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DOES FINANCE ALTER THE RELATION BETWEEN INEQUALITY AND GROWTH?

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This paper introduces a model in which greater inequality reduces growth in economies with low levels of financial development but that this effect is attenuated in economies with more developed systems. The model also predicts that individuals in economies with developed financial markets have a higher tolerance to inequality. Using a panel dataset that covers a large number of countries, this paper shows empirical evidence that is consistent with the main predictions of the model. Overall, this paper's major findings highlight that some of the pernicious effects of inequality can be attenuated by improving access to credit. (*JEL* D3, E6, P1, O4, I2)

I. 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. For instance, saving rates when modeled as an increasing function of wealth generate a positive relationship between inequality and economic growth (Bourguignon 1981; Kaldor 1957; Keynes 1920; Lewis 1954; Smith 1776). In contrast, credit constraints on investment in human capital trigger a mechanism through which equality could enhance economic growth (Benabou 2000; Durlauf 1996; Fernandez and Rogerson 1996; Galor and Zeira 1993; Mookherjee and Ray 2003). Empirically, the answer remains elusive. While a number of empirical studies suggest that more inequality reduces economic growth (Alesina and Rodrick 1994; Deininger and Squire 1998; Easterly 2007; Panizza 2002; Perotti 1996; Persson and Tabellini 1994), other 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 nonlinear effects in the relationship between inequality and economic growth (e.g., Barro 2000; Brueckner and Lederman 2015; Castelló-Climent 2010).

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 resources to optimally invest in the knowledge or human capital required to develop the specific project that they

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ABBREVIATIONS

GDP: Gross Domestic Product
GMM: Generalized Method of Moments
OLS: Ordinary Least Squares
WDI: World Development Indicators
WVS: World Values Survey

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have at hand. This type of investment exhibits diminishing marginal returns and cannot be collateralized. 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 our model. Our empirical findings show that the negative effect of inequality on growth is mitigated in economies with more developed domestic financial systems, which is consistent with our theoretical results. We also document evidence of the relationship between: (1) patent applications and financial market development and (2) tolerance to income inequality and financial market development. We show that inequality negatively impacts patent applications but that the effect is attenuated in economies with a more developed financial market. In addition, we show that more developed domestic financial markets increase the tolerance to income inequality. This 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 nonlinear 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 nonlinearities in the relationship between inequality and growth could arise. Our results are also relevant in terms of policy. Some of the lessons that can be extracted from our analysis are: (1) the financial markets constitute a powerful instrument to generate a path of inclusive economic growth, (2) some of the pernicious effects of initial inequality in endowments can be attenuated by improving access to credit, and (3) financial development not only has effects on economic outcomes but it also has an effect on beliefs.

Our model consists of an economy that is populated by agents who have a particular investment project at hand. To capitalize on these opportunities, individuals need to invest in project-specific knowledge, which cannot be collateralized. In the spirit of Galor and Zeira (1993), and Galor and Moav (2004), we simply refer to this type of investment as human capital accumulation. Agents are individual producers and the aggregate production is, therefore, the sum of the output generated by each of the agents that populate the economy. In this environment, more inequality implies that few agents concentrate much of the resources of the economy and, therefore, experience low marginal productivity of investment as individual producers. In contrast, poorly endowed agents face high marginal productivity on their investment opportunities but cannot invest more than their limited endowment. A broader access to the financial market moves resources from the highly endowed to the poorly endowed individuals. Then, a development of the domestic financial market detaches investment decisions from the resource endowment of agents, which attenuates the negative effects of inequality on growth.[1] 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, Demirguc-Kunt, and Levine (2007), and that there is a positive relationship between financial development and growth, which is consistent with the evidence documented by Calderón and Liu (2003).[2]

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 financial development has a positive effect on economic growth, which is consistent with the results reported in Rajan and Zingales (1998), Beck, Levine, and Loayza (2000), Levine, Loayza, and Beck (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. In other words, the development of the domestic financial markets has an attenuating effect on the negative relationship between inequality and growth. Additionally, we show that this effect is not simply an artifact arising from: (1) the nonlinear effect of inequality on growth along the per capita gross domestic product (GDP) path, as documented in Brueckner and

1. This mechanism is highlighted in the survey discussed by Aghion, Caroli, and Garcia-Penaloza (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 nonlinear relationship between inequality and growth found in the literature as discussed above.

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

Lederman (2015) or (2) the positive correlation of financial development with per capita income.

The results from our pooled ordinary least squares (OLS) regressions show that, when comparing countries with low and high financial development (in the 10th and the 90th percentiles of private credit to GDP), a one standard deviation increase in the Gini index is associated with 80 basis points lower per capita GDP growth in economies with less developed domestic credit markets but with only five 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 because of the 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 empirical relationship between (1) patent applications, inequality, and financial development and (2) finance and tolerance to inequality. The output generated by investments in project-specific knowledge can take the form, among others, of patentable technologies, or in general, intangible assets. Our model predicts that the negative effect that inequality exerts on investments in these type of 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 applications was collected from the World Bank's world development indicators (WDIs). Consistent with the model, we find that inequality reduces patent applications, but the negative effect of inequality on patents is attenuated in economies with a more developed financial market.

Our model also 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 attractive investment opportunities 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 they agree with the statement "We need larger income differences as incentives for individual effort."

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. This paper further contributes to the literature by showing how more developed financial markets make people more tolerant of inequality. Thus, this paper shows that financial development not only has effects on economic outcomes but also has effects on beliefs and, potentially, political outcomes.

The rest of this paper is organized as follows. Section II discusses the related literature. Section III describes our theoretical model. Section IV presents our econometric framework and it gives the main results. Finally, Section V concludes this paper.

II. 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 further developed by Keynes (1920), Lewis (1954), Kaldor (1957), and Bourguignon (1981), 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 channeling 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

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.

in human capital, which increases the average stock of human capital of the economy and enhances economic growth (Benabou 2000; Durlauf 1996; Fernandez and Rogerson 1996; Galor and Zeira 1993; Mookherjee and Ray 2003). Galor and Moav (2004) propose a unified theory that reconciliates the conflicting viewpoints of 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 the 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. Benos and Karagiannis (2017) provide support for the theoretical prediction of the unified theory of inequality and growth that was developed by Galor and Moav (2004). 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 sociopolitical mechanism through which inequality affects economic growth. According to this literature, as surveyed by Benabou (1996), equality diminishes the tendency for sociopolitical instability and distortionary redistribution, which stimulates 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. Consequently, 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; Deininger and Squire 1998; Easterly 2007; Panizza 2002; Perotti 1996; Persson and Tabellini 1994; among others).[5] In contrast, several studies have documented a positive effect of inequality on growth (Forbes 2000; Li and Zou 1998). In addition, recent papers suggest the existence of nonlinear effects in the relationship between inequality and growth. For example, Barro (2000), Castelló-Climent (2010), and Brueckner 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 there is a negative relationship in less developed economies. Brueckner and Lederman (2015) show that, on average, increases in income inequality reduce GDP per capita but that 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 nonlinear 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 at the lower end of the distribution retards growth. Halter, Oechslin, and Zweimuller (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 to help us 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

4. Aghion, Caroli, and Garcia-Penaloza (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 is 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: (1) inequality reduces investment opportunities, (2) inequality worsens the borrowers' incentives, and (3) inequality generates macroeconomic volatility.

5. Deininger and Squire (1998) 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.

level of domestic financial development. We also present evidence that sheds light on the channels through which a potential nonlinear relationship between inequality and economic growth could be triggered.

III. THE MODEL

In this section, we develop a model to motivate the empirical analyses conducted in this study. We build on Galor and Zeira (1993) and Galor and Moav (2004), who model human capital as the engine of output accumulation in an economy with credit market imperfections. The authors use this type of framework to study the relationship between income distribution and economic growth. Our focus, however, is on the role of financial markets in shaping the relationship between inequality and growth, and on the effects that financial development has on beliefs, specifically, on agents' tolerance to income inequality. We extend the previous frameworks by including the possibility of redistribution being voted by the agents, which allows us to derive an empirically testable measure of tolerance to inequality. Our model allows us to derive theoretical relationships between financial development and the inequality-growth effect, and between financial development and the tolerance to income inequality, which we empirically test in Section IV.

Formally, consider an economy populated by agents endowed with resources and time. Each individual has a particular investment project at hand. The development of each individual project requires investments in specific knowledge, which cannot be collateralized and exhibits diminishing marginal returns at the individual level. Galor and Zeira (1993) and Galor and Moav (2004) explicitly label this type of investment as human capital accumulation.[6] In the spirit of Galor and Zeira (1993) and Galor and Moav (2004), we refer to this type of individual investment simply as human capital accumulation.

In this setting, the marginal productivity of investment is relatively low for rich agents due to the diminishing returns of the production technology. In contrast, poor agents face a relatively high marginal productivity of investment but cannot invest more than their limited endowment. Therefore, a broader access to the financial markets that move resources from the highly endowed agents to poorly endowed agents would enhance productivity and, thus, economic growth. Moreover, it could also shape the tolerance that agents exhibit to the current distribution of resources. All of these interrelationships are formalized in the following sections.

A. *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. The agents may use their endowment of resources to invest in project-specific human capital or they may save them in the financial market by holding units of a financial asset. We denote by h^i for $i \in \{r, p\}$ the amount of resources invested by agent i in human capital and by b^i her financial asset holdings. We assume a small open economy that faces an exogenous return to the financial asset and an exogenous output price (normalized to 1).

Individual production technology 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 $\lim_{h\to 0} g(h) = \infty$. Additionally, we denote by $q^i = g(h^i)$ the units of output that an agent that invests h^i in human capital produces in the market with the technology g. Notice that the production technology is identical across the agents but is subject to diminishing marginal returns at the individual level. Aggregate output is the sum of the output generated by each production unit, $Q = N^p q^p + N^r q^r$.

We model the state of development of the domestic financial market with a single policy parameter $\alpha \in [0, 1]$. Concretely, agents can save any amount of resources in the financial market but they only have access to a fraction α of the optimal debt that they need to finance their investment in human capital. For instance, $\alpha = 0$ implies that agents have no access to indebtedness in the financial market and, therefore, they can invest in human capital up to the amount of the resources that they are endowed with. 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 domestic financial market. Formally, $b^i \geq \min\left\{-\alpha\left(h^* - y_0^i\right), 0\right\}$ is the relevant and

6. In the eyes of the authors, human capital is the emblematic type of capital in which accumulation is subject to diminishing marginal returns at the individual level. Galor and Moav (2004) explicitly state: "In contrast to physical capital, human capital is inherently embodied in humans and the existence of physiological constraints subjects its accumulation at the individual level to diminishing returns" (p. 1002).

feasible set of choice for the financial asset holdings of a type i agent, where h^* is defined as the investment level in human capital carried out by unconstrained agents. Notice that the financial friction α does not constrain the relevant set of choice of well-off agents who can indeed reach the optimal investment level using their own resources and, thus, who are lenders in the financial market.

We denote by R the exogenous return of the financial asset. Then, the total income earned by a type i agent is $y^i = g(h^i) + Rb^i$. The agents maximize income, taking prices and the state of development of the financial market as given:

$$(1)\quad \max_{h^i, b^i} \left\{y^i\right\} \qquad \text{s.t.}: \qquad y_0^i = h^i + b^i \text{ and } b^i \geq \min\left\{-\alpha\left(h^* - y_0^i\right), 0\right\}.$$

Finally, we assume that rich agents are not financially constrained whereas poor agents are born with not enough resources to reach the optimal investment in human capital:

ASSUMPTION 1. $y_0^r \geq h^*$ *and* $y_0^p < h^*$.

B. Equilibrium

Let b^* be the aggregate net external assets held in the economy. The equilibrium is defined as the set of allocations $\{h^r, h^p, b^r, b^p, b^*\}$ such that: (1) the agents' maximization problem is solved and (2) $b^* = N^r b^r + N^p b^p$, which clears the financial asset market.

Assumption 1 implies that rich agents are not financially constrained. These agents then invest resources in human capital until the marginal productivity of investment equals the gross return of the financial asset; that is, $h^r = h^*$, where $h^* = (g')^{-1}(R)$. Each rich agent saves the rest of their endowment in the financial markets: $b^r = y_0^r - h^*$. Poor agents, who are financially constrained according to Assumption 1, demand $h^* - y_0^p$ resources in the financial market. However, only $\alpha\left(h^* - y_0^p\right)$ resources flow to them given the state of development of the financial market, α. Then, poor agents invest $h^p = \alpha\left(h^* - y_0^p\right) + y_0^p$ and hold an amount $b^p = -\alpha\left(h^* - y_0^p\right) < 0$ of the financial asset. Notice that diminishing returns in individual investments implies that $g'(h^p) > R$. Then, the marginal productivity of investment is relatively higher for the poor agents who, therefore, would like to increase their level of indebtedness. However, they are not able to do so when $\alpha < 1$. Aggregate output is, thus, $Q = N^r g(h^*) + N^p g\left(\alpha\left(h^* - y_0^p\right) + y_0^p\right)$ and the aggregate net external assets held in the economy equals $N^r\left(y_0^r - h^*\right) - N^p \alpha\left(h^* - y_0^p\right)$.

A more developed domestic financial market, as captured by a higher value of α, implies that more resources flow to the financially constrained local agents of the economy. For instance, $\alpha = 1$ implies that $h^* - y^p$ resources flow to each poor agent at an exogenous cost of R. Some of those resources are supplied by local highly endowed agents whereas the remaining resources flow from the international capital market (i.e., from foreign-rich agents). In contrast, $\alpha = 0$ implies that although unconstrained agents save, those resources do not flow to the local poorly endowed agents. Therefore, in this sense, the parameter α captures a financial friction that prevents the flow of resources at an exogenous gross cost R from highly endowed agents towards the poorly endowed agents of the economy.

C. Redistribution and Tolerance to the Income Inequality

A redistributive policy can be voted by the agents and can then be implemented by the government. This policy taxes market output and distributes the collected resources back through flat transfers, such that the government's budget constraint is balanced. However, redistribution is costly. A fraction of the collected resources are destroyed when they are distributed back to the population. This type of iceberg cost of redistribution captures government inefficiencies that, *ceteris paribus*, can make agents less prone to support redistributive policies in economies with a worse institutional quality. The redistributive policy can then be described by the set of parameters $\{\tau, c\}$, where τ is the tax rate levied on the output of individual investments and c is the fraction of the collected resources that are destroyed in the redistribution process. Then, c can be viewed as a measure of the inefficiency of government in achieving their goals, redistribution in particular. Although the government announces the level of τ, c is unknown for the agents at the moment when they vote on the policy. However, the agents know that c is drawn from a cumulative distribution function Γ whose support is over the interval (0, 1). Therefore, the after-tax income earned by a type i agent is:

$$(2)\quad y^i = (1 - \tau\mathcal{D})\, q^i + \tau\mathcal{D}\,(Q/N)(1 - c) + Rb^i$$

where $\mathcal{D} = 1$ if the redistributive policy is implemented and 0 otherwise.

Assume that a traditional one-person one-vote democracy rules this economy. In this democracy, the decisive voter is the representative poor agent since $N^p > N^r$. First, the agents decide the optimal investment of their endowed resources. The agents are then asked if they support a change in the allocation of resources through a policy, such as the one previously described. Consider the following definition:

DEFINITION 1. *The level of tolerance to the income inequality level of the economy is 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 current allocation of resources. Therefore, by assessing the probability with which the median voter would support a redistributive policy, we can determine 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. By denoting the degree of tolerance to the inequality level of the economy by $TI \in [0, 1]$, we have:

$$TI\left(q^r/q^p\right) = 1 - \Gamma\left(m\left(q^r/q^p\right)\right) \tag{3}$$

where $m(q^r/q^p) = 1 - [1/(\phi^r q^r/q^p + \phi^p)]$ and ϕ^i is the fraction of the type i agent in the population.

D. Comparative Statics

We now perform some comparative statistics. We start by defining two inequality measures, which are the object of our analysis. First, we define ex ante total income inequality as the ratio between the total endowment of rich and poor agents: $G = y_0^r/y_0^p$. Second, we define ex post total income inequality as the ratio between the before-tax income level earned by rich and poor agents: $G' = y^r_{\mathcal{D}=0}/y^p_{\mathcal{D}=0}$, where $y^i_{\mathcal{D}=0}$ is the before-tax total income of agent i. The following propositions characterize the interrelationships between the financial market, the output level of the economy, inequality, and the tolerance for income inequality.[7] 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: $\partial G'/\partial\alpha < 0$.*

We can use the definition of G' to get: $\partial G'/\partial\alpha = -y^r_{\mathcal{D}=0}\left(g'\left(h^p\right) - R\right)\left(h^* - y_0^p\right)/\left(y^p_{\mathcal{D}=0}\right)^2$. Poor agents are financially constrained to invest optimally in human capital and, thus, $g'(h^p) - R > 0$. By Assumption 1, we have $h^* - y_0^p > 0$, which completes the proof of Proposition 1.

Rich agents have an endowment of resources that is high enough to reach the optimal investment in human capital, supplying the remaining resources in the financial market. In contrast, each poor agent demands $h^* - y_0^p$ resources. The financial market channels only a fraction of these resources to them. A more developed financial market (i.e., a rise in α) unlocks the flow of resources to the poorly endowed agents of the economy. These resources allow poor agents to increase their individual investments in human capital, which exhibit a high marginal productivity as a consequence of the diminishing marginal returns in the production technology g. Then, $g'(h^p) - R > 0$ directly implies that the total income earned by poor agents increases when the financial market broadens their access to fund their human capital investments. The final result is a fall in the ex post income inequality level.

The first theoretical prediction of the model is in agreement with the results documented in Beck, Demirguc-Kunt, and Levine (2007), who emphasize the importance of the financial system for the poor. These authors document that about 40% of the long-run impact of financial development on the income growth of the poorest quintile is the result of a reduction in income inequality, while 60% is due to the impact of financial development on aggregate economic growth. Beck, Demirguc-Kunt, and Levine (2007) conclude that "financial development disproportionately boosts incomes of the poorest quintile and reduces income inequality."

7. 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, we conjecture that the output generated by the projects can contain mechanisms that trigger endogenous growth; thus, under this conjecture, our conclusions on the output level also hold for economic growth. This conjecture would be supported by the literature when h is labeled as investment in human capital, as we have done in this section.

Therefore, our first theoretical proposition points in this direction.

PROPOSITION 2. *A financial market deepening increases output: $\partial Q/\partial\alpha > 0$.*

A more developed financial market allows poorly endowed agents to borrow a greater amount of resources from rich agents to increase the resources invested in human capital. Then, the individual output generated by poor agents rises and, consequently, so does aggregate output. Formally, $\partial Q/\partial\alpha = N^p g'(h^p)\left(h^* - y_0^p\right)$. Then, Assumption 1 directly implies that $\partial Q/\partial\alpha > 0$.

PROPOSITION 3. *A higher level of ex ante inequality reduces output: $\partial Q/\partial G < 0$.*

Rich agents are unconstrained to invest optimally in human capital. Then, when the rise in G is driven by a rise in y_0^r together with a fall in y_0^p, we get $sign\left[\partial Q/\partial G\right] = -sign\left[\partial Q/\partial y_0^p\right]$ where $\partial Q/\partial y_0^p = N^p(1-\alpha)g'(h^p) > 0$. Therefore, a rise in the ex ante inequality reduces the output of the economy. This case resembles a policy experiment consisting of a redistribution of resources from the poor to the rich agents. Rich agents are already investing optimally and thus, the rise in their endowment only increases their supply of funds in the financial market. On the other hand, poor agents are financially constrained and thus, their individual output is positively correlated with their endowment. Then, the fall in the endowment of poor agents impacts negatively the individual output that these agents produce. Hence, aggregate output falls.

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: $\partial^2 Q/\partial G\partial\alpha > 0$.*

From the equation in Proposition 3, we can directly get $sign\left[\partial^2 Q/\partial G\partial\alpha\right] = -sign\left[\partial^2 Q/\partial y_0^p\partial\alpha\right]$. Moreover, $\partial^2 Q/\partial y_0^p\partial\alpha = N^p\left((1-\alpha)\left(h^* - y_0^p\right)g''(h^p) - g'(h^p)\right) < 0$. Hence, $\partial^2 Q/\partial G\partial\alpha > 0$. A more developed financial market implies that the endowment of resources becomes less relevant for the investment decisions of agents. Consider the case when $\alpha = 1$. This level of development of the financial market allows both rich and poor agents to reach the optimal investment level in human capital, independent of the endowment of resources that these agents are born with. Therefore, in this case, a worsening in the ex ante income distribution is irrelevant on individual investments and, therefore, on aggregate output. In contrast, when $\alpha = 0$, the investment of poorly endowed agents is highly dependent from the level of their endowments. Then, a worsening in the ex ante income distribution, even though it does not alter the investment level of rich agents, which is already optimal, reduces the amount invested by poor agents, decreasing the aggregate output of the economy. Therefore, the negative effect of inequality on aggregate output vanishes in economies with a more developed financial market.

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

Let $G'' = q^r/q^p$, Equation (3) implies that $\partial TI/\partial G'' < 0$. Moreover, we have $\partial G''/\partial\alpha = -q^r g'(h^p)\left(h^* - y_0^p\right)/(q^p)^2 < 0$. Then, $\partial TI/\partial\alpha = (\partial TI/\partial G'')(\partial G''/\partial\alpha) > 0$. This proposition is a direct consequence of the fact that a more developed financial market increase the individual output of poor agents. 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.

In the next section we will present empirical evidence of the testable implications that we have derived in Propositions 1–5.

IV. EMPIRICAL ANALYSIS

In this section, we test the main predictions of the model that was developed in Section III. Specifically, we quantify the effect of financial development and inequality on growth, and we determine 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 III 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 that these agents have to inequality. This political economy implication of a financial market development is also tested in this section. In addition, because in our model the central channel through which financial development attenuates the negative effect of inequality on growth is the investment in some types of intangible assets (e.g., project-specific knowledge), we also empirically study the relationship between patent applications, economic inequality, and financial development.

A. Financial Development, Inequality, and Growth

We first conduct growth panel data regressions. We assemble a panel dataset of 150 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 GDP. We include as covariates the level of domestic financial development, income inequality, the interaction between those variables and, for robustness, a broad set of control variables that, according to the literature, directly impact economic growth. Specifically, we consider the previous level of income per capita to take convergence into account, government size, openness to trade, and inflation (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 nonlinearity 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 WDIs, 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 a value from 0 (perfect equality) to 100 (perfect inequality).[8] The World Bank estimates the index for a number of 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, fixed effects panel regressions, generalized method of moments (GMM) dynamic panel, and instrumental variables regressions. GMM dynamic panel data models and instrumental variables 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.[9]

Our baseline empirical model is close to that estimated by Levine, Loayza, and Beck (2000). However, we augment their cross-sectional and GMM dynamic panel models to explore the effect of inequality on growth and to find whether this effect depends on the private credit to GDP ratio. Columns 1–4 of Table 3 report the results from estimating various specifications of our pooled OLS regressions, columns 5–8 report the results from the fixed effects panel regressions, and columns 9–12 estimate the GMM dynamic panel models. Table 3 also reports the p values for the Sargan–Hansen 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 III, 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, Levine, and Loayza (2000), and Levine, Loayza, and Beck (2000),

8. In countries with missing values of the Gini index in particular years, we replace the missing value with a lag of this variable (up to the fifth yearly lag). The same treatment was given to the alternative inequality measure, which will be discussed later in this section.

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

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 %)	WDIs
Patent applications per capita[a]	(Patent applications by residents × 1,000,000)/population	WDIs
GDP per capita	GDP per capita is GDP divided by midyear population	WDIs
Private credit to GDP	Domestic credit to private sector by banks (% of GDP)	WDIs
Gini	Gini index. A value of 0 represents perfect equality, while an index of 100 implies perfect inequality	WDIs
Government size	General government final consumption expenditure (% of GDP)	WDIs
Openness to trade	Sum of exports and imports of goods and services (% of GDP)	WDIs
Inflation	Inflation, consumer prices (annual %)	WDIs
10% Top income share	Income share held by highest 10%	WDIs
Loan accounts from commercial banks	Loan accounts from commercial banks (per 1,000 adults)	WDIs
Legal origin	Identifies the legal origin of the company law or commercial code of each country: (1) English; (2) French; (3) German; (4) Scandinavian; and (5) Socialist	La Porta et al. (1998)
Ethnic, linguistic, and religious fragmentation	Measures the degree of ethnic, linguistic, and religious heterogeneity in various countries	Alesina et al. (2003)
Tolerance to inequality	A value of 1 if the responder agrees completely with the statement that "Incomes should be made more equal" and a value of 10 if she agrees completely with the statement that "We need larger income differences as incentives for individual effort"	WVS
Government efficiency	Assessment of corruption within the political system. A score of 6 points equates to very low corruption and a score of 0 points to very high corruption	International Country Risk Guide

[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	Observed	Mean	Standard Deviation	Minimum	Maximum
Real per capita GDP growth	719	2.15	3.09	−11.93	20.28
Patent applications per capita	496	124.918	348.816	0.03	2,911.31
GDP per capita	719	9.18	13.86	0.13	81.44
Private credit to GDP	719	43.31	40.38	1.56	281.27
Gini	719	40.67	9.97	18.48	74.30
Government size	645	15.37	5.44	2.80	37.39
Openness to trade	645	79.94	48.15	12.86	408.09
Inflation	645	0.22	1.30	−0.03	24.06
10% Top income share	626	31.75	7.77	17.47	65.00
Borrowers from commercial banks	146	155.1015	203.421	0.12	966.32
English common law	645	0.31	0.46	0	1
French commercial code	645	0.53	0.50	0	1
Ethnicity	383	0.45	0.26	0	0.93
Language	383	0.41	0.29	0	0.92
Religion	383	0.45	0.23	0	0.86
Tolerance to inequality	255,851	5.74	3.02	1	10
Government efficiency	166	2.89	1.07	1	6

among others. Additionally, our results show that there is a statistically significant negative effect of income inequality on growth (column 1). Importantly, we find that this negative effect of inequality on growth is attenuated in economies with more developed domestic financial systems (column 2). This effect is not simply an artifact of the facts that, on the one hand, the effect of inequality on growth is nonlinear along the per capita GDP levels, as documented in Brueckner

TABLE 3
Financial Development, Inequality, and Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real Per Capita GDP Growth	**Pooled OLS**				**Panel Regressions**				**Dynamic Panel Regressions**			
Logarithm GDP per capita ($t-1$)	−0.4841***	−0.4343***	−0.1013	−0.0450	−8.6842***	−8.7867***	−13.4653***	−12.2781***	−0.6160***	−0.5806**	−0.2302	−0.1098
	(0.109)	(0.117)	(0.104)	(0.101)	(0.802)	(0.771)	(2.746)	(2.298)	(0.233)	(0.242)	(0.197)	(0.225)
Logarithm private credit to GDP	0.7626***	−0.3883	−1.4904**	−2.0348***	0.7896**	−0.3708	0.2945	−0.6486	0.6467	−0.4280	−4.0067**	−5.0866***
	(0.215)	(0.700)	(0.652)	(0.682)	(0.338)	(0.739)	(0.933)	(0.835)	(0.476)	(1.521)	(1.716)	(1.463)
Gini	−0.0427***	−0.1358**	−0.1864***	−0.2254***	0.0164	−0.0758	−0.0655	−0.1297*	−0.1343***	−0.2005*	−0.4604***	−0.5235***
	(0.012)	(0.056)	(0.052)	(0.058)	(0.028)	(0.063)	(0.063)	(0.074)	(0.035)	(0.118)	(0.136)	(0.121)
Logarithm private credit to GDP × Gini		0.0285*	0.0468***	0.0575***		0.0321*	0.0219	0.0417**		0.0310	0.1163***	0.1347***
		(0.015)	(0.014)	(0.016)		(0.019)	(0.020)	(0.020)		(0.034)	(0.041)	(0.037)
Logarithm GDP per capita residual ($t-1$) × Gini			−0.2065***	−0.1953***			0.1265**	0.1236**			−0.1693***	−0.1587***
			(0.021)	(0.022)			(0.062)	(0.056)			(0.025)	(0.023)
Logarithm government size				−0.7893***				−2.4209***				−1.4785
				(0.276)				(0.604)				(1.009)
Logarithm openness to trade				0.6796***				2.6762***				2.6798***
				(0.178)				(0.702)				(0.868)
Logarithm (1 + Inflation)				−1.4026**				−2.4371***				−1.2652
				(0.602)				(0.533)				(0.821)
Observations	719	719	694	645	719	719	694	645	719	719	694	645
Adjusted R^2	0.1362	0.1419	0.3219	0.3568	0.4953	0.4976	0.5153	0.5955				
Hansen test (p value)									.110	.249	.726	.509
Country fixed effects	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parenthesis.
*$p < .1$; **$p < .05$; ***$p < .001$.

and Lederman (2015) and, on the order hand, financial development is positively correlated with per capita income. We show in column 3 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. We also observe in columns 4, 8, and 12 that the mitigating effect of financial development on the negative effect of inequality on growth is generally robust to the inclusion of a full set of covariates in the three empirical models exhibited in Table 3.

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 80 and 5 basis points in economies with private credit to GDP ratios in the 10th and 90th percentiles, respectively. That is, the reduction of growth associated with inequality is negligible when the financial system is sufficiently developed.

Alternative Measure of Financial Development. 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). However, this is problematic because, as the theoretical model developed in Section III 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 1–4 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 III. 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 pooled OLS regressions.[10] 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.

Alternative Measure of Income Inequality. 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 allows us to explore whether medium and upper medium income individuals also face financial constraints that prevent them from optimally financing their projects. Columns 5–8 of Table 4 report the results for the pooled OLS specification and columns 9–12 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 in most of the specifications included in Table 4. Moreover, the effects found using this alternative measure of inequality are of a similar magnitude to those found when we used the Gini coefficient. Therefore, our results are robust to this alternative measure of inequality.

Instrumental Variable Estimates. 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

10. Therefore, we cannot present this robustness check for the fixed effects and dynamic panel regressions.

TABLE 4
Alternative Measures of Financial Development and Income Inequality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real Per Capita GDP Growth	**Pooled OLS**								**Dynamic Panel Regressions**			
Logarithm GDP per capita ($t-1$)	−1.0254***	−0.7709***	−0.7699***	−0.8043***	−0.5286***	−0.4954***	−0.1920*	−0.0901	−0.5618***	−0.1521	−0.4314**	−0.2642
	(0.225)	(0.220)	(0.221)	(0.216)	(0.116)	(0.125)	(0.113)	(0.114)	(0.215)	(0.303)	(0.203)	(0.194)
Logarithm borrowers from commercial banks	0.6413***	−1.4224**	−1.4140**	−1.7273***								
	(0.233)	(0.602)	(0.609)	(0.548)								
Gini	−0.0495	−0.2206***	−0.2187***	−0.2420***								
	(0.034)	(0.060)	(0.061)	(0.061)								
Logarithm borrowers from commercial banks × Gini		0.0438***	0.0435***	0.0471***								
		(0.011)	(0.011)	(0.011)								
Logarithm GDP per capita residual ($t-1$) × Gini			0.0034	0.0109								
			(0.036)	(0.037)								
Logarithm private credit to GDP					0.7212***	−0.1840	−1.2108	−1.6449**	0.3286	−6.1480**	−3.4925*	−3.4257**
					(0.230)	(0.834)	(0.764)	(0.724)	(0.466)	(2.906)	(1.808)	(1.599)
10% Top income share					−0.0569***	−0.1517*	−0.2251***	−0.2470***	−0.1725***	−0.8104***	−0.5945***	−0.5313***
					(0.016)	(0.084)	(0.076)	(0.075)	(0.040)	(0.305)	(0.180)	(0.171)
Logarithm private credit to GDP × 10% top income share						0.0290	0.0526**	0.0595***		0.1869**	0.1378**	0.1241**
						(0.023)	(0.021)	(0.021)		(0.088)	(0.054)	(0.052)
Logarithm GDP per capita residual ($t-1$) × 10% top income share							−0.2633***	−0.2516***			−0.2263***	−0.2171***
							(0.032)	(0.033)			(0.039)	(0.037)
Logarithm government size				−1.2205**				−0.5462*				−1.0813
				(0.556)				(0.318)				(0.874)
Logarithm openness to trade				0.5681				0.5818***				1.9080**
				(0.464)				(0.223)				(0.884)
Logarithm (1 + Inflation)				−10.1577*				−1.6058**				−1.4697*
				(5.428)				(0.622)				(0.806)
Observations	146	146	143	132	626	626	604	564	626	626	604	564
Adjusted R^2	0.1976	0.2524	0.2461	0.3047	0.1511	0.1534	0.3085	0.3302				
Hansen test (p value)									.147	.157	.327	.334
Country fixed effects	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parenthesis.
*$p < .1$; **$p < .05$; ***$p < .001$.

purpose, we follow an instrumental variables strategy that is 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. We also consider the ethnicity, language, and religion fragmentation as additional instruments for inequality. Finally, 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. Table 5 reports the results derived from the instrumental variables regressions, including different combinations of instruments and fixed effects. Given that most of our instruments are time-invariant, our instrumental variables regressions (except specifications 7 and 8) do not consider country fixed effects. Overall, our results remain qualitatively unchanged and they are mostly 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.

B. Financial Development, Inequality, and Patents

We now study the empirical relationship between patent applications, economic inequality, and financial development. As suggested by our theoretical model, inequality harms economic growth by preventing poorly endowed agents from investing in some types of intangible assets (i.e., a project-specific embodied knowledge). In contrast, a financial market development facilitates 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 World Bank's WDIs. Table 6 presents the results for pooled OLS regressions, dynamic panel models, and instrumental variables regressions.[11] We observe in Table 6 that the number of per capita patent applications by residents is smaller in more unequal countries. Moreover, the pooled and the instrumental variables regressions suggest that the negative effect of inequality on patent applications vanishes in countries that are more financially developed.[12] 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 intangible assets or any type project-specific embodied knowledge, which decreases the negative effect that an initial inequality in endowments produces on economic growth.

C. Financial Development and Tolerance to Inequality

Finally, we test whether the access to more developed domestic financial markets increases the tolerance to income inequality. As suggested by the model in Section III, a more developed financial market provides more access to credit for poorly endowed agents to capitalize investment opportunities, 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.

The data on tolerance to income inequality was extracted from the WVS. The WVS is a comparative investigation of sociocultural 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 100 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,"

11. To keep the table size manageable, we do not report the results from the fixed effects panel regressions and we only report the results that include the most exhaustive controls for the instrumental variable specifications. The main results hold for the specifications in which only the basic controls are included.

12. The results from the dynamic panel models also show a mitigating effect of the financial market development on the negative impact of inequality on patent applications, although the interaction coefficient is only statistically significant in specification 7.

TABLE 5
Instrumental Variables

Real Per Capita GDP Growth	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Logarithm GDP per capita ($t-1$)	−1.1036***	−0.9944**	0.0246	−0.0372	−0.1048	−0.0501	−13.1510***	−12.0822***
	(0.399)	(0.469)	(0.157)	(0.151)	(0.103)	(0.100)	(2.387)	(2.013)
Logarithm private credit to GDP	0.8654	0.3144	−7.0387***	−6.6997***	−1.5867**	−2.1541***	0.3289	−0.6546
	(2.626)	(3.206)	(1.805)	(1.685)	(0.644)	(0.678)	(0.796)	(0.731)
Gini	−0.1712	−0.2128	−0.6808***	−0.6675***	−0.1999***	−0.2425***	−0.0898	−0.1618**
	(0.184)	(0.219)	(0.173)	(0.164)	(0.052)	(0.058)	(0.057)	(0.068)
Logarithm private credit to GDP × Gini	0.0455	0.0563	0.1659***	0.1618***	0.0489***	0.0602***	0.0210	0.0418**
	(0.054)	(0.064)	(0.043)	(0.040)	(0.014)	(0.016)	(0.017)	(0.018)
Logarithm GDP per capita residual ($t-1$) × Gini	−0.1922***	−0.1860***	−0.0730**	−0.0583	−0.2054***	−0.1939***	0.1205**	0.1194**
	(0.021)	(0.023)	(0.037)	(0.040)	(0.021)	(0.022)	(0.054)	(0.049)
Logarithm government size		−0.8164**		−0.4293		−0.7936***		−2.3989***
		(0.362)		(0.452)		(0.275)		(0.521)
Logarithm openness to trade		0.4992**		0.6475**		0.6913***		2.7713***
		(0.213)		(0.268)		(0.177)		(0.612)
Logarithm (1 + Inflation)		−0.3006		2.7342		−1.3836**		−2.3928***
		(0.757)		(1.764)		(0.609)		(0.466)
Observations	694	645	406	383	694	645	694	645
Country fixed effects	No	No	No	No	No	No	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments								
Legal origins	Yes	Yes	No	No	No	No	No	No
Ethnicity, language, and religion	No	No	Yes	Yes	No	No	No	No
Gini residual	No	No	No	No	Yes	Yes	Yes	Yes

Note: Robust standard errors are in parenthesis. Instrument for private credit to GDP: legal origins; instrument for inequality: (1) ethnicity, language and religion, and (2) Gini residual. *$p < .1$; **$p < .05$; ***$p < .001$.

TABLE 6
Financial Development, Inequality, and Patents

Logarithm (Patents Applications Per Capita)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Pooled OLS				Dynamic Panel Regressions				Instrumental Variables			
Logarithm GDP per capita ($t-1$)	0.9020***	0.9218***	0.9302***	0.8502***	1.1187***	1.1554***	1.0943***	0.7819***	0.0166	0.8055***	0.8485***	−0.1632
	(0.043)	(0.045)	(0.050)	(0.057)	(0.121)	(0.133)	(0.137)	(0.179)	(0.350)	(0.093)	(0.056)	(0.409)
Logarithm private credit to GDP	0.0345	−0.5531*	−0.6416*	−0.6040	−0.7392***	−1.8211*	−2.4120**	−1.9570*	4.6471*	−2.0489**	−0.6044*	−0.3362*
	(0.090)	(0.330)	(0.358)	(0.371)	(0.272)	(1.091)	(1.091)	(1.135)	(2.765)	(0.890)	(0.364)	(0.189)
Gini	−0.0529***	−0.1063***	−0.1145***	−0.1212***	−0.0928***	−0.1907**	−0.2687***	−0.2486***	0.1844	−0.2818***	−0.1224***	−0.0385**
	(0.005)	(0.028)	(0.029)	(0.031)	(0.015)	(0.086)	(0.089)	(0.094)	(0.199)	(0.089)	(0.030)	(0.018)
Logarithm private credit to GDP × Gini		0.0153*	0.0177**	0.0189**		0.0282	0.0496*	0.0454	−0.0676	0.0544**	0.0189**	0.0087*
		(0.008)	(0.008)	(0.009)		(0.026)	(0.027)	(0.028)	(0.056)	(0.022)	(0.009)	(0.005)
Logarithm GDP per capita residual ($t-1$) × Gini			0.0035	−0.0028			0.0019	0.0081	0.0169	0.0128	−0.0023	0.0441***
			(0.012)	(0.013)			(0.025)	(0.027)	(0.021)	(0.025)	(0.013)	(0.011)
Logarithm government size				0.6653***				1.6389***	0.8194***	0.4584	0.6602***	−0.1689
				(0.165)				(0.505)	(0.261)	(0.295)	(0.163)	(0.124)
Logarithm openness to trade				−0.2283**				0.3026	−0.2433	−0.2943	−0.2293**	0.3591***
				(0.109)				(0.367)	(0.159)	(0.184)	(0.108)	(0.134)
Logarithm (1 + Inflation)				0.4073*				0.0992	1.3720**	1.0588	0.4110*	−0.0603
				(0.217)				(0.249)	(0.569)	(0.993)	(0.214)	(0.063)
Observations	496	496	480	451	496	496	480	451	451	264	451	451
Adjusted R^2	0.6799	0.6823	0.6872	0.7042								
Hansen test (p value)					.39	.421	.948	.753				
Country fixed effects	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments												
Legal origins	No	No	No	No	No	No	No	No	Yes	No	No	No
Ethnicity, language, and religion	No	No	No	No	No	No	No	No	No	Yes	No	No
Gini residual	No	No	No	No	No	No	No	No	No	No	Yes	Yes

Note: Robust standard errors are in parenthesis.
*$p < .1$; **$p < .05$; ***$p < .001$.

and it 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, we include an index for the corruption level of the political system as a proxy for government efficiency. This variable takes a lower value for more corrupt political systems (see Table 1). A more corrupt government is less efficient in achieving their goals, redistribution in particular. Therefore, our model predicts that individuals should be more prone to support redistributive policies—that is, they are less tolerant to the income inequality level of the economy—in economies with a less corrupt government. All of the models include country and wave-fixed effects. Table 7 reports the results for the pooled OLS, dynamic panel, and instrumental variables models.[13]

In Table 7, 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 III, which emphasizes how financial development makes poorly endowed agents able to forecast the possibility of climbing up the income ladder and, thus, become more tolerant to inequality and less prone to support redistributive policies. Moreover, we observe in the pooled OLS regressions (columns 3 and 4) that there is a negative and statistically significant impact of government efficiency on the tolerance to inequality; that is, agents are less tolerant to the current inequality level of the economy in countries with a more efficient government. This result is consistent with the relationship between the government efficiency to redistribute and the probability for the agents to support redistributive policies predicted by the model developed in Section III.[14] Finally, we observe in columns 5–8 that the positive effect of financial development on the tolerance to inequality persists for the panel regressions and instrumental variables models.

V. 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 some type of project-specific human capital, whose individual accumulation is subject to diminishing marginal returns. A broader access to the financial market moves resources from the highly endowed agents to poorly endowed, which detaches investment decisions from the resource endowment of agents, attenuating the negative effects of inequality on growth. 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 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. Our results also highlight that some of the pernicious effects of initial inequality in endowments can be attenuated by

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

14. Given that the government efficiency variable only exhibits a small variation over time, we have not included it in the country fixed effects panel regressions. In addition, this variable was excluded from the growth regressions because the GDP per capita level variable should already capture the institutional quality heterogeneity across countries. However, we have alternative specifications available at request where the government efficiency variable is an additional covariate in the growth regressions. Our main results stay robust.

TABLE 7
Financial Development and Tolerance to Inequality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Higher Tolerance)	**Pooled OLS**				**Panel regressions**		**Instrumental variables**	
Logarithm private credit to GDP	0.0195***	0.0236***	0.0362***	0.0397***	0.0395***	0.0113*	0.0455***	0.0347***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.006)	(0.006)	(0.009)	(0.009)
Gini	−0.0008***		−0.0014***		0.0107***		−0.0009***	
	(0.000)		(0.000)		(0.001)		(0.000)	
10% Top income share		−0.0024***		−0.0034***		0.0178***		−0.0024***
		(0.000)		(0.000)		(0.001)		(0.000)
GDP per capita growth	−0.0098***	−0.0145***	−0.0113***	−0.0183***	−0.0158***	−0.0094***	−0.0117***	−0.0154***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Logarithm GDP per capita	−0.0518***	−0.0759***	−0.0474***	−0.0763***	−0.1838***	−0.2959***	−0.0634***	−0.0806***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.013)	(0.013)	(0.004)	(0.004)
Government efficiency			−0.0186***	−0.0147***				
			(0.002)	(0.002)				
Observations	255,851	235,982	238,492	219,632	255,851	235,982	251,255	233,647
Adjusted R^2	0.0145	0.0188	0.0138	0.0189	0.0732	0.0755	0.0142	0.0188
Country fixed effects	No	No	No	No	Yes	Yes	No	No
Wave fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instrument for private credit to GDP	No	No	No	No	No	No	Legal origins	Legal origins

Note: Robust standard errors are in parenthesis.
*$p < .1$; **$p < .05$; ***$p < .001$.

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 it also has an effect on beliefs. Therefore, more developed financial markets could reduce the pressure for distortionary redistribution and increase the levels of sociopolitical stability, thereby stimulating economic growth through that channel.

REFERENCES

Aghion, P., and P. Bolton. "A Theory of Trickle-Down Growth and Development." *Review of Economic Studies*, 64(2), 1997, 151–72.

Aghion, P., E. Caroli, and C. Garcia-Penaloza. "Inequality and Economic Growth: The Perspective of the New Growth Theories." *Journal of Economic Literature*, 37(4), 1999, 1615–60.

Alesina, A., and D. Rodrick. "Redistributive Politics and Economic Growth." *Quarterly Journal of Economics*, 436, 1994, 465–90.

Alesina, A., A. Devleeschauwer, W. Easterly, S. Kurlat, and R. Wacziarg. "Fractionalization." *Journal of Economic Growth*, 8(2), 2003, 155–94.

Banerjee, A., and E. Duflo. "Inequality and Growth: What Can the Data Say?" *Journal of Economic Growth*, 8(3), 2003, 267–99.

Banerjee, A., and A. Newman. "Occupational Choice and the Process of Development." *Journal of Political Economy*, 101(2), 1993, 274–98.

Barro, R. "Inequality and Growth in a Panel of Countries." *Journal of Economic Growth*, 5(1), 2000, 5–32.

Bazillier, R., and J. Hericourt. "The Circular Relationship between Inequality, Leverage, and Financial Crises." *Journal of Economic Surveys*, 31(2), 2017, 463–96.

Beck, T., R. Levine, and N. Loayza. "Finance and the Sources of Growth." *Journal of Financial Economics*, 58(1-2), 2000, 261–300.

Beck, T., A. Demirguc-Kunt, and R. Levine. "Finance, Inequality and the Poor." *Journal of Economic Growth*, 12(1), 2007, 27–49.

Benabou, R. "Inequality and Growth." *NBER Macroeconomics Annual*, 11, 1996, 11–74.

———. "Unequal Societies: Income Distribution and the Social Contract." *American Economic Review*, 90(1), 2000, 96–129.

Benos, N., and S. Karagiannis. "Inequality and Growth in the United States: Why Physical and Human Capital Matter." *Economic Inquiry*, 56(1), 2017, 572–619.

Bourguignon, F. "Pareto Superiority of Unegalitarian Equilibria in Stiglitz' Model of Wealth Distribution with Convex Saving Function." *Econometrica*, 49(6), 1981, 1469–75.

Brueckner, M. "On the Simultaneity Problem in the Aid and Growth Debate." *Journal of Applied Econometrics*, 28, 2013, 102–25.

Brueckner, M., and D. Lederman. "Effects of Income Inequality on Aggregate Output." Policy Research Working Paper Series 7317, The World Bank, 2015.

Calderón, C., and L. Liu. "The Direction of Causality between Financial Development and Economic Growth." *Journal of Development Economics*, 72(1), 2003, 321–34.

Castelló-Climent, A. "Inequality and Growth in Advanced Economies: An Empirical Investigation." *Journal of Economic Inequality*, 8(3), 2010, 293–321.

Deininger, K., and L. Squire. "New Ways of Looking at Old Issues: Inequality and Growth." *Journal of Economic Growth*, 57, 1998, 259–87.

Durlauf, S. N. "A Theory of Persistent Income Inequality." *Journal of Economic Growth*, 1(1), 1996, 75–94.

Easterly, W. "Inequality Does Cause Underdevelopment." *Journal of Development Economics*, 84(2), 2007, 755–76.

Fernandez, R., and R. Rogerson. "Income Distribution, Communities, and the Quality of Public Education." *Quarterly Journal of Economics*, 111(1), 1996, 135–64.

Forbes, K. J. "A Reassessment of the Relationship between Inequality and Growth." *American Economic Review*, 90(4), 2000, 869–87.

Galor, O., and O. Moav. "From Physical to Human Capital Accumulation: Inequality and the Process of Development." *Review of Economic Studies*, 71(4), 2004, 1001–26.

Galor, O., and J. Zeira. "Income Distribution and Macroeconomics." *Review of Economic Studies*, 60(1), 1993, 35–52.

Halter, D., M. Oechslin, and J. Zweimuller. "Inequality and Growth: The Neglected Time Dimension." *Journal of Economic Growth*, 19(1), 2014, 81–104.

Kaldor, N. "A Model of Economic Growth." *Economic Journal*, 67(268), 1957, 591–624.

Keynes, J. M. *The Economic Consequences of the Peace*. New York: Harcourt, Brace, and Howe, 1920.

La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. W. Vishny. "Law and Finance." *Journal of Political Economy*, 106(6), 1998, 1113–55.

Leigh, A. "How Closely Do Top Income Shares Track Other Measures of Inequality?" *The Economic Journal*, 117, 2007, 589–603.

Levine, R., N. Loayza, and T. Beck. "Financial Intermediation and Growth: Causality and Causes." *Journal of Monetary Economics*, 46(1), 2000, 31–77.

Lewis, W. A. "Economic Development with Unlimited Supply of Labor." *The Manchester School*, 22(2), 1954, 139–91.

Li, H., and H. Zou. "Income Inequality Is not Harmful for Growth: Theory and Evidence." *Review of Development Economics*, 2(3), 1998, 318–34.

Mookherjee, D., and D. Ray. "Persistent Inequality." *Review of Economic Studies*, 70(2), 2003, 369–93.

Panizza, U. "Income Inequality and Economic Growth: Evidence from American Data." *Journal of Economic Growth*, 7(1), 2002, 25–41.

Perotti, R. "Growth, Income Distribution, and Democracy: What the Data Say." *Journal of Economic Growth*, 1(2), 1996, 149–87.

Persson, T., and G. Tabellini. "Is Inequality Harmful for Growth?" *American Economic Review*, 84, 1994, 600–21.

Rajan, R., and L. Zingales. "Financial Dependence and Growth." *American Economic Review*, 88, 1998, 559–86.

Rioja, F., and N. Valev. "Does One Size Fit All? A Reexamination of the Finance and Growth Relationship." *Journal of Development Economics*, 74(2), 2004, 429–47.

Smith, A. *TheWealth of Nations*. New York: Modem Library, 1776.

Voitchovsky, S. "Does the Profile of Income Inequality Matter for Economic Growth?" *Journal of Economic Growth*, 10(3), 2005, 273–96.