

Investor Protection, Risk Sharing and Inequality*

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Abstract

This paper studies the relationship between investor protection, financial risk sharing and income inequality. In the presence of market frictions, better protection makes investors more willing to take on entrepreneurial risk while lending to firms. This implies lower cost of external finance and better risk sharing between financiers and entrepreneurs. Investor protection, by boosting the market for risk sharing plays the twofold role of encouraging agents to undertake risky enterprises and providing them with insurance. By increasing the number of risky projects, it raises income inequality. By extending insurance to more agents, it reduces it. As a result, income inequality grows with the size of the market for risk sharing until this market is big enough, then it declines. Empirical evidence from a cross-section of sixty-eight countries and a panel of fifty countries over the period 1976-2000, supports the predictions of the model and documents a new stylized fact on the link between stock market development and inequality.

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1 INTRODUCTION

A recent literature on law and finance has shown that investor protection plays a significant role in shaping the financial structure of an economy, by affecting the relative weights of equity and debt in external finance, with ambiguous effects on economic performance.¹ What has not been recognized though, 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. This paper investigates the link between investor protection, risk sharing and income inequality, both theoretically and empirically. It proposes a simple model where investor protection promotes risk sharing between financiers and entrepreneurs, thereby inducing more risk taking in the economy. Better insurance on individual earnings and wider risk taking, in turn, affect income inequality in opposite ways. The relationships predicted by the model are then confronted with the data.

To formalize these ideas, I construct a general equilibrium overlapping generation model where agents are risk averse and heterogeneous in their entrepreneurial ability. When young, agents face a choice between a safe and a risky technology, and entrepreneurial ability affects the probability of success in the risky project. Starting up a firm requires an initial investment, so that entrepreneurs need to borrow capital. Financial contracts are designed to be optimal and incentive compatible, and may make risk sharing between investors and entrepreneurs possible to a certain degree. Financial markets are subject to imperfections arising from the non-observability of output to financiers, but measures of investor protection can be adopted to amend these frictions. In particular, by promoting transparency, investor protection makes it costly for entrepreneurs to misreport their cash flow.² For instance, this cost can be thought of as the extra-compensation an advisory firm charges to certify a falsified book or to design financial operations to hide revenues from outside financiers. Better guarantees generate more confidence among investors, thereby making them more willing to bear risk and insure the entrepreneurs through lending. In turn, investors can spread the individual risk by holding diversified portfolios of risky activities. As a result, financial systems with stronger investor protection provide entrepreneurs with higher degrees of risk sharing. Finally, I rule out wealth heterogeneity, so that all inequality is due to idiosyncratic factors (ability), financial market conditions and income risk. Under these assumptions, better investor protection affects

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

²Investor 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.

income inequality in three ways. (i) It improves risk sharing, thereby reducing income volatility for a given mass of agents operating the risky technology; (ii) it raises the share of the population choosing the risky option, and therefore being exposed to earning risk; and (iii) it increases the reward to ability. (i) tends to reduce inequality, while (ii) and (iii) raise it.

The main result of the paper is that income inequality is a hump-shaped function of investor protection and of the size of the market for financial instruments that allow risk sharing (briefly, the market for risk sharing). Any improvement upon a low level of investor protection increases risk taking more than risk sharing, thereby driving inequality up. However, when investor protection is sufficiently high - and the market for risk sharing is big enough - any further improvement affects more risk sharing than risk taking, hence reduces income inequality.

This theoretical result is derived in terms of the size of the market for risk sharing, which cannot be measured directly. It can be argued, though, that entrepreneurs bear more risk the more leveraged they are, and thus the market for risk sharing is bigger, the higher the weight of equity relative to debt in the capital structure. Therefore, to evaluate empirically the predictions of the model, I follow Castro et al. (2004) in proxying the size of the market for risk sharing with the ratio of stock market capitalization over total credit to the private sector. In particular, I provide supportive evidence from a cross-section of sixty-eight countries and a panel of fifty countries, spanning from 1976 to 2000. First, the results show that income inequality grows with the ratio of stock market capitalization over total credit to the private sector, until this ratio is a little higher than one, than it declines. This is a new stylized fact in the literature on finance and inequality. Moreover, the data confirm that the relative size of the stock market increases with investor protection.

The contribution of this paper is related to three main strands of literature. Acemoglu and Johnson (2005), as well as La Porta et al. (1997, 1998, 1999, 2006), show that investor protection, and in general institutions aimed at contracting protection affect the financial structure of an economy by promoting the development of stock markets, but have unclear effects on economic performance. None of these studies has considered income inequality.

Many papers (see Levine, 2005 for a survey) have addressed, both theoretically and empirically, the link between financial development and macroeconomic performance in terms of GDP growth, investments, productivity and aggregate volatility.³ It is also shown that whether financial markets are more stock- or debt-based does not seem to matter for

³In particular, Acemoglu and Zilibotti (1997) show that development goes hand in hand with better risk diversification and is closely related to aggregate (GDP growth) volatility. The present paper does not feature aggregate volatility, rather it addresses income variability and dispersion across individuals.

macroeconomic performance, but no attention has been paid to the effects of financial structure on income distribution.

Theoretical contributions by Aghion and Bolton (1997), Banerjee and Newman (1993), Galor and Zeira (1993), Greenwood and Jovanovic (1990), and Piketty (1997), 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 efficient investments in the most productive activities.⁴ Over time, capital accumulation determines the dynamics of wealth and income. I depart from this approach in two main respects. First, I shift the focus from financial development, broadly defined as the overall availability of external finance to the private sector, to the development of instruments that allow agents not only to raise external finance but also to share risks at the same time. Second, I consider a different source of ex-ante heterogeneity (entrepreneurial ability), and propose a new mechanism translating differences in ability into income inequality that is independent of wealth accumulation. In the present paper, heterogeneity in productivity, the extent of risk sharing and the size of the risky sector ultimately determine the income distribution. Similarly, in Acemoglu and Zilibotti (1999) income inequality is not generated by ex-ante wealth heterogeneity, but by managerial incentives.

There are, to my knowledge, only two empirical assessments of the relationship between financial development and income inequality (Clarke et al., 2006 and Beck et al., 2007). As the theoretical works above, these papers are interested in the effects of overall external finance availability on income inequality, and both find evidence of a negative relationship. My contribution focuses explicitly on the impact of a particular form of finance, i.e. risk sharing instruments, on income inequality. Therefore, instead of taking a general measure of financial depth as a regressor for income inequality, I use the size of the stock market relative to total private credit, that seems well suited to account for the degree of risk sharing allowed by a financial system. The empirical results, supporting the theoretical predictions in this paper, document a new stylized: an increase in stock market size tends to raise income inequality, while a rise in credit availability reduces it. Not only is this consistent with the previous evidence on the negative effect of financial depth on income inequality, but it also provides a novel contribution by emphasizing the opposite role of equity-like finance in raising inequality.

The remainder of the paper is organized as follows. Section 2 presents the model and its

⁴The credit constraint can derive from the non-observability of physical output as in Banerjee and Newman (1992) and Galor and Zeira (1993), or effort as in Aghion and Bolton (1997) and Piketty (1997).

solution in partial equilibrium (a small open economy). In section 3, I study analytically and by means of numerical solution how income inequality varies with investor protection and the size of the market for risk sharing. I show in the appendix that the main results hold in general equilibrium (a closed economy). Section 4 shows that empirical evidence from a cross-section of sixty-eight countries and a panel of fifty countries over the period 1976-2000 supports the main results of the model. Section 5 concludes.

2 THE MODEL

2.1 SET UP

The model economy is populated by two-period overlapping generations of risk-averse agents. There is no population growth and the measure of each cohort is normalized to one. For simplicity, preferences are represented by the following utility function:

$$U_t = \log(c_t) + \beta \log(c_{t+1}).$$

Second-period utility is discounted at the rate $\beta \in (0, 1)$.

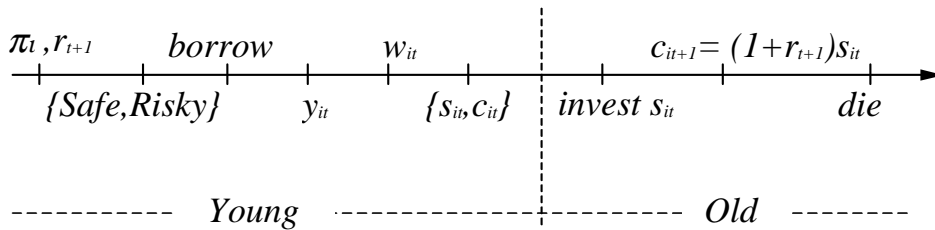


Figure 1: Timing of the model

At any time t , each young agent in ability group i is born with no wealth and ability $\pi_i \in [0, 1]$, drawn from a distribution $G(\pi)$. Each group has a density $g(\pi)$ of individuals. In the first period, agents work as self-employed entrepreneurs producing an intermediate good, and allocate their income among consumption and savings, $s(\cdot)$. When old, they invest their savings and consume all the proceeds before dying. When investing, they can choose between safe loans, yielding a return r_{t+1} , and portfolios of risky assets. There are no bequests.

2.1.1 Intermediate goods sector

Two production processes are available to each young agent: a safe and a risky one. Both technologies require a fixed unit investment. I assume that the risky activity, if successful, has higher returns than the safe one and that the probability of success depends on the ability of the entrepreneur.⁵ For simplicity, and without much loss of generality, I assume that ability only affects the probability of success and not the payoffs.⁶ In particular, production is given by:

$$x_{it} = \left\{ \begin{array}{ll} B & \text{for } i \text{ running } \textit{Safe} \text{ technology} \\ A \quad \text{with prob. } \pi_i & \\ \varphi A \quad \text{with prob. } 1 - \pi_i & \end{array} \right\} \text{ for } i \text{ running } \textit{Risky} \text{ technology,}$$

where $B < A$, $\varphi \in (0, 1)$ and success is i.i.d. within each group. It follows that there is no aggregate risk and total production of group i equals $g(\pi_i)B$ or $g(\pi_i)[\pi_i + (1 - \pi_i)\varphi]A$, depending on the technology, safe or risky, in use.

2.1.2 Final good sector

A homogeneous final good Y , used for consumption and investment, is produced by competitive firms using capital and intermediate goods. The intermediate goods produced by all types of agents are perfect substitutes in production. The aggregate technology has the following Cobb-Douglas form:

$$Y_t = K_{Yt}^\alpha X_t^{1-\alpha}, \tag{1}$$

where X_t is the total amount of intermediate goods, with a unit price of χ_t , K_{Yt} is the amount of capital employed in the final good sector and $\alpha \in (0, 1)$ is its share of production. Y_t is the numeraire.

2.1.3 Financial sector

Firms in both the final and the intermediate good sectors need to borrow capital from the old in order to produce. Information about technology (A, B, φ, α) , individual ability (π_i) , and the technological choice is public, but outside financiers cannot observe the outcome

⁵See Schiller and Crewson (1997), and Fairly and Robb (2003) for empirical studies on the determinants of entrepreneurial success, mainly among small firms.

⁶Ability can be considered as playing a twofold role. It enhances the chance of succeeding in risky enterprises, as assumed in the model. But it may also raise productivity regardless of the riskiness of projects. Introducing this second effect into the model would not affect the results.

of risky activities, x_{it} .

The financial contract is modeled as follows. Upon receiving capital, each firm commits to pay, after production, shares θ_t^h and θ_t^l of its cash flow in case of success and failure, respectively. Final good producers and young entrepreneurs using the safe technology are not subject to any risk, nor information asymmetry, so that they will repay a fixed amount for each unit of capital, corresponding to the safe interest rate, r_t . The repayment schedule facing young risky entrepreneurs is different. Once production has occurred, unlucky entrepreneurs of type i can only return the promised amount $\theta_{it}^l x_{it}^l \chi_t$. Successful entrepreneurs, instead, may misreport their realization of x_{it} and pay $\theta_{it}^l x_{it}^l \chi_t$, pretending to be in the bad state. However, I assume that measures of investor protection make misreporting costly. For every unit of hidden cash flow, the entrepreneur incurs a cost $p \in [0, 1]$. Since both ability and technology are common knowledge, either the entire amount $(x_{it}^h - x_{it}^l)$ or nothing is hidden, so that the payoff from misreporting is $(x_{it}^h - \theta_{it}^l x_{it}^l) \chi_t - p (x_{it}^h - x_{it}^l) \chi_t$. Truth-telling is rational as long as its value is at least equal to that of misreporting. Therefore, the financial contract $\{\theta_{it}^h, \theta_{it}^l\}$ must satisfy the incentive compatibility (IC) constraint:

$$v \left[\left(1 - \theta_{it}^h\right) x_{it}^h \chi_t, r_{t+1} \right] \geq v \left[\left(x_{it}^h - \theta_{it}^l x_{it}^l\right) \chi_t - p \left(x_{it}^h - x_{it}^l\right) \chi_t, r_{t+1} \right], \quad (\text{IC})$$

where $v[w_t, r_{t+1}]$ is the indirect utility of a young agent with a given income w_t and facing an interest rate r_{t+1} when old.

Financial contracts are set to maximize the agents' expected indirect utility, V_{it} , subject to the IC constraint and the outsiders' participation constraint. The latter requires that (atomistic) old agents be indifferent between lending to all firms of group i , and lending to safe firms.⁷ Thus, the payoffs from the risky technology are determined as the solution to the optimal financial contract problem:

$$\max_{\theta_{it}^h, \theta_{it}^l} V_{it} \equiv \left\{ \pi_i v \left[\left(1 - \theta_{it}^h\right) A \chi_t, r_{t+1} \right] + (1 - \pi_i) v \left[\left(1 - \theta_{it}^l\right) \varphi A \chi_t, r_{t+1} \right] \right\}, \quad (\text{P1})$$

subject to the incentive compatibility constraint:

$$v \left[\left(1 - \theta_{it}^h\right) A \chi_t, r_{t+1} \right] \geq v \left[\left(1 - \varphi \theta_{it}^l\right) A \chi_t - p (1 - \varphi) A \chi_t, r_{t+1} \right], \quad (\text{IC}')$$

and the old's participation constraint:

$$\pi_i \theta_{it}^h A \chi_t + (1 - \pi_i) \theta_{it}^l \varphi A \chi_t = r_t. \quad (\text{PC})$$

⁷See Castro et al. (2004) for a similar way of modelling the optimal financial contact.

Note that a pooled portfolio of loans to the i.i.d. firms of group i yields the LHS of (PC) with certainty, so that the old face no uncertainty.⁸

2.1.4 Equilibrium

Firms in the final good sector are perfectly competitive and maximize profits taking prices (r_t, χ_t) as given. Each young agent from group i has perfect foresight and chooses how much to save, $s(\cdot)$, and the technology to use (safe or risky), to maximize her expected utility. Thus, each of them solves the following program:

$$\max_{T \in \{Safe, Risky\}} V_{it}^T, \quad (P2)$$

where

$$\begin{aligned} V_{it}^{Safe} &= v(B\chi_t - r_t, r_{t+1}) \\ V_{it}^{Risky} &= \pi_i v \left[\left(1 - \theta_{it}^h\right) A\chi_t, r_{t+1} \right] + (1 - \pi_i) v \left[\left(1 - \theta_{it}^l\right) \varphi A\chi_t, r_{t+1} \right] \\ v(w_{it}, r_{t+1}) &= \log[w_{it} - s(w_{it}, r_{t+1})] + \beta \log[(1 + r_{t+1}) s(w_{it}, r_{t+1})] \\ s(w_{it}, r_{t+1}) &= \arg \max_{s_{it}} \{ \log(w_{it} - s_{it}) + \beta \log[(1 + r_{t+1}) s_{it}] \}. \end{aligned}$$

Here, w_{it} is realized income, i.e., $B\chi_t - r_t$ in case the safe technology is chosen, otherwise $(1 - \theta_{it}^h) A\chi_t$ and $(1 - \theta_{it}^l) \varphi A\chi_t$ in the good and bad state respectively. In other words, young entrepreneurs choose technology, given their individual ability π_i , factor prices r_t and χ_t , and the optimal financial contract $\{\theta_{it}^l, \theta_{it}^h\}$ which solves (P1).

To state the mechanism of the model in the clearest way, I first assume this to be a small open economy.⁹ Both capital and intermediate goods are internationally traded, so that r_t and χ_t are exogenously given from world markets, while the final good Y is non traded.¹⁰ Assuming that prices (r , χ and p) are constant, the economy is always in a steady-state and I can drop all the time indexes. It follows that aggregate domestic demand for the final good is $Y^D = (1 + r) \int_0^1 s(\pi) g(\pi) d(\pi) + \int_0^1 w(\pi) g(\pi) d(\pi)$.

Definition *Given the interest rate r , the intermediate good price χ , and the misreporting cost p , the equilibrium for this small open economy is defined as the set of savings, technological choices and financial contracts $\{s_i, T_i, \theta_i^l, \theta_i^h\}_{i \in [0,1]}$, such that each agent*

⁸It follows that the participation constraint is the same as in the case of risk-neutral financiers with a single type- i borrower.

⁹In the appendix, I endogenize the interest rate and the price of the intermediate good, and show that the main results continue to hold.

¹⁰This assumption is immaterial, since factor prices are equalized everywhere.

in group i solves (P1) -(P2); and factor employments $\{K_Y, X\}$ that maximize profits in the final good sector.

For simplicity, I assume that $\varphi A < \frac{r}{\chi} < B < A$. This implies that both safe and risky intermediate projects are run in equilibrium when $p > 0$; and when investor protection is absent, nobody chooses the risky technology.¹¹

2.2 SOLUTION

2.2.1 Final good sector

Profit maximization by competitive firms in the final good sector yields the following demand functions for capital and intermediates: $K_Y = \alpha \frac{Y}{r}$ and $X = (1 - \alpha) \frac{Y}{\chi}$. Market clearing requires $Y = Y^D$.

2.2.2 Young agents

Due to log-utility, the optimal saving function of each young agent is simply a constant fraction $(1 + \beta)^{-1}$ of her earnings. To solve for the optimal occupational choice (P2), an agent born in group i needs to know the payoffs from the risky technology. Therefore, I proceed backwards. First, I derive the optimal financial contracts $\{\theta_i^h, \theta_i^l\}_{i \in [0,1]}$ from (P1), under both perfect and imperfect investor protection. Next, I characterize the occupational choice, $\{T_i\}_{i \in [0,1]}$, given the optimal payoffs. Finally, I show how the equilibrium is affected by investor protection.

Optimal financial contract: efficient markets, $p = 1$

In this case, the payoff from hiding cash flow equals earnings in the bad state, $(1 - \theta_i^l) \chi x_i^l$. This means that there is no incentive for entrepreneurs to misreport, so that investors can act as if they had perfect information about x_i . Having a state-invariant income is the first best for risk-averse entrepreneurs. Since outside financiers behave as if they were risk-neutral and perfectly informed, they are willing to provide insiders with full insurance, given that the expected return equals the safe rate. Analytically, the first-order conditions for (P1) subject to (PC) require:

$$\begin{aligned} v'_h &= v'_l && \text{and} \\ (1 - \theta_i^h) &= [\pi_i + (1 - \pi_i) \varphi] - \frac{r}{A\chi}, \end{aligned}$$

¹¹This assumption also rules out risky debt. However, it can be shown that removing this restriction would not have any considerable effect on the results.

where v'_h and v'_l are the derivatives of $v[(1 - \theta_i^h) A\chi, r]$ and $v[(1 - \theta_i^l) \varphi A\chi, r]$ with respect to θ_i^h and θ_i^l , respectively. This means that (IC') holds with equality and $(1 - \theta_i^h) A\chi = (1 - \theta_i^l) \varphi A\chi$ (i.e., earnings of entrepreneurs are state invariant: $w_i^h = w_i^l$).

Optimal financial contract: general case, $0 < p < 1$

If investor protection is not perfect, state invariant earnings are not incentive compatible: entrepreneurs in the good state would be tempted to misreport x_i and enjoy the higher utility given by earnings $(1 - \varphi\theta_i^l) A\chi - p(1 - \varphi) A\chi$. Investors are aware of this and hence account for it when determining the repayments. In other words, both (IC') and (PC) must hold with equality, so that

$$\begin{aligned} w_i^l &= (1 - \theta_i^l) \varphi A\chi = \{[\pi_i + (1 - \pi_i)\varphi] - \pi_i(1 - p)(1 - \varphi)\} A\chi - r, \\ w_i^h &= (1 - \theta_i^h) A\chi = (1 - \theta_i^l) \varphi A\chi + (1 - p)(1 - \varphi) A\chi. \end{aligned}$$

The wedge between state-contingent earnings, i.e. the price for the temptation to misreport, is decreasing in investor protection. If the cost of hiding profits is high, temptation to misreport is low, as is its price in terms of distance from the first best of perfect insurance. Expected earnings for entrepreneurs are the same as under perfect investor protection, but expected utility is lower, due to risk aversion. Notice that for $p = 0$, the optimal financial contract implies state independent repayments, which leave the entire risk burden on the entrepreneur.

Technological choice

The solution to $(P2)$ features a threshold ability level π^* such that the *Risky* technology is chosen by any agent with ability higher than π^* . This property is formalized in Lemma 1.

Lemma 1 *There exists a unique π^* such that $\forall \pi_i \geq \pi^*$, $\pi_i v[(1 - \theta_i^h) A\chi, r] + (1 - \pi_i) v[(1 - \theta_i^l) \varphi A\chi, r] \geq B\chi - r$, and $\{\theta_i^h, \theta_i^l\}$ is the solution to $(P1)$.*

Proof. *See the Appendix.* ■

2.2.3 Investor protection and the equilibrium

Since the dividend payouts $\{\theta_i^h, \theta_i^l\}$ are functions of investor protection, also the threshold ability π^* varies with p , as formalized in Lemma 2

Lemma 2 *The threshold ability π^* is a decreasing, convex function of investor protection p .*

Proof. *See the Appendix.* ■

Notice that the risky technology is chosen only when some degree of risk sharing is attainable through the financial contract. Thus, the measure of agents who become risky entrepreneurs represents the size of the market for risk sharing. Safe firms instead get started and operate regardless of the borrowing conditions in the financial market. From Lemmas 1 and 2, it follows that the size of the market for risk sharing is a function of investor protection, as stated by Proposition 1.

Proposition 1 *The size of the market for risk sharing, $M \equiv 1 - G(\pi^*)$, is increasing in investor protection, and concave for high p .*

Proof. *See the Appendix.* ■

Corollary 1 *Define the size of the overall external finance as $F \equiv K_Y + 1$. The size of the market for risk sharing as a ratio of the total external finance, $\frac{M}{F}$ is increasing in investor protection and concave for high p .*

Proof. *See the Appendix.* ■

In the efficient case ($p = 1$), the value of producing with the risky technology is higher than that of running the safe project whenever $[\pi_i + (1 - \pi_i)\varphi]A \geq B$. Therefore, I can easily get a closed form solution for the threshold ability,

$$\pi_{p=1}^* = \frac{B - A\varphi}{(1 - \varphi)A},$$

and verify that it lies in the support of π under the hypotheses that $A > B$ and $\varphi A < B$.

In the general case of imperfect investor protection ($p < 1$), the expression for the threshold ability is more complicated. However, payoffs are easily derived:

$$w(\pi_i) = \begin{cases} B\chi - r & \text{with probability 1} & \text{for } \pi_i < \pi^* \\ w_i^h & \text{with probability } \pi_i & \text{for } \pi_i \geq \pi^* \\ w_i^l & \text{with probability } 1 - \pi_i & \text{for } \pi_i \geq \pi^* \end{cases}$$

$$w_i^h = [\pi_i p(1 - \varphi) + \varphi + (1 - p)(1 - \varphi)]A\chi - r \quad (2)$$

$$w_i^l = [\pi_i p(1 - \varphi) + \varphi]A\chi - r. \quad (3)$$

Henceforth, I denote the threshold abilities associated with $p = 1$ and $0 < p < 1$ by $\pi_{p=1}^*$ and $\pi_{p<1}^*$, respectively. For $p = 1$, perfect risk sharing is achieved through the optimal financial contract, so that entrepreneurs act as if they were risk-neutral. They choose the risky technology as soon as their ability implies expected earnings equal to the safe ones, i.e. $\pi_i = \pi_{p=1}^*$. This means that their earnings are state invariant and exhibit no discontinuity at the threshold ability level. When $0 < p < 1$, at $\pi_i = \pi_{p<1}^*$ the expected

productivity of the risky technology needs to be higher than the productivity of the safe technology, because entrepreneurs are risk averse and cannot be fully insured by investors.

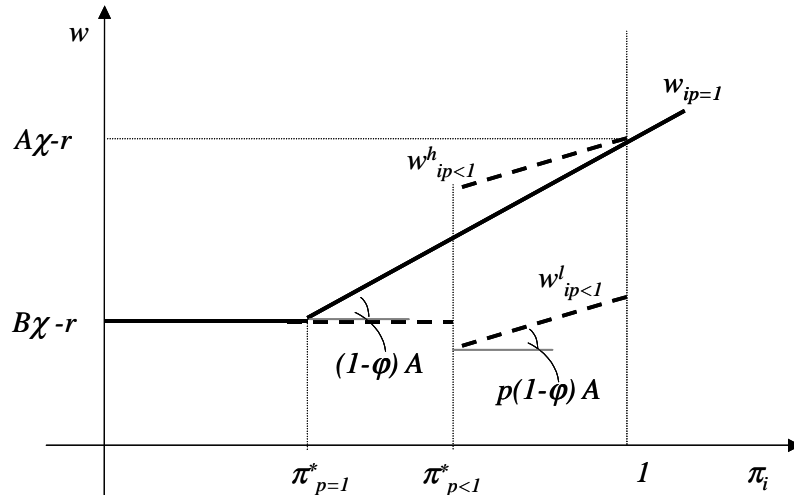


Figure 2: Model solution: ability-earnings profiles.

Figure 2 illustrates the optimal ability-earnings profiles. If there is no investor protection, nobody chooses the risky technology and hence earnings are flat and equal to $B\chi-r$. In the opposite extreme case of $p = 1$, income of young agents is described by the solid line. It is flat for the less able, who run the safe project, and proportional to ability for the more talented, risky entrepreneurs. Due to perfect risk sharing, earnings are state invariant. If investor protection drops to $0 < p < 1$ (dashed line), financing a risky firm becomes more costly, thereby inducing the least able among risky entrepreneurs to shift to the safe sector. Graphically, (1) the market for risk sharing shrinks, i.e., the flat portion of the earnings profile becomes longer. I define this as the “market size” effect. (2) The proportionality between stochastic payoffs and ability becomes weaker due to higher incentives to misreport, and the wedge between state contingent earnings widens due to worse risk sharing. I call this, as illustrated by the flatter slope and higher distance between $w_{ip<1}^h$ and $w_{ip<1}^l$, the “insurance” effect. The extent of imperfect insurance is captured by the jump in expected earnings at $\pi_{p<1}^*$. At any $\pi_i \geq \pi_{p<1}^*$, the expected payoff from the risky technology is independent of p since, for a given interest rate, the old are indifferent between borrowers. However, even though expected earnings are invariant, welfare is higher under perfect investor protection because of risk aversion.

3 EVALUATING INCOME INEQUALITY

In this section, I derive the key implications of the model on the overall effect of investor protection on income inequality, through the development of the market for risk sharing. To do so, I compute the variance of earnings,

$$\begin{aligned} Var(w) = & G(\pi^*) [B\chi - r - E(w)]^2 + \int_{\pi^*}^1 \left\{ \pi [w^h(\pi) - E(w)]^2 \right. \\ & \left. + (1 - \pi) [w^l(\pi) - E(w)]^2 \right\} g(\pi) d\pi, \end{aligned}$$

with $E(w) = G(\pi^*) B\chi + A\chi \int_{\pi^*}^1 [\pi + (1 - \pi)\varphi] g(\pi) d\pi - r$, and study how it varies with p .¹²

If there is no investor protection, all agents choose the safe technology and thus, the variance is zero. If the cost of hiding cash flow becomes any higher than zero ($p = \varepsilon$), some agents prefer the risky technology and get insured while raising funds, thereby driving the size of the market for risk sharing from zero to $M(\varepsilon)$. By the “market size” effect, a share of the economy becomes subject to income risk (having state-contingent earnings), thereby raising the variance of income (analytically, positive terms fall under the integral). Moreover, average earnings grow higher than $B\chi$, so that also the agents on the flat portion in Figure 2 contribute to raising the variance.

As investor protection improves, the “market size” effect is paired with the “insurance” effect, that shrinks the wedge between state-contingent earnings and hence, tends to reduce the variance. Analytically, the “insurance” effect tends to reduce the term under integration. The extent of the “market size” effect is decreasing in investor protection, due to the concavity of M at high p . On the other hand, “insurance” becomes more effective, the larger is the mass of agents that benefit from it. This means that, when investor protection is weak (M is small), the market-size effect dominates because risk sharing applies to a small fraction of the economy. Therefore, inequality at first increases with p (and with M).

When investor protection is perfect, $Var(w) = G(\pi_{p=1}^*) [B\chi - r - E(w)]^2 + \int_{\pi_{p=1}^*}^1 \{[\pi + (1 - \pi)\varphi] A\chi - r - E(w)\}^2 g(\pi) d\pi > 0$. As p falls any lower than 1 ($p = 1 - \varepsilon$), the “market size” effect drives only few agents out of the risky sector, thereby reducing income inequality by a small amount, since the difference between $B\chi$, $w^h(\pi^*)$ and $w^l(\pi^*)$ is still slight. The “insurance” effect, instead, applies to a large share of the population, and outweighs the “market size” effect, so that there is an increase in income inequality.

¹²Since income of the old is $1 - \pi + r$ linked to that of the young, I focus on the earnings of the active population only.

Therefore, improvements upon an already very good investor protection may in fact reduce inequality, although never below the case of no investor protection. Lemma 3 and Proposition 2 formalize this intuition.

Lemma 3 *The variance of earnings is a non-monotonic function of investor protection: $\frac{dVar(w)}{dp} > 0$ in a neighborhood of $p = 0$, and $\frac{dVar(w)}{dp} < 0$ in a neighborhood of $p = 1$.*

Proof. *See the Appendix.* ■

Since, from Proposition 1, the size of the market for risk sharing (M) is continuous and monotonic in investor protection (p), also the relationship between the former and income inequality follows a non-monotonic pattern.

Proposition 2 *The relationship between earnings variance and the size of the market for risk sharing, $M \equiv 1 - G(\pi^*)$, is non-monotonic: $\frac{dVar(w)}{dM} > 0$ in a neighborhood of $M(0)$, and $\frac{dVar(w)}{dM} < 0$ in a neighborhood of $M(1)$.*

Proof. *See the Appendix.* ■

Proposition 2 shows that income inequality, as measured by the variance of earnings, increases with the size of the risk-sharing market for small M and falls with large M . However, this does not give a full characterization of the relationship between inequality and the size of the risk-sharing market for any p . Moreover, there are alternative measures of inequality, such as the Gini coefficient, that are more commonly used in empirical work. Since a characterization of this indicator is awkward to derive analytically, I obtain it through numerical solution. This exercise allows me to study the relationship between investor protection, the size of the risk-sharing market and income inequality on the whole domain of p and to obtain a more testable version of the prediction in Proposition 2.¹³

To simulate the model, I choose parameter values consistently with the restrictions imposed on parameters throughout the paper.¹⁴ I approximate the distribution of ability with a Lognormal(μ, σ) and parametrize the mean and variance of the associated Normal distribution, μ and σ , with values from the actual data. Although ability per se is difficult to measure, it is likely to be reflected in educational attainment. Therefore, I take the sample mean and variance of school years from the Barro and Lee (2000) database of 138 countries in 1995. Since the support of the Lognormal distribution is unbounded from

¹³If the assumption that risky output in the bad state is lower than the international interest rate is removed, some of the most able agents can finance the risky project, even at $p=0$. This means that the upper bound for the threshold ability becomes $\tilde{\pi} < 1$ s.t. $\tilde{\pi}v(A\chi - r) + (1 - \tilde{\pi})v(\varphi A\chi - r) = v(B\chi - r)$, and the size of the risk-sharing market is $G(\tilde{\pi}) - G(\pi^*)$. All results hold, after this relabeling.

¹⁴Notice that this numerical solution is for qualitative rather than quantitative purposes. Therefore, the technological parameters are not calibrated to the actual data.

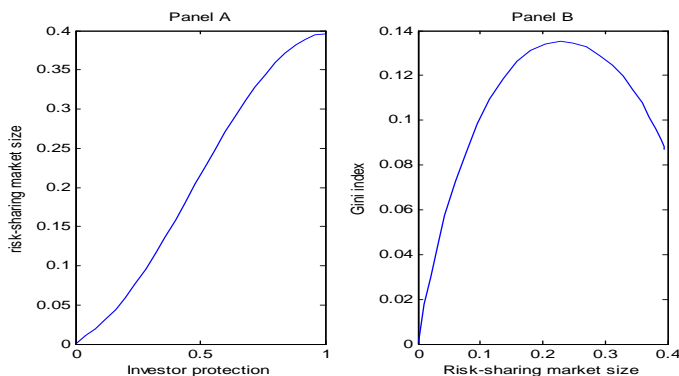


Figure 3: Investor protection, Risk-sharing market size and income inequality. Simulation output.

above, it must be truncated to comply with the set-up of the model. I assume the top 0.05 per cent to have ability 1, while π is lognormally distributed across the remaining 99.95 per cent of the population. I parameterize μ and σ to match the US data, where the average years of schooling are 14.258, with a variance of 26.93. I normalize the resulting ability distribution so that it fits in the interval $[0, 1]$, consistent with the model. I set $\alpha = 0.33$, $\chi = 1.5$, $r = 0.06$, $B = 1$, $A = 2.84$, $\varphi = 0.014$, implying $M(p = 1) \simeq 0.4$.

Both the “market size” and the “insurance” effects are expected to affect the Gini coefficients and the variance of earnings in similar ways. Panel A of Figure 3, plotting the Gini coefficient against the size of the risk-sharing market, confirms the expectations: the Gini exhibits a non-monotonic pattern, featuring a hump with its peak at a high M . Panel B shows market size to be a function of investor protection, with the properties predicted by Proposition 1.

4 EMPIRICAL EVIDENCE

The model developed through sections 2 and 3 generates two main predictions: (1) Income inequality has a hump-shaped relationship with the size of the market for risk sharing, and (2) this market is bigger, the better is investor protection. Here, I empirically assess these results by applying a series of cross-section and panel data methodologies. The section is structured as follows: first, I present the data, then I devote three subsections to describe the econometric techniques and the results.

4.1 DATA

I use a cross-section of 68 countries observed between 1980 and 2000, and a panel of 50 countries with 144 non-overlapping five-year observations spanning from 1976 to 2000.¹⁵

As a measure of income inequality, I take the Gini coefficient of the net individual income distribution from Dollar and Kraay's (2002) database, which relies on four sources: the UN-WIDER World Income Inequality Database, the "high quality" sample from Deininger and Squire (1996), Chen and Ravallion (2001), and Lundberg and Squire (2000).¹⁶

I proxy the size of the market for risk sharing with data on the financial structure of countries. It can be argued that entrepreneurs bear more risk the larger their firm's leverage. In terms of standard financial contracts, this means that firms' insiders achieve more (less) risk sharing in countries where equity (debt) accounts for a larger share of external finance. Therefore, I use stock market capitalization as a share of total credit to the private sector as empirical counterpart for the size of the risk-sharing market. This variable (*smpr*) is constructed as the ratio between stock market capitalization over GDP (*smcap*) and credit to the private sector over GDP (*privo*), from the database by Beck et al. (2001) on Financial Development and Structure, which expands the data used in Beck et al. (1999).

The indicators of investor protection and efficiency of the judiciary come from LLS (2006). Both *investor_pr* and *eff_jud* are indexes scaling from 0 to 10 in ascending order of protection and efficiency. See LLS (2006) for a detailed description.

When estimating equations for the Gini's as a function of stock market capitalization over total credit, I control for a number of other relevant variables, as suggested by the model and by the empirical literature on inequality. In particular, I include real per capita GDP and its square to account for technology differences and the Kuznets hypothesis. I also control for government expenditure and trade as a share of GDP. These variables are taken from Heston and Summers' version 6.1 of the Penn World Tables.¹⁷ I take two

¹⁵The cross-section shrinks to 42 observations when I account for investor protection and efficiency of the judiciary in the regressions, since these variables are only available for 49 countries, some of which do not intersect with the wider dataset. I use the full panel dataset only for the static regressions. Since 18 countries have less than the three consecutive observations needed for the Arellano and Bover (1995) estimation, I perform the dynamic panel GMM on a restricted sample of 112 observations for 32 countries.

¹⁶The original sample consists of 953 observations, which reduce to 418 separated by at least five years, on 137 countries over the period 1950-1999. Countries differ with respect to the survey coverage (national vs subnational), the welfare measure (income vs expenditure), the measure of income (net vs gross) and the unit of observation (households vs individuals). Data from Deininger and Squire are usually adjusted by adding 6.6 to the Gini coefficients based on expenditure. Here, the adjustment was made in a slightly more complicated way to account for the variety of sources; see Dollar and Kraay (2002) for details.

¹⁷Throughout the estimations, real per capita GDP is expressed as a ratio of the first observation for the US (1980 in the cross-section, 1976 in the panel).

measures of education attainment to proxy both the level and the dispersion of human capital. I use the share of the population aged above 25 with some secondary education (sec25), from the Barro and Lee's (2000) database, and the Gini coefficient for the years of education in the population aged above 15 (gh_15), constructed by Castellò and Doménech (2002) with data from Barro and Lee (2000).

Finally, as in LLS (2006), I use legal origins, from the World Development Indicators, as instruments in the cross-sectional analysis.

4.2 CROSS-SECTIONAL ESTIMATES

4.2.1 Econometric specifications

To test the predictions of the model across countries, I estimate the following static equation:

$$G_{i(t-k,t)} = \alpha + \beta \mathbf{X}_{i(t-k,t)} + \gamma_1 smpr_{i(t-k,t)} + \gamma_2 (RS_{i(t-k,t)})^2 + \epsilon_i, \quad (4)$$

where $G_{i(t-k,t)}$ is the Gini coefficient, the terms in $\mathbf{X}_{i(t-k,t)}$ are additional explanatory variables, and $smpr_{i(t-k,t)}$ is stock market capitalization as a ratio of total credit to the private sector. Subscripts $i(t-k)$ indicate the average of a variable observed in country i in the period between $t-k$ and t , that means 1980 and 2000 in the case of cross-sectional regressions. $\mathbf{X}_{i(t-k,t)}$ includes: real per capita GDP observed at time $t-k$ and its square; period averages of the share of population aged above 25, with some secondary education (sec25), and alternatively of the Gini coefficient of the years of education in the population aged above 15 (gh_15); the period averages of government expenditure and trade as ratios of GDP. For sensitivity analysis, I replace $G_{i(t-k,t)}$ with G_{it} . The main result of the model is confirmed by the data if $\hat{\gamma}_1 > 0$ and $\hat{\gamma}_2 < 0$.

The OLS estimates of γ_1 and γ_2 may be biased if there is reverse causation between income inequality and stock market size. To control for this possibility, I also estimate equation (4) by Two-Stages Least Squares, using a number of investor protection indicators as instruments for $smpr_{i(t-k,t)}$:

$$\begin{aligned} G_{i(t-k,t)} &= \alpha + \beta \mathbf{X}_{i(t-k,t)} + \gamma_1 smpr_{i(t-k,t)} + \gamma_2 (smpr_{i(t-k,t)})^2 + e_i \\ smpr_{i(t-k,t)} &= \zeta + \xi \mathbf{IP}_{i(t-k,t)} + u_i. \end{aligned}$$

This strategy also allows me to evaluate the intermediate link between investor protection and the size of the risk-sharing market. I adopt two alternative sets of instruments, $\mathbf{IP}_{i(t-k,t)}$, for stock market capitalization over total credit: (i) the indicators of investor

protection and efficiency of the judiciary suggested by LLS (2006) as determinants of stock market development; (ii) the origin of the legal system which is, in turn, used by LLS (2006) to instrument investor protection. The main advantage of the second set of instruments is that these are most certainly exogenous and available for a wider cross-section of countries. The IV estimation validates the theoretical prediction on the positive relationship between investor protection and risk sharing, if $\hat{\xi} > 0$ and the F statistics of the excluded instruments from the first-stage regression is high. If the Sargan test of overidentifying restrictions has a high p-value, excluding correlation between investor protection and the residuals e_i , the data suggest that the whole mechanism suggested by the model is plausible: investor protection affects income inequality precisely through its effect on the risk-sharing market.

4.2.2 Results

Table 1 reports the Ordinary Least Squares estimates for different versions of equation (4). Columns 1-7 suggest human capital and stock market development to be the major forces driving income inequality. As predicted by the model, $\hat{\gamma}_1$ is positive and significant for both measures of stock market development, while $\hat{\gamma}_2$ is negative. According to the estimates, an increase in the relative size of the stock market should start reducing inequality after *smpr* has crossed a level that only three countries have reached in the sample. The fact that only very few countries are beyond the point where the relationship between risk sharing and inequality becomes negative may explain the low statistical significance for $\hat{\gamma}_2$. Since the model predicts that inequality should never completely revert, even when the stock market achieves its maximum relative size, it is reasonable to expect the linear term to be generally more significant, as is the case in Table 1.

In column 3, I control separately for stock market size and a measure of overall financial development, the ratio of credit to the private sector over GDP (*privo*). Interestingly, the coefficient estimates suggest that equity-like and debt-like finance have opposite effects on income inequality (positive and negative, respectively), as predicted by the model. The negative coefficient for *privo* is in line with the evidence by Beck et al. (2007) and Clarke et al. (2006), while the positive coefficient for *smcap* is novel in the literature.

The significant, negative coefficients on *sec25* through columns 1-3 and 6, in line with most empirical evidence, mean that inequality tends to be lower, the larger is the share of the population with high education. The positive and significant estimates for *gh_15* in columns 4-5 show that the dispersion of human capital boosts income inequality. However, the coefficients for *sec25* and *gh_15* jointly estimated (column 6) suggest that the former is more significant. Given that *sec25* dominates *gh_15*, I will henceforth report the results

obtained with *sec25* only. Finally, for the Kuznets hypothesis to hold, the estimated coefficients of GDP and $(GDP)^2$ should be positive and negative, respectively. The results in Table 1 do not validate this hypothesis.

To get a quantitative flavor of the implications of column 2 and 3, take pairs of countries with similar human capital (the other main determinant of inequality) but different relative size of the stock market, and compare the actual Gini differentials with their predicted values. Venezuela and South Africa, for instance, had very similar school attainment (29.3 and 28.5 per cent of the population aged above 25 with secondary education), while stock market capitalization over GDP was eleven times larger in South Africa. Column 3 would predict a lower Gini coefficient in Venezuela, with a difference of about 19 points: very close to the actual 18. Consider also Austria, which had the same level of secondary school attainment as Switzerland (65.1 vs 65.3), but a much less developed stock market (*smpr* was seven times smaller). Its predicted Gini (from the estimates in column 2) is lower than the Swiss by 6.8 vs the actual 7.1 points.¹⁸

The results in Table 1 support the main prediction of the model on the relationship between the size of the risk-sharing market and income inequality, but cannot provide evidence on the mechanism generating it, starting from investor protection. To see if investor protection affects income inequality independently from the risk-sharing market, I first regress the Gini coefficient on the control variables in \mathbf{X} and LLS's indicator of investor protection, and then add *smpr*. Table 2 shows that *investor_pr* has indeed a positive and significant effect on income inequality. However, the coefficients in columns 2 and 3 suggest that this effect is absorbed by stock market capitalization over total credit, once I control for it. Moreover, column 3 support the hypothesis that investor protection has no effect on inequality, unless paired by a bigger relative size of the stock market. These results suggest that investor protection only affects income inequality through the development of the equity market relative to debt.

The instrumental variables estimates reported in Table 3 are meant to explicitly account for the intermediate step linking risk sharing to the degree of investor protection. Estimating the first step of the IV regressions allows me to partially replicate the analysis in LLS (2006) to verify the predictive power of investor protection and efficiency of the judiciary on the size of the market for risk sharing. The coefficients from the first step estimations in column 3 of Panel A confirm that better investor protection and efficiency of the judiciary system boost the development of the market for risk sharing. Since these variables could be endogenous, I replace them with legal origins when estimating the first

¹⁸Remember that the Gini coefficient can, in principle, take values between zero and one hundred, and ranges between 22.6 and 58.3 in the sample.

step for *smpr*. Columns 1-2 confirm the results in LLS (2006) that the common law (UK) legal origin strongly promoted the development of stock markets.

Panel B of Table 3 reports the coefficient estimated in the second step, instrumenting *smpr* with legal origins and investor protection. The estimates for the relative size of the stock market strongly support the prediction that $\gamma_1 > 0$. The p-values of the F and Sargan tests guarantee that both sets of instruments are valid. In other words, investor protection is a good predictor for *smpr* (result 1), and only affects inequality through stock market development. Estimating equation (4) instrumenting both the linear and the quadratic terms for *smpr* is problematic, given the collinearity of the instruments. Therefore, I try to capture the non linearity in the effect of stock market development on income inequality by re-estimating the equations of column 1 on a restricted sample, excluding the countries with bigger stock markets (those with $smpr > 1.5$). The coefficient γ_1 , reported in column 2 of Panel B, is higher than the one in column 1. This suggests that the relationship between the relative size of the stock market and the Gini's tend to revert when the market for risk sharing is big enough.

So far, I have regressed the average of the Gini coefficients between 1980 and 2000 on the average relative size of the stock market in the same period. To verify if the results are sensitive to the timing of observations, I replicate the regressions of Tables 1 and 3 in two alternative ways. First, I replace the average Gini with its latest available observation, after 1985, and keep the regressors as in the previous estimates. The results are reported in columns 1-4 of Table 4 and do not display major differences from Table 1 and 3. As a further check, I focus on the period 1985-2000 and regress the average Gini on the initial values of *smpr*. In this case, I do not need to perform instrumental variables estimations, since reverse causality is arguably ruled out by the choice of the timing of observations. As shown in columns 5 and 6 of Table 4, the estimates for the linear term of stock market size remain positive and significant, while those for its square lose significance. Overall, the evidence from the sensitivity analysis favors strongly the existence of a positive γ_1 and, to a weaker extent, of a negative γ_2 .

Finally, the robustness of the results is tested in Table 5, which reports the estimates of equation (5) where government expenditure and trade (as a ratio of GDP) are added as additional regressors. There are no major changes from Tables 1 and 3, and the additional coefficients are not significantly different from zero.

4.3 PANEL FIXED AND RANDOM EFFECTS

4.3.1 *Econometric specifications*

To test the results of the paper both across countries and over time, I use the panel data methodology and estimate the following equation:

$$G_{it} = \alpha + \beta' \mathbf{X}_{it} + \gamma_1 smpr_{it} + \gamma_2 (smpr_{it})^2 + \eta_i + \nu_t + \epsilon_{it}, \quad (5)$$

where G_{it} is the average Gini coefficient observed in country i over a five-year period t , the terms in \mathbf{X}_{it} and $smpr_{it}$ are the same as for equation (4), and η_i , ν_t and ϵ_{it} are unobservable country- and time-specific effects, and the error term, respectively. I estimate equation (5) under the alternative hypotheses of a random versus fixed idiosyncratic component η_i . Fixed-effects estimates capture the evolution of the relationship within each country over time. Random effects are more efficient, since they exploit all the information available across countries and over time. However, the latter may be inconsistent if country-specific effects are correlated with the residuals. Including time fixed effects in both regressions allows me to account for the presence of global trends, such as skill-biased technical change, which drives inequality worldwide. I rely on the Hausman test for the choice between FE and RE, and an F test for the inclusion of time dummies.

4.3.2 *Results*

Columns 1 and 2 in Table 6 report the coefficients of equation (5) estimated with random and fixed effects on a panel of 50 countries, with 5-year observations spanning between 1976 and 2000.¹⁹ The estimates confirm the existence of a positive γ_1 , but do not provide strong support for $\gamma_2 < 0$. The estimates in column 3 are in line with the results from the cross-section on the opposite effects of equity-like *vis-à-vis* debt-like finance on income inequality. Education turns out to be negatively related to inequality throughout all estimations, consistently with most of the empirical literature. The Kuznets hypothesis is not validated by the results in Table 6. In conclusion, the static panel analysis suggests that stock market development plays as important a role as education in shaping income distribution.

¹⁹For all equations I ran regressions with both fixed and random effects, then I chose the best specification relying on the (reported) Hausman test and reported coefficient estimates only for that one. The other results are available upon request.

4.4 DYNAMIC PANEL DATA

4.4.1 Econometric specification

As a further evaluation of the relationship between risk-sharing market size and inequality, I follow the latest approach of dynamic panel analysis, and focus on the equation:

$$g_{it} = \lambda g_{it-1} + \tilde{\beta}' \mathbf{x}_{it} + \tilde{\gamma}_1 smpr_{it} + \tilde{\gamma}_2 (smpr_{it})^2 + \eta_i + \nu_t + \epsilon_{it}, \quad (6)$$

where all variables are expressed in logarithms. Notice that the specification in equation (6) includes a lagged endogenous variable among the regressors. It immediately follows that, even if ϵ_{it} is not correlated with g_{it-1} , the estimates are not consistent with a finite time span. Moreover, consistency may be undermined by the endogeneity of other explanatory variables, such as income and stock market capitalization. A number of contributions provide theoretical support (see, for instance, Banerjee and Duflo, 2003, Barro, 2000, Benabou, 1997, Forbes, 2003, and Lopez, 2003) and empirical treatments for the simultaneity between growth and inequality. Feedbacks with stock market size instead capture the reaction of capital supply to changes in the income distribution. To correct for the bias created by lagged endogenous variables and the simultaneity of some regressors, I adopt the approach of Arellano and Bover (1995) and Blundell and Bond (1998).²⁰ I time-differentiate both sides of (6) to obtain

$$\Delta g_{it} = \lambda \Delta g_{it-1} + \tilde{\beta}' \Delta \mathbf{x}_{it} + \tilde{\gamma}_1 \Delta smpr_{it} + \tilde{\gamma}_2 \Delta (smpr_{it})^2 + \Delta \nu_t + \Delta \epsilon_{it}, \quad (7)$$

and estimate the system of equations (6) and (7). The differences in the variables that are either endogenous or predetermined can be instrumented with their own lagged values, while lagged differences are instruments for levels. For instance, I use g_{it-3} as an instrument for Δg_{it-1} and $smpr_{it-2}$ for $\Delta smpr_{it}$, as well as Δg_{it-2} and $\Delta smpr_{it-1}$ for g_{it-1} and $smpr_{it}$. The estimation is performed with a two-step System-GMM technique. The moment conditions for the equation in differences are $E[\Delta g_{it-s} (\epsilon_{it} - \epsilon_{it-1})] = 0$ for $s \geq 2$, and – if the explanatory variables y are predetermined – $E[\Delta y_{it-s} (\epsilon_{it} - \epsilon_{it-1})] = 0$ for $s \geq 2$. For equation (6), the additional conditions are $E[\Delta g_{i,t-s} (\eta_i + \epsilon_{i,t})] = 0$ and $E[\Delta y_{i,t-s} (\eta_i + \epsilon_{i,t})] = 0$ for $s = 1$. The validity of the instruments is guaranteed under the hypothesis that ϵ_{it} exhibit zero second-order serial correlation. Coefficient estimates are consistent and efficient, if both the moment conditions and the no-serial correlation

²⁰The system-DPD methodology dominates the difference-DPD proposed by Arellano and Bond (1991), because it amends problems of measurement error bias and weak instruments, arising from the persistence of the regressors (as pointed out by Bond et al., 2001).

are satisfied. I can validate the estimated model through a Sargan test of overidentifying restrictions, and a test of second-order serial correlation of the residuals, respectively. As pointed out by Arellano and Bond (1991), the estimates from the first step are more efficient, while the test statistics from the second step are more robust. Therefore, I will report coefficients and statistics from the first and second step, respectively.

4.4.2 Results

Table 7 reports the coefficients estimated with the two-step system GMM à la Arellano and Bover (1995), that accounts for the dynamics and controls for country fixed effects. These results support again the existence of a significant positive linear relationship between the Gini's and the relative size of the stock market. The quadratic term is also significant and exhibits the expected negative sign. The estimates in column 3 imply that stock market development has significant effects on income inequality in the short run, while the dynamic analysis suggests that these effects persist also in long run, with coefficients $\gamma_1 = .36$ and $\gamma_2 = -.212$. The positive γ_1 remains significant after the inclusion of time, as well as time-continent effects.²¹ All estimated coefficients for the lagged Gini's support the convergence hypothesis for income inequality, as in previous empirical work by Benabou (1996), Lopez (2003) and Ravallion (2002). As in the cross-sectional and static panel regressions, the Kuznets' hypothesis finds no support and the predictive power of human capital becomes weaker. Columns 5 and 6 confirm the new stylized fact, that bigger stock markets generate more inequality, while deeper credit markets reduce it.

When shifting from the static to the dynamic panel regressions, the countries with less than three consecutive observations are dropped from the sample. To make the results from the two panel techniques comparable, I replicate the Fixed and Random Effects estimates on the reduced sample and report the coefficients in columns 4-6 of Table 6. The coefficients for *smp*r and its square are positive and negative, respectively, and both significantly different from zero, as in the dynamic panel of Table 7.

As a robustness check, I re-estimate the equations in Tables 6 and 7 with government expenditure and trade over GDP as additional regressors, and report the results in Table 8. Both static and dynamic regressions support the prediction of a positive γ_1 and negative γ_2 . The estimates for government expenditure, which are non-significantly different from zero, reflect the ambiguity of theoretical predictions and previous empirical evidence. Neither are the coefficients for trade openness significantly different from zero.

²¹Results with time-continent effects are available upon request.

4.5 SUMMARY

The estimates reported in this section suggest that the development of the market for risk sharing, proxied by the size of the stock market relative to private credit, tends to raise income inequality. The declining part of the hump predicted by the model is supported in a less robust way by the data. This evidence can be reconciled with the model, since the Gini coefficient is not expected to revert completely, even at very high levels of market development. Dynamic panel estimates show that the relationship between stock market development and income inequality continues to hold in the long run. Results from the cross-sectional regressions confirm the prediction that investor protection only affects income inequality through the development of the risk-sharing market.

5 CONCLUSIONS

This paper provides theoretical and empirical support for a systematic relationship between investor protection, risk sharing and income inequality. I develop an overlapping generation model with risk-averse agents, heterogeneous in their ability, where production can take place with a safe or a risky technology. In the presence of financial frictions, arising from the non-observability of realizations and imperfect investor protection, I study the occupational and financial choices for different ability groups. Better investor protection promotes risk sharing between entrepreneurs and financiers and affects income inequality in a number of ways. First, it provides insiders with better insurance, thereby reducing income volatility for a given mass of risky entrepreneurs. Second, it raises the share of agents that choose the risky technology and are thereby exposed to earning risk. Finally, since ability affects risky payoffs, better investor protection also increases the overall reward to ability. The first effect tends to reduce inequality, while the other two boost it. The main result of the paper is that income dispersion increases at first with the size of the market for risk sharing, and then declines. In the empirical section, I provide evidence consistent with the predictions of the model. Not only do the results support the theoretical mechanism, but they also document a new stylized fact about the nexus between finance and income inequality. While inequality falls with the increase of credit availability (as proven in the existing literature), it tends to grow as the funds raised on the stock market rise.

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A PROOFS

Lemma 1

The assumptions that $A > B$ and $\varphi A < B$ together with continuity of V_i in π_i imply the existence of a unique point $\pi^* \in (0, 1)$ where $V^* = B\chi - r$. From this, it follows that for $\pi_i = 1$, $(1 - \theta_i^h) A\chi = (A\chi - r) > B\chi - r$, hence $V_i = v[(1 - \theta_i^h) A\chi, r] > v(B\chi - r, r)$, and for $\pi_i = 0$, $(1 - \theta_i^l) \varphi A\chi = \varphi A\chi - r < B\chi - r$, thus $V_i = v[(1 - \theta_i^l) \varphi A\chi, r] < v(B\chi - r, r)$. To prove that π^* is a threshold, I just need to show that V_i is increasing in π_i . The derivative of V_i w. r. t. π_i under the optimal equity contract is

$$\frac{dV_i}{d\pi_i} = v\left[(1 - \theta_i^h) A\chi, r\right] - v\left[(1 - \theta_i^l) \varphi A\chi, r\right] + [\pi_i v'_h + (1 - \pi_i) v'_l] p A\chi > 0.$$

Therefore, $\forall \pi_i \geq \pi^*$, $\pi_i v[(1 - \theta_i^h) A\chi, r] + (1 - \pi_i) v[(1 - \theta_i^l) \varphi A\chi, r] \geq v(B\chi - r, r)$.

Lemma 2

To prove that the threshold ability is decreasing in investor protection, I obtain the derivative of π^* with respect to p ,

$$\frac{d\pi^*}{dp} = -\frac{dV}{dp} \left(\frac{dV}{d\pi}\right)^{-1},$$

and show that it is negative. I have derived $\frac{dV}{d\pi^*} > 0$ in the proof of Lemma 1. I just need to derive

$$\frac{dV}{dp} = \pi_i (1 - \pi_i) (1 - \varphi) A (v'_l - v'_h).$$

Notice that $\frac{dV}{dp} > 0$ for any π , since utility is concave. It follows that $\frac{d\pi^*}{dp} < 0$.

To prove that the threshold is convex in investor protection, I need to prove that $\frac{d^2\pi^*}{(dp)^2} > 0$.

$$\begin{aligned} \frac{d^2\pi^*}{(dp)^2} &= \frac{\frac{d^2V}{d\pi dp} \frac{dV}{dp} - \frac{d^2V}{(dp)^2} \frac{dV}{d\pi}}{\left(\frac{dV}{d\pi}\right)^2} \\ &= -\left(\frac{dV}{d\pi}\right)^{-1} \left\{ \pi^* (1 - \pi^*) A\chi (v'_l - v'_h) + A\chi [\pi^* v'_h + (1 - \pi^*) v'_l] \right. \\ &\quad \left. - p (A\chi)^2 \pi^* (1 - \pi^*) (1 - \varphi) (v''_l - v''_h) \right\} \frac{d\pi^*}{dp} \\ &\quad - \left(\frac{dV}{d\pi}\right)^{-1} \left\{ (A\chi)^2 (1 - \varphi)^2 \pi^* (1 - \pi^*) [\pi^* v''_h + (1 - \pi^*) v''_l] \right\}. \end{aligned}$$

All terms divided by $\frac{dV}{d\pi}$ are positive, since the CRRA specification of the utility function implies that $v'_l > v'_h$ and $v''_l < v''_h$, and $\frac{d\pi^*}{dp} \leq 0$. Therefore, $\frac{d^2\pi^*}{(dp)^2} = -(> 0)^{-1} \{(\geq 0) +$

$(> 0) - (\leq 0) \} (\leq 0) - (> 0)^{-1} \{ < 0 \} > 0$.

Proposition 1

To prove the increasing monotonicity of the size of the risk-sharing market, and its concavity at high levels of investor protection, I derive

$$\begin{aligned} \frac{dM}{dp} &= -g(\pi^*) \frac{d\pi^*}{dp} \\ \frac{d^2M}{(dp)^2} &= -g'(\pi^*) \left(\frac{d\pi^*}{dp} \right)^2 - g(\pi^*) \frac{d^2\pi^*}{(dp)^2}. \end{aligned}$$

From Lemma 1, $\frac{d\pi^*}{dp} \leq 0$, that implies $\frac{dM}{dp} \geq 0$; hence, the size of the market for risk sharing is increasing in investor protection. From Lemma 2, $\frac{d^2\pi^*}{(dp)^2} > 0$. Moreover, $\lim_{p \rightarrow 1} \frac{d\pi^*}{dp} = \lim_{p \rightarrow 1} \left(\frac{dV}{dp} / \frac{dV}{d\pi} \right) = \lim_{p \rightarrow 1} \frac{\pi(1-\pi)(1-\varphi)[v'(w^l, r) - v'(w^h, r)]}{v(w^h, r) - v(w^l, r) + [\pi v'(w^h, r) + (1-\pi)v'(w^l, r)]pA} = 0$. It follows that M is concave in p in a neighborhood of $p = 1$, since $\lim_{p \rightarrow 1} \frac{d^2M}{(dp)^2} < 0$.

Corollary 1

By optimality of factor employment in the final good sector, $K_Y = Y \times \left[\frac{\alpha}{r(1-\alpha)} \right]^{1-\alpha}$, which can be re-written, after substituting Y with Y^D , as $K_Y = \Gamma \frac{2+r+\beta}{1+\beta} \left\{ G(\pi^*) B\chi + \int_{\pi^*}^1 \{ [\pi + (1-\pi)\varphi] Ag(\pi) d\pi - r \} \right.$, with $\Gamma = \left[\frac{\alpha}{r(1-\alpha)} \right]^{1-\alpha}$. The first derivative of $\frac{M}{F}$ w.r.t. p is

$$\begin{aligned} \frac{d\frac{M}{F}}{dp} &= -\frac{d\pi^*}{dp} \frac{g(\pi^*)}{(1+\Gamma Y)^2} \left\{ 1 + \Gamma \frac{2+r+\beta}{1+\beta} \left\{ A\chi \int_{\pi^*}^1 [\pi + (1-\pi)\varphi] d\pi \right. \right. \\ &\quad \left. \left. - [1 - G(\pi^*)] A\chi [\pi^* + (1-\pi^*)\varphi] + B\chi - r \right\} \right\}, \end{aligned}$$

Risk-sharing finance as a ratio of total external finance is increasing in investor protection, $\frac{d\frac{M}{F}}{dp} \geq 0$ for any $p \in [0, 1]$, since $\frac{d\pi^*}{dp} \leq 0$ and the term in brackets is always positive. To prove concavity of $\frac{M}{F}$ in a neighborhood of $p = 1$, I derive

$$\begin{aligned} \frac{d^2\frac{M}{F}}{(dp)^2} &= -\frac{d^2\pi^*}{(dp)^2} \frac{g(\pi^*)}{(1+\Gamma Y)^2} \left(1 + \Gamma \frac{2+r+\beta}{1+\beta} \Psi \right) \\ &\quad - \left(\frac{d\pi^*}{dp} \right)^2 \frac{g'(\pi^*)}{(1+\Gamma Y)^2} \left(1 + \Gamma \frac{2+r+\beta}{1+\beta} \Psi \right) \\ &\quad + \left(\frac{d\pi^*}{dp} \right)^2 \frac{g(\pi^*)}{(1+\Gamma Y)^2} \Gamma \frac{2+r+\beta}{1+\beta} \Psi [1 - G(\pi^*)] A\chi (1-\varphi) \\ &\quad - 2 \left(\frac{d\pi^*}{dp} \right)^2 \frac{g(\pi^*)^2}{(1+\Gamma Y)^3} \left(1 + \Gamma \frac{2+r+\beta}{1+\beta} \Psi \right) \Gamma \frac{2+r+\beta}{1+\beta} \\ &\quad \times A\chi [\pi^* + (1-\pi^*)\varphi] - B\chi, \\ \Psi &\equiv A\chi \int_{\pi^*}^1 [\pi + (1-\pi)\varphi] d\pi - A\chi [1 - G(\pi^*)] [\pi^* + (1-\pi^*)\varphi] + B\chi - r. \end{aligned}$$

As $\lim_{p \rightarrow 1} \frac{d\pi^*}{dp} = 0$, while $\frac{d^2\pi^*}{(dp)^2} > 0$ at any p , $\lim_{p \rightarrow 1} \frac{d^2 M}{(dp)^2} < 0$.

Lemma 3

To prove non monotonicity, I differentiate $Var(w)$ with respect to p :

$$\begin{aligned}
\frac{dVar(w)}{dp} &= \frac{d\pi^*}{dp} \left\{ g(\pi^*) [B\chi - r - E(w)]^2 - 2G(\pi^*) [B\chi - r - E(w)] \frac{dE(w)}{d\pi^*} \right\} \\
&\quad - \frac{d\pi^*}{dp} g(\pi^*) \left\{ \pi^* [w^h(\pi^*) - E(w)]^2 + (1 - \pi^*) [w^l(\pi^*) - E(w)]^2 \right\} \\
&\quad + \frac{d\pi^*}{dp} \frac{dE(w)}{d\pi^*} 2 \int_{\pi^*}^1 \left\{ \pi [w^h - E(w)] + (1 - \pi) [w^l - E(w)] \right\} g(\pi) d\pi \\
&\quad + 2 \int_{\pi^*}^1 \left\{ \pi \frac{dw^h}{dp} [w^h - E(w)] + (1 - \pi) \frac{dw^l}{dp} [w^l - E(w)] \right\} g(\pi) d\pi \\
&= \frac{d\pi^*}{dp} g(\pi^*) \left\{ [B\chi - r - E(w)]^2 - \pi^* [w^h(\pi^*) - E(w)]^2 \right. \\
&\quad \left. - (1 - \pi^*) [w^l(\pi^*) - E(w)]^2 \right\} \\
&\quad - 2(1 - \varphi) A\chi \int_{\pi^*}^1 \pi(1 - \pi) (w^h - w^l) g(\pi) d\pi.
\end{aligned}$$

Notice that the term in the first two lines represents the market size effect and is positive for all p , while the last line accounts for the risk sharing effect and is negative for all p .

For $p \rightarrow 0$, $\pi^* \rightarrow 1$, $E(w) \rightarrow B\chi - r$, $w^h \rightarrow A\chi - r$, $w^l \rightarrow \varphi A\chi - r$. Therefore,

$$\lim_{p \rightarrow 0} \frac{dVar(w)}{dp} = -\frac{d\pi^*}{dp} g(1) (A - B)^2 \chi^2 > 0.$$

For $p \rightarrow 1$, $\pi^* \rightarrow \pi_{p=1}^* = \frac{B - \varphi A}{(1 - \varphi)A}$, $w^h(\pi^*) - w^l(\pi^*) \rightarrow 0$, $w^h(\pi_{p=1}^*) \rightarrow w^l(\pi_{p=1}^*) = [\pi_{p=1}^* + (1 - \pi_{p=1}^*)\varphi] A\chi - r = B\chi - r$, $\frac{d\pi^*}{dp} \rightarrow 0$. I study how $\frac{dVar(w)}{dp}$ approaches zero in a left neighborhood of $p = 1$ by means of Taylor's first-order approximation. Notice that

$$\begin{aligned}
\frac{d^2 Var(w)}{(dp)^2} &= \left[\frac{d^2 \pi^*}{(dp)^2} g(\pi^*) + \left(\frac{d\pi^*}{dp} \right)^2 g'(\pi^*) \right] \left\{ [B\chi - r - E(w)]^2 \right. \\
&\quad \left. - \pi^* [w^h(\pi^*) - E(w)]^2 - (1 - \pi^*) [w^l(\pi^*) - E(w)]^2 \right\} \\
&\quad + \frac{d\pi^*}{dp} g(\pi^*) \left\{ 2 \frac{d\pi^*}{dp} \frac{dE(w)}{d\pi^*} \{ [\pi^* + (1 - \pi^*) \varphi] A\chi - B\chi \} \right. \\
&\quad \left. + 2\pi^* (1 - \pi^*) (1 - \varphi)^2 (A\chi)^2 - \frac{d\pi^*}{dp} \left\{ [w^h(\pi^*) - E(w)]^2 \right. \right. \\
&\quad \left. \left. - [w^l(\pi^*) - E(w)]^2 \right\} + 2(1 - \varphi)^2 (A\chi)^2 \int_{\pi_{p=1}^*}^1 \pi (1 - \pi) g(\pi) d\pi \right.
\end{aligned}$$

It follows that, in a neighborhood to the left of $p = 1$,

$$\frac{dVar(w)}{dp} = 2(p - 1)(1 - \varphi)^2 (A\chi)^2 \int_{\pi_{p=1}^*}^1 \pi (1 - \pi) g(\pi) d\pi < 0.$$

Proposition 2

Recall from Proposition 1 that M is increasing in p . I characterize the relationship between the size of the risk-sharing market and the variance of earnings by studying

$$\begin{aligned}
\frac{dVar(w)}{dM} &= \frac{dVar(w)}{dp} \left(\frac{dM}{dp} \right)^{-1} \\
&= -[B\chi - r - E(w)]^2 + (1 - \pi^*) [w^l(\pi^*) - E(w)]^2 \\
&\quad + \pi^* [w^h(\pi^*) - E(w)]^2 + \left[\frac{d\pi^*}{dp} g(\pi^*) \right]^{-1} \times \\
&\quad 2(1 - \varphi)^2 (A\chi)^2 (1 - p) \int_{\pi^*}^1 \pi (1 - \pi) g(\pi) d\pi
\end{aligned}$$

For $p \rightarrow 0$, $\pi^* \rightarrow 1$, $E(w) \rightarrow B\chi - r$, $w^h \rightarrow A\chi - r$, $w^l \rightarrow \varphi A\chi - r$, hence

$$\lim_{p \rightarrow 0} \frac{dVar(w)}{dM} = (A - B)^2 \chi^2 > 0.$$

For $p \rightarrow 1$, $\pi^* \rightarrow \pi_{p=1}^* = \frac{B - \varphi A}{(1 - \varphi)A}$, $w^h(\pi^*) - w^l(\pi^*) \rightarrow 0$, $w^h(\pi_{p=1}^*) \rightarrow w^l(\pi_{p=1}^*) =$

$[\pi_{p=1}^* + (1 - \pi_{p=1}^*)] A\chi - r = B\chi - r$, and $\frac{d\pi^*}{dp} \rightarrow 0$. It thus follows that

$$\begin{aligned} \lim_{p \rightarrow 1} \frac{dVar(w)}{dM(p)} &= \lim_{p \rightarrow 1} \frac{\frac{d}{dp} \left[2(1 - \varphi)^2 (A\chi)^2 (1 - p) \int_{\pi^*}^1 \pi(1 - \pi) g(\pi) d\pi \right]}{\frac{d}{dp} \left[\frac{d\pi^*}{dp} g(\pi^*) \right]} \\ &= 2 \int_{\pi_{p=1}^*}^1 \pi(1 - \pi) g(\pi) d\pi \frac{v(B\chi - r) + A\chi v'(B\chi - r)}{\pi_{p=1}^* (1 - \pi_{p=1}^*) g(\pi_{p=1}^*) v''(B\chi - r)} < 0, \end{aligned}$$

since $v'' < 0$ for any CRRA utility function.

B CLOSED ECONOMY

In this section, I show how the economy can be closed without affecting the main results discussed in sections 2 and 3. Assume that capital and intermediate goods can no longer be imported or exported. It follows that their prices will be pinned down by domestic demand and supply: $r_t = \alpha \frac{Y_t}{K_{Yt}}$, and $\chi_t = (1 - \alpha) \frac{Y_t}{X_t}$. Further, capital will follow the law of motion:

$$K_{t+1} = \frac{1}{1 + \beta} \left\{ G(\pi_t^*) B\chi_t + A\chi_t \int_{\pi_t^*}^1 [\pi + (1 - \pi)\varphi] g(\pi) d\pi - r_t \right\}, \quad (8)$$

where the RHS is aggregate savings. Aggregate capital is allocated between the final and the intermediate good sectors:

$$K_{t+1} \equiv K_{Yt+1} + 1.$$

The aggregate supply of intermediate goods, X_t , equals total production of safe and risky projects:

$$X_t = G(\pi_t^*) B + A \int_{\pi_t^*}^1 [\pi + (1 - \pi)\varphi] g(\pi) d\pi.$$

Notice that the production of intermediate goods X_t is decreasing in the threshold ability π_t^* . Optimal technology adoption maintains the threshold property of Lemma 1, since agents take prices as given and the risky payoffs are still increasing in ability. In any period, the threshold ability π_t^* satisfies:

$$\pi_t^* v(w_t^h(\pi_t^*), r_{t+1}) + (1 - \pi_t^*) v(w_t^l(\pi_t^*), r_{t+1}) = v(B\chi_t - r_t, r_{t+1}). \quad (9)$$

Equations (9) and (8) characterize the dynamic equilibrium. In the next sections, I report numerical solutions for the steady state and the transition dynamics. In particular, I show that Lemmas 2-3 and Propositions 1-2 continue to hold in the steady state. Moreover, along the transition between steady states with different investor protection, the size of

the risk-sharing market converges monotonically. Income inequality may instead converge along an oscillatory path, as a consequence of the dynamics of prices and capital.

B.1 THE DYNAMICS

The dynamics of the closed economy satisfies equations (??) and (9):

$$\pi_t^* v \left(w_t^h(\pi_t^*), r_{t+1} \right) + (1 - \pi_t^*) v \left(w_t^l(\pi_t^*), r_{t+1} \right) = v(B\chi_t - r_t, r_{t+1})$$

$$K_{t+1} = \frac{1}{1 + \beta} \left\{ G(\pi_t^*) B\chi_t + A\chi_t \int_{\pi_t^*}^1 [\pi + (1 - \pi)\varphi] g(\pi) d\pi - r_t \right\}$$

Differently from the small open economy, equilibrium earnings $w_t(\pi_i)$ now depend also on factor prices, that are functions of the threshold ability (π_t^*), and of the capital employed in the final sector ($K_{Yt} = K_t - 1$). Given K_t (which is predetermined), an increase in the hiding cost p raises the left-hand side of equation (9), which would determine a drop in the threshold ability π^* . A lower threshold would in turn imply an increase in the production of intermediate goods (X_t) and in the demand of capital in the final good sector (K_{Yt}), and therefore a drop in the price of intermediate goods (χ_t) and a rise in the interest rate (r_t). These changes in factor prices would feed back into equation (9), reducing both the left and the right-hand sides. In general equilibrium, the overall effect on the threshold depends on which side drops more. Notice however, that under perfect investor protection the threshold ability does not depend on relative factor prices, since $\pi_{p=1}^* = \frac{A-B}{(1-\varphi)A}$.

Since the analytical characterization of the dynamic equilibrium becomes awkward, I proceed by means of numerical solutions. The main results are displayed in Figures 4-6. In all simulations, I adopt the following parametrization: $A = 150$, $B = 100$, $\alpha = 0.33$, $\beta = 0.17$ (equivalent to a six per cent annual discount for thirty years, i.e. a generation), and G uniform in $[0, 1]$.

Notice that, in the absence of investor protection, a minimum initial capital is required in order for production of the intermediate good, and hence of the final good too, to be feasible: $K_0 > \frac{1}{1-\alpha}$ (which makes sure that $B\chi(\pi^* = 1) > r(\pi^* = 1)$). Also, even in under perfect investor protection ($p = 1$), no young agent chooses the risky technology if capital is so scarce that the repayment due by an entrepreneur with ability 1 exceeds her cash flow: $K < \frac{\alpha}{1-\alpha} \frac{B}{A}$ (which makes sure that $A\chi(\pi^* = 1) > r(\pi^* = 1)$). Given that $\alpha = 0.33$, at $p = 1$ there is a non-zero market for risk sharing, whenever capital satisfies $K > \frac{1}{1-\alpha}$.

Figure 4 describes the dynamics of an economy that starts with a very low capital endowment, $K_0 = 0.5 + \frac{1}{1-\alpha}$, and an intermediate degree of investor protection, $p = 0.5$. When K_0 is very low, the interest rate is so high relative to the price of the intermediate

good that no young agent chooses the risky technology. Hence, the market for risk sharing is inactive and inequality is zero. As capital is accumulated, the interest rate falls and the price of intermediates rises. When the ratio r/χ becomes low enough, some young agents prefer the risky project and raise capital through the risk-sharing market. This implies that some income inequality arises due to the “market size” effect, as in the model of sections 2-3. The adjustment of capital and prices continues until the steady state is reached. Decreasing marginal productivity of capital guarantees the existence of the steady state.

Notice that the price of intermediate goods (χ) affects inequality also by changing the earnings differentials between safe and risky entrepreneurs. The higher χ , the wider the earnings differentials, the higher inequality (“price” effect). This implies that, with endogenous prices, inequality may vary even if stock market size does not.

Figure 5 shows the adjustment after a policy change that increases investor protection from $p = 0$ to $p = 0.05$, starting from the steady state. Due to the convexity of π_t^* in p , the risky intermediate sector expands remarkably in response to the policy change. The marginal productivity of capital in the final sector rises sharply because the production of intermediates increases. This causes an overshooting of the interest rate, that gradually declines with capital accumulation to its new (higher) steady state level. Inequality immediately jumps up and oscillates around its new (higher) steady state level until capital and prices are stable.

If the policy change occurs at high levels of investor protection, as shown in figure 6 for p from 0.85 to 0.9, the effect on productivity of factors (hence prices) is weaker. An increase in p induces a small increase in the size of the risky intermediate sector, and has virtually no effect on the interest rate. Inequality falls, since the “risk sharing” effect outweighs the “market size” effect at high levels of investor protection.

B.2 THE STEADY STATE

In the steady state, $K_{t+1} = K_t = K$ and $\pi_{t+1}^* = \pi_t^* = \pi^*$. The equilibrium is the solution to the system:

$$\begin{aligned} VV &\equiv \pi^* v(w^h(\pi^*), r) + (1 - \pi^*) v(w^l(\pi^*), r) - v(B\chi - r, r) = 0 \\ KK &\equiv (1 + \beta) K - G(\pi^*)(B\chi - r) - \int_{\pi^*}^1 [\pi w^h(\pi) + (1 - \pi) w^l(\pi)] g(\pi) d\pi = 0. \end{aligned}$$

In the presence of perfect investor protection, the threshold ability does not depend on factor prices and is equal to $\frac{B-\varphi A}{(1-\varphi)A}$ as in the small open economy. Figure 7 plots the comparative statics for all levels of investor protection $p \in [0, 1]$ in the steady state, which

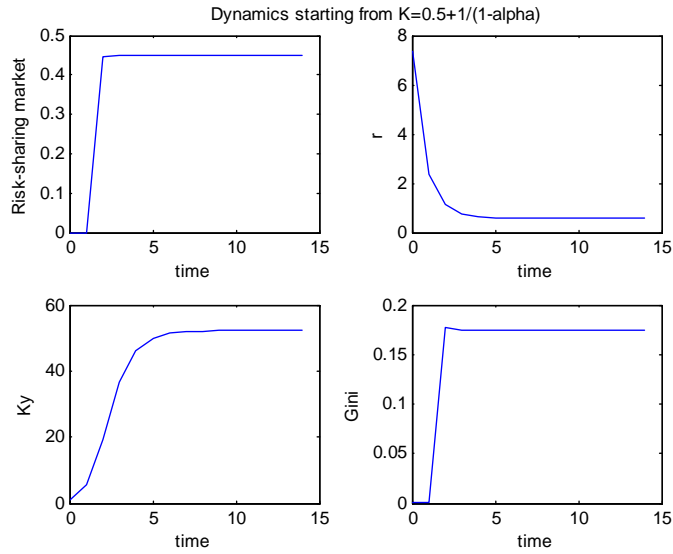


Figure 4: Dynamics from a low initial capital endowment ($K=0.5+\frac{1}{1-\alpha}$) to the steady state, given $p=0.5$.

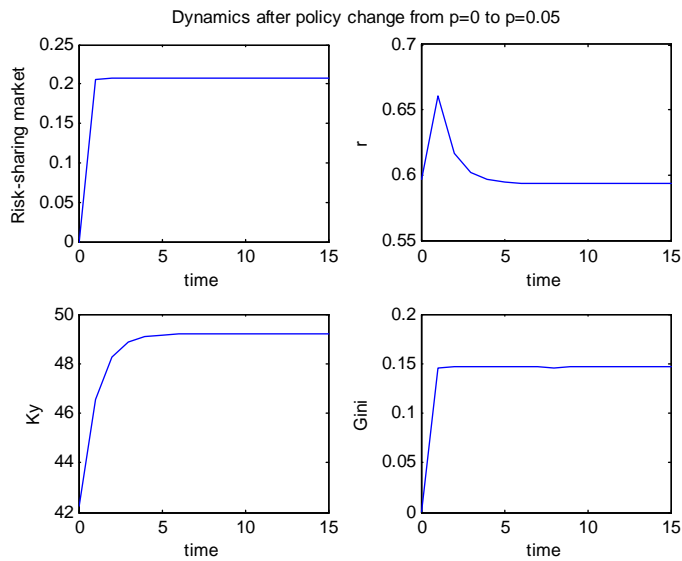


Figure 5: Dynamic adjustment after a policy change from $p=0$ to $p=0.05$.

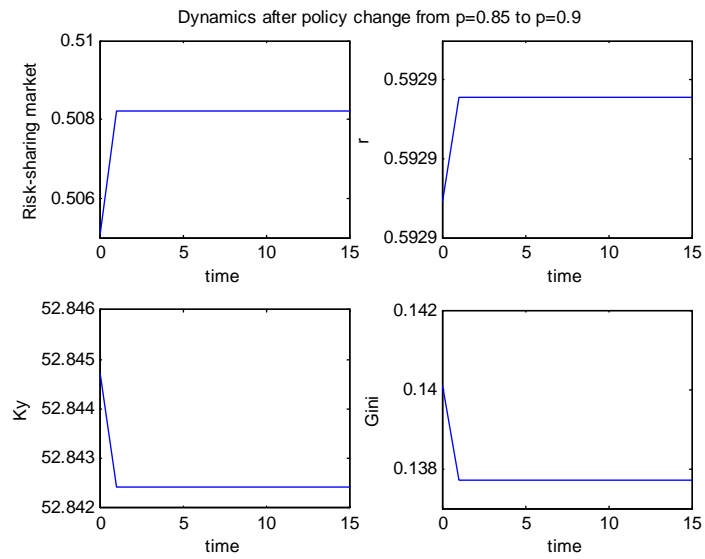


Figure 6: Dynamic adjustment after a policy change from $p=0.85$ to $p=0.9$.

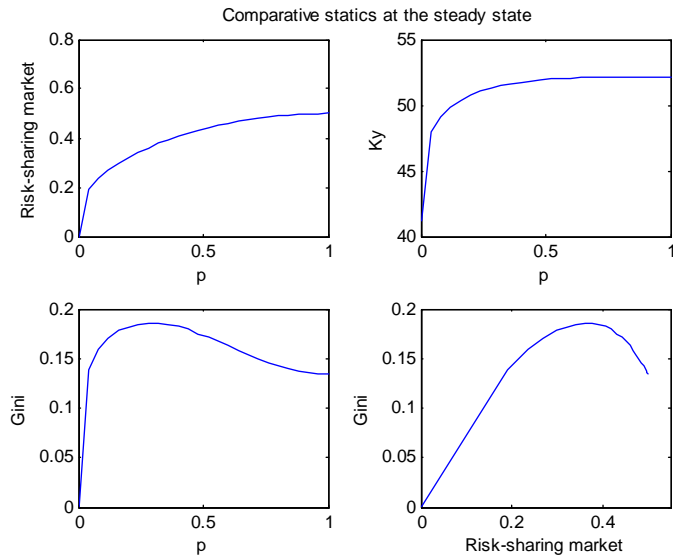


Figure 7: Comparative statics for varying investor protection across steady states.

shows that Lemmas 1-3 and Propositions 1-2 continue to hold in the closed economy. In fact, the “price” effect, that affects inequality along the dynamics, is irrelevant in the steady state. Therefore, the comparative statics on investor protection is driven by the “market size” and “insurance” effects only, as in the small open economy.

C SIMULATION DETAILS

This section describes step by step the procedure I followed for simulating the small open economy of section 2 and 3 (and the closed economy in the previous section of the Appendix).

1. Give values for the main parameters $(A, B, \varphi, \beta, \alpha)$ and the interest rate, and compute the threshold ability with perfect investor protection $(\pi_{p=1}^*)$.
2. Compute values for the parameters of the Lognormal distribution of abilities, (μ, σ) , from Barro and Lee’s (2000) data. The database provides observations for the percentages of the population aged 15 and above with no, primary, secondary and tertiary education (lu, lp, ls, lh) , along with the average year of each education level (pyr, syr, hyr) . I compute the average years of schooling for people with primary, secondary and tertiary education (q_1, q_2, q_3) , respectively):

$$q_1 = \frac{pyr}{lp + ls + lh}; q_2 = q_1 + \frac{syr}{ls + lh}; q_3 = q_1 + q_2 + \frac{hyr}{lh}.$$

The average years of schooling and their variance are then

$$E(Q) = \sum_{i=1}^3 l_i q_i$$

$$V(Q) = \sum_{i=0}^3 l_i (q_i - E(Q))^2,$$

with $l_0 = lu$, $l_1 = lp$, $l_2 = ls$ and $l_3 = lh$. Group the countries in low-income, middle-income and high-income following the WDI criterion and take the average values of $E(Q)$ and $V(Q)$. Finally, μ and σ can be derived from the expressions for mean and variance of the Lognormal distribution:

$$E(Q) = e^{\mu + \frac{\sigma^2}{2}}$$

$$V(Q) = e^{2\mu + 2\sigma^2} - e^{\mu + \sigma^2}.$$

3. Define a grid of 101 degrees of investor protection $p \in [0, 1]$, and a grid of initial

guesses for the threshold ability $\pi^* \in [\pi_{p=1}^*, 1]$, equally spaced by 0.0001 (the finer the grid, the better the approximation).

4. Draw $\Pi = 10001$ ability levels from a Lognormal (μ, σ) and sort them in ascending order. Identify the ability level $\pi_{.9995}$: $G(\pi_{.9995}) = 0.9995$ and divide every $\pi \leq \pi_{.9995}$ by this figure. Replace all $\pi > \pi_{.9995}$ by 1, so that the distribution is normalized to values included in $[0, 1]$, and truncated in a way that makes the top 0.05 per cent of the population successful with certainty. Compute the Cdf of ability,

$$G(\pi_i) = \frac{\# \text{ of realizations } \pi \leq \pi_i}{\Pi}.$$

5. For every degree of investor protection p

- (a) compute $\pi^*(p)$ as the solution to the technology choice problem. In particular, recursively find the point in the grid of π^* satisfying:

$$\begin{aligned} \log(B - r) &= \pi^* \log(w^h) + (1 - \pi^*) \log(w^l) & (10) \\ w^h &= A [\pi^* p (1 - \varphi) + \varphi + (1 - p)(1 - \varphi)] - r \\ w^l &= A [\pi^* p (1 - \varphi) + \varphi] - r > 0. \end{aligned}$$

- (b) For every ability π

- i. draw the earning realization:

$$\begin{aligned} w &= \begin{cases} B - r & \pi < \pi^* \\ A [\pi^* p (1 - \varphi) + \varphi + (1 - p)(1 - \varphi)] - r & \pi \geq \pi^* \end{cases} \\ \epsilon &\sim Bi(N, \pi), \text{ with } N = \# \text{ of } \pi \geq \pi^*. \end{aligned}$$

- ii. sort w and derive its cumulative density function as $F(w_i) = \frac{\# \text{ of realizations } w \leq w_i}{\Pi}$

- iii. compute the Lorenz Curve as $L(w_m) = \frac{\text{mean of } w \leq w_m}{\text{mean of } w} \frac{m}{\Pi}$ for $m = 1, 2, \dots, \Pi$

- iv. compute the Gini coefficient as $Gini = 1 - 2 \sum_{m=1}^{\Pi} \frac{L(w_m)}{\Pi}$

- (c) save the threshold and the Gini in $(1 \times p)$ vectors, $\pi^*(p)$ and $Gini(p)$, the earnings realizations, their distribution and the Lorenz curve in $(p \times \Pi)$ matrices, $\mathbf{w}(p, \pi)$, $\mathbf{F}(p, w(p, \pi))$ and $\mathbf{L}(p, w(p, \pi))$

When simulating the closed economy, step 1 does not specify r .

Step 5.(a) finds the threshold ability $\pi_t^*(p)$ which solves (10) for a given initial capital K_t , taking into account that $\chi_t = (1 - \alpha)(K_t - 1)^\alpha \times \left\{ A \sum_{i=\pi_t^*}^1 [\pi_i + (1 - \pi_i) \varphi] g(\pi_i) + G(\pi^*) B \right\}^{-\alpha}$ and $r_t = \alpha (K_t - 1)^{\alpha-1} \times \left\{ A \sum_{i=\pi_t^*}^1 [\pi_i + (1 - \pi_i) \varphi] g(\pi_i) + G(\pi^*) B \right\}^{1-\alpha}$.

After step 5.(c), capital in the next period is computed as $K_{t+1} = \sum_{i=0}^1 w_i - r$ and plugged into step 5.a. as new initial capital K_t . This recursion goes on until the steady state is reached and $K_t = K_{t+1}$.

Table A
Countries and Samples

Country	CL	CS	PL	PS	Country	CL	CS	PL	PS
Australia	y	y	y	y	Kenya	y	y		
Austria	y				Korea	y	y	y	y
Bangladesh	y		y	y	Malaysia	y	y	y	y
Barbados	y				Mauritius	y		y	
Belgium	y	y	y		Mexico	y	y	y	y
Bolivia	y				Nepal	y			
Botswana	y				Netherlands	y	y	y	y
Bulgaria			y		New Zealand	y	y	y	y
Brazil	y	y	y	y	Norway	y	y	y	y
Canada	y	y	y	y	Pakistan	y	y	y	y
Chile	y	y	y		Panama	y			
China	y		y		Paraguay	y			
Colombia	y	y	y		Peru	y	y	y	y
Costa Rica	y		y	y	Philippines	y	y	y	
Denmark	y	y	y	y	Poland	y		y	y
Ecuador	y	y	y		Portugal	y	y	y	
Egypt	y	y	y		Romania	y			
El Salvador	y				Russia			y	y
Finland	y	y	y	y	Singapore	y	y	y	y
France	y	y	y	y	Slovak Republic			y	
Germany	y	y	y	y	South Africa	y	y		
Ghana	y		y	y	Spain	y	y	y	y
Greece	y		y		Sri Lanka	y	y	y	y
Guatemala	y				Sweden	y	y	y	y
Honduras	y				Switzerland	y			
Hong Kong	y	y	y	y	Taiwan	y	y	y	y
Hungary	y		y		Thailand	y	y	y	y
India	y	y	y	y	Trinidad and Tobago	y		y	y
Indonesia	y	y	y	y	Tunisia	y		y	
Iran	y				Turkey	y	y	y	
Ireland	y				United Kingdom	y	y	y	y
Israel	y	y			United States	y	y	y	y
Italy	y	y	y	y	Uruguay	y	y		
Jamaica	y		y		Venezuela	y	y	y	y
Japan	y	y	y	y	Zambia	y			
Jordan	y	y	y	y	Zimbabwe	y	y		

Note: C and P stand for cross-sectional and panel datasets, respectively.
L and S for large and small samples.

Table 1. Risk-sharing market and income inequality
OLS - cross-section - 1980-2000

	1	2	3	4	5	6
<i>Smpr</i>	.038 (.029)	.142** (.032)		.035 (.029)	.142** (.032)	.141** (.033)
<i>Smpr</i> ²		-.033** (.008)			-.034** (.008)	-.034** (.008)
<i>Smcap</i>			.252** (.085)			
<i>Smcap</i> ²			-.069* (.036)			
<i>Privo</i>			-.089* (.049)			
<i>Sec25</i>	-.185** (.056)	-.197** (.052)	-.214** (.063)			-.133 (.085)
<i>Gh_15</i>				.114* (.058)	.149** (.061)	.070 (.086)
<i>GDP</i>	-.099 (.122)	-.157 (.109)	-.173* (.106)	-.061 (.127)	-.088 (.114)	-.123 (.119)
<i>GDP</i> ²	.115 (.126)	.162 (.113)	.169 (.106)	.008 (.122)	.034 (.106)	.116 (.121)
R ²	.499	.579	.562	.472	.555	.573
Obs.	68	68	68	67	67	67

The dependent variable is the average Gini coefficient between 1980 and 2000. Real per capita GDP and education (*sec25* and *gh_15*) are in initial values, financial variables (*smpr*, *smcap* and *privo*) are in sample averages. All regressions include a dummy for Latin American countries. Coefficients are estimated with Ordinary Least Squares. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 2. Risk-sharing market, investor protection and income inequality
OLS - cross-section - 1980-2000

	1	2	3
<i>Investor_pr</i>	.008* (.005)	-.001 (.005)	-.009* (.005)
<i>Smpr</i>		.101** (.025)	
<i>Smpr*investor_pr</i>			.014** (.002)
<i>Sec25</i>	-.175** (.067)	-.166** (.067)	-.158** (.067)
<i>GDP</i>	-.167 (.223)	-.308 (.183)	-.338* (.183)
<i>GDP</i> ²	.131 (.238)	.286 (.202)	.306 (.197)
R ²	.496	.641	.646
Obs.	43	42	42

The dependent variable is the average Gini coefficient between 1980 and 2000. Real per capita GDP and education (*sec25* and *gh_15*) are in initial values, *smpr* is in sample averages. All regressions include a dummy for Latin American countries. Coefficients are estimated with Ordinary Least Squares. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 3. Investor protection, risk-sharing market and income inequality
IV - cross-section - 1980-2000

Panel A. First Step – Dependent variable: <i>smpr</i>			
	1	2	3
	Whole sample	Smpr<1.5	Whole sample
<i>Sec25</i>	.031 (.598)	.246 (.313)	-.293 (.471)
<i>GDP</i>	.212 (1.016)	.579 (.545)	1.299 (.941)
<i>GDP</i> ²	-.298 (1.093)	-.539 (.585)	-1.597 (1.039)
<i>Investor_pr</i>			.097** (.024)
<i>Eff_jud</i>			.047 (.040)
<i>UK legal origin</i>	.588** (.242)	.419** (.128)	
<i>FR legal origin</i>	.135 (.269)	.126 (.141)	
<i>GE legal origin</i>	.017 (.339)	-.053 (.177)	
R ²	.183	.302	.386
Obs.	68	65	42
Panel B. Second Step – Dependent variable: <i>Gini</i>			
	1	2	3
	Whole sample	Smpr<1.5	Whole sample
<i>smpr</i>	.109** (.042)	.136** (.047)	.077** (.038)
<i>Sec25</i>	-.176** (.077)	-.201** (.060)	-.163** (.067)
<i>GDP</i>	-.082 (.143)	-.224* (.114)	-.275* (.152)
<i>GDP</i> ²	.102 (.155)	.233* (.123)	.246 (.173)
Sargan (p-value)	.345	.149	.369
F-test	3.98	7.08	9.44
(p-value)	.012	.000	.000

Panel A. The dependent variable is average *smpr* between 1980 and 2000. Real per capita GDP and education (*sec25* and *gh_15*) are in initial values, investor protection and efficiency of the judiciary are averages.

Panel B. The dependent variable is the average Gini coefficient between 1980 and 2000. Real per capita GDP and education (*sec25* and *gh_15*) are in initial values, *smpr* is in sample averages. Both p-values and statistics are reported for the F-test of the excluded instruments. Only p-values are reported for the Sargan test of overidentifying restrictions.

All regressions include a dummy for Latin American countries. Coefficients are estimated with Two-Stage Least Squares. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 4. Risk-sharing market and income inequality
Sensitivity analysis - cross-section - 1980-2000

	OLS Latest <i>Gini</i> Average <i>smp</i>		IV – legal origins Latest <i>Gini</i> Average <i>smp</i>		OLS Average <i>Gini</i> <i>smp</i> (1985)	
	1 Whole sample	2 Whole sample	3 Whole sample	4 <i>smp</i> <1.5	5 Whole sample	6 Whole sample
<i>Smp</i>	.032 (.031)	.136** (.035)	.109** (.046)	.131** (.051)	.087** (.032)	.040 (.063)
<i>Smp</i> ²		-.034** (.009)				.0003 (.0004)
R ²	.469	.543	.265	.541	.633	.639
F-Test (p-value)			3.900 (.013)	7.600 (.000)		
Sargan (p-value)			1.786 (.409)	3.202 (.202)		
Obs.	65	65	65	62	40	40

In columns 1-4 the dependent variable is the latest available observation of Gini coefficient after 1985, *smp* is 1980-2000 average. Initial (1980) values of real per capita GDP and *sec25* plus a dummy for Latin America are included. In columns 5-6 the dependent variable is the 1985-2000 average of Gini, *smp* is observed in 1985. Initial (1985) values of real per capita GDP and *sec25* plus a dummy for Latin America are included. Coefficients in columns 1-2 and 5-6 are estimated with Ordinary Least Squares. Coefficients in columns 3-4 are second step estimates from 2SLS regressions, with legal origins as instruments for *smp*; first step estimates are not reported but available from the author. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 5. Risk-sharing market and income inequality
Robustness analysis - cross-section - 1980-2000

	OLS		IV – legal origins	
	1 Whole sample	2 Whole sample	3 Whole sample	4 <i>smpr</i> <1.5
<i>Smpr</i>	.039 (.032)	.158** (.037)	.122** (.049)	.165** (.058)
<i>Smpr</i> ²		-.037** (.009)		
<i>Gov</i>	-.0006 (.0008)	-.001 (.0008)	-.002 (.002)	-.0015 (.0011)
<i>Trade</i>	.00001 (.0001)	-.0002 (.0002)	-.0002 (.0003)	-.0003 (.0003)
<i>Sec25</i>	-.186** (.057)	-.207** (.054)	-.185** (.082)	-.220** (.063)
<i>GDP</i>	-.111 (.136)	-.140 (.120)	-.069 (.162)	-.182 (.125)
<i>GDP</i> ²	.122 (.138)	.139 (.124)	.081 (.172)	.184 (.133)
R ²	.502	.592	.264	.571
F-Test (p-value)			3.18 (.030)	5.45 (.002)
Sargan (p-value)			2.231 (.328)	3.942 (.139)
Obs.	68	68	68	65

The dependent variable is the average Gini coefficient between 1980 and 2000. Real per capita GDP and *sec25* are in initial values, *smpr*, government expenditure (*gov*) and *trade* over GDP are in sample averages. All regressions include a dummy for Latin American countries. Coefficients in columns 1-2 are estimated with Ordinary Least Squares. Coefficients in columns 3-4 are second step estimates from 2SLS regressions, with legal origins as instruments for *smpr*; first step estimates are not reported but available from the author. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 6. Risk-sharing market and income inequality
Static Panel – 1976-2000

	Large sample			DPD sample		
	1 RE	2 FE	3 RE	4 RE	5 RE	6 RE
<i>Smpr</i>	2.615** (.551)	2.88* (1.62)		3.368** (1.059)	7.430** (2.389)	
<i>Smpr</i> ²		-.023 (.259)			-1.983* (1.036)	
<i>Smcap</i>			17.449** (3.886)			6.579** (1.760)
<i>Privo</i>			-5.358** (1.899)			-3.097 (2.472)
<i>Sec25</i>	-.177** (.049)	-.149** (.068)	-.206** (.049)	-.180** (.050)	-.198** (.050)	-.161** (.048)
<i>GDP</i>	-12.923* (7.151)	-7.803 (11.89)	-14.892** (7.196)	-9.053 (7.181)	-9.107 (7.011)	-10.417 (7.439)
<i>GDP</i> ²	10.839** (4.838)	8.795 (6.443)	9.369** (4.774)	9.054* (4.686)	8.875* (4.651)	8.368* (4.652)
Hausman test	.425	.026	.951	.461	.248	.369
Countries	50	50	50	34	34	34
Obs.	144	144	144	112	112	112

The dependent variables is the Gini coefficient. Real per capita GDP, and education (*sec25*) are in initial values, financial variables (*smpr*, *smcap* and *privo*) are in sample averages over non-overlapping 5-year periods. All equations were estimated with random (RE) and fixed effects (FE). The coefficients are reported from the specification chosen based on the Hausman tests, whose p-values are reported in the table. Robust standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively.

Table 7. Risk-sharing market and income inequality
Dynamic Panel Data – System GMM – 1976-2000

	1	2	3	4	5	6
$\log(Smpr)$	.045** (.021)	.041** (.021)	.204** (.071)	.128* (.068)		
$\log(Smpr^2)$			-.119** (.054)	-.061 (.054)		
$\log(Smcap)$					.106** (.029)	.095** (.034)
$\log(Privo)$					-.106** (.041)	-.131** (.037)
$\log(Gini_5)$	.369** (.151)	.387** (.144)	.361** (.139)	.441** (.132)	.379** (.181)	.445** (.164)
$\log(Sec25)$	-.081 (.104)	-.095 (.083)	-.105 (.079)	-.069 (.069)	-.117 (.095)	-.134 (.103)
$\log(GDP)$	.188 (.174)	.249 (.170)	.166 (.168)	.274 (.167)	.161 (.158)	.320* (.176)
$\log(GDP^2)$	-.211 (.206)	-.280 (.204)	-.198 (.189)	-.322 (.196)	-.146 (.177)	-.287 (.187)
Sargan (p-value)	.387	.506	.793	.776	.508	.647
m_2 (p-value)	.527	.870	.383	.822	.346	.481
Time FE	No	Yes	No	Yes	No	Yes
(F-Test)		(.153)		(.293)		(.123)
Countries	32	32	32	32	32	32
Obs.	84	84	84	84	84	84

The dependent variables in the system are the log and the log-difference of the Gini coefficient. All regressors are in log and log-differences. Real per capita GDP, and education (*sec25*) are in initial values, financial variables (*smpr*, *smcap* and *privo*) are in sample averages over non-overlapping 5-year periods. Coefficients are first step estimates from 2-step system GMM regressions *à la* Arellano and Bover, performed with PcGive. All regressors are treated as endogenous (Gini) or predetermined, hence instrumented. Lagged levels are used as instruments for differences, and lagged differences as instruments for levels. Robust (first step) standard errors are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively. P-values for the Sargan and m_2 tests are reported from the second step.

Table 8. Risk-sharing market and income inequality
Robustness analysis – Panel – 1976-2000

	Static Panel – RE		Dynamic Panel – System GMM			
	1	2	3	4	5	6
<i>Smpr</i>	2.858** (1.139)	6.683** (2.411)	.047** (.020)	.168** (.068)	.057** (.022)	.189** (.069)
<i>Smpr</i> ²		-1.865* (1.031)		-.093* (.051)		-.099* (.053)
<i>Gov</i>	.066 (.089)	.059 (.087)	-.009 (.087)	-.004 (.077)		
<i>Trade</i>	.024 (.017)	.022 (.016)			-.028 (.024)	-.034* (.019)
<i>Gini</i> ₅			.347** (.149)	.367** (.133)	.390** (.143)	.400** (.140)
<i>Sec25</i>	-.174** (.050)	-.189** (.050)	-.088 (.072)	-.092 (.071)	-.139** (.064)	-.163** (.067)
<i>GDP</i>	-10.074 (7.363)	-10.070 (7.214)	.189 (.171)	.196 (.166)	.219 (.168)	.169 (.143)
<i>GDP</i> ²	9.576** (4.667)	9.353** (4.636)	-.211 (.196)	-.232 (.183)	-.214 (.194)	-.169 (.171)
Hausman	.325	.118				
Sargan (p-value)			.584	.896	.808	.967
m ₂ (p-value)			.504	.393	.414	.386
Countries	34	34	32	32	32	32
Obs.	112	112	84	84	84	84

The dependent variable is the 5-year average Gini coefficient. Real per capita GDP and *sec25* are in initial values, *smpr*, government expenditure (*gov*) and *trade* over GDP are in 5-year averages. All regressions include a dummy for Latin American countries. All variables are in levels in columns 1-2, in logs and log-differences in columns 3-6. Coefficients in columns 1-2 are estimated with random effects (preferred to fixed effects on the basis of the Hausman test). Coefficients in columns 3-4 are first step estimates from 2-step system GMM regressions *à la* Arellano and Bover, performed with PcGive. All regressors are treated as endogenous (Gini) or predetermined, hence instrumented. Lagged levels are used as instruments for differences and lagged differences as instruments for levels. Robust standard errors (from the first step, in columns 3-6) are reported in parenthesis, 5 and 10 per cent significant coefficients are marked with ** and *, respectively. P-values for the Sargan and m₂ tests are reported from the second step.