitted variables, they do not correct for endogeneity biases associated with reverse causality. This is an important concern given a potential effect running from growth to inequality and from growth to finance. Indeed, financial development may simply follow growth opportunities or anticipate growth. And, of course, better access to credit improves poor individuals' opportunities and, therefore, may reduce inequality.

To clean the potential effect of growth on inequality, we construct an inequality variable that contains all of the dimensions of inequality that are unrelated to economic growth. For this purpose, we follow an instrumental variables strategy similar to Brueckner (2013) and Brueckner and Lederman (2015), by first regressing inequality on economic growth (together with country and time fixed effects) and then computing the residual variation in inequality that is not due to growth. Brueckner (2013) implements this instrumental variable strategy to explore the effect of foreign aid on economic growth, and Brueckner and Lederman (2015) use it to examine the effect of inequality on output. Additionally, based on the literature on financial development and legal origins (see La Porta et.al 1998), we instrument private credit to GDP using legal origins. Finally, we also include the ethnicity, language, and religion fragmentation as an additional instrument for inequality. Table 5 reports the results derived from the instrumental variables regressions, including different combinations of instruments and fixed effects. Overall, our results remain qualitatively unchanged and they are robust to control by potential endogeneity using instrumental variables. These regressions confirm the negative effect of income inequality on economic growth and the attenuating effect that financial development triggers on the negative relationship between inequality and growth.

We now test whether the access to more developed domestic financial markets increases

the tolerance to income inequality. As suggested by the model in Section 3, a more developed financial market provides more opportunities for poorly-endowed agents to finance good ideas, thereby attenuating the negative effect of inequality on growth. It follows that agents should be more tolerant to income inequality in economies where better opportunities are provided by the financial market.

Data on tolerance to income inequality was extracted from the World Values Survey (WVS). The WVS is a comparative investigation of socio-cultural and political change that uses a common questionnaire to gather information on beliefs, values, economic development, democratization, religion, gender equality, social capital, and subjective well-being. Six waves of surveys have been conducted covering almost a hundred countries: wave 1 (1981–1984), wave 2 (1990–1994), wave 3 (1995–1998), wave 4 (1999–2004), wave 5 (2005–2009), and wave 6 (2010–2014). After merging WDI and WVS data, we assemble a panel dataset of 81 countries.

The dependent variable comes from a WVS question that measures tolerance to income inequality. Specifically, the answer to the question takes a value of 1 if the person interviewed completely agrees with the following statement "Incomes should be made more equal," and takes a value of 10 if the person agrees completely with the following statement "We need larger income differences as incentives for individual effort." The regressors include the private credit to GDP ratio, an inequality measure (Gini index and the 10% top income share), the GDP per capita growth and the GDP per capita (in logarithm terms). Additionally, all our models include country and wave fixed effects. Table 6 reports the results.[13]

In Table 6, we observe a positive and statistically significant effect of financial development on our measure of tolerance to income inequality. This result is in agreement with the theoretical argument that was developed in Section 3, which emphasizes how financial development makes poorly-endowed agents able to forecast the possibility of climbing up the income ladder, and in turn they become them more tolerant to inequality and less prone to support redistributive policies.

Lastly, we study the empirical relationship between patents applications, economic inequality, and financial development. As suggested by our theoretical model, inequality harms

[13]Notice that endogeneity is unlikely to bias the results in this setting since the aggregate level of both financial development and inequality are not likely to be affected by any one individual.

economic growth by preventing poorly-endowed agents from investing in some types of intangible assets (i.e., ideas). On the other hand, a financial market development facilitates these individuals' access to credit, allowing them to carry out investments in these types of assets. We test this theoretical prediction by using data on patent applications that were collected from the from the World Bank's World Development Indicators. Table 7 presents the results for the pooled and the panel models. From our pooled OLS regressions, we observe that the number of per capita patent applications by residents is smaller in more unequal countries and larger in countries with more developed domestic financial markets. The results from our panels regressions suggests that within-country increases in income inequality lead to a smaller number of per capita patent applications by residents but that this negative effect of inequality on patents applications vanishes in countries that are more financially developed. This evidence is consistent with the theoretical channel that is emphasized in our model: an extended access to credit allows financially-constrained individuals to carry out investment in ideas or intangible assists, which decreases the negative effect that an initial inequality in endowments produces on economic growth.

5 Conclusions

In this paper, we studied the relationship between income inequality, financial development, and growth. We developed a theoretical framework where a more developed financial market allows initially poorly endowed agents to invest in ideas, whose individual accumulation is subject to diminishing returns. More equal access to finance good ideas enhances economic growth. Therefore, even though higher inequality in initial endowments harms economic growth, financial development attenuates this effect by spreading accumulation of a type of capital (ideas) that presents a high return in the hands of low-endowed agents. The model also predicts that when poorly endowed agents have greater access to financial markets, they will be more tolerant to the income inequality level.

We also test the main predictions of the model with a rich panel data that covers a significant number of countries and is observed over a long period of time. Our findings show that greater income inequality is associated with lower economic growth but that this effect

is significantly attenuated (and in some cases reversed) in economies with developed financial markets. This result is robust to the estimation of cross-sectional and dynamic panel regressions, and to potential endogeneity bias. This is consistent with the idea that, by providing credit to poorly endowed agents, a developed financial system generates growth by allowing greater investment in projects with a high marginal return.

Also consistent with this idea, we show that the degree of tolerance to inequality is higher—when people are asked about it—when domestic financial markets are more developed.

These results are relevant in terms of policy. Our findings show that the development of financial markets constitutes a powerful instrument to generate a path of inclusive economic growth. We have both theoretically and empirically shown that when capital markets are imperfect, there is not necessarily a trade-off between equity and efficiency. Additionally, our results highlight that some of the pernicious effects of initial inequality in endowments can be attenuated by improving access to credit. Therefore, financial development can become an important engine of intergenerational mobility. We have also demonstrated that financial development not only has effects on economic outcomes but also has an effect on beliefs. Therefore, more developed financial markets could reduce the pressure for distortionary redistribution and increase the levels of socio-political stability, thereby stimulating economic growth through that channel.

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Tables

Table 1: Description of Variables

Variable	Description	Source
Real per capita GDP growth	Growth rate of GDP per capita based on constant local currency (annual %)	World Development Indicators (WDI)
Patents applications per capita[a]	(Patents applications by residents x 1,000,000) / population	World Development Indicators (WDI)
GDP per capita	GDP per capita is gross domestic product divided by midyear population	World Development Indicators (WDI)
Government size	General government final consumption expenditure (% of GDP)	World Development Indicators (WDI)
Openness to trade	Sum of exports and imports of goods and services (% of GDP)	World Development Indicators (WDI)
Inflation	Inflation, consumer prices (annual %)	World Development Indicators (WDI)
Average years of secondary schooling	Number of grades (years) in secondary school	World Development Indicators (WDI)
Private credit to GDP	Domestic credit to private sector by banks (% of GDP)	World Development Indicators (WDI)
Loan accounts from commercial banks	Loan accounts from commercial banks (per 1,000 adults)	World Development Indicators (WDI)
Gini	Gini index. A value of 0 represents perfect equality, while an index of 100 implies perfect inequality	World Development Indicators (WDI)
10% Top income share	Income share held by highest 10%	World Development Indicators (WDI)
Ethnic, linguistic and religious fragmentation	Measures the degree of ethnic, linguistic and religious heterogeneity in various countries.	Alesina et al. (2003)
Legal origin	Identifies the legal origin of the Company law or Commercial Code of each country: (1) English; (2) French; (3) German; (4)Scandinavian; (5) Socialist	La Porta et al. (1998)
Tolerance to inequality	A value of 1 if the responder agree completely with the statement that "Incomes should be made more equal" and a value of 10 if she agree completely with the statement that "We need larger income differences as incentives for individual effort".	World Values Survey (WVS)
Vote share government parties	Vote share of the three largest government parties	Database of Political Institutions (Beck, et al., 2001)

Note: (a) Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention–a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years

Table 2: Descriptive Statistics

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Real per capita GDP growth	632	2.09	2.96	-11.93	20.06
Patents applications per capita	436	136.56	369.58	0.55	2911.31
GDP per capita	632	10.15	13.77	0.07	80.11
Government size	632	15.68	5.50	2.80	37.39
Openness to trade	632	81.50	49.32	12.86	408.09
Inflation	632	0.27	1.69	-0.03	27.19
Average years of secondary schooling	632	6.96	3.20	0.55	13.42
Private credit to GDP	632	47.09	41.52	1.89	281.27
Loan accounts from commercial banks	109	193.69	220.65	0.27	966.32
Gini	556	40.00	9.79	21.88	66.48
10% Top Income Share	484	31.34	7.75	19.09	56.80
Tolerance to inequality	255,851	5.74	3.02	1.00	10.00
Vote share government parties	766	52.27	15.68	7.84	99.98
English common law	629	0.33	0.47	0.00	1.00
French commercial code	629	0.52	0.50	0.00	1.00
Ethnic	310	0.42	0.25	0.00	0.93
Language	310	0.38	0.29	0.00	0.92
Religion	310	0.43	0.24	0.00	0.86

Table 3: Finance, Inequality, and Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Real per capita GDP growth	**Pooled OLS**			**Dynamic panel regressions**		
Real per capita GDP growth (t-1)				-0.2355***	-0.2046***	-0.0468
				(0.058)	(0.058)	(0.079)
Logarithm GDP per capita (t-1)	-0.8268***	-0.7069***	-0.4340***	-1.0024***	-0.5793	-0.6665**
	(0.144)	(0.153)	(0.134)	(0.342)	(0.398)	(0.296)
Logarithm Government size	-1.3242***	-1.2135***	-1.0176***	-2.2073*	-1.7207	-2.3990***
	(0.326)	(0.333)	(0.288)	(1.268)	(1.105)	(0.889)
Logarithm Openness to trade	0.3342	0.3521*	0.3903**	-0.1313	0.1797	1.5437*
	(0.209)	(0.208)	(0.173)	(1.06)	(0.952)	(0.826)
Logarithm (1+Inflation)	-2.2365***	-2.3296***	-1.4554**	-3.3568***	-3.4477***	-1.8220**
	(0.752)	(0.739)	(0.563)	(0.921)	(0.817)	(0.759)
Average years of secondary schooling	0.3583***	0.3239***	0.2610***	0.4633**	0.3535*	0.4855***
	(0.063)	(0.064)	(0.054)	(0.181)	(0.186)	(0.142)
Logarithm Private credit to GDP	0.4555**	-1.3338**	-1.3557**	0.8332*	-3.7690**	-4.5592***
	(0.214)	(0.601)	(0.55)	(0.478)	(1.78)	(1.552)
Gini	-0.0325***	-0.1840***	-0.1623***	-0.0277	-0.3758***	-0.4702***
	(0.011)	(0.051)	(0.047)	(0.04)	(0.143)	(0.137)
Logarithm Private credit to GDP x Gini		0.0446***	0.0413***		0.1091***	0.1260***
		(0.014)	(0.013)		(0.041)	(0.041)
Logarithm GDP per capita residual (t-1) x Gini			-0.1845***			-0.1828***
			(0.026)			(0.042)
Observations	556	556	541	554	554	541
Adjusted R-squared	0.2414	0.2556	0.3933			
Hansen test (p-value)				0.112	0.132	0.141
Country fixed effects	NO	NO	NO	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: (a) Robust standard errors in parenthesis. (b) *** p<0.001. ** p<0.05. * p<0.1.

Table 4: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Real per capita GDP growth	**Pooled OLS**						**Dynamic panel regressions**		
Real per capita GDP growth (t-1)							-0.2148***	-0.1883***	-0.0178
							-0.062	-0.065	-0.086
Logarithm GDP per capita (t-1)	-1.0914***	-0.8623***	-0.9055***	-0.8875***	-0.7964***	-0.5811***	-1.0750***	-0.7262*	-0.9571***
	(0.266)	(0.262)	(0.27)	(0.157)	(0.172)	(0.156)	(0.365)	(0.417)	(0.341)
Logarithm Government size	-0.7811*	-0.8321*	-0.7362	-0.8385**	-0.7510**	-0.7220**	-1.7453	-1.4653	-1.3617
	(0.443)	(0.471)	(0.495)	(0.341)	(0.349)	(0.311)	(1.12)	(1.002)	(0.897)
Logarithm Openness to trade	-0.1351	-0.0638	-0.1322	0.0377	0.0485	0.1239	-0.7611	-0.5022	0.5896
	(0.412)	(0.401)	(0.436)	(0.26)	(0.263)	(0.23)	(1.019)	(1.019)	(0.724)
Logarithm (1+Inflation)	-7.4825	-6.1036	-6.169	-2.4049***	-2.5298***	-1.7265***	-3.2776***	-3.4241***	-2.1688***
	(5.503)	(4.974)	(4.939)	(0.757)	(0.745)	(0.59)	(0.901)	(0.823)	(0.833)
Average years of secondary schooling	0.0596	0.0757	0.0755	0.3787***	0.3560***	0.3059***	0.4452**	0.3449*	0.5479***
	(0.123)	(0.12)	(0.127)	(0.071)	(0.073)	(0.063)	(0.195)	(0.196)	(0.165)
Logarithm Private credit to GDP				0.4005*	-1.2390*	-0.8512	0.9273**	-3.3571*	-3.1166**
				(0.232)	(0.708)	(0.653)	(0.459)	(1.943)	(1.492)
Logarithm Loan accounts from commercial banks	0.5174**	-1.1711	-1.2369*						
	(0.25)	(0.754)	(0.737)						
Gini	-0.0022	-0.1484**	-0.1528**						
	(0.023)	(0.069)	(0.07)						
Logarithm Loan accounts from commercial banks x Gini		0.0341**	0.0345**						
		(0.014)	(0.014)						
Logarithm GDP per capita residual (t-1) x Gini			0.0421						
			(0.05)						
10% Top Income Share				-0.0338**	-0.2095***	-0.1490**	-0.0506	-0.4850**	-0.4544***
				(0.016)	(0.075)	(0.065)	(0.052)	(0.197)	(0.167)
Logarithm Private credit to GDP x 10% Top Income Share					0.0522**	0.0376**		0.1317**	0.1164**
					(0.021)	(0.018)		(0.057)	(0.049)
Logarithm GDP per capita residual (t-1) x 10% Top Income Share						-0.2220***			-0.2267***
						(0.038)			(0.063)
Observations	99	99	98	484	484	469	482	482	469
Adjusted R-squared	0.2712	0.3164	0.3216	0.2499	0.2606	0.3612			
Hansen test (p-value)							0.095	0.137	0.308
Country fixed effects	NO	NO	NO	NO	NO	NO	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: (a) Robust standard errors in parenthesis. (b) *** p<0.001. ** p<0.05. * p<0.1.

Table 5: Instrumental Variables

Real per capita GDP growth	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Logarithm GDP per capita (t-1)	-1.0882**	-0.6106**	-0.4334***	-10.5518***	-1.5617***	-1.0163**
	(0.461)	(0.244)	(0.133)	(1.649)	(0.436)	(0.457)
Logarithm Government size	-0.8214**	-0.7507*	-1.0193***	-1.4565***	-1.0142**	-0.8258**
	(0.38)	(0.441)	(0.285)	(0.514)	(0.477)	(0.375)
Logarithm Openness to trade	0.2461	0.2757	0.4022**	2.2245***	0.0691	0.2725
	(0.212)	(0.262)	(0.17)	(0.594)	(0.298)	(0.208)
Logarithm (1+Inflation)	-0.8141	-2.9296*	-1.4256**	-2.1235***	1.3427	-0.8522
	(0.607)	(1.731)	(0.566)	(0.437)	(2.697)	(0.602)
Average years of secondary schooling	0.2188***	0.3048***	0.2543***	-0.0704	0.3884***	0.2117***
	(0.068)	(0.097)	(0.053)	(0.15)	(0.116)	(0.066)
Logarithm Private credit to GDP	-1.3272	-4.6220**	-1.3757**	-1.3126*	0.7236	-1.5723
	(2.586)	(1.827)	(0.538)	(0.742)	(2.948)	(2.524)
Gini	-0.3190*	-0.4573***	-0.1700***	-0.1467**	-0.1463	-0.3315*
	(0.176)	(0.174)	(0.046)	(0.061)	(0.252)	(0.172)
Logarithm Private credit to GDP x Gini	0.0904*	0.1143***	0.0416***	0.0456***	0.0277	0.0921*
	(0.05)	(0.043)	(0.013)	(0.017)	(0.064)	(0.049)
Logarithm GDP per capita residual (t-1) x Gini	-0.1708***	-0.0211	-0.1838***	0.0924**	-0.0739	-0.1714***
	(0.027)	(0.05)	(0.026)	(0.04)	(0.058)	(0.027)
Observations	541	306	541	541	306	541
Country fixed effects	NO	NO	NO	YES	NO	NO
Time fixed effects	YES	YES	YES	YES	YES	YES
Instrument for private credit to GDP:	Legal origins	NO	NO	NO	Legal origins	Legal origins
Instrument for inequality:	NO	Ethnic, language, and religion	Gini residual	Gini residual	Ethnic, language, and religion	Gini residual

Note: (a) Robust standard errors in parenthesis. (b) *** p<0.001. ** p<0.05. * p<0.1.

Table 6: Finance, Inequality, and Tolerance to Inequality

	(1)	(2)
Logarithm Private credit to GDP	0.0395***	0.0113*
	(0.006)	(0.006)
Gini	0.0107***	
	(0.001)	
10% Top Income Share		0.0178***
		(0.001)
GDP per capita growth	-0.0158***	-0.0094***
	(0.001)	(0.001)
Logarithm GDP per capita	-0.1838***	-0.2959***
	(0.013)	(0.013)
Observations	255,851	235,982
Adjusted R-squared	0.0732	0.0755
Country fixed effects	YES	YES
Wave fixed effects	YES	YES

Note: (a) Robust standard errors in parenthesis.
(b) *** p<0.001. ** p<0.05. * p<0.1.

Table 7: Finance, Inequality, and Patents

	(1)	(2)	(3)	(4)	(5)	(6)
Logarithm (Patents Applications per capita)	**Pooled OLS**			**Panel regressions**		
Logarithm GDP per capita (t-1)	0.4426***	0.4534***	0.4013***	1.5485***	1.5504***	0.1954
	(0.051)	(0.054)	(0.062)	(0.253)	(0.243)	(0.518)
Logarithm Government size	0.4752***	0.4781***	0.4203***	-0.0757	-0.0919	-0.0944
	(0.146)	(0.149)	(0.150)	(0.172)	(0.174)	(0.175)
Logarithm Openness to trade	-0.5614***	-0.5673***	-0.5592***	0.1864	0.1781	0.1730
	(0.094)	(0.092)	(0.092)	(0.160)	(0.160)	(0.157)
Logarithm (1+Inflation)	0.1666	0.1715	0.0257	-0.1436**	-0.1174*	-0.1073
	(0.153)	(0.150)	(0.164)	(0.070)	(0.061)	(0.069)
Average years of secondary schooling	0.3156***	0.3130***	0.3283***	0.2993***	0.2969***	0.2778***
	(0.025)	(0.025)	(0.027)	(0.073)	(0.071)	(0.071)
Logarithm Private credit to GDP	0.3097***	0.1138	0.2539	-0.0968	-0.6799***	-0.4410**
	(0.083)	(0.320)	(0.335)	(0.064)	(0.200)	(0.213)
Gini	-0.0364***	-0.0546*	-0.0482*	-0.0069	-0.0684***	-0.0510**
	(0.005)	(0.028)	(0.029)	(0.007)	(0.021)	(0.023)
Logarithm Private credit to GDP x Gini		0.0050	0.0030		0.0167***	0.0122**
		(0.008)	(0.008)		(0.005)	(0.006)
Logarithm GDP per capita residual (t-1) x Gini			0.0236**			0.0378***
			(0.012)			(0.013)
Observations	436	436	425	436	436	425
Adjusted R-squared	0.7928	0.7926	0.8004	0.9561	0.9570	0.9583
Country fixed effects	NO	NO	NO	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: (a) Robust standard errors in parenthesis. (b) *** p<0.001. ** p<0.05. * p<0.1.

Appendix A: Derivation of the Competitive Equilibrium

Consider first the maximization problem of the representative firm:

$$\max_{\{K,L\}} F(K, \widehat{L}) - w\widehat{L} - r^* K$$

where r^* denotes the rental price of capital. We have normalized the price of the final good produced in the economy to one. Using the homogeneity of degree one property of the production function, we can express it in terms of the efficiency units of labor, $y = f(k^d)$, where k^d is the ratio between the aggregate capital and aggregate efficiency units of labor. The first order conditions are, thus,

$$f'(k^d) = r^* \tag{A.1}$$

$$f(k^d) - k^d f'(k^d) = w \tag{A.2}$$

We can use Equation (A.1) to get the demand of capital in terms of efficiency units of labor as a function of the return on the international asset (given),

$$k^d = \kappa(r^*) \tag{A.3}$$

Plugging Equation (A.3) into Equation (A.2), we get an equation for the equilibrium rental price of each efficiency unit of labor as a function of the return on the international asset:

$$w = \omega(r^*) \tag{A.4}$$

where $\omega(r^*) = f(\kappa(r^*)) - \kappa(r^*) f'(\kappa(r^*))$.

Next, given Assumption (1), we have that optimal investment in the production of ideas must satisfy the following equation:

$$g_h(h^*) w(1 - \tau) = R^* \tag{A.5}$$

where h^* denotes the optimal investment in ideas. From Equation (A.5) we can get h^*

$$h^* = g_h^{-1}\left(\frac{R^*}{w(1-\tau)}\right) \tag{A.6}$$

Then, given Assumptions 1 and 2, the amount of ideas produced by rich and poor agents, respectively, is

$$I^r = g(h^*) \tag{A.7}$$

$$I^p = g(\alpha(h^* - y_0^p) + y_0^p) \tag{A.8}$$

Next, with the equilibrium stock of ideas produced in the economy (Equations A.7 and A.8) and the demand for capital in efficiency units of labor (equation A.3) we can determine the domestic demand of aggregate capital, K^d, the amounts of good produced $F(K^d, \widehat{L})$, and the aggregate domestic and international holdings of the tradable asset, B^d and B^*, respectively. First, notice that

$$\overline{I} = (I^r N^r + I^p N^p)/N \tag{A.9}$$

where I^r and I^p are given by Equations (A.7) and (A.8), respectively. Then,

$$K^d = k^d \widehat{L} \tag{A.10}$$

$$Q = F(k^d \widehat{L}, \widehat{L}) \tag{A.11}$$

$$b^r = y_0^r - h^* \tag{A.12}$$

$$b^p = -\alpha(h^* - y_0^p) \tag{A.13}$$

$$B^d = N^r b^r + N^p b^p \tag{A.14}$$

$$B^* = \kappa(r^*)\widehat{L} - B^d \tag{A.15}$$

Notice that, the constant return to scale property of the production function F implies that $Q = F_{\widehat{L}}\widehat{L} + F_K K^d$. Competitive markets imply that $w = F_{\widehat{L}}$ and $R^* = F_K$. Then, using the market clearing condition for capital we have that $Q = wL(\phi^r I^r + \phi^p I^p) + R^*(N^r b^r + N^p b^p + B^*)$. Then, output is exhausted with the payment to the producers of ideas, and the domestic and foreign owners of the capital used by firms. Additionally, notice that total national income, $Y = w(1-\tau)L(\phi^r I^r + \phi^p I^p) + R^*(N^r b^r + N^p b^p) + \tau w L(\phi^r I^r + \phi^p I^p)$. Using the equilibrium

prices for the efficiency units of labor and capital, we can express the national income as: $Y = Q - R^*B^*$. Therefore, national income equals the product of the economy net of the payments to the foreign owners of the capital used in production. These are two alternative ways to understand the market clearing conditions in our economy model.

Appendix B

In this appendix we develop the proof of the propositions that summarize the comparative statics discussed in Section 3.

Appendix B.1: Proof of Proposition 1

Using the the definition of ex-post income inequality, Assumptions 1 and 2, and Equation (2), we have that:

$$\frac{y^r}{y^p} = \frac{wg(h^*) + R^*b^r}{wg(y_0^p + \alpha(h^* - y_0^p)) + R^*b^p} \tag{B.1.1}$$

Next, notice that $b^r = y_0^r - h^*$ and $b^p = -\alpha(h^* - y_0^p)$. Replacing b^r and b^p in (B.1.1), we have

$$\frac{y^r}{y^p} = \frac{wg(h^*) + R^*(y_0^r - h^*)}{wg(y_0^p + \alpha(h^* - y_0^p)) - R^*\alpha(h^* - y_0^p)} \tag{B.1.2}$$

Taking the derivate of (B.1.2) with respect to α, we get:

$$\frac{\partial\ (y^r/y^p)}{\partial\alpha} = -\frac{(wg(h^*) + R^*(y_0^r - h^*))\,(h^* - y_0^p)\,(wg_h(h^p) - R^*)}{(wg(y_0^p + \alpha(h^* - y_0^p)) - R^*\alpha(h^* - y_0^p))^2} \tag{B.1.3}$$

Since $wg_h(h^p) - R^* > 0$ (poor agents are credit-constrained to optimally invest in ideas), we conclude that $\frac{\partial\ (y^r/y^p)}{\partial\alpha} < 0$

Appendix B.2: Proof of Proposition 2

The equilibrium aggregate output in this economy is $Q = F(\widehat{L}, \kappa(r^*)\widehat{L})$ where $\widehat{L} = \overline{I}N$ (see Equation A.11). Therefore, the per capita number of ideas $\overline{I}$ is a sufficient statistic to establish

the qualitative effects of different variables on output ($\frac{\partial Q}{\partial \overline{I}} > 0$). In turn, we know that

$$\overline{I} = \phi^r g(h^*) + \phi^p g(\alpha(h^* - y_0^p) + y_0^p) \tag{B.2.1}$$

Taking the derivative of Equation (B.2.1) with respect to the policy parameter α we get

$$\frac{\partial \overline{I}}{\partial \alpha} = (h^* - y_0^p)\phi^p g_h(\alpha(h^* - y_0^p) + y_0^p) > 0 \tag{B.2.2}$$

Therefore, we have that

$$\frac{\partial Q}{\partial \alpha} = \left(F_{\widehat{L}} L + F_K L \kappa(r^*)\right) \left[(h^* - y_0^p)\phi^p g_h(\alpha(h^* - y_0^p) + y_0^p)\right] \tag{B.2.3}$$

Then, Assumption 2 implies that $\frac{\partial Q}{\partial \alpha} > 0$.

Appendix B.3: Proof of Proposition 3

Assume a mean preserving increase in inequality; That is, a fall in y_0^p and a rise in y_0^r such that $\phi^r dy_0^r + \phi^p dy_0^p = 0$. We have that

$$dQ = \frac{\partial Q}{\partial \overline{I}} \frac{\partial \overline{I}}{\partial y_0^p} dy_0^p + \frac{\partial Q}{\partial \overline{I}} \frac{\partial \overline{I}}{\partial y_0^r} dy_0^r \tag{7}$$

Using , (B.2.1) we can compute:

$$\frac{\partial \overline{I}}{\partial y_0^r} = 0 \tag{B.3.1}$$

$$\frac{\partial \overline{I}}{\partial y_0^p} = \phi^p g_h(1 - \alpha) \tag{B.3.2}$$

Then, we get:

$$dQ = \left(F_{\widehat{L}} L + F_K L \kappa(r^*)\right) \phi^p g_h(1 - \alpha) dy_0^p, \tag{B.3.3}$$

From Equation B.3. we conclude that $dQ < 0$ when $dy_0^p < 0$.

Appendix B.4: Proof of Proposition 4

Equation (B.3.3) shows the impact of a mean preserving increase in inequality on output. Denote by $\beta(\alpha; Z) = \left(F_{\widehat{L}}L + F_K L\kappa(r^*)\right)\phi^p g_h(1-\alpha)$ the coefficient measuring that impact. Z denotes the other parameters included in the expression. Since $\beta(\alpha; Z) > 0$, we have that a mean preserving increase in inequality reduces output as shown in Proposition 3. Taking the derivative of $\beta(\alpha; Z)$ with respect to α, we get:

$$\frac{\partial\beta(\alpha;Z)}{\partial\alpha} = \left(F_{\widehat{L}\widehat{L}}L^2 + F_{KK}(L\kappa(r^*))^2\right)\frac{\partial\overline{I}}{\partial\alpha}\frac{\partial\overline{I}}{\partial y_0^p} + \left(F_{\widehat{L}}L + F_K L\kappa(r^*)\right)\left((h^* - y_0^p)\phi^p(1-\alpha)g_{hh} - \phi^p g_h\right) \tag{B.4.1}$$

Using (B.2.2), (B.3.2), $F_{KK} < 0$, $F_{LL} < 0$, and $g_{hh} < 0$, we get $\frac{\partial\beta(\alpha;Z)}{\partial\alpha} < 0$. That means that the negative impact of a mean preserving increase in inequality is reduces for greater values of α.

Appendix B.5: Proof of Propositions 5

Using Equations (3) and (5), we can express the degree of tolerance to the income inequality level as:

$$TI(\phi^r, \phi^p, G_{id}) = \mathbb{P}\left(c > 1 - \frac{1}{\phi^r G_{id} + \phi^p}\right) = 1 - F_c\left(1 - \frac{1}{\phi^r G_{id} + \phi^p}\right) \tag{B.5.1}$$

where F_c is the CDF of c. Then,

$$\frac{\partial}{\partial G_{id}}\left(1 - F_c\left(1 - \frac{1}{\phi^r G_{id} + \phi^p}\right)\right) = -f_c\left(1 - \frac{1}{\phi^r G_{id} + \phi^p}\right)\frac{\phi^r}{(\phi^r G_{id} + \phi^p)^2} < 0, \tag{B.5.2}$$

given that f_c is a density function.

Additionally, notice that

$$\frac{\partial G_{id}}{\partial\alpha} = -\frac{g(h^*)g_h(h^* - y_0^p)}{g(y_0^p + \alpha(h^* - y_0^p))^2} < 0 \tag{B.5.3}$$

Therefore, $\frac{\partial TI}{\partial\alpha} = \frac{\partial TI}{\partial G_{id}}\frac{\partial G_{id}}{\partial\alpha} > 0$.

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