Financial Markets Development and Economic Growth: A Tale of Information Frictions

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1.The empirical facts and the theoretical interpretation

1.1 Empirical Evidence

Empirical evidence clearly shows the existence of a positive correlation between capital accumulation and financial market development. Furthermore, many works also show that financial development is strongly correlated with the rate of economic growth.

These are the main stylised facts emerging by data analysis:

1. In the early stage of economic development, financial systems are almost absent or very rudimentary. Very limited transfer of resources occur, usually from and to individual lenders and borrowers, and essentially in the form of debt. Intermediation is completely absent.
2. As countries grow, financial systems are characterised by the prevalence of financial intermediaries over other forms of financial institutions. More sophisticated financial assets develop (for example early forms of futures). Banks dominates the financial system.
3. With further capital accumulation, stock markets and nonbank financial intermediaries develop rapidly. Banks tend to represent a correspondingly smaller share of the overall financial system.
4. As stock markets and nonbanks develop, the ratio of bank assets to GDP continues to grow.
5. In the last three decades, the development of stock markets has accelerated in many economies. Some have experienced explosive stock markets development (Indonesia, Turkey, Portugal, Venezuela etc.)

The following works are some of the empirical studies which focus on the general relationship between financial development and growth:
Goldsmith (1969), King and Levine, (1993a) (1993b), De Gregorio and Guidotti, 1995, Usai and Vannini, (1996), Gurley and Shaw (1955, 1960, 1967)

These are, instead, empirical analysis which have highlighted a strong correlation between stock market development and economic growth:
Atje and Jovanovich (1993), Demirgüç-Kunt and Levine (1996), Korajczyk (1996), Levine and Zervos (1996), (1998)

1.2 Theoretical Approach

The importance of financial markets for growth has long being recognised.

Walter Bagehot (1873) and John Hicks (1969) argued that financial development played a critical role in igniting industrialisation in England by facilitating the mobilisation of capital for "immense works."

Hicks (1969, pp.143-145) argued that the industrial revolution was not the immediate consequence of a set of new technological innovations, rather the consequence of financial innovations which allowed the implementation of this technological innovation on a large scale through large investments. Many products and technologies were already available decades earlier than the start off of the industrial revolution. Capital liquidity allowed these technologies to be extensively applied.

Joseph Shumpeter (1912) contends that well-functioning banks spur technological innovation by identifying and funding those entrepreneurs with the best chances of successfully implementing innovative products and production processes.

One of the major channel through which economists have recently focused on explaining the relationship between financial market and economic growth is the possibility of increased specialisation brought about by financial development. The importance of specialisation, as a channel through which economic growth could ultimately be spurred, is well recognised by classical economists. Adam Smith (1776, p. 7) argued that division of labour (specialisation) is the principal factor underlying productivity improvements.

Improvements in resources allocation due to financial intermediation are often seen as reflecting improvements in the solutions to liquidity diversification and informational problems. The inability to pool risk or the existence of asymmetric information between lenders and borrowers may divert credit towards low-yielding investment projects and even generate credit rationing. Financial markets, by providing greater liquidity, offering greater opportunities for diversification, reducing the costs of monitoring and redirecting credit, can raise the marginal productivity of capital and stimulate growth. These are the aspects of intermediation that have occupied most attention in the literature on financial development and growth (Saint Paul, 1992, Bernanke and Gertler, 1989, Bencivenga and Smith, 1991, Levine 1991, Blackburn and Hung, 1998).

A fundamental element emerges from the theoretical literature:

Proposition 1.1 In an Arrow-Debreu framework, financial institutions play no role. In order to understand under which condition and through which channels financial markets can affect the real allocation of resources it is necessary to modify the Arrow-Debreu framework by introducing some frictions. This could be done by imposing various kind of transactions costs or to impose a structure of markets that is, exogenously, incomplete.

Proposition 1.2 It is also possible to modify the Arrow-Debreu framework by introducing information asymmetries. In economies with information asymmetries the structure of contracts and institutions will generally matter for allocations. More importantly, with information asymmetries the structure of the financial markets can be endogenously determined and explained.

The fundamental role of information distribution in determining the allocation of resources towards higher or lower productive investments was well known to classical economists. Bagehot (1873, p. 53) recognised a greater "capacity" of English financial system to allocate resources in the best way:

"[England's financial organisation is so useful because it is so easily adjusted. Political economists say that capital sets towards the most profitable trades, and that it rapidly leaves the less profitable non-paying trades. But in ordinary countries this is a slow process, . . . In England, however, . . . capital runs as surely and instantly where it is most wanted, and where there is most to be made of it, as water runs to find its level".

The theoretical literature on finance and growth has grown considerably in the last years and, correspondingly, there have been some studies that have tried to review and systematically order the different contributions to this literature (Levine, 1997; Becsi and Wang, 1997). However, as far as we know, there has been no attempt to review the most recent literature on information asymmetry, financial development and economic growth. Given the fact that in a framework where informational frictions play a crucial role, the financial structure is determined endogenously, it looks important and useful to concentrate on these theoretical works. Moreover, the result of endogenously determined financial structure, together with the assumption of imperfect information distribution, gives to this literature stronger flavours of classical ideas.

We will follow an analytical exposition of some basic models, concentrating the attention on frameworks that explain the general interrelationship between finance and growth (the first two models) and the most recent works on the co-evolution of stock market and growth (the last two models).

2. Who's Who? A model with adverse selection and credit rationing. Based on Bencivenga, V.R. and Smith, B. (1993) [B-S (93)]

2.1 The Microeconomic Framework

The following are the main assumptions of the model:

- infinite sequence of two period lived OG. Time is discrete.
- agents: borrowers (fraction 0,5 of population)
  lender (fraction 0,5 of population)
- fraction λ borrowers : project *H*-risk
  fraction 1- λ borrowers : project *L*-risk
- borrower's type is private information
- Young Agents: 1 unit of labour supplied inelastically
  Old Agents: no labour endowment
- Agents are risk neutral; borrower's intertemporal utility function $U(c_t,c_{t+1}) = c_{t+1}$; lender's intertemporal utility function $U(c_t,c_{t+1}) = c_{t+1}$
- Young borrower has an investment project
  (1 unit of labour + consumption good => capital)
  x output (at t) $\rightarrow$ Qx capital (at t+1) with prob p_i
  0 capital (at t+1) with prob 1-p_i
  where $1 \geq p_L > p_H \geq 0$
- Altenatively young borrower can supply labour to the market and store the output.

Borrower's storing technology

x output (at t) $\rightarrow$ $x\beta_i$ output (at t+1) $\beta_i \leq 1$

where $\beta_L / p_L > \beta_H / p_H$ (setting $\beta_H = 0$ is sufficient) (2.1)

- Lenders possess a storing technology

  1 output (at t) $\rightarrow$ 1 output (at t+1)
- production of output requires a minimum level of own capital, therefore only successful borrowers produce output in the second period according to:

  $$y_t = \bar{k}_t^{\delta} k_t^{\theta} L_t^{1-\theta} \quad (2.2)$$

  where $\bar{k}_t$ is the average per firm capital stock
- capital market and labour market are perfectly competitive and therefore factors are paid their marginal productivity. In equilibrium:

  $$w_t = (1-\theta) k_t L_t^{-\theta} \quad (2.3)$$

  $$\rho_t = \theta L_t^{1-\theta} \quad (2.4)$$

2.2 The Credit Market

Each borrower can contact only one lender (and conversely, so that in particular intermediation is ruled out). This assumption is necessary to bounds loan sizes.

Given that borrowers have different probability of success, fully informed lenders would charge different interest rate to different borrowers. In the specific higher risk borrowers (here type *H*) with lower expected return would pay a higher interest rate. In a framework with information asymmetries, however, different interests rate would give the incentive to *H* type borrower to imitate *L* type borrower.

In order to separate borrowers lender needs a way to make the contract designed for one type unattractive for the other. In Bencivenga and Smith, as in Rothschild and Stiglitz (1976), self selection is achieved by introducing a probability of denying credit.

Since borrowers have different alternative costs (in particular type *L* has a higher alternative costs than type *B*, eq. 2.1), lender can successfully separate borrowers by designing a contract which involves a probability of borrower being credit rationed.

At time t the lenders announce loan contracts specifying for each type i borrower:

R_{it} gross real rate of interest

q_{it} loan quantity offered

π_{it} probability of getting a loan

Competition drives lenders' profit to zero and, therefore, the optimal contract will be determined by the maximisation of borrower's expected utility

$$\underset{R,q,\pi}{Max}\ p_i \pi_{it} (Q \rho_{t+1} - R_{it}) q_{it} + (1-\pi_{it}) \beta_i w_t \quad (2.5)$$

subject to

incentive constraints (the contract designed for one type unattractive or indifferent to the other)

$$p_H \boldsymbol{p}_{Ht}(Q\boldsymbol{r}_{t+1} - R_{Ht})q_{Ht} + (1-\boldsymbol{p}_{Ht})\boldsymbol{b}_H w_t \geq p_H \boldsymbol{p}_{Lt}(Q\boldsymbol{r}_{t+1} - R_{Lt})q_{Lt} + (1-\boldsymbol{p}_{Lt})\boldsymbol{b}_H w_t \quad (2.6)$$
$$p_L \boldsymbol{p}_{Lt}(Q\boldsymbol{r}_{t+1} - R_{Lt})q_{Lt} + (1-\boldsymbol{p}_{Lt})\boldsymbol{b}_L w_t \geq p_L \boldsymbol{p}_{Ht}(Q\boldsymbol{r}_{t+1} - R_{Ht})q_{Ht} + (1-\boldsymbol{p}_{Ht})\boldsymbol{b}_L w_t \quad (2.7)$$

and the rationality constraint (lender's zero profit constraint)

$$p_i R_{it} = 1 \quad (2.8)$$

Features of the Optimal Contract:

1. The gross interest rate for each type is determined by the zero profit constraint (2.8);
2. since type H's repayment is higher and he has a lower alternative cost, he will never imitate L type and will never be imitated. Therefore, H type is not affected by consideration of self selection. Competition among lenders will imply that H type receive the best contract. Since (2.5) is increasing in π_{it} and q_t these will be set at maximum:
   $\pi_{Ht} = 1$ and $w_t = q_{Ht}$
3. the incentive constraint (2.6) is binding since the equilibrium contract for type L borrower must be maximal among all contracts satisfying this constraint;
4. since expected utility is increasing in the loan quantity and probability of rationing, lender will fix at the maximum the loan size $w_t = q_{Lt}$ while π_{Lt} will be determined by the incentive constraint (2.6):
   $$\boldsymbol{p}_{Lt} = \frac{p_H Q\boldsymbol{r}_{t+1} - 1 - \boldsymbol{b}_H}{p_H Q\boldsymbol{r}_{t+1} - (p_H / p_L) - \boldsymbol{b}_H} < 1. \quad (2.9)$$

Proposition 2.1: *The marginal productivity of capital and the equilibrium level of credit rationing are jointly determined.*

2.3 Interrelationship financial market-Economic Growth

From (2.9), it is clear that the level of credit rationing is an increasing function of the marginal productivity of capital, ρ_t. Contemporaneously, since the marginal productivity of capital depends on the labour per firm (2.4) and labour per firm depends on the level of credit rationing, the marginal productivity of capital depends, in turn, on the level of credit rationing. An increase on π decreases the equilibrium level of labour per firm and decreases the marginal productivity of capital. Therefore, the level of credit rationing and the marginal productivity of capital are jointly determined.

The equilibrium rate of growth will be:

$$k_{t+1}/k_t = Q(1-\boldsymbol{q})(\boldsymbol{r}/\boldsymbol{q})^{-\boldsymbol{q}/(1-\boldsymbol{q})} \quad (2.10)$$

Proposition 2.2: *The level of financial activity (measured as the level of credit rationing) and the real rate of growth are jointly determined. Policy actions that reduce the level of credit rationing can spur economic growth.*

In this model, interest rates on loans are determined entirely by the opportunity cost of funds to lenders and default probabilities. Forces related to supply and demand in credit markets play no role whatsoever.

In this model total savings are always constant (since every borrower either borrows w_t units or saves w_t units in the form of inventories of the consumption good). Thus the effects of programs that increase the availability of credit do not depend on them having any effect whatsoever on savings behaviour. Such effects would, of necessity, be of dubious empirical validity.

It may at first glance seem odd to have low risk borrowers be the rationed group. Mckinnon: “an important aspect of financial markets in underdevelped economies is that rates of return on some physical and financial assets are negative while extremely remunerative investment opportunities are forgone”.

3. Screening or rationing?
A model based on Bose and Cothren (1997) (1996)[B-C(97),(96)]

Assume now

- Young lenders: 1 unit of labour supplied inelastically
  Young borrowers: no labour endowment
  Old Agents: no labour endowment
- Lender’s possess a storing technology
  1 output (at t) $\rightarrow$ Qe capital (at t+1) where $0 < \varepsilon < 1$
  (this implies that borrower’s gross repayment will depend on the price of capital at time t+1)
- young borrowers if unfunded have access to a home production technology
  1unit of time $\rightarrow$ b_i output b_i £ 1
  where $b_L / p_L > b_H / p_H$ (3.1)
  (this implies that borrower’s alternative cost is fixed and does not depend on the wage level, as in B-S(93))
- all borrowers (successful and not successful) produce output in the second period according to:
  $$y_t = k_t^q L_t^{1-q} \quad (3.2)$$
  (Since only lenders supply labour and only borrowers produce output, the amount of labour per firm is fixed and equal to 1)
- capital market and labour market are perfectly competitive and therefore factors are paid their marginal productivity. In equilibrium:
  $$w_t = (1-q) k_t^q L_t^{-q} \quad (3.3)$$
  $$r_t = q k_t^{q-1} L_t^{1-q} \quad (3.4)$$

3.1 The credit market

The main innovation of B-C (97) is to allow lender to separate borrowers not only through rationing but also by screening. Through screening, lender can acquire information at a given cost and determine borrower’s type.

Borrower is screened with probability 1-f . If he is found to be H type as a penalty he will be denied the loan.

The cost of screening reduces the resources available to lender for loan. If the cost of screening is d, the amount available for loan will be $w_t/(1+d)$.

As in B-S (93) type H is not affected by self selection, therefore we can focus on type L borrower.

Problem for lender becomes:

$$\underset{R,q,p,f}{Max}\ f_t\left\{p_L p_{Lt}(Q r_{t+1} - R^n_{Lt})q^n_{Lt} + (1-p_{Lt})b_L\right\} + (1-f_t)p_L(Q r_{t+1} - R^s_{Lt})q^s_{Lt} \qquad (3.5)$$

s.t.

H borrowers' incentives constraints (we know L type never imitates H type)

$$p_H p_{Ht}(Q r_{t+1} - R^n_{Ht})q^n_{Ht} + (1-p_{Ht})b_H \geq f_t p_{Lt} p_H(Q r_{t+1} - R^n_{Lt})q^n_{Lt} + (1-f_t)b_H \qquad (3.5)$$

Lender's zero profit constraint:

$$f_t\left\{p_L p_{Lt}(Q r_{t+1} - R^n_{Lt})q^n_{Lt} + (1-p_{Lt})b_L\right\} + (1-f_t)p_L(Q r_{t+1} - R^s_{Lt})q^s_{Lt} = 0 \qquad (3.6)$$

Note if $\phi = 1$ we are back to B-S (93) framework

As in B-S type H is not distorted (it gets the best terms):
$q_{Ht} = w_t$ and $R_{Ht} = Qer_{t+1}/p_H$

For type L, it is easy to show that there will be either rationing or screening but not a combination of the two. Therefore

when $1 > f_t > 0$, $p_{Lt} = 1$ (only screening)
when $f_t = 1$, $1 > p_{Lt} > 0$ (only rationing)

Two possible financial contract: one with credit rationing, the other with screening.

1. $\beta^* \equiv Qw_t\rho_{t+1}(p_L-\varepsilon)/(1+\delta) > \beta_L$ => <u>credit screening</u> (3.7)

With terms
$f = f_t = 1 - (1/p_H - 1/p_L)\varepsilon$; $R^n_{Lt} = Qer_{t+1}/f p_L$; $R^s_{Lt} = 0$; $q^n_{Lt} = w_t$; $q^s_{Lt} = w_t/(1+d)$

2. $\beta^* \equiv Qw_t\rho_{t+1}(p_L-\varepsilon)/(1+\delta) < \beta_L$ => <u>credit rationing</u> (3.8)

With terms
$p = p_{Lt} = (1-\varepsilon/p_H)(1-\varepsilon/p_L)$; $R^n_{Lt} = Qer_{t+1}/p_L$; $q^n_{Lt} = w_t$;

Proposition 3.1: *Prevalence of one type of financial contract or the other depends on the marginal productivity of capital and wage rate.*

Intuition: when gross return from project is large, rationing will be more costly. Moreover the screening cost for unit of intermediated funds will decrease.

Proposition 3.2: *The interest rate on loan depends on the marginal productivity of capital, while probability of monitoring and probability of screening are given exogenously.*

3.3 Interrelationship financial market-Economic Growth

The contract's form depends on the wage rate and the marginal product of capital, and hence on time t and time t+1 capital stock. On the other hand, time t+1 capital stock and marginal product of capital depend on the contract form at time t. In fact, screening reduces the amount of resources available for productive investment, and so does rationing, as in B-S (93). Therefore we have two possible capital accumulation paths corresponding to two financial contracts.

For a given k_t it is easy to show that:

under rationing $\beta^* = \beta^*_r(k_t) > \beta^* = \beta^*_s(k_t)$, under screening

Three cases to consider:

Case 1: $\beta_L > \beta^*_r(k_t) > \beta^*_s(k_t)$ => rationing contract (prevailing for low level of k_t)

If this case prevails, the interest rate is ρ^r_{t+1}, the optimal contract is the rationing and no lender wants to deviate. If lenders offer a screening contract, then the interest rate is ρ^s_{t+1} and given that $\beta_L > \beta^*_s(k_t)$ agents want to deviate.

Case 2: $\beta^*_r(k_t) > \beta^*_s(k_t) > \beta_L$ => screening contract (prevailing for high level of k_t)

Case 3: $\beta^*_r(k_t) > \beta_L > \beta^*_s(k_t)$ => no pure strategy equilibrium exists (prevailing for intermediate level of k_t) Agents randomise and we have a mix of regimes

Proposition 3.3: *Financial market structure depends on the level of capital accumulation. For low level of capital accumulation a rationing regime prevails. As growth occurs, the economy goes from a stage where two financial contracts coexist to a regime with only screening. The changes in the financial regime push the economy onto a higher capital accumulation path and spurs temporarily the rate of growth.*

4. The co-evolution of stock market and economic growth: the need to modify the standard costly verification framework.

Boyd and Smith (1998) [B-S (98)]

Agency problem: lender cannot observe the result of the production process unless he pays some monitoring costs (costly state verification, CSV, problem).

The standard solution of literature (Townsend, 1979, Diamond 1984, Gale and Hellwig 1985, Williamson 1986, 1987) to this problem is the use of debt: it is optimal for lender to fix a repayment and to monitor the borrower only when this repayment cannot be met (bankruptcy).

In this framework equity repayment is sub-optimal since equity (fixed share of production) implies lender always verifying the result of production (which is by assumption costly).

Boyd and Smith modify the CSV framework by introducing the assumption of two investment technologies. One is freely observable at no cost, the other is unobservable but has a higher expected return.

- infinite sequence of two period lived OG
- agents: borrowers (fraction 0,5 of population)
  lender (fraction 0,5 of population)
- young lender: 1 unit of labour supplied inelastically
  old lender: no labour endowment
- Borrower has no labour endowment
- Young borrower has an investment project which can use any combination of:
  Observable technology (o) x output (at t) $\rightarrow$ yx capital (at t+1)
  where $y \in \{y_1, y_2, \ldots y_N\}$ is iid with $p_n \equiv \text{prob}(y = y_n)$ and $\hat{y} = \sum y_n p_n$
  Unobservable technology (u) x output (at t) $\rightarrow$ wx capital (at t+1)
  where $w \in [0, W]$ has p.d.f. $g(w)$ and expected value $\hat{\omega} = \int_0^{\Omega} \omega g(\omega) d\omega$
- γ fixed cost in units of output to observe investment in the unobservable tech
- Agents are risk neutral; borrower's intertemporal utility function $U(c_t, c_{t+1}) = c_{t+1}$; lender's intertemporal utility function $U(c_t, c_{t+1}) = c_{t+1}$
- Lender's possess a home production technology
  1 output (at t) $\rightarrow$ r capital (at t+1)
- production function has decreasing marginal returns in capital and labour and satisfies the usual Inada condition:
  $f'(k_t) > 0$ and $f''(k_t) < 0$ (4.1)
  therefore $\rho_t = f'(k_t)$ and $w_t = f(k_t) - k_t f'(k_t)$
- $\hat{y} > \hat{\omega} > r$ (4.2)
- $i_t = i_t^o + i_t^u$ total investment (i_t^o investment in o, i_t^u investment in u); $\theta_t = i_t^o / i_t$ share of investment in o; $1 - q_t = i_t^p / i_t$ share of investment in u.
- R_t repayment in case of bankruptcy (can be made contingent on both w and y)
- b_t repayment in case of non bankruptcy (can be made contingent only on y)

4.1 Credit Market

At time t borrower chooses contract terms in order to maximise his own expected utility:

$$\max_{i,R,x,\theta} i_t \rho_{t+1} [\theta_t \hat{z} + (1-\theta_t)\hat{\omega}]$$

$$-i_t \left[\sum_n p_n \int_{w \in A_t(y_n)} R_t(w, y_n) g(w) dw + \sum_n p_n \int_{w \in B_t(y_n)} b_t(y_n) g(w) dw \right] \quad (4.3)$$

subject to

incentive constraint:

$$R_t(w, y) \leq b_t(y) \quad \forall \ w \in A_t(y) \quad (4.4)$$

Lender's zero profit constraint:

$$i_t \left[\sum_n p_n \int_{w \in A_t(y_n)} R_t(w, y_n) g(w) dw + \sum_n p_n \int_{w \in B_t(y_n)} b_t(y_n) g(w) dw \right] \geq$$

$$r\, r_{t+1} + g \sum_n p_n \int_{w \in A_t(y_n)} g(w) dw, \quad (4.5)$$

and the feasibility constraints

$$R_t(w, y) \leq r_{t+1} [q_t y + (1-q_t) w] \quad (4.6)$$

$$b_t(y) \leq r_{t+1} [q_t y + (1-q_t) w], \quad (4.7)$$

Boyd and Smith show that the (4.6) and (4.7) are binding and the minimum value of w, w^*, that allow to repay the lender is fixed and it is only a function of q. This implies that the optimal repayment will take the form:

$$b_t(y) = r_{t+1} [q_t y + (1-q_t) w^*],$$

Proposition 4.1: *the optimal repayment in case of non bankruptcy is composed by two parts: one is fixed and does not depend on the actual return (debt), the other is proportional to the actual return (equity).*

In turn, the optimal composition of investment, q^*, is an increasing function of the monitoring costs per unit of intermediated funds expressed in unit of capital $\gamma / i_t \rho_{t+1}$. Hence, capital accumulation will reduce the price of capital and induce an increase in the share of investment in the observable technology.

Proposition 4.2: *With capital accumulation, the price of capital falls and the perceived monitoring cost increases. Borrower will respond by increasing the share of investment in the observable technology (increase in q). Financial markets will be characterised by an increased share in equity issue.*

5. More on the development of Stock Market. What if agents face multiple moral hazard problem? A model based on Blackburn, Bose and Capasso (2001)

- infinite sequence of two period lived OG
- agents: borrowers (fraction 0,5 of population); population size=2
  lender (fraction 0,5 of population)
- young lender: 1 unit of labour supplied inelastically
  old lender: no labour endowment

- Borrower has no labour endowment, and no funds.
- Young borrower have

  capital production technology:

  l_t output (at t) $\rightarrow$ $A(x_t) l_t^a h_t^b$ capital (at t+1) with $a, b \in [0,1[$; $a+b < 1$

  $A(x_t) = x_t$ with probability $p(x_t) = e^{-r x_t}$ ($r > 0$)

  0 with probability $1-p(x_t)$.

  $x_t \in \Re_+$ is a particular project to choose

  $h_t \in (0,1)$ entrepreneurial time. Each borrower is endowed with one unit

  Home production technology:

  If project adopted ($h_t \in (0,1)$): it gives $\phi(1- h_t)$

  If project not adopted ($h_t = 0$): ϕ_0

  with $\phi > \phi_0$ due to knowledge spillovers

- Repayment on the loan takes two forms

  d_t = payment of debt (amount of payment predetermined at the time of contact, it does not depend on the actual profit)

  s_t = share of profit after debt payment (amount of payment that is function of actual profit: equity)
- Every borrower produce output when old according to

  $y_{t+1} = \Theta \bar{k}_{t+1}^{\,q} k_{t+1}^{\,1-q} L_{t+1}^{\,q}$, $0 < q < 1$, and $Q > 0$

  markets are competitive =>

  $$w_t = q \Theta k_t L_t^{q-1} \tag{2.3}$$

  $$r_t = r = (1-q) \Theta L^q \tag{2.4}$$

Information structure

Lender cannot observe borrower's labour effort, h_t
Expected outcome is observable but stochastic
Lender cannot observe the project chosen, x_t
Lender can enforce and observe the choice of the project by spending $1-h$ units of time
Lender cannot observe output of home production technology

6.1 Optimal Financial Contract

There is a double moral hazard problem. Borrower can choose his effort, h_t, as well as the project, x_t, and lender cannot observe the choice. One of this problem can be eliminated by the lender if he spends part of his time in monitoring the borrower. We can have two possible financial contracts depending on whether we have one moral hazard problem (lender chooses the project) or a double moral hazard problem (borrower chooses the project).

The following is a typical Principal-Agent framework

The first case we consider is when

Household choose the project

Lender maximises borrower’s expected utility

$$\underset{s_t,d_t,x_t}{Max} e^{-r x_t}[s_t(r x_t l_t^a h_t^b - d_t) + d_t] \quad (5.1)$$

s.t.

rationality constraint

$$e^{-r x_t}(1-s_t)(r x_t l_t^a h_t^b - d_t) + f(1-h_t) \geq f_0 \quad (5.2)$$

and borrower’s incentive constraint

$$h_t = \text{argmax}\, e^{-r x_t}(1-s_t)(r x_t l_t^a h_t^b - d_t) + f(1-h_t) \quad (5.3)$$

and

$$0 \leq s_t < 1 \quad (5.4)$$

Solutions => (in this case $l_t = hw_t$ and $r = (1\text{-}q)QL^q$, $L = 1\text{-}h$)

$s_t = \hat{s} = 0$; $x_t = \hat{x} = 1/r$;

$$d_t = \hat{d} = (1-b)\left[\frac{(1-q)\Theta(q\Theta)^a\, b^b h^{q(1+a)}}{re^b f^b}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}} + e\Phi \quad (5.5)$$

$$h_t = \hat{h} = \left[\frac{(1-q)\Theta(q\Theta)^a\, bh^{q(1+a)}}{ref}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}}.$$

Household's expected payoff :

$$E(v_t) = (1-b)\left[\frac{(1-q)\Theta(q\Theta)^a\, b^b h^{q(1+a)}}{ref^b}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}} + \Phi \quad (5.6)$$

$$= \hat{V} k_t^{\frac{a}{1-b}} + \Phi$$

Firm's expected payoff:

$$E(u_t) = \phi_0 \quad (5.7)$$

Proposition 5.1: *With a single moral hazard problem, the optimal financial contract involves a repayment only in the form of debt ($d_t > 0$). There is no equity issue ($s_t = 0$). Moreover, lender’s expected utility is an increasing function of capital.*

The second possibility lender has, it is to leave the choice of the project up to borrower.

Borrowers choose the project

Problem for lender

$$\underset{s_t,d_t}{Max} e^{-r x_t}[s_t(r x_t l_t^a h_t^b - d_t) + d_t] \quad (5.8)$$

s.t.

$$e^{-r x_t}(1-s_t)(r x_t l_t^a h_t^b - d_t) + f(1-h_t) \geq f_0 \quad (5.9)$$

$$h_t = \text{argmax}\, e^{-r x_t}(1-s_t)(r x_t l_t^a h_t^b - d_t) + f(1-h_t) \quad (5.10)$$

$$x_t = \text{argmax}\, e^{-r x_t}(1-s_t)(r x_t l_t^a h_t^b - d_t) + f(1-h_t) \quad (5.11)$$

$0 \le s_t < 1$

Solutions => (in this case $l_t = w_t$ and $r = (1-q)QL^q$, $L= 1$)

$s_t = \tilde{s} = 1-b(1+b)$; $x_t = \tilde{x} = (1+b)/r$; (5.12)

$$d_t = \tilde{d} = \left[\frac{(1-q)\Theta(q\Theta)^a\, b^{1+b}(1+b)^{2b}}{re^{(1+b)b} f^b}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}}; \tag{5.13}$$

$$h_t = \tilde{h} = \left[\frac{(1-q)\Theta(q\Theta)^a\, b^2(1+b)^2}{re^{1+b} f}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}}. \tag{5.14}$$

Lender's expected payoff:

$$E(v_t) = (1-b)\left[\frac{(1-q)\Theta(q\Theta)^a\, b^{2b}(1+b)^{1+b}}{re^{(1+b)} f^b}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}}; \tag{5.15}$$

$$= \tilde{V} k_t^{\frac{a}{1-b}}$$

Firm's expected payoff:

$$E(u_t) = [1-b(1-b)]\left[\frac{(1-q)\Theta(q\Theta)^a\, b^{1+b}(1+b)^{1+b}}{re^{(1+b)} f^b}\right]^{\frac{1}{1-b}} k_t^{\frac{a}{1-b}} + f \tag{5.16}$$

Proposition 5.2: *With a double moral hazard problem, the optimal financial contract involves a repayment both in the form of debt and equity ($s_t > 0$)and debt ($d_t > 0$). Lender's expected utility is again an increasing function of capital.*

6.2 Stock Market Development

Condition for equity to emerge:

$$\tilde{V} k_t^{\frac{a}{1-b}} \ge \hat{V} k_t^{\frac{a}{1-b}} + \Phi \Leftrightarrow k_t > \left(\frac{\Phi}{\tilde{V} - \hat{V}}\right)^{\frac{1-b}{a}} = k^c$$

Proposition 5.3: k^c *is the critical level of capital below which the prevailing financial contract is the debt-only financial contract. For level of capital higher than* k^c *the financial contract which involves equity and debt repayment dominates the contract with only debt.*

Proposition 5.4: *For low level of capital accumulation the financial system will be characterised by the prevalence of debt. Growth occurring, equity markets will develop. However, it is possible that the capital accumulation path is such that the economy reaches the steady state before equity markets appear, if this is the case we will have a financial trap.*

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