The Mystery of Capital under Adverse Selection: The Net Effect of Titling Policies

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Abstract

In "The Mystery of Capital," Hernando de Soto advocates economic policies that enable poor agents to collateralize a larger fraction of their total wealth. This policy recommendation is supported by models in which debt transactions do not emerge due adverse selection, as in Akerlof (1970). However, under alternative assumptions on the distribution of agents' hidden types, debt market need not collapse even in the absence of collateral. We show that, in this context, titling policies are never Pareto improving and can actually reduce total investments and social welfare. In an economy with an operating (formal or informal) debt market, this policy reduces interest payments but exposes entrepreneurs to greater down-side risk if their project fails. It thus reduces the cross-subsidization inherent to a pooling debt market and discourages investments in high-risk high-return projects. *Keywords: Adverse selection, capital market, debt financing, collateral, mystery of capital. J.E.L. codes: O12, D82, G14.*

1 Introduction

In an influential book, de Soto (2000) advocates economic policies that enable the poor in developing countries to use a larger fraction of their total wealth to collateralize investments by providing them with title to their homes and land. This policy advice is Pareto improving in environments with adverse selection in which the absence of collateral coupled with a particular distribution of agents' hidden information eliminate credit transactions in equilibrium—e.g., Akerlof (1970). As a consequence, titling policies have received considerable attention in economics, and it is widely believed to be capable of increasing investments and welfare among the poor by promoting their access to credit. However, recent empirical evidence does not seem to fully support this thesis. For instance, Galiani and Schargrodsky (2006) analyze a natural experiment in the allocation of land titles in a poor suburban area of Buenos Aires and find that the average effect of this policy over credit access was weak.

This paper extends classic models of adverse selection in capital markets in order to address the land titling policy from a theoretical perspective. We rely on standard models of adverse selection such as Stiglitz and Weiss (1981), de Meza and Webb (1987), and Boadway and Keen (2006). Like in these papers, we make assumptions on the distribution of agents' hidden types in order to avoid the collapse of the credit market due to absence of collateral. We depart from their framework in two different ways. First we allow agents to hold arbitrary utility functions.[1] (Risk neutrality was assumed in the original models.) Second, we assume that a fraction of the agents' wealth cannot be invested or used as collateral due to legal restrictions or the absence of full property rights. The first departure is to emphasize that the results do not depend on risk neutrality, which need not be a sensible assumption for the environment analyzed by de Soto (2000). The second is a simple adaptation needed for investigating the effect of titling policies.

In this environment, we show that titling policies reduce the expected utility of agents endowed with projects with high reward and low probability of success. The rationale for this is as follows. In a debt-market equilibrium, lending contracts always require as much self-investment and collateral as possible. Therefore, entrepreneurs become exposed to greater down-side risk when more of their illiquid wealth is available to be pledged as collateral. This increased exposure to risk offsets the benefit from lower interest rates on loans with higher collateral and necessarily makes some entrepreneurs worse off. Investments in high-risk high-return projects decline and social welfare may decline as well.

An important point to be stressed is that our result does not depend on risk aversion or the lack of insurance against the project's failure. Our main point is related to the fact that projects with different characteristics are financed by the same debt contract with safe projects subsidizing risky projects. This cross-subsidization—intrinsic to the debt market—generates externalities that are absent in the conventional view that underlies de Soto's argument.

This reasoning sheds light on why de Soto's thesis is not universally valid and provides insights for empirical investigations of the impact of land titling. In particular, although the titling program does change the composition of investments, it need not affect the average treatment effect typically measured in randomized experiments.

[1]This extension is also found in our companion work Braido et al. (2009).

The remainder of this paper is organized as follows. Section 2 describes the model and discusses its equilibrium properties. In Section 3, we present a comparative static analysis showing how the equilibrium variables change when one changes the fraction of wealth that individuals are allowed to use as collateral. A numerical example is presented in Section 4. Finally, Section 5 serves as a brief conclusion.

2 Debt Market with Adverse Selection

Consider an economy populated by a mass of agents whose preferences are represented by an expected utility function with an increasing and continuously differentiable Bernoulli function $u : \mathbb{R}_+ \to \mathbb{R}$. Each agent is endowed with a project that requires one unit of capital if it is to be realized. Projects are characterized by their probability of success, $p \in (0, 1)$, and the magnitude of their return if they are successful, $R > 0$. If the project is unsuccessful, the return is zero. The returns on the individual projects are uncorrelated, and agents know the characteristics of their own projects, namely $(p, R) \in (0, 1) \times (0, \infty)$. Agents are also endowed with two types of assets: one illiquid, $H > 0$ (e.g., housing), and another available to be invested, $K \geq 0$ (e.g., cash).

As in Akerlof (1970), Stiglitz and Weiss (1981), de Meza and Webb (1987), and Boadway and Keen (2006), this economy has a debt market which is represented by a price-taking firm subject to a zero-profit condition. This financial firm can raise funds from outside investors at an exogenously risk-free rate $r \geq 0$. It costlessly observes whether a project is successful or not. It can also credibly threat to audit successful entrepreneurs who claim that their returns were too low to pay their debts.

The financial firm is aware that agents have private information about the characteristics of their projects, and it accesses the population distribution of (p, R). This is assumed to be given by a continuous probability function $F(p, R)$ with associated density $f(p, R) > 0$, $\forall (p, R) \in (0, 1) \times (0, \infty)$. As is stressed later, the assumption that $f(\cdot)$ is strictly positive over the entire domain guarantees the existence of an equilibrium with credit transactions even in the absence of collateral.

We assume that only a fraction $\alpha \in [0, 1]$ of agents' illiquid wealth, H, can be pledged as collateral in a loan. The complementary fraction cannot be used as collateral because of legal restrictions or the absence of full property rights. We also assume that the amount of collateral that can be pledged does not meet the financial needs of individuals, i.e., $0 \leq K + \alpha H < 1$. Therefore, projects are always risky for the financial firm.

All lending contracts are anonymous and require entrepreneurs to invest $k \in [0, K]$ directly into the project and to pledge $h \in [0, \alpha H]$ as collateral. Borrowers bear an interest rate $i \in \mathbb{R}$ over the total amount borrowed, namely, $1 - k$. The vector $\theta \equiv (k, h, i)$ is endogenously determined in equilibrium.

Agents can invest any fraction of their liquid wealth in the safe asset which pays r. Those who decide to finance their projects are called entrepreneurs. When the project fails, the entrepreneur's consumption is given by:

$$c_l \equiv (K - k)(1 + r) + (H - h). \tag{1}$$

On the other hand, when the project succeeds, the entrepreneur consumes:

$$c_h \equiv (K - k)(1 + r) + \max(0, R - (1 + i)(1 - k)) + H. \tag{2}$$

Agents who opt not to finance the project and to invest the liquid wealth in the safe asset obtain a secure amount of consumption:

$$\bar{c} \equiv (1 + r) K + H. \tag{3}$$

Notice that agents whose projects display $R < (1 + i)(1 - k)$ never apply for loans for, if this were the case, they would consume less than $\bar{c}$ in both states of nature (success and failure). Therefore, without loss of generality, we can rewrite equation (2) as:

$$c_h = (K - k)(1 + r) + R - (1 + i)(1 - k) + H. \tag{4}$$

For each $\theta \equiv (k, h, i)$, the entrepreneur's expected utility is given by:

$$EU_\theta \equiv pu(c_h) + (1 - p) u(c_l). \tag{5}$$

Agents prefer debt financing their projects to investing in the safe asset whenever:

$$EU_\theta \geq u(\bar{c}). \tag{6}$$

The lender's profit function is represented by:

$$\pi(\theta) \equiv \bar{p}_\theta (1 + i)(1 - k) + (1 - \bar{p}_\theta) h - (1 + r)(1 - k), \tag{7}$$

where

$$\bar{p}_\theta \equiv E\left[p \mid EU_\theta \geq u\left(\bar{c}\right)\right] \tag{8}$$

is the average probability of success over all debt-financed projects.

Remark 1 *The conditional expectation in (8) is well-defined thanks to the assumption that* $f\left(p,R\right) > 0$*, for any* $(p,R) \in (0,1) \times (0,\infty)$*. To see this, define the set of projects that are debt financed as* $B\left(\theta\right) \equiv \left\{(p,R) \in (0,1) \times (0,\infty) : EU_\theta \geq u\left(\bar{c}\right)\right\}$*. This set is non-empty, for any* $\theta \equiv (k,h,i) \in [0,K] \times [0,\alpha H] \times \mathbb{R}$*. Moreover, since* $f\left(\cdot\right) > 0$*,* $B\left(\cdot\right)$ *is also non-null with respect to* F*. The result follows then from the monotone convergence theorem, since* $0 < p < 1$*.*

For each fixed $\theta \equiv (k,h,i)$, the locus of points (p,R) satisfying condition (6) is given by the convex upper-contour set—namely, the area above the line displayed in Figure 1. The frontier of this set is implicitly defined by a continuous and differentiable function $\bar{R}\left(p,\theta\right)$ such that, for each given θ, one has:

$$\frac{d\bar{R}}{dp} = \frac{u\left(c_l\right) - u\left(c_h\right)}{pu'\left(c_h\right)} < 0, \tag{9}$$

and

$$\frac{d^2\bar{R}}{dp^2} = \frac{u\left(c_h\right) - u\left(c_l\right)}{p^2u'\left(c_h\right)} > 0. \tag{10}$$

[Figure 1]

2.1 Equilibrium Concept

Let us now define a notion of equilibrium for this class of debt-market economies with adverse selection.

Definition 1 *A zero-profit price-taking equilibrium for this class debt-market economies with adverse selection is given by a vector* $\theta \equiv (k,h,i)$ *such that:*
(a) $\pi(k,h,i) = 0$*;*
(b) there is no vector $(k',h') \in [0,K] \times [0,\alpha H]$ *such that:*

$$\pi(k',h',i) > \pi(k,h,i). \tag{11}$$

The debt market is represented by a price-taking financial firm that is subject to a zero-profit condition. Condition (a) imposes zero profit in equilibrium. This is interpreted as if there were no barriers to entry, since it implies that no price-taking firm is interested in entering the market in equilibrium.[2] Moreover, since $\bar{p}_\theta \in (0,1)$ and $0 \leq k+h \leq K+\alpha H < 1$, condition (a) implies $i > r$ in equilibrium.

Condition (b) states that self-financing and collateral requirements are profit maximizing when i is taken as given. As is shown in Proposition 1, this condition implies that the financial firm will require entrepreneurs to use any available wealth as self-investiment or collateral—that is, $k = K$ and $h = \alpha H$.

Proposition 1 *One always has $k = K$ and $h = \alpha H$ in any zero-profit price-taking equilibrium for this class debt-market economies with adverse selection.*

Proof. One must have $i > r$ for profits not to be negative. For any given $i > r$, $\bar{p}_\theta = E\left[p \mid EU_\theta \geq u\left(\bar{c}\right)\right]$ is strictly increasing in (k,h). In words, when $i > r$ is taken as given, higher levels of h and k make the contract relatively less attractive to agents endowed with riskier projects. It follows from condion (b) that $h = \alpha H > 0$, since $\pi\left(k,h,i\right)$ is strictly increasing in h. Moreover, since $h > 0$ and $\bar{p}_\theta < 1$, the zero-profit condition implies $\bar{p}_\theta\left(1+i\right) < \left(1+r\right)$. Therefore, $k = K$ also follows from condition (b). ■

The next proposition presents a general existence result. This relies strongly on the assumption that $f\left(\cdot\right) > 0$. As stressed in Remark 1, this assumption implies that $\bar{p}_\theta$ is always well-defined and avoids the collapse of the debt market derived in Akerlof (1970).

Proposition 2 *There exists a zero-profit price-taking equilibrium for this class debt-market economies with adverse selection.*

Proof. Take $k = K$ and $h = \alpha H$ and notice that $\bar{p}_\theta$ is a bounded continuous function of i.[3] The result follows then from the intermediate value theorem. ■

It is important to stress that all of the equilibrium properties depend on the assumption that the financial firm (and potential entrants) take the interest rate as given. This simply amounts to saying that financiers recognize that they cannot raise the interest charged on

[2]To attract an entrepreneur, a price-taking entrant must set lower requirements for the entrepreneur's self-investment or collateral. However, this generates a loss when the interest rate is taken as given.

[3]Notice that $\bar{R}\left(p,\theta\right)$ is continuous and that $E\left[p \mid EU_\theta \geq u\left(\bar{c}\right)\right] = \frac{1}{\bar{F}(\theta)}\int_0^1\int_{\bar{R}(p,\theta)}^{\infty} pf\left(p,R\right)dRdp$, where $\bar{F}\left(\theta\right) = \int_0^1\int_{\bar{R}(p,\theta)}^{\infty} f\left(p,R\right)dRdp$.

a given contract, nor do they gain from lowering it. However, we acknowledge that our equilibrium concept does not allow financiers to design more sophisticated contracts to screen different entrepreneurs. In the Conclusion, we briefly discuss alternative equilibrium concepts in which general mechanisms could be used to screen projects. We emphasize that our results are specific to the price-taking set up in which heterogeneous projects are polled in a single debt contract. We believe this framework describes the characteristics of the debt markets in developing economies that de Soto was concerned about. That is, markets in which potential entrepreneurs have relatively little capital or collateral, and each individual loan is relatively small so that the fixed costs associated with designing and implementing complex loan contracts make such contracts prohibitively expensive.

3 The Effects of a Titling Policy

This section shows that a public policy that increases the fraction of wealth that can be pledged as collateral is never Pareto improving. Such a policy will benefit individuals endowed with low-risk projects and increase investments in this type of project. However, by eliminating cross-subsidization, this policy discourages the implementation of projects with low probability of success and high return in case of success, thus making some individuals worse-off.

We know from Proposition 1 that any zero-profit price-taking equilibrium displays $k = K$ and $h = \alpha H$. Thus, we replace $\theta \equiv (k, h, i)$ by (i, α) in our notation in order to make explicit the dependence of some variables on α. For instance, the debt-financing participation condition (6) becomes:

$$EU_{i,\alpha} \equiv pu\left(R - (1+i)(1-K) + H\right) + (1-p)\,u\left((1-\alpha)H\right) \geq u\left(\bar{c}\right). \tag{12}$$

We also have:

$$\bar{p}_{\theta} = \bar{p}_{i,\alpha} \equiv E\left[p \mid EU_{i,\alpha} \geq u\left(\bar{c}\right)\right]. \tag{13}$$

Moreover, the zero-profit condition is written as follows:

$$\bar{p}_{i,\alpha}\left(1+i\right)\left(1-K\right) + \left(1-\bar{p}_{i,\alpha}\right)\alpha H - \left(1+r\right)\left(1-K\right) = 0. \tag{14}$$

From Definition 1 and Proposition 1, any interest rate satisfying conditions (12) and (14), along with the required levels $k = K$ and $h = \alpha H$, defines a zero-profit price-taking equilibrium for this debt-market economy with adverse selection.

As before, condition (12) defines the set of debt-financed projects. The frontier of this set—represented by $\bar{R}(p,\theta) = \bar{R}(p,i,\alpha)$—is implicitly defined by the equality $EU_{i,\alpha} = u(\bar{c})$. For each level of p, the minimum return $\bar{R}$ for a project being debt financed changes according to the following equation:[4]

$$\frac{d\bar{R}}{d\alpha} = (1-K)\frac{di}{d\alpha} + \frac{(1-p)Hu'(c_l)}{pu'(c_h)}. \tag{15}$$

Leibnitz's rule applies, and $di/d\alpha$ can be derived from the zero-profit condition (14). For any finite $di/d\alpha$, one obtains from (15) that $d\bar{R}/d\alpha$ is positive for projects with p sufficiently close to 0. Thus, an increase in the fraction of collateralizable wealth increases the minimum required level of return for a project with a low probability of success.

Moreover, from the definition of $EU_{i,\alpha}$ in (12), one obtains:

$$\frac{dEU_{i,\alpha}}{d\alpha} = -pu'(c_h)(1-K)\frac{di}{d\alpha} - (1-p)u'(c_l)H. \tag{16}$$

Once again, for any finite $di/d\alpha$, one has:

$$\lim_{p\to 0}\frac{dEU_{i,\alpha}}{d\alpha} < 0. \tag{17}$$

Since $EU_{i,\alpha}$ is continuous on α, there exists a locus of debt-financed projects (p,R) such that $dEU_{i,\alpha}/d\alpha < 0$. Therefore, the welfare effect of a titling policy will be negative for agents endowed with projects with low probability of success and high return in case of success.

These results do not depend on risk aversion, although they are reinforced by it. Our point is still valid when $u'(c_l) \leq u'(c_h)$, but the quantitative effect is higher when $u(\cdot)$ is concave—and then $u'(c_l) > u'(c_h)$—as one can see from equations (15) and (16). Although risk aversion drives projects with low p away from the debt market, the key force behind our finding is the cross-subsidization implemented by a debt market that pools projects with different characteristics (p,R) into an identical contract.

Figure 2 illustrates how the main forces act. The effects of a titling policy can be decomposed as follows. For a given interest rate i, an increase in α rotates the frontier of the locus of debt-financed projects from the solid line representing $\bar{R}(p,i,\alpha)$ to the dashed

[4] When $\alpha = 0$ and $\alpha = 1$, $d/d\alpha$ refers to the right and left derivatives, respectively.

line representing $\bar{R}(p,i,\alpha')$, where $\alpha' > \alpha$. However, this policy also reduces the debt-financing interest rates and, thereby, shifts the frontier from the dashed line representing $\bar{R}(p,i,\alpha')$ to the stared line representing $\bar{R}(p,i',\alpha')$, where $i' < i$. The area above the solid line and below the stared line represents the mass of high-risk high-return projects that are canceled after the titling policy. The area below the solid line and above the stared line represents the mass of low-risk low-return projects that starts to be financed after the titling policy.

[Figure 2]

4 The Effects of Titling on Welfare and Investments: Simulation Results

We now perform numerical exercises to illustrate the results in this paper. We assume that entrepreneurs have a constant relative risk aversion utility function. With debt financing, the entrepreneur's expected utility is:

$$EU_{i,\alpha} = \frac{1}{1-\sigma}\left\{p\left[R-(1+i)(1-K)+H\right]^{1-\sigma}+(1-p)\left[(1-\alpha)H\right]^{1-\sigma}\right\}, \tag{18}$$

where σ is the coefficient of relative risk aversion, $0 \leq \sigma$, $\sigma \neq 1$. Entrepreneurs will prefer debt financing their project to investing K in the safe asset if the following condition hold:

$$\bar{R}(p,i,\alpha) = (1+i)(1-K) - H + \left[\frac{\left[(1+r)K+H\right]^{1-\sigma}-(1-p)\left[(1-\alpha)H\right]^{1-\sigma}}{p}\right]^{\frac{1}{1-\sigma}} \geq 0. \tag{19}$$

Note that $\bar{R}(p,i,\alpha)$ is decreasing in p and increasing in σ. Expected profits are zero when the average success rate on debt-financed projects is:

$$\bar{p}_{i,\alpha} = \frac{(1+r)(1-K)-\alpha H}{(1+i)(1-K)-\alpha H} \tag{20}$$

The market equilibrium was determined by computing the solution to equations (20), (21), and (22):

$$\bar{F}(i,\alpha) = \int_0^1 \int_{\bar{R}(p,i,\alpha)}^{\infty} f(p,R)\, dRdp, \tag{21}$$

$$\bar{p}_{i,\alpha} = \frac{1}{\bar{F}(i,\alpha)} \int_0^1 \int_{\bar{R}(p,i,\alpha)}^{\infty} pf(p,R)\, dRdp, \tag{22}$$

where $\bar{F}(i,\alpha)$ is the proportion of projects which are debt financed.

We perform a numerical simulation using a density function $f(p,R) = 1.25e^{-1.25R}$ and the following parameter values: $r = 0.05$, $\sigma = 0.90$, $H = 0.8$, and $K = 0.4$. With this density function, $\Pr(R > 1) = 0.287$, $\Pr(R > 2) = 0.082$, $E(p) = 0.5$, $E(R) = 0.80$, and $E(pR) = 0.40$. The proportion of the projects with positive net present values, evaluated at the risk-free rate of return, is 0.095. Table 1 shows the computed values of the key endogenous variables as a function of α. When $\alpha = 0$ and the entrepreneurs cannot use H as collateral, the market interest rate for loans is 0.441 and the proportion of projects financed is 0.090. The average success rate of these projects is 0.728.

We use the following social welfare function to evaluate the policy of increasing α:

$$SWF = \frac{1}{1-\zeta} \int \int \left[EU_{i,\alpha}\right]^{1-\zeta} f(p,R)\, dpdR, \tag{23}$$

where ζ is the coefficient of inequality aversion. (The utilitarian social welfare function corresponds to $\zeta = 0$.) Any level of social welfare can be expressed in terms of the equally distributed equivalent (EDE) level of wealth, where:

$$SWF = \frac{1}{1-\zeta} u\,(EDE)^{1-\zeta}. \tag{24}$$

The last three rows in the table indicate the EDE wealth levels for this equilibrium calculated with different levels of inequality aversion. The last column shows the computed equilibrium with $\alpha = 0.5$. Allowing half of the individual's illiquid assets H to be used as collateral reduces the equilibrium interest rate on loans to 0.133. However, the increased exposure to risk if the project fails reduces the proportion of projects that are financed to 0.068. In other words, total investment falls when entrepreneurs use half of their illiquid wealth as collateral for loans. Entrepreneurs with risky projects are especially discouraged from taking out loans, and therefore the success rate on loans increases to 0.822.

This effect is illustrated in Figure 3. When $\alpha = 0$, the projects with (p, R) values above the solid line would be financed. When $\alpha = 0.5$, the projects that are financed lie above the stared line. Although the stared line does not lie entirely above the solid line, and some project with high p and low R values are now undertaken when $\alpha = 0.5$, the main effect of the increase in α is to discourage investment by entrepreneurs with low p, high R projects. All individuals with projects that lie above the solid line and below the stared line are worse off with the increase in α. On the other hand, individuals with projects above the stared line are better off due to the decline in the interest rate on their loans. However, social welfare, as measured by the EDE wealth, declines when α increases, for all levels of inequality aversion. These simulations confirm the prediction of our model that titling property and allowing it to be used as collateral for loans always makes some entrepreneurs worse off, and that total investment may decline.[5]

Table 1

	$\alpha = 0$	$\alpha = 0.5$
Interest rate on loans, i	0.441	0.133
Proportion of projects financed, $\bar{F}$	0.090	0.068
Avg. probability of success of financed projects, $\bar{p}$	0.728	0.822
EDE Wealth $\zeta = 0$	1.253821	1.247367
EDE Wealth $\zeta = 0.5$	1.253393	1.247001
EDE Wealth $\zeta = 1.5$	1.252568	1.246294

Simulation results for: $f(p,R)$=$1.25e^{-1.25R}$, r=0.05, σ=0.90, H=0.8, and K=0.4.

[Figure 3]

5 Conclusion

In this paper we provide theoretical reasons to question whether de Soto's titling policy will result in real improvements for poor people in developing countries. The model is rather simplistic, though encompassing standard models of capital market imperfections arising from adverse selection—e.g., Stiglitz and Weiss (1981), de Meza and Webb (1987), and Boadway and Keen (2006). As such, our results should not be viewed as a definite answer to how policies should be designed but rather as a reminder that our current theoretical

[5] If the scale of the investment were variable, the decline in the interest rate might lead to an expansion in the scale of investment by those entrepreneurs who want to invest, and this might lead to an increase in total investment. In our model, however, each entrepreneur has a project with a fixed size. Therefore, the decline in the proportion of entrepreneurs that are willing to invest unequivocally leads to a decline in total investment.

knowledge of how capital markets function is not entirely aligned with the suggested policies.

The intuition behind our main point is simple. In environments without market imperfection, agents typically benefit from policies that increase their set of possible actions. However, it must be acknowledged that debt contracts demand collateral exactly because of market frictions, such as adverse selection. In pooling competitive markets with adverse selection, low-risk projects subsidize high-risk high-return projects (as they all pay the same interest rate). In this setting, an economic policy that increases the amount of wealth pledged as collateral for loans imposes a greater down-side risk on agents endowed with high-risk high-return projects.

We do not argue that our result remains valid in a contracting setting in which a general mechanism is used to screen projects. However, given the current state of the art, a general characterization of multi-dimensional screening models capable of providing useful insights regarding real world is not available. The crux of the matter is that in the multi-dimensional screening problem the lack of a natural (exogenous) ordering of types greatly increases the program's complexity. Even when a solution can be computed, results seem to be based on very specific additional assumptions about the environment. For instance, in an enlightening survey, Rochet and Stole (1987) show an algorithm that can be used to compute the solution for quasi-linear multi-dimensional screening problems. However, even in this case, robust qualitative results are hardly available.[6]

Given these theoretical considerations regarding general mechanisms, the competitive (zero-profit price-taking) paradigm seems to be a natural first step to analyze titling policies in developing economies. Our main finding shows that Hernando de Soto's thesis on titling policies is restricted to environments in which the debt market does not emerge due to adverse selection and the absence of collateral. However, in environments where a debt market already exists—as the one considered here—these policies are never Pareto optimal and may reduce total investments and social welfare.

[6] In considering the general contracting environment, we have referred to a multi-dimensional screening problem. However, although p is not observed, R may be. The assumption that R is *ex-post* observable raises new possibilities. For instance, with extreme punishments for an agent who misrepresents R in the contracting stage, a monopolist financial firm is able to separate entrepreneurs with different R's in different markets, and solve the unidimensional problem of screening agents with different p's. Without extreme punishments, however, this separation is no longer possible, since agents with very low p will have incentives to lie about R. Furthermore, if one allows for competition among multiple financial firms, then a pure strategy Nash equilibrium need not exist even in the case of market segmentation (i.e., the case where each R defines a different market). In fact, such equilibrium never exists if all agents participate, or if one does not impose additional assumptions on the conditional distribution of p—see the discussion in Riley (2001).

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Figure 1. Locus of Debt-Financed Projects

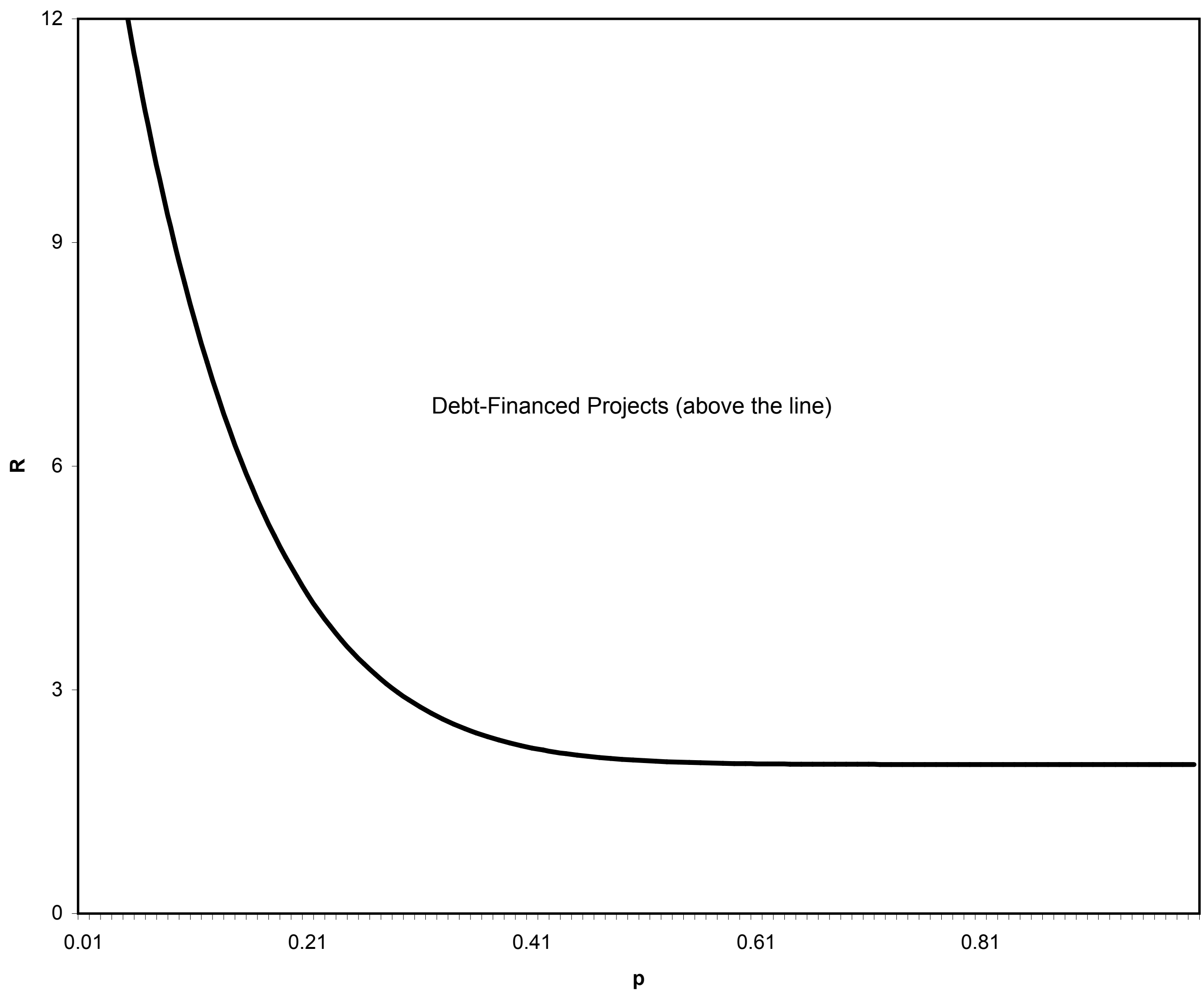

Figure 2. The Effects of a Titling Policy

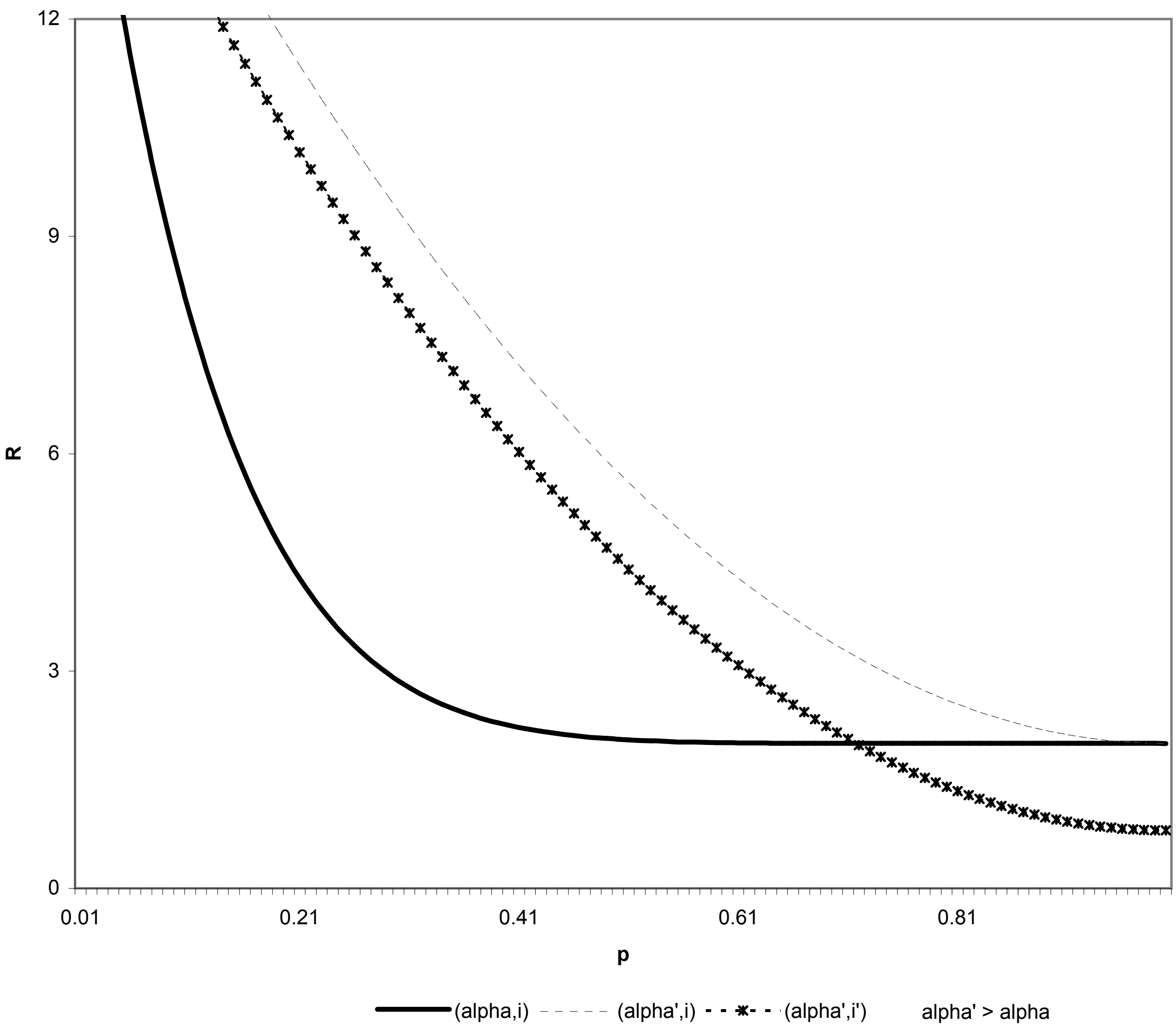

Figure 3. Numerical Illustration