Incentives and the De Soto Effect

T.J. Besley, K.B. Burchardi, M. Ghatak

Presentation by Shresth Garg

Introduction

- The term property right refers to an owner's right to use a good for consumption and/or income generation (referred to as **use rights.**). It can also include the right to transfer it to another party, in the form of a sale, gift, or bequest (referred to as **transfer rights**).
- **Private vs common rights.** Private rights entail the ability to **exclude** others from using the asset.

Property rights influence the following aspects of economic activity:

1. **Expropriation risk** - insecure property rights imply that individuals may fail to realize the fruits of their investment and efforts.
2. Insecure property rights may lead to costs that individuals have to incur to defend their property rights which, from economic POV, is unproductive.
3. Failure to facilitate gains from trade.
4. Use of property in supporting other transactions - use as **collateral**.

- The idea of improving property rights is frequently proclaimed as a magic bullet to improve the workings of capital markets.
- **De Soto 2001** What the poor lack is easy access to the property mechanisms that could legally fix the economic potential of their assets so that they could be used to produce, secure, or guarantee greater value in the expanded market....Just as a lake needs hydroelectric plant to produce usable energy, assets need a formal property system to produce significant surplus.

- Paper develops a theoretical framework to explore these ideas. Quantitative analysis shows that the effect of property rights improvements is likely to be both non linear and heterogeneous.
- Also looks at welfare - in the absence of competition in the credit markets the borrowers may be worse off.
- Even with competition the gains are relatively modest. While expected profits increases, so does the effort which must be taken into account when doing welfare analysis.
- Thus, the quantitative significance of de Soto effect, depends upon the environment in which in which the property rights improvements are being contemplated.

Existing work

- **Contracting models for low-income environment**, Stiglitz 1988 and Banerjee 2003 review.
- **Legal systems support trade in credit, labour and land markets,** Kraton and Swamy 1999, Genicot 2002, Ray 2006, Acemoglu, Johnson and Robinson 2001.
- **Empirical work** exploring the effect that collateral improvement has on credit contracts. Looking at the literature as a whole, the empirical estimates vary widely and are context specific.

The Model

- Standard agency model with **moral hazard, limited liability and limited contract enforcement**.
- **Borrowers** have a wealth level of w. However, due to poorly defined property rights only a part can be pledged as collateral. Specifically, wealth w has a collateral value of only $(1-\tau)w$. τ can be interpreted as either the fraction of property that cannot be seized or the probability that the property cannot be seized.
- Borrower supplies effort level $e \in [0, \bar{e}]$ and uses capital $x \in [0, \bar{x}]$ to produce an output.Output is stochastic and takes the value $q(x)$ with probability $p(e)$ and 0 with probability $(1-p(e))$. Marginal cost of effort is normalized to 1 and marginal cost of capital is γ. Expected surplus is therefore:

$$p(e)q(x) - e - \gamma x$$

Assumption 1

The following conditions hold:

1. Both $p(e)$ and $q(x)$ are twice-continuously differentiable, strictly increasing and strictly concave fucntions.
2. $p(0) = 0$, $p(\bar{e}) \in (0, 1]$, and, $q(0) \geq 0$.
3. $\lim_{e \to 0} p'(e)q(x) > 1$ for all $x > 0$, $\lim_{x \to 0} p(e)q'(x) > \gamma$ for all $e > 0$, $p'(\bar{e})q(\bar{x}) < 1$, and $q'(\bar{x})p(\bar{e}) < \gamma$.
4. $p(e)q(x)$ is strictly concave for all $(e, x) \in [0, \bar{e}] \times [0, \bar{x}]$.
5. $\epsilon(e) \equiv -p''(e)p(e)/\{p'(e)\}^2$ is bounded and continuous for all e and $p''' \leq -\frac{p''p'}{p}$.

Sufficient to ensure a well defined optimization problem and interior solution.

- Two **lenders** with marginal cost of funds being $\bar{\gamma}$ and $\underline{\gamma}$, with $\bar{\gamma} \geq \underline{\gamma}$.
- $\bar{\gamma} - \underline{\gamma}$ represents the degree of competition.
- Lenders have unlimited capacity to lend.
- Lenders can be interpreted as financial intermediaries that borrow money from risk neutral depositors. The cost of fund then represents the trustworthiness of the lender or the state of intermediary's balance sheet.
- Two lenders without loss of generality.

Contracting

- Assume that e is not contractible.
- A credit contract is a triple (c, r, x) where r is the payment when project is successful, c when the project is unsuccessful, and x is the loan size.
- Payoff to the borrower is

$$p(e)[q(x) - r] - (1 - p(e))c - e$$

- Lender's payoff is given by

$$p(e)r + (1 - p(e))c - \gamma x$$

- Let the borrower's outside option be $u \geq 0$. Initially exogenous, will be endogenously determined later.

The First-Best

- In the absence of any informational or contractual frictions the effort and lending will be chosen so as to maximize the joint surplus, $p(e)q(x) - e - \gamma x$.
- The first best $(e^*(\gamma), x^*(\gamma))$ is given by :

$$p'(e^*(\gamma))q(x^*(\gamma)) = 1 \quad (1)$$
$$p(e^*(\gamma))q'(x^*(\gamma)) = \gamma \quad (2)$$

- The marginal product of effort and capital are set equal to their marginal costs. Effort and capital are complimentary inputs and a fall in γ or anything which raises marginal product will increase the use of both inputs.

- The first best surplus is given by

$$S^*(\gamma) = p(e^*(\gamma))q(x^*(\gamma)) - e^*(\gamma) - \gamma x^*(\gamma), \qquad (3)$$

  which is decreasing in γ.
- It is efficient to have all the credit issued by the lowest cost lender. Profit of this lender is given by $\pi = max\{S^*(\gamma) - u, 0\}$, that is, the lender can exit the market in case of negative profits.

Second-Best Contracts

- In reality, contracts are constrained by information and limited claims to wealth.
- Given the contract (r, c, x), the borrower will choose effort as the solution to:

$$\arg\max_{e\in[0,\bar{e}]} \{p(e)[q(x) - r] - (1 - p(e))c - e\}$$

- The first order condition yields the incentive compatibility constraint (ICC) on effort by the borrower:

$$p'(e)[q(x) - (r - c)] = 1, \tag{4}$$

defining e implicitly as $e(r, c, x)$.

Efficient contracts between a lender and a borrower now solve the following problem:

$$\max_{\{r,c,x\}} \pi(r,c,x) = p(e)r + (1-p(e))c - \gamma x$$

subject to:

1. The participation constraint (PC),

$$p(e)\{q(x) - r\} - (1-p(e))c - e \geq u \tag{5}$$

2. The ICC,

$$e = e(r,c,x)$$

3. The limited liability constraint (LCC),

$$(1-\tau)w \geq c. \tag{6}$$

Proposition 1

Suppose that Assumption 1 (1)-(4) holds. Then for $\upsilon \geq \bar{\upsilon}(\gamma)$ and $u \leq S^*(\gamma)$, the first-best outcome is achieved with

$$r = c = \gamma x^*(\gamma) + S^*(\gamma) - u$$
$$x = x^*(\gamma)$$
$$e = e^*(\gamma)$$

where,

$$\upsilon \equiv u + (1 - \tau)w$$

and,

$$\bar{\upsilon}(\gamma) \equiv S^*(\gamma) + \gamma x^*(\gamma)$$

- Intuitively, we would expect the first-best to be achievable when the borrower has sufficient effective wealth to pledge as collateral. The condition in Proposition 1 that $\upsilon \geq \bar{\upsilon}(\gamma)$ is equivalent to $(1-\tau)w \geq S^{*} - u + \gamma x^{*}(\gamma)$. This says that the borrower's effective wealth must be greater than the part of surplus which the lender can extract plus the cost of credit. The borrower in this situation effectively becomes the full residual claimant on returns to effort which results in first best level of output.
- The condition $u \leq S^{*}(\gamma)$ says that there needs to be non-negative net surplus for lending to occur.

Proposition 2

Suppose that Assumption 1 (1)-(5) holds. There exists $\underline{v}(\gamma) \in (0, \bar{v}(\gamma))$ such that for $v < \bar{v}(\gamma)$ the optimal contract is as follows:

$$c = (1-\tau)w$$

$$r = \begin{cases} \rho(\underline{v}(\gamma), \gamma) + (1-\tau)w, & v < \underline{v}(\gamma) \\ \rho(v, \gamma) + (1-\tau)w, & v \in [\underline{v}(\gamma), \bar{v}(\gamma)) \end{cases}$$

$$r > c$$

$$x = \begin{cases} g(\underline{v}(\gamma), \gamma), & v < \underline{v}(\gamma) \\ g(v, \gamma), & v \in [\underline{v}(\gamma), \bar{v}(\gamma)). \end{cases}$$

where $\rho(v, \gamma) = q(g(v, \gamma)) - \frac{1}{p'(f(v))}$ and g and f are strictly increasing in v, while g is strictly decreasing in γ. It implements

$$e = \begin{cases} f(\underline{v}(\gamma)), & v < \underline{v}(\gamma) \\ f(v), & v \in [\underline{v}(\gamma), \bar{v}(\gamma)) \end{cases}$$

- As $\upsilon < \bar{\upsilon}(\gamma)$, the level of wealth is insufficient to achieve the first-best, and effort and credit are below the first best level.
- All effective wealth is pledged as collateral. Level of payment reflects the standard trade-off between extracting more rent from the borrower and reducing the borrower's effort as a consequence.
- Two subcases corresponding to whether the PC binds or not.
- When the outside option is very low and/or the wealth is low the PC clearly cannot bind.The lender maximizes her payoff subject to ICC.
- In this case the borrower will receive an expected payoff that exceeds his outside option, that is, he will receive an "efficiency utility" level. (High returns to effort).

- In the second case $v \in [\underline{v}(\gamma), \bar{v}(\gamma)]$, where $\underline{v}$ is defined by the point where the outside option is high enough, such that r cannot be set as before and must be reduced to satisfy the borrower's PC.
- In this situation both ICC and PC are binding.
- The lender will still want to set $c = (1 - \tau)w$, as setting a lower c rather than a lower r would reduce the borrower's effort.

The problem is,

$$\max_{\{r, c, x\}} \Pi(r, c, x) = p(e)\, r + (1 - p(e))\, c - \gamma x$$

subject to

Participation constraint,

$$p(e)\{q(x) - r\} - (1 - p(e))\, c - e \geq u$$

The ICC

$$e = e(r, c, x)$$

The LLC

$$(1 - \tau)\, w \geq c$$

from the optimization behaviour of the borrower, we know that,

$$p'(e)\,[q(x) - (r - c)] = 1$$

$$\Rightarrow \quad q(x) - r + c = \frac{1}{p'(e)}$$

$$\Rightarrow \quad r = q(x) + c - \frac{1}{p'(e)}$$

Modify the original problem using this relation.

The objective function becomes,

$$p(e)\left(q(x) + c - \frac{1}{p'(e)}\right) + (1 - p(e))\, c - \gamma x$$

$$= \boxed{p(e)\, q(x) - \frac{p(e)}{p'(e)} + c - \gamma x} \quad \text{—— (1)}$$

The PC becomes,

$$p(e)\left\{ q(x) - q(x) - c + \frac{1}{p'(e)} \right\} - (1 - p(e))\, c - e \geq u$$

$$\boxed{\frac{p(e)}{p'(e)} - c - e \geq u} \quad \text{—— (2)}$$

The ICC has been incorporated in our problem. LCC remains unchanged.

The modified problem then is,

$$\max_{\{e,\, c,\, x\}} \; p(e)\, q(x) - \frac{p(e)}{p'(e)} + c - \gamma x$$

st

$$\frac{p(e)}{p'(e)} - c - e \geq u$$

and

$$(1-\tau)\, w \geq c$$

(In the modified problem, the choice variables are now $\{e, c, x\}$.)

Writing out the Lagrangian,

$$\mathcal{L} = p(e)\, q(x) - \frac{p(e)}{p'(e)} + c - \gamma x + \lambda \left[\frac{p(e)}{p'(e)} - c - e - u \right] + \mu \left[(1-\tau)\, w - c \right]$$

The conditions for optima are,

$$e: \quad p'(e)\, q(x) - \frac{p'(e)^2 - p(e)\, p''(e)}{(p'(e))^2} + \lambda \frac{(p'(e))^2 - p(e)\, p''(e)}{(p'(e))^2} - \lambda = 0$$

define $\epsilon(e) \equiv \dfrac{-p''(e)\, p(e)}{(p'(e))^2}$

Then the condition becomes,

$$p'(e)\, q(x) - 1 - \epsilon(e) + \lambda + \lambda\, \epsilon(e) - \lambda = 0$$

$$\boxed{p'(e)\, q(x) = 1 + \epsilon(e)(1-\lambda)} \quad \text{——— ③}$$

c: $1 - \lambda - \mu = 0$ ——— (4)

x: $p(e) q'(x) - \gamma = 0$ ——— (5)

CS1: $\lambda \left[\frac{p(e)}{p'(e)} - c - e - w \right] = 0$; $\lambda \geq 0$; $\frac{p(e)}{p'(e)} - c - e - w \geq 0$ ——— (6)

CS2: $\mu [(1-\tau) w - c] = 0$; $\mu \geq 0$; $(1-\tau) w - c \geq 0$ ——— (7)

There are four cases to consider depending upon which of the two constraints are binding.

Case I PC does not bind ; LLC does not bind.

From the complementary slackness conditions,

$\lambda = 0$; $\mu = 0$.

However this violates (4). Hence, this case is never possible.

Case II : PC ~~does not~~ binds ; LLC does not.

From (7) $\mu = 0$

From (4) $\lambda = 1$

Conditions (3) and (5) reduce to,

$p'(e) q(x) = 1$ ——— (8)

$p(e) q'(x) - \gamma = 0$

These conditions are the same as the first-be[st] and thus the education level and capital level are given by,

$x = x^*(\gamma)$

$e = e^*(\gamma)$

From the binding PC,

$$c = \frac{p(e^*)}{p'(e^*)} - e^* - u$$

Using ⑧ this reduces to,

$$c = p(e^*)\, q(x^*) - e^* - u$$

Using the expression for the Surplus ~~total~~ at first Best, we obtain

$$c(\gamma) = \gamma x^*(\gamma) + S^*(\gamma) - u$$

Also the expression of r was,

$$r = q(x) + c - \frac{1}{p'(e)}$$

$$\Rightarrow \quad r = c \qquad \left\{ \text{As } q(x^*) = \frac{1}{p'(e^*)} \right\}$$

Thus the contract under this case is the same as in Proposition ① and we obtain the first best case.

To obtain the sufficient conditions, note that, LLC does not bind iff

$$c < (1-\tau)\, w$$

$$\Rightarrow \gamma x^*(\gamma) + S^*(\gamma) - u < (1-\tau) w$$

$$\Rightarrow \gamma x^*(\gamma) + S^*(\gamma) < (1-\tau) w + u$$

Define

$$\bar{v}(\gamma) = \gamma x^*(\gamma) + S^*(\gamma)$$

$$v = (1-\tau) w + u$$

Then this is equivalent to

$$v \geq \bar{v}(\gamma)$$

The condition $S^*(\gamma) \geq u$ states that there must be non-negative net surplus.

Thus, this is the case corresponding to PROPOSITION I.

(The solutions obtained are interior due to ASSUMPTION I)

Case III PC does not bind; LLC binds.

From ⑥ $\lambda = 0$

From ⑨ $\mu = 1$

The ~~educ~~ effort level and capital level, denoted by, (e_0, x_0) are given by equations ③ and ⑤,

$$p'(e_0(\gamma))\, q(x_0(\gamma)) = 1 + \epsilon(e_0(\gamma)) \quad \text{—— ⑨}$$

$$p(e_0(\gamma))\, q'(x_0(\gamma)) = \gamma \quad \text{—— ⑩}$$

(Note that these are independent of wealth levels or outside option.)

We first show that the effort level and capital level are below the first best.

Write equation ⑨ as

$$p'(e_0(\gamma))\, q(x_0(\gamma)) = a$$

Then

$$\frac{de}{da} = \frac{p q''}{p'' q p q'' - (p' q')^2}$$

where $p'' q p q'' - (p' q')^2 > 0$ by concavity of $p(e)\, q(x)$ and $q'' < 0$ by concavity of $q(x)$.

Thus e reduces as a rises.

$a = 1$ is the first best level and with $\epsilon(e_0(\gamma)) > 0$, we have $e_0 < e^*$.

By equation (10)

$x_0 < x^*$.

c is given by the binding LLC,

$c_0 = (1-\tau) w$

r_0 then becomes,

$$r_0 = \frac{\epsilon(e_0)}{p'(e_0)} + (1-\tau) w > c_0 .$$

Finally we need to ensure that PC does not bind. This will also give us a range of v ~~when~~ for when this contract will be offered.

Using the binding LLC, the PC can be written as,

$$\frac{p(e_0)}{p'(e_0)} - e_0 \geq v$$

As $p(e)$ is strictly concave, $\frac{p(e)}{e} > p'(e)$ (AP > MP).

Also $\frac{p(e)}{p'(e)} - e$ is strictly increasing for $e > 0$.

To see this, differentiate wrt e.

$$\frac{p'(e)p'(e) - p(e)p''(e)}{(p'(e))^2} - 1$$

$$= \epsilon(e) > 0 .$$

Hence any $e_0(\gamma) > 0$ will define a $\underline{v}(\gamma)$ given by $\underline{v} = \frac{p(e_0)}{p'(e_0)} - e_0$, such that for any $v < \underline{v}$ the PC will not be binding and hence the contract derived above is indeed feasible and optimal. As $e_0 > 0$, it ~~fact~~ follows that $\underline{v} > 0$.

Case IV : Both bind.

Proceeding as in case III, we get

$c_0 = (1-\tau)w$

Also the binding PC gives, (like in last step),

$$\frac{p(e)}{p'(e)} - e = v$$

From last case, we know that this is positive and increasing. Define $f(v)$ as the solution for e which solves the binding PC.

Now

$$\frac{\partial f}{\partial v} = -\frac{f_v}{f_e} = \frac{-(-1)}{\frac{(p'(e))^2 - p'(e)p_e}{(p'(e))^2} - 1}$$

$$= -\frac{(p'(e))^2}{p(e)\,p''(e)} = \frac{1}{\epsilon(e)} > 0$$

As $f(\bar{v}) = e^*$ and $f(v)$ is strictly increasing for all $v \leq \bar{v}$, we know that the optimal contract satisfies $e = f(v) < e^*$.

from the FOC

$$p(f(v))\, q'(g(v, \gamma)) = \gamma \quad \text{—(11)}$$

when $f(v) < e^*$ $x < x^*$. {q is concave and q' is decreasing in x}

Also from equation (11)

$$\frac{\partial g}{\partial v} = -\frac{F_1}{F_2} = -\frac{p'(f(v))\, f_v\, q'(\cdot)}{p(f(v))\, q''(g(\cdot))} > 0 \quad \{\text{only } q'' < 0\}$$

Thus g is increasing in v.

To see its behaviour wrt γ, differentiate wrt γ.

$p(f(\theta))\, q''(g(\theta,\gamma))\, g_\gamma = 1$

$$g_\gamma = \frac{1}{p(f(\theta))\, q''(g(\theta,\gamma))} < 0$$

Thus decreasing in γ.

The value of r is given by,

$$r = \underbrace{q(g(\theta,\gamma)) - \frac{1}{p'(f(\theta))}} + (1-\tau)w$$

For $r > c$, this will have to be > 0.

suppose not, i.e.

$q - \frac{1}{p'} = 0$ {as $r \geq c$ always}

Then the first best will be implemented.

However, $e = f(\theta) \neq e^*$. CONTRADICTION.

This case is the one where both constraints bind. From the last two cases we know that when $\theta \geq \bar{\theta}$ or $\theta \leq \underline{\theta}$ one of the constraint does not bind.

Thus in this case,

$$\theta \in [\underline{\theta}(\gamma), \bar{\theta}(\gamma)]$$

The surplus in the three cases is given by,

$$S(\upsilon,\gamma) \equiv \begin{cases} S^*(\gamma), & \upsilon \geq \bar{\upsilon}(\gamma) \\ p(f(\upsilon))q(g(\upsilon,\gamma)) - f(\upsilon) - \gamma g(\upsilon,\gamma), & \upsilon \in (\underline{\upsilon}(\gamma),\bar{\upsilon}(\gamma)) \\ p(f(\underline{\upsilon}))q(g(\underline{\upsilon},\gamma)) - f(\underline{\upsilon}) - \gamma g(\underline{\upsilon},\gamma), & \upsilon \leq \underline{\upsilon} \end{cases}$$

Lemma 1

Suppose Assumption 1 holds. Then

1. $S(\upsilon,\gamma) > 0$ for any $\upsilon \geq 0$;
2. $S(\upsilon,\gamma)$ is strictly increasing in υ, with slope less than 1, for $\upsilon \in (\underline{\upsilon}(\gamma),\bar{\upsilon}(\gamma))$, constant at $S(\underline{\upsilon}(\gamma),\gamma)$ for $\upsilon \leq \underline{\upsilon}(\gamma)$, and constant at $S^*(\gamma)$ for $\upsilon \geq \bar{\upsilon}(\gamma)$;
3. $S(\upsilon,\gamma)$ is everywhere strictly decreasing in γ.

- Since effort $f(v)$ is increasing in v when the participation constraint is binding, and it is undersupplied relative to to the surplus maximizing level, $S(v,\gamma)$ is strictly increasing in v for $v \in [\underline{v}(\gamma), \bar{v}(\gamma)]$.
- If the participation constraint is not binding or the first best is attainable then surplus is constant with respect to v.
- Also as the amount of loan is decreasing in γ, so is $S(v,\gamma)$.

PROOF OF LEMMA 1

(i) $S(\varphi, \gamma) > 0$ for any $\varphi \geq 0$.

Note that

$$S(\varphi, \gamma) = p(e_0)\, q(x_0) - \gamma x_0 - e_0 ,$$

where (e_0, x_0) are as defined in case III

By concavity

$$p(e_0)\, q(x_0) \geq p'(e_0)\, q(x_0)\, e_0 + p(e_0)\, q'(x_0)\, x_0$$

By the FOCs of case III,

$$p'(e_0)\, q(x_0)\, e_0 = e_0 + \epsilon(e_0)\, e_0$$

and $p(e_0)\, q'(x_0)\, x_0 = \gamma x_0$

Hence $S(\varphi, \gamma) \geq \epsilon(e_0)\, e_0 > 0$ as long as $e_0 > 0$, which is alway true (Case III).

As S is increasing in φ (proved below),

$S(\varphi, \gamma) > 0 \quad \forall \varphi$

(ii) $S(\varphi, \gamma)$ is strictly increasing in φ, with slope less than 1, for $\varphi \in (\underline{\varphi}(\gamma), \overline{\varphi}(\gamma))$, constant at $S(\underline{\varphi}(\gamma), \gamma)$ for $\varphi \leq \underline{\varphi}(\gamma)$ and constant at $S^*(\gamma)$ for $\varphi \geq \overline{\varphi}(\gamma)$

PROOF Note that,

~~$\frac{\partial S}{\partial \varphi} = p'(f(\varphi))\, f'(\varphi)\, q'(g(\varphi, \gamma))\, g_\varphi$~~

$$\frac{\partial S}{\partial \varphi} = p'(f(\varphi))\, f'(\varphi)\, q(g(\varphi, \gamma)) + p(f(\varphi))\, q'(g(\varphi, \gamma))\, g_\varphi - f'(\varphi) - \gamma\, g_\varphi(\varphi, \gamma)$$

$$= (p' q - 1)\, f'(\varphi) + \underbrace{(p q' - \gamma)}_{= 0 \text{ from FOC}}\, g_\varphi$$

$$= \left(p'(f(\varphi))\, q(g(\varphi, \gamma)) - 1\right) f_\varphi(\varphi)$$

For $\theta > \bar{\theta}(\gamma)$,

$$p'(e^*)\, q(x^*(\gamma)) = 1 \quad \text{and thus}$$

$S_\theta = 0$

and S is constant at $s^*(\gamma)$

Similarly when $\theta < \underline{\theta}(\gamma)$ the capital and effort level are independent of θ at (e_0, x_0). Thus for $\theta < \underline{\theta}(\gamma)$

$S_\theta = 0$.

Now consider the case $\underline{\theta} \le \theta \le \bar{\theta}$.

From the previous proof we know that,

$$p'(f(\theta))\, q(g(\theta, \gamma)) > 1 \quad \text{and} \quad f_\theta(\theta) = \frac{1}{\epsilon(e)} \quad \text{— ①}$$

Also at $\theta = \underline{\theta}$ we have $p'(f(\underline{\theta}))\, q(g(\underline{\theta}, \gamma)) - 1 = \epsilon(f(\underline{\theta}))$

{$\lambda = 0$ and first FOC}

Thus $S_\theta = \epsilon(f(\theta))\, f_\theta(\theta) = 1$

The expression can be rewritten as (using ①)

$$\frac{p'(f(\theta))\, q(g(\theta, x)) - 1}{\epsilon(e)}$$

Consider the numerator,

$$\frac{\partial(\text{NUMERATOR})}{\partial \theta} = p'' f_\theta q + p' q' g_\theta$$

Using the expression of g_θ derived in last proof,

$$= p'' f_\theta q + (p' q')\left(\frac{-p' q' f_\theta}{p q''}\right)$$

$$= \frac{[p'' q p q'' - (p' q')^2] f_\theta}{p q''}$$

The term in square brackets is positive by concavity of pq. $f_\theta > 0$ from last proof. $p > 0$ by assumption. q is concave and hence the numerator is decreasing

Also we know that the denominator $E(e)$ is non decreasing. Thus the ratio is less than one for $e > \underline{e}$. (As $e \to \bar{e}$, $S(e) \to 0$).

(iii) To show the third part, differentiate wrt γ,

$$\frac{\partial S}{\partial \gamma} = p(f(e))\, q'(g(e,\gamma))\, g_e - g(e,\gamma) - \gamma g_e$$

$$= \left(p(f(e))\, q'(g(e,\gamma)) - \gamma\right) g_\gamma(e,\gamma) - g(e,\gamma)$$

$$= -g(e,\gamma). \quad \{\text{from FOC } 2\}$$

This expression is negative for all $e \geq 0$ and $\gamma \geq 0$.

Market Equilibrium

- In the market setup, lenders compete to attract borrowers by posting contracts (r, c, x), described by Proposition 1 and 2. Borrowers pick the lender that gives them the highest expected utility.
- Outside option is given by expected utility from the other contract.
- Let the market equilibrium payoffs for the borrower from efficient and inefficient lender be $u_{\underline{\gamma}}$ and $u_{\bar{\gamma}}$, and profits for the lenders be $\pi_{\underline{\gamma}}$ and $\pi_{\bar{\gamma}}$.
- Because the contractual terms are characterized by Proposition 1 and 2, the payoffs of the borrowers and lenders must exhaust the available surplus and hence solve:

$$S(u_{\bar{\gamma}} + (1-\tau)w, \underline{\gamma}) = \pi_{\underline{\gamma}} + u_{\underline{\gamma}} \tag{7}$$

$$S(u_{\underline{\gamma}} + (1-\tau)w, \bar{\gamma}) = \pi_{\bar{\gamma}} + u_{\bar{\gamma}} \tag{8}$$

- Now define $\bar{u}$, from (8), as the maximum utility that the high-cost lender can offer consistent with him making non-negative profits.
- The lenders will compete upto this point (Bertrand competition), with the intensity of competition given by $\bar{\gamma} - \underline{\gamma}$.

Proposition 3

In a market equilibrium, the least efficient lender makes zero profit and the borrower borrows from the efficient lender. For borrower utility, there are two cases:

1. If competition is weak enough, he receives his efficiency utility level from the efficient lender.
2. If competition is intense enough, the the borrower receives his outside option available from the inefficient lender.

- If there is little competition, the lender captures most of the surplus and the borrower is driven down to his efficiency utility.
- If the efficient and inefficient lender have similar cost of funds, most of the surplus is captured by the borrower and the efficient lender make small profits.

Proof of proposition 3

- In equilibrium high cost lender makes zero profit. Suppose not, i.e., $\pi_{\bar{\gamma}} > 0$. Then $u_{\bar{\gamma}} \geq u_{\underline{\gamma}}$. By lemma 1, $S(u_{\bar{\gamma}} + (1-\tau)w, \underline{\gamma}) > S(u_{\underline{\gamma}} + (1-\tau)w, \bar{\gamma})$. Thus the more efficient lender can offer $u_{\bar{\gamma}}$ and make a strictly positive profit. Therefore in equilibrium, we must have $\pi_{\bar{\gamma}} = 0$.
- We first show that PC binding is equivalent to $\bar{u} + (1-\tau)w \geq \underline{\upsilon}(\underline{\gamma})$.
- First assume that the PC is binding in equilibrium as far as the low cost lender is concerned, that is, $u_{\bar{\gamma}} + (1-\tau)w \geq \underline{\upsilon}(\underline{\gamma})$.Then by the previous argument $u_{\underline{\gamma}} = u_{\bar{\gamma}}$ and $u_{\bar{\gamma}}$ will be given by $\bar{u}$.
- Conversely, assume that $\bar{u} + (1-\tau)w \geq \underline{\upsilon}(\underline{\gamma})$. Then it cannot be the case that the efficient lender offers a contract that gives utility smaller than $\bar{u}$ to the borrower as this would allow the inefficient lender to make a profit.

- Note that $\bar{u}((1-\tau)w, \bar{\gamma})$, which is decreasing in $\bar{\gamma}$.
- The PC is binding iff $\bar{u} + (1-\tau)w \geq \underline{v}(\underline{\gamma})$. As $\bar{u}$ is decreasing in $\bar{\gamma}$, for $\bar{\gamma}$ small enough the inequality will hold giving us Case 1.
- Case 2 for $\bar{\gamma}$ large.

The Model at Work

We now explore what happens when τ is reduced so that more wealth can be used as collateral.

Implications for Credit Contracts

We first consider what happens to credit contracts as τ varies.There are two underlying effects working: a **limited liability effect** and a **competition effect**.

- The limited liability effect comes from the fact that as τ falls, more wealth can be collateralized and liability of borrowers for losses incurred is greater.
- The competition effect works through the outside option of the borrower.

Proposition 4

Suppose that property rights improve so that more collateral can be pledged by borrowers. Then the impact depends on which of the following two cases are relevant:

1. If the outside option is binding $v \geq \underline{v}(\gamma)$, the limited liability and competition effects operate in the same direction, increasing lending and borrower effort, and reducing interest payments.
2. If the outside option is not binding, then neither the limited liability nor the competition effect is operative. Lending and effort do not increase but interest payments are higher.

- **Case I**: Higher liability on the part of the borrower allows the lender to offer a larger loan. Because effort and capital are complements, expected output increases too. The limited liability effect is further reinforced by a competition effect that operates because the outside option, $\bar{u}$, also increases. This also increases lending and expected output.
- Competition effect works iff the participation constraint of the borrower w.r.t. to the outside lender is binding. We know that participation constraint binds if the competition is strong enough. As for the inefficient lender the competition is always strong, the PC always binds and competition effect always works in this case.
- **Case II**:If the borrower earns an 'efficiency utility' which exceeds his outside option, things are different. Increasing property rights can increase the power of the lender who can force the borrower to put up more of his wealth as collateral and pay a higher interest rate.

Proof

- Consider $\upsilon < \underline{\upsilon}(\gamma)$. Consider the contract defined in Proposition 2. Both x and e are independent of τ but r is decreasing in τ.
- Consider $\upsilon \geq \underline{\upsilon}(\gamma)$. Both x and e are increasing in υ and υ is decreasing in τ. Thus increasing property rights increases effort and amount of loan offered. The effect on $\frac{r}{x}$ is unclear a priori. However, under certain sufficient condition it can be shown to reduce with improving property rights. (Footnote 13)

Implications for Welfare

- To evaluate welfare, one needs to take a stance on the weight that is attached to the utility of the borrowers and lenders. Let λ denote the relative weight on the welfare of borrowers. The welfare function then is:

$$W(\tau; \lambda) = (\lambda - 1)u + S(u + (1 - \tau)w, \gamma)$$

- The case $\lambda \geq 1$, corresponds to the one where there is greater concern for the borrowers' welfare compared to the profits made by the lender.

Proposition 5

When the property rights improve

1. If competition is intense enough, welfare is increasing for all values of λ. Moreover, borrowers and the efficient market lender are both strictly better off.
2. If competition is intense enough, the outside option is not binding and for λ greater than or equal to 1, welfare is decreasing.

- In the first case the total surplus increases and with sufficient market competition, most of this goes to the borrowers who are therefore strictly better off. Some part of this increase goes to the efficient lender who is also made strictly better off.
- In the latter case the lender has the market power and poor borrowers receive an efficiency utility. With better property rights the lender is able to demand more wealth as collateral.
- However this is a pure transfer - no change in surplus. Thus any welfare which puts more weight on the borrower will register a welfare reduction.

- These results emphasize the complementarity between market competition and market supporting reforms to improve property rights.
- In the absence of market competition it may be optimal to keep property rights under developed.
- We assume exogenous market competition. Improving property rights may itself improve competition. Improving property rights increases lender profits which may stimulate entry into the market.

Proof of Proposition 5

Case I: We show that both efficient lenders and the borrowers are strictly better off.

- For competition intense enough the PC of the borrower will bind. In this case the borrower makes his outside option, which is decreasing in τ. Thus improving property rights (decreasing τ) makes the borrower better off.
- Consider the lender. His profits are given by

$$\pi(z) = S(z, \underline{\gamma}) - S(z, \bar{\gamma})$$

where, $z \equiv \bar{u}((1-\tau)w, \bar{\gamma}) + w(1-\tau)$. Now $\frac{\partial \pi(z)}{\partial z} = S_1(z, \underline{\gamma}) - S_1(z, \bar{\gamma})$ which is positive if $S_{12} < 0$. This is indeed the case as by using Envelope theorem we have (use expression of S defined in Lemma 1):

$$\frac{\partial S}{\partial \gamma} = -g(\upsilon, \gamma) \qquad \frac{\partial^2 S}{\partial \gamma \partial \upsilon} = -g_\gamma(\upsilon, \gamma) < 0$$

Case II: This follows directly from part 2 of Proposition 4. Effort level and lending do not change but the borrower now pays a higher interest rate. Hence, his utility goes down. More formally, utility of the borrower in this case is,

$$u = p(e_o)q(x_o) - p(e_o)\rho - (1-\tau)w - e_o$$

which decreases as the property rights improve. The higher interest payment increases the payoff to the lender on a one to one basis, however as we put more weight on the utility of the borrower, the welfare goes down.

Application

One way to measure De Soto effect will be to look for a exogenous policy change, and its impact on loan size, interest rates etc. However, under such an exercise it will be difficult to account for the following three sources of heterogeneity:

- Comparative static results above are local, i.e., for a small change in τ. However a policy change may result in a large change, even a flip between cases.
- Results derived above are for a specific wealth level.
- Depends upon degree of competition in the market.

Therefore, the study estimates the parameter values from Sri Lankan data and uses that to study the quantitative impact of changing property rights.

Baseline results

This is the case when the outside option is autarky, that is, $\bar{u} = 0$.

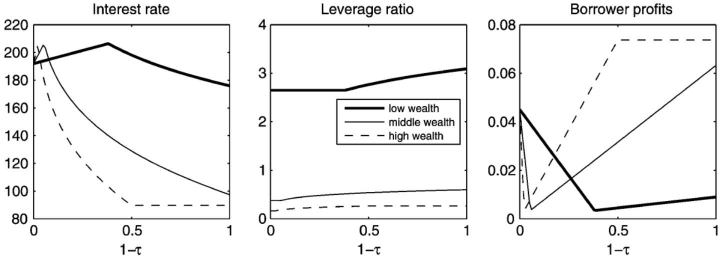
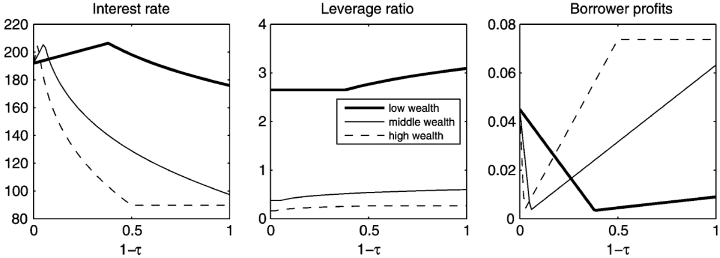


Figure shows the predicted interest rate, $(\frac{r}{x} - 1)/100$, the leverage ration, $\frac{x}{w}$, and the borrower's profit, $p(e)(q(x) - r) - (1 - p(e))c$, as a function of the extent to which capital can be collateralized as measured by $(1 - \tau)$. They are shown for three wealth levels.

Impact on interest rate

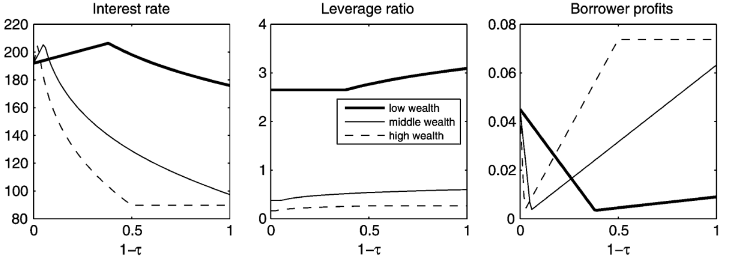
Impact on interest rate



Initially at low levels of $(1-\tau)$ it rises, and then falls. This happens as $\upsilon(\equiv (1-\tau)w + u)$, moves from being less than $\underline{\upsilon}$ to being greater than it.

Impact on leverage ratio

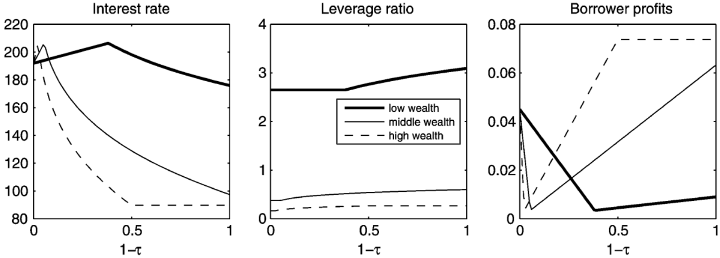
Impact on leverage ratio



Initially remains constant. This corresponds to the range of τ in which improvements in property rights only leads to an increased extraction of surplus by the lender.

Impact on Profits

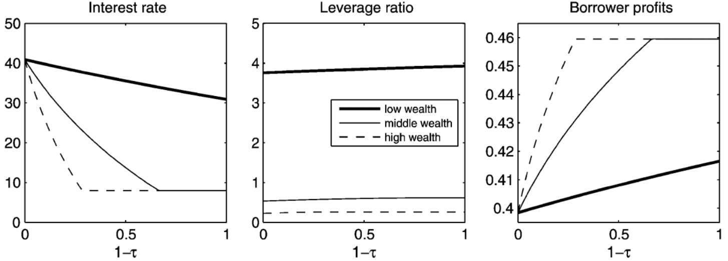
Impact on Profits

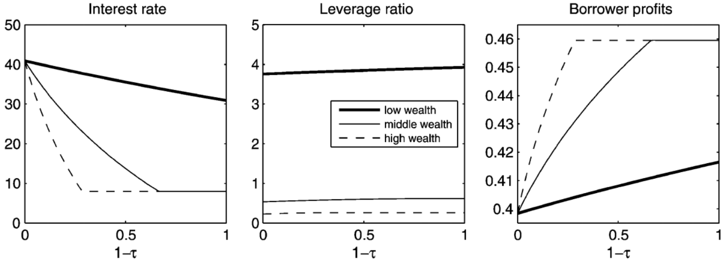


Increases through out for high and middle wealth groups. However for the poor, it is falling for high values of τ reflecting surplus extraction by the monopolistic lender.

With competition

Now consider the other extreme of perfect competition by allowing the other lender to also have the same cost of funds.





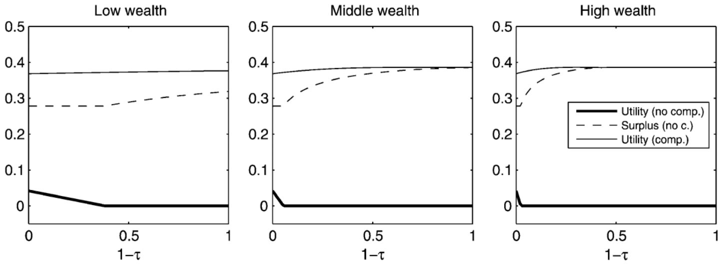
Note that:

- Interest rate is dramatically lower, compared to monopoly.
- Increases in leverage ratio are modest, suggesting that the primary effect is through increased effort.
- Profits are increasing for all values of τ.

Suggests that there are potentially high returns complementary reforms aimed at enhancing competition in the market and improving property rights as opposed to focusing on the latter in isolation.

Welfare

Now the cost of effort is also taken into account.



Note that:

- Borrower's welfare falls in case of no competition, as expected.
- However the rise in welfare even in presence of competition is modest at 2%. Due to costs associated with higher effort level.

Conclusion

- Can be extended to include things like fixed costs and other forms of competition.
- Gains vary by initial wealth, extent of competition in the market and the initial level of effective property rights.
- Gains from increased effort rather than increased lending.An increase in measurable output may not be the same as an increase in economic welfare.
- **Overall, the analysis serves as reminder that when it comes to policy reform in environments with many institutional failures, there are unlikely to be any magic bullets, and policy reform needs to be assessed in light of the specific context and its features.**