Investor protection and income inequality: Risk sharing vs risk taking

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A B S T R A C T

This paper studies the relationship between investor protection and income inequality. In the presence of market frictions, better protection makes investors more willing to take on entrepreneurial risk when lending to firms, thereby improving the degree of risk sharing between financiers and entrepreneurs. On the other hand, by increasing risk sharing, investor protection also induces more risk taking. By increasing entrepreneurial risk taking, it raises income dispersion. By reducing the risk faced by entrepreneurs, it reduces income volatility. As a result, the relationship between investor protection and income inequality is non monotonically, since the risk-taking effect dominates at low levels of investor protection, while risk sharing becomes stronger when more risk is taken. Empirical evidence from up to sixty-seven countries spanning the period 1976–2004 supports the predictions of the model.

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1. Introduction

The literature on institutions, law and economics has shown that investor protection affects significantly the financial structure of an economy, and has investigated the effects of financial development on economic performance in terms of GDP growth, productivity and investment. What has received less attention is that investor protection, through its effect on financial structure and the allocation of risk, may influence the risk taking behavior of investors and firms, thereby affecting income inequality. To fill this gap, this paper investigates the link between investor protection and income inequality, both theoretically and empirically. It proposes a model where investor protection promotes risk sharing between financiers and entrepreneurs, thereby inducing more risk taking in the economy. Better risk sharing and wider risk taking, in turn, affect income inequality in opposite ways. The main results of the model are then confronted with the data.

To formalize these ideas, I construct a simple model of investors and entrepreneurs where agents are risk averse and heterogeneous in ability. Investors decide how to allocate their endowment between safe loans (debt) and diversified portfolios of risky (equity-like) assets, while entrepreneurs face a choice between a safe and a risky technology, whose probability of success depends on ability. Starting up a firm entails a fixed entry cost that entrepreneurs must cover by borrowing. Financial markets are subject to a moral hazard problem arising from the non-observability of output to financiers. Measures of investor protection alleviate this financial friction. In particular, I assume that investor protection promotes transparency by imposing a cost to misreport cash flow. Better guarantees generate more confidence among investors, thereby making them more willing to insure the entrepreneurs through lending. It follows that in financial systems with stronger investor protection there is more equity-like external finance relative to debt, which offers entrepreneurs a higher degree of risk sharing. Finally, I rule out wealth heterogeneity among agents, so that all inequality is due to idiosyncratic factors (ability), financial market conditions and income risk.

In the model, better investor protection affects income inequality in two ways. (i) It improves risk sharing, thereby reducing income volatility for risky entrepreneurs; and (ii) it raises the share of risky firms, and hence agents exposed to earnings risk. While (i) tends to

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1 See, among others, Acemoglu and Johnson (2005), Beck and Levine (2004), La Porta et al. (1997, 2006), Levine (2005) and references therein.

2 Investor protection takes the form of a hiding cost also in Aghion et al. (2005), Castro et al. (2004) and Lacker and Weinberg (1989). In this paper, like in the two latter, the cost is proportional to the hidden amount, while in the first, it equals a fraction of the initial investment.

3 Using microdata, Hurst and Lusardi (2004) show that wealth may not be the key factor affecting entrepreneurial choices, while Ardagna and Lusardi (2008) provide evidence that skills and the fear of failure are among the most important determinants of entrepreneurship. This lends support to my modeling choice of abstracting from wealth heterogeneity to better focus on other factors, such as risk and ability.
reduce inequality, (ii) raises it. The analysis shows that the “risk taking” effect (ii) dominates when investor protection is low since risky entrepreneurs still face a considerable earnings risk, while the “risk sharing” effect (i) prevails when investor protection is high since better insurance applies to a large mass of risky entrepreneurs. Hence, the relationship between investor protection and income inequality is predicted to be non-monotonic. Moreover, since investor protection affects the financial structure of the economy, the same non-monotonic relationship holds between the share of equity-like external finance and inequality.

To evaluate empirically the main results of the model, I consider a dataset covering up to sixty-seven countries observed between 1976 and 2004. The choice of a cross-country analysis is dictated by the fact that investor protection is generally set by law and hence exhibits little within-country variation. I adopt two proxies for inequality: first, the Gini coefficient of the income distribution, which is available for a relatively large sample of countries and years. Although the model refers to entrepreneurs, which belong to the top income percentiles, three main arguments may justify the use of a general indicator of inequality. First, recent evidence from several countries suggests that a large fraction of the variation in income inequality over the last two decades is explained by changes at the top of the distribution (see, among others, Atkinson et al., 2009 and Heathcote et al., 2010). Second, employees normally earn higher wages and are subject to higher employment risk when working in more productive and riskier firms. Hence the results obtained for entrepreneurs may be expected to trickle down to all workers. Finally, the model could also be interpreted as one of occupational choice à la Kihlstrom and Laffont (1979), where each agent can either be a worker receiving a fixed wage or an entrepreneur facing risk. In this case, the implications on earnings inequality would refer to the entire population. Nonetheless, for robustness, I replicate part of the analysis proxying inequality with the ratio of the top 1st to 10th percentiles of the income distribution. The main shortcoming with this variable, recently compiled by Alvaredo et al. (2011), is its very limited cross-sectional availability (at present, the database covers only 23 countries).

Turning to the independent variables, I proxy investor protection with the de jure index compiled by La Porta et al. (2006), and estimate its non-linear relationship with inequality. Next, I evaluate the theoretical mechanism following a two-step approach. I first show that better protection tends to coincide with a higher share of equity-like external finance, and then I estimate a non-linear relationship between the indicator of financial structure and inequality on a wider cross-section and a panel. The results suggest that inequality varies non-monotonically both with investor protection and the relative weight of equity-like finance, as predicted by the model.

The paper is related to four main strands of literature. Acemoglu and Johnson (2005), as well as La Porta et al. (1998), show that investor protection, and in general institutions aimed at contractual protection, affect the financial structure of an economy by promoting the development of stock markets, but have unclear effects on economic performance. No attention was devoted, however, to study the effects on inequality.

Theoretical contributions from the growth literature (see Aghion and Bolton, 1997; Banerjee and Newman, 1993; Galor and Zeira, 1993, and Greenwood and Jovanovic, 1990, among others) have proposed explanations for the relationship between financial development, inequality and growth. In most of these models, income inequality originates from heterogeneity in the initial wealth distribution, paired with credit market frictions. As the poorest are subject to credit constraints, they are prevented from making the efficient investment, which affects the dynamics of wealth and income. I depart from this approach in two main respects. First, the financial friction affects the share of risk borne by agents, rather than the amount of external finance available to them. Second, I consider a different source of ex-ante heterogeneity (in productivity) which, together with the extent of risk sharing and risk taking, ultimately determines the income distribution.

This paper also contributes to the recent literature on the macro-economic implications of entrepreneurship which addresses the effects of financial frictions on investment, growth and volatility through their impact on entrepreneurial choices (see Quadrini, 2009 for a review). The papers focusing on distributional issues tend to consider financial frictions as a factor that perpetuates and exacerbates wealth inequality by affecting the investment and saving choices of entrepreneurs, and abstract from entrepreneurial risk sharing and risk taking. Other papers, such as Castro et al. (2004) and Michelacci and Fabiano (2011), relate financial institutions and entrepreneurship to growth through risk sharing, risk taking, and managerial ability, but do not study inequality. Thesmar and Thoeng (forthcoming) point out that better risk sharing may induce higher risk taking and raise volatility. Caselli and Gennaioli (2001) show that weak contract enforcement deteriorates productivity (TFP) by discouraging untalented family-firm owners from hiring competent managers (as in Burkart et al., 2003).

The vast empirical literature on financial development and economic performance (see Levine, 2005 and references therein) provides evidence that deeper financial markets foster growth. Very little attention was paid to the effects of financial development on income inequality. Two recent contributions (see Beck et al., 2007 and Clarke et al., 2006) show that higher availability of credit to the private sector tends to reduce income inequality. My results are consistent with this evidence, but also provide a novel insight suggesting that equity-like finance may increase inequality.

The remainder of the paper is organized as follows. Section 2 presents the model of entrepreneurial choice and shows how earnings and the degree of risk taking vary in equilibrium with investor protection. In Section 3, I characterize analytically and by means of numerical solution how income inequality responds to changes in investor protection and financial structure. Section 4 briefly discusses some reasons why investor protection may be imperfect and vary across countries. Section 5 provides empirical evidence from up to sixty-seven countries over the period 1976–2004 supporting the main results of the model, and Section 6 concludes.

2. The model

In this section, I propose a simple static model where risk-averse agents, heterogeneous in their entrepreneurial ability, have to choose between safe and risky projects and need external finance. Asymmetric information in the financial market generates a moral hazard problem that makes it too costly for some entrepreneurs to finance risky projects. Investor protection may alleviate moral hazard, thereby easing the conditions of access to finance and promoting both risk sharing and risk taking.

4 Note that, if investor protection affected inequality among the poor in a different way and through another channel, my estimates would suffer from attenuation bias.

5 Evidence that more productive firms pay higher wages is provided, among others, by Oi and Idson (1999).

6 The financial friction may consist in the non-observability of ex-post outcomes as in Banerjee and Newman (1993) and Galor and Zeira (1993), or of effort as in Aghion and Bolton (1997).

7 Similarly to this paper, in Acemoglu and Zilibotti (1999) income inequality is generated by managerial incentives. Antunes et al. (2008) propose a quantitative model with heterogeneity in wealth and ability where weak financial institutions hinder growth and raise income inequality. Yet, both papers abstract from firm-specific idiosyncratic risk.
2.1. Set up

Consider a small open economy populated by a continuum of risk-averse agents whose preferences are represented by

\[ V = E[u(c)], \]

where \( E \) is the expectation operator, \( c \) is consumption of a homogeneous good, and the utility function satisfies the following properties: \( u' > 0, u'' < 0 \) and \( \lim_{c \to -\infty} u'(c) = \infty \). The price of the consumption good is determined on the world market and is assumed to be constant and normalized to 1.

Agents are heterogeneous in their ability, denoted by \( \pi \in [0, 1] \), drawn from a continuously differentiable distribution \( G(\pi) \), but have no wealth endowment. They work as self-employed entrepreneurs and can choose to produce the consumption good using either a safe or a risky technology. The former generates a constant level of production which is independent of ability:

\[ y^S(\pi) = y^S = B. \]

The performance of the risky technology depends on entrepreneurial ability. For simplicity, I assume that ability only affects the probability of success and not the quantities produced. In particular, an entrepreneur with ability \( \pi \) generates output

\[ y(\pi) = \begin{cases} y^H = A & \text{with probability } \pi \\ y^L = \phi A & \text{with probability } 1 - \pi \end{cases} \]

where \( \phi \in (0, 1) \) and \( y^H \) and \( y^L \) denote production in the good and bad state respectively. This implies that a firm’s expected cash flow is \( [\pi + (1 - \pi)]\phi A \), which is increasing in ability. Success is i.i.d. within each ability group, hence there is no aggregate risk and total production of entrepreneurs with ability \( \pi \) equals \( g(\pi)[\pi + (1 - \pi)]\phi A \), where \( g(\pi) \) is the density of the ability distribution.

Each entrepreneur, regardless of her technological choice, has to pay a fixed entry cost of 1 that can be covered by raising funds on the international financial market. Here, I assume that investors are atomistic and risk-averse, and have perfect information about the risk-free interest rate (\( r \), normalized to 1), production technologies \((B, A, \phi)\), the individual ability of each entrepreneur (\( \pi \)) and her technological choice, but cannot observe final output (\( y \)).

The financial contract entails the commitment of the firm to repay after production a certain amount, possibly contingent on the reported realization of output. Given that ex-ante information is perfect, entrepreneurs using the safe technology are known to generate with after production a certain amount, possibly contingent on the reported technological choice, but cannot observe atomistic and risk-averse, and have perfect information about the state respectively. This implies that a risky entrepreneur may misreport the output realization and pretend to be in the bad state.

2.2. Solution

To find the equilibrium, I proceed backwards and start by solving for the optimal financial contract, first under efficient markets, and then with asymmetric information for a given level of investor protection. Next, I characterize the technological choice, and finally I show how the equilibrium varies with the degree of investor protection. For simplicity, I assume that \( \phi A < B - A \), which implies that the risky technology is on average more productive than the safe one for some entrepreneurs.

2.2.1. Optimal financial contract: efficient markets

If investors could perfectly observe the cash flow of a firm, misreporting would be impossible, and hence the optimal financial contract would simply maximize the expected utility of a risk-averse borrower with success probability \( \pi \) subject to the participation constraint of a perfectly diversified lender. Thus, investors would provide entrepreneurs with full insurance in exchange for an expected gross return equal to the safe rate:

\[ w^H(\pi) = w^L(\pi) = w^B(\pi) = \pi A + (1 - \pi)\phi A - 1, \]

where \( w^B(\pi) \) denotes the efficient, first-best, payoff of a risky entrepreneur with ability \( \pi \), which is equal to her expected cash flow, increasing in ability, minus the risk-free interest rate repayment.

2.2.2. Optimal financial contract: asymmetric information

If the cash flow cannot be observed by outsiders, entrepreneurs may have an incentive to misreport, and hence the first-best contract is incentive compatible only if investor protection drives the gain from misreporting down to zero, which happens only for \( p = 1 \).

If investor protection is not perfect (0 \( \leq p < 1 \)), first-best contracts are not incentive compatible since entrepreneurs in the good state would gain \( (1 - p)\phi (1 - \phi)A > 0 \) from misreporting. Due to risk aversion, agents want to minimize the difference between payoffs in the two states. However, this is possible only up to the point where both the incentive-compatibility constraint and the investors’ participation constraint hold with equality, so that the optimal financial contract satisfies:

\[ w^H(\pi) = w^L(\pi) + (1 - p)(1 - \phi)A. \]  
\[ w^L(\pi) = \phi A - 1 + p \phi (1 - \phi)A. \]

Note that both payoffs are increasing in entrepreneurial ability since they are correlated to expected cash flow, and that \( w^H(\pi) > w^B(\pi) > w^L(\pi) \) is needed to offset the temptation to misreport.

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8 See Fairlie and Robb (2003) and Schiller and Crompton (1997) for empirical studies on the determinants of entrepreneurial success, mainly among small firms.

9 Ability can be considered as playing a twofold role. It enhances the chance of success in risky enterprises, as assumed in the model. But it may also raise productivity regardless of the technological choice. In the next section, I argue that this second effect can be introduced into the model without affecting the qualitative results. The relevant assumption is that ability is more important in the risky sector, which seems realistic.

10 See Castro et al. (2004) for a similar way of modeling the optimal financial contact.

11 Note that a pooled portfolio of loans to the i.i.d. entrepreneurs with ability \( \pi \) yields a safe return, so that investors face no risk. It follows that the participation constraint is the same as in the case of competitive, risk-neutral financiers with a single borrower with ability \( \pi \).

12 In the interest of space, the analytical characterization is reported in the online appendix (http://bonfiglioli.iiae-csic.org/ineqfin_jde_app.pdf).
2.2.3. Technological choice

Entrepreneurs with ability $\pi$ will choose the risky technology if it gives at least the same expected utility as the safe one. Since the state-contingent payoffs from the risky project in Eqs. (1) and (2) increase with ability ($\pi$), while the difference between them is independent of it, expected utility, is also increasing with ability. Expected utility of a safe entrepreneur, instead, is constant. This implies that the solution to the technological choice problem features a threshold ability level $\pi^*$ such that the agents with ability higher than $\pi^*$ choose the risky technology while those with lower ability choose the safe project. This property is formalized in Lemma 1.

Lemma 1. There exists a unique $\pi^*$ such that $\forall \pi \geq \pi^*$, $mu(w^f(\pi)) + (1-\pi)u(w^s(\pi)) \geq u(w^s)$, and $[w^f(\pi)^,\pi^*]$ is the optimal and incentive compatible financial contract.

Proof. See the Appendix.

Note that, due to risk aversion, the expected payoff of risky entrepreneurs with ability equal to the threshold, $\pi^*w^f(\pi^*) + (1-\pi^*)w^s$, must be higher than the safe earnings, $w^s$.

2.2.4. Investor protection and the equilibrium

To study how investor protection affects the equilibrium of the model, I first focus on the optimal financial contract and then on technological choice. The optimal payoffs in (1) and (2) are, respectively, decreasing and increasing in investor protection, and hence the wedge between them is decreasing in $\pi$. This happens because, when the unit cost of hiding cash flow is high, the temptation to misreport is low and hence a smaller deviation from the first best of state-invariant payoffs is enough to achieve truth-telling.

Notice, moreover, that for $\pi = 0$, the financial contract is akin to debt, implying a constant repayment equal to the risk-free rate, and the entire risk is borne by the entrepreneur. As investor protection increases, investors bear more and more risk, which makes the financial contract closer to equity.

Since equilibrium earnings and expected utility are functions of investor protection and the technological parameters, also the threshold ability $\pi^*$ varies with $\pi, A, \phi$ and $B$, as formalized in Lemma 2.

Lemma 2. The threshold ability $\pi^*$ is a decreasing function of investor protection ($\pi$) and technological level of the risky sector ($A$); it increases with the riskiness of the risky technology (inverse of $\phi$) and the productivity of the safe one ($B$):

$$\frac{\partial \pi^*}{\partial \pi} < 0; \quad \frac{\partial \pi^*}{\partial A} < 0; \quad \frac{\partial \pi^*}{\partial \phi} > 0; \quad \frac{\partial \pi^*}{\partial B} > 0$$

Proof. See the Appendix.

Intuitively, stronger investor protection allows entrepreneurs to better share risks with investors, thereby raising the expected utility drawn from the risky project. Since this is increasing in ability, a rise in $\pi$ makes the risky technology preferable to the most able among safe entrepreneurs, i.e. reduces threshold ability $\pi^*$. Higher $A$ implies that productivity of the risky project increases, and more so in the good state. As a consequence, payoffs rise but also the wedge between them. Since the overall effect on expected utility is positive, a more productive technology reduces the threshold ability. The parameter $\phi$ captures the riskiness of the risky technology (maximum risk for $\phi = 0$, no risk for $\phi = 1$), and also affects its expected productivity. If it grows, it makes the risky option preferable to the most able among safe entrepreneurs because it reduces the volatility of state-contingent earnings and increases their expected value, thereby raising expected utility. Trivially, higher productivity in the safe industry, $B$, makes it more attractive, thereby inducing the least able among risky entrepreneurs to adopt the safe technology, which rises the threshold $\pi^*$.

The threshold also depends on risk aversion, since the curvature of the utility function affects expected utility for given probability of success ($\pi$, i.e., ability). For instance, under CRRA utility with relative risk aversion equal to or higher than one, the risky technology is not run in equilibrium ($\pi^* = 1$) as long as the earnings of the most able in the bad state are non positive, i.e., for $\pi \leq (1 - \pi A)/[(1 - \phi)A]$, which is positive for $\phi A < 1$. Alternatively, when risk aversion is sufficiently low, there may be entrepreneurs choosing the risky project even in the absence of investor protection ($\pi = 0 = \pi^* < 1$).

Note that safe entrepreneurs are indifferent between raising external finance through standard debt and equity-like contracts. Risky firms instead can only be started if financed through equity-like instruments. This implies that, in the presence of an infinitesimal cost of signing the optimal financial contract, safe entrepreneurs choose debt, and hence the financial structure of the economy, described by the weight of equity in total external finance, is captured in the model by the size of the risky sector, which is denoted as $\eta \equiv 1 - G(\pi^*)$ for empirical purposes. This measure is decreasing in the threshold ability and increasing in investor protection, and varies with technological parameters.

Corollary 1. The weight of equities in total external finance, $\eta$, is decreasing in the threshold ability ($\pi^*$), the riskiness of the risky technology (inverse of $\phi$) and the productivity of the safe one ($B$):

$$\frac{\partial \eta}{\partial \pi} \leq 0, \quad \frac{\partial \eta}{\partial \phi} \geq 0, \quad \frac{\partial \eta}{\partial B} \geq 0;$$

it is increasing in investor protection ($\pi$) and technological level of the risky sector ($A$):

$$\frac{\partial \eta}{\partial \pi} \geq 0, \quad \frac{\partial \eta}{\partial A} \geq 0.$$

Proof. See the Appendix.

Finally, as proved in Lemma 3, average entrepreneurial earnings,

$$\mathbb{E}[w] = G(\pi^*)w^f + \int_0^{\pi^*} \mathbb{E}[w|\pi]g(\pi)d\pi,$$

and hence the average income of the economy, are increasing in investor protection.

Lemma 3. Average entrepreneurial earnings, $\mathbb{E}[w]$, are increasing in investor protection, $\pi$.

$$\frac{\partial \mathbb{E}[w]}{\partial \pi} \geq 0.$$ 

Proof. See the Appendix.

Intuitively, an increase in the cost of misreporting, $\pi$, gives risky entrepreneurs better insurance, thereby encouraging more agents to choose the risky technology with a higher payoff. This implies that also aggregate production and welfare increase with investor protection.\footnote{In the next session, I discuss alternative assumptions under which perfect investor protection may not be socially optimal or politically viable.}

3. Evaluating income distribution

In this section, I study how investor protection affects income inequality. I consider measures of inequality accounting for the entire distribution of income such as the variance and the Gini coefficient, and show analytically and by means of numerical solution how
these respond to changes in investor protection and in the financial structure. Intuitively better investor protection affects inequality through two channels: by reducing the gap between state-contingent earnings of entrepreneurs, it reduces income differentials among agents with the same ability, \( p = n \), and hence overall inequality. I refer to this as the “risk sharing” effect. On the other hand, a drop in the threshold ability \( n^* \) implies that a mass \( g(n^*) \) of agents switches to state-contingent earnings, which is likely to translate into higher inequality. I refer to this as the “risk taking” effect.

3.1. Analytical results

I evaluate analytically the strength of the two channels and the overall effect of investor protection on inequality by focusing on the variance of the earnings distribution, whose derivative with respect to \( p \) is:

\[
\frac{d\text{Var}}{dp} = -2(1-p)(1-\phi)^2 A^2 \int \left[ \eta(1-\eta)g(n)dn + \frac{\partial \eta}{\partial p} \frac{d\text{Var}}{dp} dn \right].
\]

The first term captures the “risk sharing” effect of investor protection, which tends to reduce inequality and is stronger the larger is the mass of risky entrepreneurs, i.e. the lower the threshold ability \( n^* \), as analytically proven in Lemma 4.

**Lemma 4.** For a given threshold ability of risky entrepreneurs \( n^* \), better investor protection reduces the variance of the earnings distribution:

\[
\frac{\partial \text{Var}}{\partial p} \big|_{n^*} \leq 0.
\]

**Proof.** See the Appendix. □

The second term in (3) captures the “risk taking” effect, whereby investor protection may increase inequality. This happens to the extent that the marginal risky entrepreneurs make the earnings distribution more dispersed, that is if the earnings of agents with ability \( n^* \) differ enough from the average, as specified in Assumption 1.

**Assumption 1.** The threshold ability in the absence of investor protection, \( n^*_{p=0} \), satisfies:

\[
\begin{align*}
\frac{n^*_{p=0}}{n^*_{p=1}} &> 0, \quad \text{with} \\
\psi &\equiv G(n^*_{p=1}) + \int_{n^*_{p=0}}^{1} \frac{n g(n)dn}{2} + \frac{n^*_{p-1}}{2}.
\end{align*}
\]

The following analytical results (Lemma 5, and Propositions 1 and 2) are obtained under Assumption 1.

**Lemma 5.** There exists at least one \( p \in [0,1) \) such that the variance of earnings is increasing in the threshold ability:

\[
\frac{d\text{Var}}{dn} > 0.
\]

**Proof.** See the Appendix. □

The overall impact of investor protection on income inequality depends on the strength of the “risk sharing” and “risk taking” effects. In particular, when the cost of misreporting, and hence the size of the risky sector, is close to its maximum, the “risk taking” effect is weak, since the marginal entrepreneurs do not add much to the existing mass of risky firms. The “risk sharing” effect is instead very strong since it applies to nearly all potential risky entrepreneurs, and hence an increase in \( p \) reduces inequality. When investor protection is very low, there is a small mass of risky firms in the economy and hence the “risk taking” effect is stronger at the margin, while the “risk sharing” effect is weak since it applies to few entrepreneurs. It follows that inequality may be a non-monotonic function of investor protection, as proven in Proposition 1.

**Proposition 1.** The variance of earnings is increasing in investor protection for low values of \( p \) and decreasing for high \( p \):

\[
\lim_{p \to 0} \frac{d\text{Var}(w)}{dp} > 0 \quad \text{and} \quad \lim_{p \to 1} \frac{d\text{Var}(w)}{dp} < 0.
\]

**Proof.** See the Appendix. □

Since, from Corollary 1, the relative weight of equity-like instruments in overall external finance, \( \eta \), is continuous and monotonic in investor protection, also the relationship between \( \eta \) and income inequality follows the non-monotonic pattern of Proposition 1, to the extent that the variation in financial structure is driven by changes in investor protection.

**Proposition 2.** For given parameters \( (A, \beta, \phi) \) and ability distribution \( G(n) \), the variance of earnings is increasing in the relative weight of equity-like instruments in overall external finance, \( \eta \equiv 1 - G(n^*) \), for low values of \( \eta \) and decreasing for high \( \eta \):

\[
\lim_{\eta \to \eta_{p=0}} \frac{d\text{Var}(w)}{d\eta} > 0 \quad \text{and} \quad \lim_{\eta \to \eta_{p=1}} \frac{d\text{Var}(w)}{d\eta} < 0.
\]

**Proof.** See the Appendix. □

After characterizing analytically the main forces driving the relationship between investor protection and inequality, it is useful to pause and consider whether changing some assumptions would alter the results. First, ability is assumed to affect productivity only when the entrepreneur chooses the risky technology. If this assumption was relaxed, the qualitative results are likely to hold as long as the expected marginal return to ability is lower in the safe than in the risky sector. Intuitively, this would raise the degree of inequality under \( p = 0 \), and may weaken the “risk taking” effect, though it does not seem to change the forces giving rise to the non-monotonic relationship between investor protection and inequality.\(^{15}\)

The financial friction in the model is given by ex-post asymmetric information about entrepreneurial outcomes, generating a moral hazard problem. It may be argued though that credit markets are also subject to ex-ante asymmetric information on the quality of the borrowers, which may give rise to adverse selection. If in addition ability was ex-ante unobservable, investors would have to induce entrepreneurs to truthfully reveal it by offering them a menu of financial contracts such that agents with a certain level of ability would be worse off declaring a higher \( n \), since earnings are proportional to it. Therefore, the degree of risk sharing would be decreasing in ability. This may weaken both the “risk sharing” and the “risk taking” effect. While adding this friction to the model would complicate the analytical characterization, it does not seem to qualitatively affect the forces behind the non-monotonic relationship between investor protection and inequality, since the risk taking effect would

\(^{14}\) Notice that this condition is always satisfied if the cashflow in the bad state is non-positive, i.e., \( \delta \eta \leq 1 \).

\(^{15}\) What may change is the parameter restriction in Assumption 1, but not the fact that the “risk taking” effect is more likely to dominate at low levels of investor protection and the “risk sharing” effect becomes stronger as \( p \) increases.
still be stronger at low levels of investor protection and risk sharing would dominate at high levels.

Finally, the assumption of fixed capital requirement implies that entrepreneurs only decide whether to take risk or not (extensive margin), but not how much risk to take (intensive margin). In reality, the degree of entrepreneurial risk taking varies along both margins, and it is therefore meaningful to wonder how the results would change if also the intensive margin was introduced in the model. Castro et al. (2004) show, within a similar framework, that investor protection may have an ambiguous effect on the intensive margin of risk taking (i.e. continuous capital investment in the risky technology). Hence, it is not a priori obvious whether introducing the intensive margin would strengthen or weaken the “risk taking” effect. Moreover, the presence of the intensive margin is unlikely to alter the “risk sharing” effect.

3.2. Numerical solution

I now move to numerical solution to compute alternative measures of inequality and study how they vary with investor protection, p. First, I solve the model under different riskiness parameters to generate variation in the threshold ability \( \pi^* \) for given \( p \). Based on the earnings distributions derived numerically, I then compute two indicators of inequality, the variance and the Gini coefficient, and plot them against investor protection. Note that this numerical solution has no quantitative aim. All details are given in the online appendix.

Fig. 1 shows that both measures of inequality may be non-monotonic in investor protection. Note first that in the simulation for low risk, nearly all entrepreneurs choose the risky technology independently of investor protection, so that Assumption 1 is violated and the “risk taking” effect is not at work. Only in this special case, inequality is unambiguously decreasing in \( p \). When Assumption 1 holds, for higher riskiness, inequality is increasing in investor protection when \( p \) is sufficiently low, and becomes decreasing when \( p \) gets high enough. The “risk sharing” channel is effectively illustrated by the downward-sloping lines for the low-risk technology, which exhibit a sharp decline in inequality associated to an increase in \( p \) when nearly all firms adopt the risky technology independently of investor protection. The “risk taking” effect is instead captured by the initial upward-sloping part of the lines for the middle and high risk cases, and by the fact that, for any value of \( p \), inequality is higher when the riskiness is lower and hence risk taking is larger.

4. Optimality and political viability of investor protection

In the model, perfect investor protection is ex-ante Pareto efficient, since it raises both aggregate income and the expected utility of all agents. This is due to the absence of costs, which implies that the level of investor protection that both the social planner and individual agents would choose is \( p = 1 \). In the real world however, we do not observe perfect investor protection, and reforms aimed at improving it may be opposed by different interest groups in the society, as argued by the literature on the political determinants of financial institutions (see Caselli and Gennaioli, 2008; Pagano and Volpin, 2005; Perotti and von Thadden, 2006; Rajan and Zingales, 2003).

Assuming that enforcing investor protection entails a cost, \( c(p) \) with \( c”(p) > 0 \), e.g. given by the monitoring and judicial activities, would immediately imply that a benevolent social planner would choose imperfect investor protection. The reason is that the marginal value of investor protection,

\[
(1-\phi)\frac{\partial}{\partial \pi} (1-n) \int_{0}^{1} \left[ u(w'(\pi)) - u(w'(\pi)) \right] g(\pi) d\pi,
\]

tends to zero for \( p = 1 \). Moreover, if the cost has to be financed through uniform lump-sum taxation, even a socially optimal \( p < 1 \) could be politically difficult to implement because there would be a constituency against it. In particular, an increase in investor protection would be opposed by the least and the most able agents since they would bear the cost without enjoying enough benefit from risk sharing. In other words, the constituency against investor protection would be formed by the more productive, and ex-post richer, incumbents of the risky sector and the least able outsiders, which recalls the result in Pagano and Volpin (2006) that managers may form a coalition with workers to oppose the reform. Interestingly, if investor protection was chosen according to the preferences of a median voter who would always choose the safe project, the prevailing \( p \) would be zero!

In the model, the entry of new entrepreneurs in the risky sector does not affect the payoffs for the incumbents. If the safe technology was assumed to be employed to produce a homogeneous final good, while the risky one produced differentiated intermediate goods, entry would erode the profits of risky incumbents, thereby giving them an additional reason to oppose the reform, as suggested, for instance, by Rajan and Zingales (2003). Safe entrepreneurs, on the other hand, might benefit from the increased competition in the risky sector, and therefore switch in favor of better investor protection if this gain outweighs its cost.

The model also abstracts from wealth heterogeneity. If this was introduced, the implications for income inequality would become more complicated to derive. Yet, more insights may arise for the political economy of investor protection, because the composition of the constituencies considered above would also be affected by wealth. On the one hand richer agents, as entrepreneurs, do not benefit much from investor protection since safe returns from investment account for a larger part of their total income. On the other hand, as investors, they would benefit from the effect that investor protection might have on the interest rate.

5. Empirical analysis

In this section, I evaluate empirically the main theoretical predictions derived in Section 3. Since investor protection is generally determined by law, it is not expected to exhibit large variation across geographical areas or sectors within a country. Hence, cross-country data, possibly with time variation, seem more appropriate for empirical purpose. First, I assess the overall relationship between investor protection and income inequality on a cross-section using a time-invariant de jure indicator of investor protection and a general measure of income inequality. Next, I evaluate the theoretical mechanism and provide evidence from a wider cross-section and a panel that the weight of equity-like finance increases with investor protection (Corollary 1) and shares a non-monotonic relationship with inequality (Proposition 2). Moreover, I show that the main result holds even when considering only inequality at the top of the income distribution, and that risk taking, captured by firm entry, is positively correlated with inequality as in the model. Finally, I show that the results are specific to investor protection and financial structure, as postulated by the model, and do not apply to more general indicators of financial development.

16 This numerical solution has no quantitative aim. All details are given in the Appendix.
17 Recall that, as predicted by Lemma 2 the ability of the marginal risky entrepreneur, \( \pi^* \), is increasing in investor protection \( p \) and decreasing in technological riskiness. Alternatively, I could assume a CRRA utility function and let the risk aversion parameter vary. The results, available upon request, are analogous.

18 As shown in Bonfiglioli (2005), in a general equilibrium version of the model, investor protection would raise productivity and hence the interest rate.
5.1. Data

The first empirical task is to measure the main variables of interest: inequality and investor protection. In most of the analysis, I proxy the dependent variable, inequality, with the Gini coefficient of the income distribution from Dollar and Kraay’s (2002) database. This is a widely used measure and is available for a relatively large sample of countries and years. Although the theory proposed in the paper refers to entrepreneurs, who usually belong to the top percentiles of the income distribution, three arguments may justify the use of a general indicator of inequality. First, recent evidence from several countries shows that a large fraction of the variation in income inequality over the last two decades is explained by changes at the top of the distribution (see, among others, Atkinson et al., 2009 and Heathcote et al., 2010), which suggests that the effects of investor protection on inequality at the top of the distribution are likely to show up even on data for the entire population. Second, employees normally earn higher wages and are subject to higher employment risk when working in more productive and riskier firms. Hence the results obtained for entrepreneurs may be expected to trickle down to all workers. Finally, the model could be interpreted as one of occupational choice à la Kihlstrom and Laffont (1979), where each agent can either be a worker receiving a fixed wage or an entrepreneur facing risk. In this case, the implications on earnings inequality refer to the entire population.

Yet, to assess the robustness of my empirical results to the measure of inequality, I replicate part of the analysis using the data on top income percentiles collected by Alvaredo et al. (2011). Unfortunately, these data are available for a limited number of countries (23 in the data release of March 2011), though over a reasonably long time-span, which restricts my sample to 16 countries with 5-year observations from 1976 to 2004. Proxying inequality with the ratio of the average income of the top 1 and 0.1 per cent over the one of the top 10 per cent of the income distribution, I obtain the same results, in line with the model predictions.

As regards the main explanatory variable, I first consider a de jure measure of investor protection, i.e., the index of shareholder protection compiled by La Porta et al. (2006), that takes values between 0 (no protection) and 10 (maximum protection). This index is available for 49 developed and developing countries and has no time variation, which is its main limitation.

Next, I adopt an alternative approach and evaluate the predictions of the model in two steps. I first take to the data Corollary 1, arguing that the relative weight of equity in external finance should be a positive function of investor protection, and then Proposition 2, establishing the non-monotonic relationship between the indicator of financial structure and inequality. The advantage of this strategy is that it allows me to enlarge the cross-sectional dimension and to exploit the time variation, since data on inequality and financial structure are available for a large number of countries and years. In particular, I proxy the size of the stock market relative to overall external finance with the ratio of stock market capitalization over credit to the private sector, where the data on stock market capitalization and credit to the private sector as a ratio of GDP are taken from the 2009 update of the database on Financial Development and Structure by Beck et al. (2000). A preliminary data inspection lends graphical support to this two-step procedure. Consistently with the empirical evidence in La Porta et al. (2006), the plot in Fig. 2 suggests that better financial structure varies with other parameters, as summarized in Corollary 1. These variables may only affect quantitatively but not qualitatively the non-monotonicity of the relation between investor protection and inequality through financial structure, for instance by determining where its sign is inverted.

Fig. 1. Investor Protection and Income Inequality.
investor protection is associated to a larger relative size of the stock market.\textsuperscript{23} Fig. 3 plots instead five-year observations of the Gini against relative stock market size. Despite showing unconditional correlations only, it is suggestive of a non-monotonic relationship, as predicted by the model.\textsuperscript{24}

Finally, since risk taking is an important determinant of inequality in the model, it would be desirable to also control for it in the empirical analysis. I take data on firm entry as a proxy for the extensive margin of entrepreneurial risk taking and control for it in the specifications for inequality among top income levels. Entry is computed as the percentage annual growth rate in the number of establishments as reported by the UNIDO database. The main shortcoming with this control variable is the time span it covers.\textsuperscript{25}

Other control variables are human capital, proxied by the share of the percentage annual growth rate in the number of establishments as reported by the UNIDO database. The main shortcoming with this control variable is the time span it covers.\textsuperscript{25}

When combining the data sources for the main dependent and explanatory variables, I am left with two cross-sections of 47 and 67 countries in each sample are reported in the Appendix. Although data are available for up to 116 countries, observations start in the late 1970s for most countries in the sample, which makes the overlap with the Gini too limited for econometric analysis.

5.2. Cross-sectional estimates

First, I focus on the cross-section of 47 countries and estimate with Ordinary Least Squares the following equation for the overall effect of investor protection on inequality:

\[
\text{Gini}_i = \alpha_0 + \alpha_1 \text{IP}_i + \alpha_2 \text{IP}_i \cdot \text{HIGH} + \alpha_3 X_i + \varepsilon_i, 
\]

where \(\text{Gini}\) is the measure of income inequality, \(i\) is the country index, \(\text{IP}\) is the indicator of investor protection, \(\text{IP}_i \cdot \text{HIGH}\) is a dummy taking value one for \(\text{IP}\) above the median, \(X\) is a vector of control variables, and \(\varepsilon\) is the error term. Following the empirical literature on income inequality, I include in \(X\) the log of the real per capita GDP and its square to account for the Kuznets’ hypothesis, human capital, government expenditure to account for the degree of redistribution, and trade. All variables are expressed in period average for the period 1980–2000. The model predicts a non-monotonic relationship between investor protection and inequality, which is consistent with a positive \(\alpha_1\) and a negative \(\alpha_2\).

Table 1 reports the estimated coefficients. In column 1, I only control for investor protection and education and obtain a non significant \(\alpha_1\), suggesting that there is no clear correlation. As soon as I allow for non-linearity in investor protection, I obtain significant coefficients with the expected sign: positive \(\alpha_1\) and negative \(\alpha_2\). These results hold if I add the other controls, in columns 3 and 4. In column 5, the dummy capturing the non linearity accounts for observations of IP above the 60th percentile instead of the median. Although more imprecise, the coefficients maintain the expected signs. To correct for possible simultaneity, in columns 6 and 7, I regress the last available observation of the Gini on the same variables as in columns 2 and 3. The estimates are qualitatively and quantitatively very close to the ones for period averages. These results suggest that the relationship between investor protection and income inequality is non-monotonic in the way predicted by the model.

As a first step in the evaluation of the theoretical mechanism, I follow La Porta et al. (2006) and regress the ratio of stock market capitalization over total credit to the private sector, SM, on real per capita GDP and an index of efficiency of the judiciary system (\textit{eff jud}). I first estimate the equation with OLS and then with Two-Stages Least Squares instrumenting investor protection with dummies for legal origins. The results, reported in Table 2, exhibit positive and significant coefficients for investor protection both with OLS and 2SLS Instrumental Variables, which is in line with Corollary 1.

The second step is to consider the relationship between financial structure and inequality on a wider cross-section. In particular, I estimate the following equation

\[
\text{Gini}_i = \alpha_0 + \alpha_1 \text{SM}_i + \alpha_2 (\text{SM}_i)^2 + \alpha_3 X_i + \varepsilon_i, 
\]

and report the results in Table 3. The estimates suggest financial structure to be an important, yet so far overlooked, covariate of inequality. In particular the significant estimates of a positive \(\alpha_1\) and a negative \(\alpha_2\) are consistent with the model prediction. The fact that the results are robust to controlling for per capita GDP and its square reassures that the non-monotonic relationship between relative stock market size and inequality is not spuriously driven by the level of income of a country. Robustness to the inclusion of other controls in columns 4 and 8 also suggests that the results are not driven by redistributive policies or openness to trade, which may be correlated with financial structure. As in Table 1, to correct for a possible simultaneity, in columns 5–8, I regress the last available observation of the Gini on the same variables...
Table 1  

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|        | Note: the dependent variable is either SM=stock market capitalization as ratio of credit to the private sector or IP = index of investor protection, as specified. The regressors are: IP, LRGDP = log of real per capita GDP, EFF_JUD = index of efficiency of the judiciary and legal origins. Estimation is performed with Ordinary Least Squares and Two-Stages Least Squares. Robust standard errors are reported in brackets.

Table 2  

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| Note: the dependent variable is either SM=stock market capitalization as ratio of credit to the private sector or IP = index of investor protection, as specified. The regressors are: IP, LRGDP = log of real per capita GDP, EFF_JUD = index of efficiency of the judiciary and legal origins. Estimation is performed with Ordinary Least Squares and Two-Stages Least Squares. Robust standard errors are reported in brackets. *., **, and *** stand for 10, 5, and 1 per cent significance level. P-values are reported for the Sargan test of over-identification and the Wu-Hausman test of endogeneity. 

as in columns 1–4 and obtain estimates qualitatively and quantitatively very close to the ones for period averages. Back of the envelope calculations suggest that an increase in the relative size of the stock market should reduce inequality only after getting to a level (between 1.34 and 1.53) that only a few countries have reached in the sample.

5.3. Panel estimates

Next, I exploit the time-series variation in the data for both financial structure and inequality, and estimate with least squares the following equation:

\[ \text{Gini}_{it} = \beta_0 + \beta_1 \text{SM}_{it} + \beta_2 (\text{SM}_{it})^2 + \beta_3 X_{it} + \nu_{it}, \] (5)

where time subscripts refer to non-overlapping 5-year periods between 1976 and 2000, all regressors are the same as described above, and \( \nu_{it} \) is the error term. I estimate Eq. (5) both considering \( \nu_{it} \) as a random effect, thereby exploiting both time and cross-sectional variation, and under the assumption that \( \nu_{it} = \eta_i + \epsilon_{it} \) where \( \eta_i \) is the country fixed effect. In the second case, the link between financial structure and inequality is identified out of within-country variation. In both cases, the reported standard errors are clustered by country and robust. A positive estimate for \( \beta_1 \) and a negative one for \( \beta_2 \) would be consistent with the model prediction that an increase in the weight of stocks in the financial structure tends to raise inequality until it becomes high enough so that the sign of the relationship changes.

The results are reported in Table 4. The first two rows tend to confirm the result of Table 3, that inequality is non-monotonic, as suggested by the model, in the relative size of the stock market, although the positive estimate for \( \beta_1 \) is now significant even when I do not control for the quadratic term. This pattern is robust to adding the other controls. The regressions in columns 5 and 10 suggest that the results are not sensitive to the exclusion of Ghana, which appears as an outlier in Fig. 3. Notice that the results of positive \( \beta_1 \) and, especially, negative \( \beta_2 \) hold stronger when the coefficients are estimated with random effects. This makes the evidence more consistent with the predictions of the model, because the cross-sectional variation in SM, accounted for in this specification, is more likely to be generated by differences in investor protection than time-series changes.

The evidence presented so far is obtained using a broad measure of inequality, based on the entire income distribution, while it may be argued that the model applies to entrepreneurs who are more likely to belong to the top end of the income distribution. I address this concern by estimating Eq. (5) for two indicators of income inequality among the rich, such as the ratio of the average income of the top 1 (or 0.1) over the top 10 per cent of the income distribution. Note that data availability is limited to a maximum of 16 OECD countries, observed between 1976 and 2004. The results, reported in Table 5, are consistent with the ones obtained for the Gini coefficients. Using the same restricted sample of OECD countries I am also able to account for the role of risk taking, which is what drives the positive effect of investor protection on inequality in the model. In particular, in columns 3 and 6–8, I add to the specification the annual growth rate of establishments, as a proxy of firm entry, capturing the extensive margin of risk taking. Consistently with the theory, the estimates for entry are positive and tend to reduce the size and significance.
of the linear coefficients for relative stock market size, suggesting that its positive correlation with inequality is driven by a higher exposure to risk.

Finally, note that the evidence of a non-monotonic relationship between investor protection, financial structure, and income inequality, reported in this section, is specific to investor protection and financial structure, as postulated by the model, and does not generalize to other, more general, measures of financial development, as shown in the online appendix.

6. Conclusions

This paper provides theoretical and empirical support for a systematic relationship between investor protection, financial structure, and income inequality. While there are contributions addressing the effects of investor protection on financial structure and economic growth through risk sharing and risk taking, little attention has been paid to the implications for income distribution. To fill this gap, I develop a simple static model with risk-averse agents, heterogeneous in their ability, that can produce using either a safe or a risky technology. I assume that entrepreneurs have to borrow funds in order to start their business, and that there are financial frictions, arising from the non-observability of a firm’s cash-flow to investors.

In this framework, I study how investor protection, by alleviating financial frictions, affects optimal financial contracts, the technological choice of agents with different ability and the distribution of their earnings. Better investor protection affects income inequality in two opposite ways. By improving risk sharing between entrepreneurs and financiers, it reduces income volatility. On the other hand, by inducing more agents to choose the risky technology, it may increase the dispersion of the earnings realizations. The first, “risk sharing”, effect reduces inequality, while “risk taking” tends to raise it. The overall impact of investor protection on inequality is shown to be non-monotonic. In particular, the “risk taking” effect dominates at low levels of investor protection.

Table 3

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Note: The dependent variable is the Gini coefficient of the income distribution. The regressors are: IP = investor protection, IP_HIGH = IP*dummy for IP>median, SM = stock market capitalization as ratio of credit to the private sector, School = share of people above 25 years with completed secondary education, LRGDP’2 = log of per capita GDP (squared), GOV = government expenditure/GDP, TRADE = (import + export)/GDP. Estimation is performed with OLS. Robust standard errors are reported in brackets. *, **, and *** stand for 10, 5, and 1 per cent significance level.

Table 4

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Note: the dependent variable is the Gini coefficient of the income distribution. The regressors are: SM = stock market capitalization as ratio of credit to the private sector, School = share of people above 25 years with completed secondary education, LRGDP’2 = log of real per capita GDP (squared), GOV = government expenditure/GDP, TRADE = (import + export)/GDP. Estimation is performed with Least Squares with random effects (columns 1-5) and country fixed effects (columns 6-10). Columns 5 and 10 are estimated on the sample without Ghana. Robust standard errors are clustered by country and reported in brackets. *, **, and *** stand for 10, 5, and 1 per cent significance level.
and is outweighed by “risk sharing” when investor protection is high. In the empirical section, I provide evidence from a cross-section of up to sixty seven countries and a panel of up to fifty-eight countries over the period 1976–2004 that is consistent with the main theoretical predictions.

The model is deliberately kept simple to emphasize the mechanism linking investor protection to income inequality. It follows that its implications for economic performance and welfare may appear simplistic: aggregate income increases with investor protection due to risk taking, and welfare increases due to higher output and better risk sharing. Yet, an interesting insight is that investor protection, I characterize π as implicit function of p,

\[ V^p(\pi^*) = V^p \quad \forall \pi > \pi^* \]

and \( p \) such that \( V^p(\pi^*) = V^p \) and \( \forall \pi > \pi^* \), \( m_u(w^p(\pi)) + (1 - \pi)u(w^p(\pi)) > u(b) \).

**Lemma 2.** To prove that the threshold ability is decreasing in investor protection, I characterize \( \pi^* \) as implicit function of \( p \),

**Lemma 1.** The assumptions that \( A > B + 1 > \phi A \) and \( u' > 0 \), imply that agents with \( \pi = 1 \) always choose the risky technology since \( V^p(1) = u(w^p(1)) = u(A - 1) > u(B) = V^p \); while agents with \( \pi = 0 \) always make the safe choice since \( V^p(0) = u(w^p(0)) = u(\phi A - 1) < V^p \). To prove that there exist a unique ability \( \pi^* \in (0,1) \) such that \( V^p(\pi^*) > V^p(\pi) \) for all \( \pi > \pi^* \), I just need to show that \( V^p \) is increasing in \( \pi \). The derivative of \( V^p \) w.r.t. \( \pi \) under the optimal financial contract is

\[ \frac{\partial V^p}{\partial \pi} = u'(\pi) - u'(\pi^*) + (1 - \phi A) m_u'(w^p(\pi)) \]

\[ + (1 - \pi)u'(w^p(\pi)) > 0 \]

since \( w^p(\pi) > w^p(\pi^*) \). Therefore, there exists a unique threshold ability \( \pi^* \) such that \( V^p(\pi^*) = V^p \) and \( \forall \pi > \pi^* \), \( m_u(w^p(\pi)) + (1 - \pi)u(w^p(\pi)) > u(b) \).

**Appendix A. Proofs**

**Lemma 1.** The assumptions that \( A > B + 1 > \phi A \) and \( u' > 0 \), imply that agents with \( \pi = 1 \) always choose the risky technology since \( V^p(1) = u(w^p(1)) = u(A - 1) > u(B) = V^p \); while agents with \( \pi = 0 \) always make the safe choice since \( V^p(0) = u(w^p(0)) = u(\phi A - 1) < V^p \). To prove that there exist a unique ability \( \pi^* \in (0,1) \) such that \( V^p(\pi^*) > V^p(\pi) \) for all \( \pi > \pi^* \), I just need to show that \( V^p \) is increasing in \( \pi \). The derivative of \( V^p \) w.r.t. \( \pi \) under the optimal financial contract is

\[ \frac{\partial V^p}{\partial \pi} = u'(\pi) - u'(\pi^*) + (1 - \phi A) m_u'(w^p(\pi)) \]

\[ + (1 - \pi)u'(w^p(\pi)) > 0 \]

since \( w^p(\pi) > w^p(\pi^*) \). Therefore, there exists a unique threshold ability \( \pi^* \) such that \( V^p(\pi^*) = V^p \) and \( \forall \pi > \pi^* \), \( m_u(w^p(\pi)) + (1 - \pi)u(w^p(\pi)) > u(b) \).

**Lemma 2.** To prove that the threshold ability is decreasing in investor protection, I characterize \( \pi^* \) as implicit function of \( p \),

\[ V^p(\pi^*, p) = V^p \]

and obtain its derivative with respect to \( p \) as

\[ \frac{\partial \pi^*}{\partial p} = -\frac{\partial V^p}{\partial p} \left( \frac{\partial V^p}{\partial \pi^*} \right)^{-1} \]

To prove that this derivative is negative, I just need to show that \( \frac{\partial V^p}{\partial p} \) is positive, since by Lemma 1 \( \frac{\partial V^p}{\partial \pi^*} > 0 \), I obtain

\[ \frac{\partial V^p}{\partial p} = \pi^* (1 - \pi^*) \left[ u'(w^p(\pi^*)) - u'(w^p(\pi^*)) (1 - \phi A) \geq 0 \right] \]

since utility is concave and \( w^p(\pi) \leq w^p(\pi^*) \), implying that \( \frac{\partial \pi^*}{\partial p} \leq 0 \).
Moreover, \( p \to \lim \frac{\partial \pi}{\partial p} = 0 \) since \( p \to \lim m^H(\pi) = p \to \lim m^W(\pi) = w^5 \). The threshold ability varies with the technological parameters \( A \), \( \phi \) and \( B \) as follows:

\[
\frac{\partial \pi}{\partial A} = \frac{\partial v^k}{\partial A} \left( \frac{\partial v^k}{\partial \pi} \right)^{-1} < 0; \quad \frac{\partial \pi}{\partial \phi} = \frac{\partial v^k}{\partial \phi} \left( \frac{\partial v^k}{\partial \pi} \right)^{-1} < 0; \quad \frac{\partial \pi}{\partial B} = \frac{\partial v^k}{\partial B} \left( \frac{\partial v^k}{\partial \pi} \right)^{-1} > 0
\]

Since

\[
\frac{\partial v^k}{\partial A} = \pi^* u \left( w^5_\theta \right) \phi + \pi p (1-\phi) + (1-p)(1-\phi) + (1-\pi^*) u \left( w^5_\theta \right) \phi + \pi p (1-\phi) \geq 0
\]

\[
\frac{\partial v^k}{\partial \phi} = (1-\pi^*) u \left( w^5_\theta \right) A \pi^* + (1-\pi^*) u \left( w^5_\theta \right) A (1-p) \pi^* > 0
\]

and

\[
\frac{\partial v^k}{\partial B} = u (B-1) > 0.
\]

**Corollary 1.** The derivative of \( \eta \) w.r.t. \( \pi^* \) is

\[
\frac{\partial \eta}{\partial \pi^*} = -g(\pi^*) \leq 0.
\]

The derivative of \( \eta \) w.r.t. \( \phi \) is

\[
\frac{\partial \eta}{\partial \phi} = \frac{\partial \pi^*}{\partial \phi} \frac{\partial \eta}{\partial \pi^*} \geq 0
\]

since \( \frac{\partial \pi^*}{\partial \phi} > 0 \) by Lemma 2. The derivative of \( \eta \) w.r.t. \( B \) is

\[
\frac{\partial \eta}{\partial B} = \frac{\partial \pi^*}{\partial B} \frac{\partial \eta}{\partial \pi^*} \leq 0
\]

since \( \frac{\partial \pi^*}{\partial B} < 0 \) by Lemma 2. The derivative of \( \eta \) w.r.t. \( p \) is

\[
\frac{\partial \eta}{\partial p} = \frac{\partial \pi^*}{\partial p} \frac{\partial \eta}{\partial \pi^*} \geq 0
\]

since \( \frac{\partial \pi^*}{\partial p} > 0 \) by Lemma 2. The derivative of \( \eta \) w.r.t. \( A \) is

\[
\frac{\partial \eta}{\partial A} = \frac{\partial \pi^*}{\partial A} \frac{\partial \eta}{\partial \pi^*} \geq 0
\]

since \( \frac{\partial \pi^*}{\partial A} < 0 \) by Lemma 2.

**Lemma 3.** The derivative of average entrepreneurial earnings w.r.t. \( \pi^* \) is

\[
\frac{\partial E[w]}{\partial \pi^*} = g(\pi^*) \left[ w^5 - \pi^* w^H(\pi^*) - (1-\pi^*) w^H(\pi^*) \right] \leq 0.
\]

since, by risk aversion and the definition of \( \pi^* \), \( w^5 \leq \pi^* w^H(\pi^*) - (1-\pi^*) w^H(\pi^*) \).

**Lemma 4.** To prove that the partial derivative of \( \text{Var}(w) \) w.r.t. \( p \) is higher the higher is the threshold ability \( \pi^* \), I obtain its derivative w.r.t. \( \pi^* \) and show that it is positive:

\[
\frac{\partial \left( \frac{\text{Var}(w)}{\partial \pi^*} \right)}{\partial \pi^*} = 2(1-p)(1-\phi)^2 A^2 \pi^* (1-\pi^*) g(\pi) \geq 0.
\]

**Lemma 5.** Derive the partial derivative of \( \text{Var}(w) \) w.r.t. the threshold, \( \pi^* \):

\[
\frac{\partial \text{Var}}{\partial \pi^*} = \frac{g(\pi^*) \left[ w^H(\pi^*) - w^H(\pi') \right]}{\left[ w^H(\pi^*) + w^H(\pi') - 2E[w] \right] + g(\pi') \left[ w^5 - w^H(\pi') \right] \left[ w^5 + w^H(\pi') - 2E[w] \right]}
\]

This is positive, \( \frac{\partial \text{Var}}{\partial \pi^*} > 0 \), iff

\[
\pi^* \left[ w^H(\pi^*) - w^H(\pi') \right] \left[ 2E[w] - w^5 \right] > 0,
\]

that is, since both \( 2E[w] - w^5 \) are positive, iff:

\[
\pi^* \left[ w^H(\pi^*) - w^H(\pi') \right] > 0.
\]

Substituting for \( E[w] \), \( w^H(\pi^*) \), \( w^5 \), and \( (1-\phi)A/(1-\phi) = \pi_{p-1} \), and multiplying and dividing by \( A(1-\phi) \) delivers, after further simplifications, the following condition:

\[
\pi^* \left[ w^H(\pi^*) - w^H(\pi') \right] \left[ 2E[w] - w^5 \right] > 0,
\]

which holds for the threshold \( \pi^* \) high enough relative to its first-best value, \( \pi_{p-1} \). Since the highest \( \pi^* \) is associated to \( p=0 \), condition for the existence of at least one value of \( p \) so that \( \frac{\partial \text{Var}}{\partial \pi^*} > 0 \) is that

\[
\pi_{p-0} > \frac{G(\pi^*) \pi_{p-1}^* + \int_0^1 ng(\pi) d\pi}{G(\pi^*) \pi_{p-1}^* + \int_0^1 ng(\pi) d\pi - (\pi^* \pi_{p-1}^*)/2} > 0
\]

**Proposition 1.** Compute the limit of \( \frac{\partial \text{Var}}{\partial \phi} \) at the extreme values of \( p \). For \( p \to 0 \), \( \pi^* \to \pi_{p-0} \) satisfying Lemma 5, so that \( \lim_{p \to 0} \frac{\partial \text{Var}}{\partial \phi} > 0 \), and

\[
\lim_{p \to 0} \frac{\partial \text{Var}}{\partial \phi} = -\pi_{p-0} (1-\phi) A \left[ u \left( w^H(\pi_{p-0}) \right) - u \left( w^H(\pi_{p-0}) \right) \right] < 0,
\]

hence:

\[
\lim_{p \to 0} \frac{d \text{Var}}{dp} = -\frac{\partial \text{Var}}{\partial \pi^*} \frac{\partial \pi^*}{\partial p} = \frac{\partial \text{Var}}{\partial \pi^*} > 0.
\]

For \( p \to 1 \), \( w^H(\pi) \to w^H(\pi) \) for any \( \pi \geq \pi^* \), and \( w^H(\pi') = w^H(\pi^*) = w^5 \), hence \( \frac{\partial \text{Var}}{\partial \pi^*} = 0 \) and \( \frac{\partial \text{Var}}{\partial \phi} = 0 \). To verify that it approaches zero from above, express \( \frac{\partial \text{Var}}{\partial \phi} \) in second order Taylor expansion in a neighborhood of \( p = 1 \):

\[
\lim_{p \to 1} \frac{d \text{Var}}{dp} = \frac{1}{(p-1)^2} \left[ \frac{d^2 \text{Var}}{dp^2} \right] \left( p(1-\phi)^2 A^2 \int_{p-1}^1 \pi (1-\pi) g(\pi) d\pi < 0 \right).
\]

**Proposition 2.** For given parameters and ability distribution, the derivative of the variance of earnings w.r.t. \( \eta \) can be expressed as:

\[
\frac{d \text{Var}}{d \eta} = \frac{\partial \left( \frac{\text{Var}(\pi^*)}{\partial \pi^*} \right)}{\partial \pi^*} \frac{\partial \pi^*}{\partial \eta} = \frac{\partial \text{Var}}{d \pi^*} \left( \frac{\partial \pi^*}{\partial \eta} \right)^{-1} = \frac{\partial \text{Var}}{d \pi^*} \left( \frac{\partial \pi^*}{\partial \eta} \right)^{-1}.
\]
As $p \to 0$, Proposition 1 and the non-degenerate ability distribution imply that:

$$\lim_{p \to 0} \frac{\partial \Var}{\partial \eta} = \frac{\partial^2 \Var}{\partial \eta^2} \left( g'(\eta) \frac{\partial \eta}{\partial p} \right)^{-1} \geq 0.$$ 

As $p \to 1$, $\frac{\partial \Var}{\partial \eta} \to 0$ since $\frac{\partial \eta}{\partial p} \to 0$, and hence

$$\lim_{p \to 1} \frac{\partial \Var}{\partial \eta} = (p-1) \left[ \frac{\partial^2 \Var}{\partial \eta^2} \left( \frac{\partial \eta}{\partial p} \right)^2 \right]_{p=1},$$

which is negative since $\frac{\partial^2 \Var}{\partial \eta^2} > 0$, $\lim_{p \to 1} \frac{\partial \Var}{\partial \eta} < 0$ from Proposition 1, $\frac{\partial \eta}{\partial p} > 0$ from Corollary 1, and $\lim_{p \to 1} \frac{\partial \Var}{\partial \eta} < 0$ since the threshold is convex as proven below.

Derive

$$\frac{\partial^2 \eta}{\partial p^2} = \frac{\partial^2 \eta}{\partial p^2} - \frac{\partial \eta}{\partial p} \frac{\partial \eta}{\partial p} \left( \frac{\partial \Var}{\partial \eta} \right),$$

This is conveniently expressed multiplied by the positive term $\frac{\partial \eta}{\partial p}$:

$$\frac{\partial^2 \eta}{\partial p^2} = \frac{\partial \eta}{\partial p} \left( \frac{\partial \Var}{\partial \eta} \right),$$

which is positive since $u'(w(\eta)) > u'(w(\eta'))$ and $u'(w(\eta')) - u'(w(\eta')) = u'(w(\eta'))$ by assumption, and $\frac{\partial \eta}{\partial p} \leq 0$.

References


Heston, Alan, Robert Summers and Bettina Aten, 2009 “Penn World Tables version 6.3.” Center for International Comparisons at the University of Pennsylvania.


http://g-mond.parisschoolofeconomics.eu/topincomes