Online Appendix

Banks as Secret Keepers

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Abstract

In this Online Appendix we

1. Show that our results in the published manuscript hold under more general and arbitrary risk-averse preferences.
2. Extend the model to an overlapping generations structure and discuss the dynamic implications that maintaining information in secret represent for banking contracts.
3. Introduce the possibility of aggregate shocks and study their implications for banking contracts.
4. Allow entry decisions in the banking industry, explicitly modeling the opportunity costs of setting up a bank.

1 Results with arbitrary risk-averse preferences.

In the main text we discuss the optimality of secret keeping intermediaries assuming risk neutral preferences and liquidity needs. This combination generates a kinked utility function that is globally concave (globally risk-averse preferences) but locally linear (locally risk-neutral preferences). These preferences are not only convenient

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to capture risk-sharing, while maintaining the exposition clear, but also highlight the fundamental forces from liquidity needs and future investment opportunities on the dynamics of the banking industry.

These preferences, however, are not critical to obtain the results. Here we assume consumers have arbitrary risk-averse preferences. Even though the unconstrained first-best looks different, as all consumers have to be compensated for financing risky projects, we show that, while banks that hide secrets can implement the unconstrained first best, capital markets cannot.

Assume consumers do not have liquidity needs on the period after they born but rather they only value consumption at $t = 2$. They have risk-averse preferences $U_i(c_i) = u(c_i)$ where c_i is the consumption in the last period for $i \in \{E, L\}$, with $u' > 0$ and $u'' < 0$. Assume also there is a single late consumer, this is $N = 1$. If $N > 1$ as in the text, many late consumers participate in markets but only one interacts with the bank, which gives markets an additional advantage in terms of risk diversification, which is not the focus of the paper. The rest of assumptions about timing, endowments, production and information remain as in the text.

In the autarky benchmark, no project is financed, and each consumer consumes its endowment e in $t = 2$, obtaining a utility $U_i = u(e)$ each. In contrast, the first best is trivially characterized by investing in the project, which is ex-ante efficient. A planner's problem is to choose consumption for each consumer $i \in \{E, L\}$ in each state $j \in \{b, g\}$ to maximize total utility (for simplicity we assign the same Pareto weight to both consumers).

$$\max_{\{c_{i,j}\}} U = \sum_j Pr(j) \sum_i u(c_{i,j}) \tag{1}$$

subject to resource constraints in each state

$$e - w + s^{FB}(j) \geq \sum_i c_{i,j} \qquad \forall j \tag{2}$$

where $s^{FB}(j)$ is the transfer from the firm to the consumers at each state in the first best, and participation constraints when the outside option is the utility under autarky,

$$u(e) \geq \sum_j Pr(j) u(c_{i,j}) \qquad \forall i \tag{3}$$

From the resource constraints (2) and equal weights, consumption for each consumer $i \in \{E, L\}$ is

$$c_{i,b} = e - \frac{w}{2} + \frac{s^{FB}(b)}{2} \qquad \text{and} \qquad c_{i,g} = e - \frac{w}{2} + \frac{s^{FB}(g)}{2}$$

By limited liability $s^{FB}(b) = 0$. By the assumption, as in the text, that all surplus is assigned to the firm, participation constraints (3) bind

$$\lambda u\left(e - \frac{w}{2} + \frac{s^{FB}(g)}{2}\right) + (1 - \lambda) u\left(e - \frac{w}{2}\right) = u(e)$$

determining the transfer from the firm to the consumers in the good state (this is, $s^{FB}(g)$) that the planner has to implement to make consumers indifferent between participating or autarky. This leads to the next proposition

Proposition 1.1 *In the unconstrained first-best the firm has to transfer to consumers in expectation more than the project's cost, this is $\lambda s^{FB}(g) > w$.*

Proof We can prove this result by contradiction. If $s^{FB}(g) \leq \frac{w}{\lambda}$ then $\sum_j Pr(j)c_{i,j} \leq e$, but then, by Jensen's inequality $\sum_j Pr(j)u(c_{i,j}) < u(\sum_j Pr(j)c_{i,j}) \leq u(e)$, violating participation constraints (3). Then $s^{FB}(g) > \frac{w}{\lambda}$. Q.E.D.

In the unconstrained first best consumers have to be compensated as the project is risky and they are risk averse. However, as long as $s^{FB}(g) \leq x$ this compensation is feasible and welfare is larger than in autarky. As in the text, the measure of how superior the first best is with respect to autarky, when feasible, is $\lambda(x - s^{FB}(g))$, which is the numeraire consumed by the firm in expectation by being able to invest in the project, after compensating consumers for risk.

In contrast to the main text, in which we assumed parameters such that the global risk aversion is not binding at the first best and there is no need to pay a risk premium (this is, $s^{FB}(g) = \frac{w}{\lambda}$), in this extension risk aversion is also local and risk has to be compensated also in the unconstrained first best (this is, $s^{FB}(g) > \frac{w}{\lambda}$). Even though this generalization changes the characterization of the first best benchmark, it does not affect the main result that banks dominate capital markets.

Now, we can study the situation under capital markets. By construction capital markets generates information at $t = 1$ about whether the project will be successful at $t = 2$. Then, all risk is faced only by early consumers. As in the text, if the late consumer realizes the project is bad, he is not willing to buy claims on the project at any positive price, while if he realizes the project is good, he is willing to buy claims on the project at the full price $s^M(g)$. Having to face all the risk, early consumers would be indifferent between financing the project or not when

$$\lambda u\left(e - w + s^M(g)\right) + (1-\lambda)u\left(e - w\right) = u(e)$$

which determines $s^M(g)$.

Proposition 1.2 *When raising funds in capital market the firm pays in expectation more than the transfer under the unconstrained first-best, this is $s^M(g) > s^{FB}(g)$.*

Proof Assume $s^M(g) = \frac{w}{\lambda}$, such that $\sum_j Pr(j)c_{E,j} = e$. The lottery the early consumer faces in capital markets would be

$$\lambda(e - w + \frac{w}{\lambda}) + (1-\lambda)(e-w) = e$$

which can be written as a mean preserving compound lottery

$$\Big[\lambda(e-\frac{w}{2}+\frac{w}{2\lambda})+(1-\lambda)(e-\frac{w}{2})\Big]+\Big[\lambda(\frac{w}{2\lambda}-\frac{w}{2})+(1-\lambda)(-\frac{w}{2})\Big]=e.$$

This compound lottery second-order stochastically dominates (as in Rothschild and Stiglitz (1970)) the lottery in the first set of brackets, which corresponds to the lottery that the planner would make the early consumer to face when $s^{FB}(g)=\frac{w}{\lambda}$. By applying Jensen's inequality we show in Proposition 1.1 that $s^{FB}(g)>\frac{w}{\lambda}$ makes early consumers indifferent between the lottery in the first set of brackets and $u(e)$ in autarky. Then, by a further application of Jensen's inequality $s^{M}(g)>s^{FB}(g)$ makes early consumers indifferent between the compound lottery and $u(e)$. Q.E.D.

As welfare is captured by $\lambda x-s(g)$, and since $s^{M}(g)>s^{FB}(g)$, the allocation under capital markets does not achieve the unconstrained first-best allocation. In the text we obtained this difference explicitly as $s^{M}(g)-s^{FB}(g)=\frac{(1-\lambda)}{\lambda}\alpha(k-z)$, which is feasible because of the local risk-neutrality feature of preferences. In the general case, however, the explicit solution depends on the assumed functional form of the utility.

Finally, we introduce banks that hide information about the financed project. The bank can replicate the lotteries the planner offers to consumers, implementing the unconstrained first-best allocation. When a consumer deposits e, the bank promises to repay $e-\frac{w}{2}$ in case the project fails, and $e-\frac{w}{2}+\frac{s^{B}(g)}{2}$ in case the project succeeds. A promise $s^{B}(g)=s^{FB}(g)$ makes consumers indifferent between depositing or not, and this promise is feasible as it fulfills the resource constraints.

In essence, even under general risk-averse preferences, secret hiding avoids conditional participation constraints on arriving investors, and prevents risk to concentrate on the investors without information. In the presence of risk aversion, regardless its particular functional form, it is optimal to split the risk among the largest possible set of individuals, which can be indeed done by hiding information that is useful for investments but detrimental for risk sharing in the economy.

2 Overlapping generations.

Here we extend the model in the main text by developing an overlapping generations structure where the firm has the same investment opportunity in period $t=0$, but the project matures and pays out at an arbitrary date $T\geq 2$, which is unknown ex-ante. More specifically, conditional on the project not having paid out in a given period t, the probability it pays out during the next period, $t+1$, is a parameter ν.

This extension just introduces a longer gap between the time a project is financed and the time it pays out, which is filled by the participation of generations that only live for three periods and overlap over time. The main goal of this extension is to show that the banking contract for all generations, except the two involved with the bank at the time the project matures, is non-conditional on the project's result, corresponding more closely to standard demand deposits. Only when the project matures are payments conditional on its results.

The next proposition shows that the contract is identical to the one we study in our benchmark model, and independent of the probability the project matures.

Proposition 2.1 *When the time T at which the project matures is uncertain, all generations participating during $t < T$ obtain non-contingent payments, while generations participating at $t = T$ receive the same contingent payments as in the benchmark. None of these payments depend on the probability ν of the project maturing.*

Proof We start with consumers born at $t = 0$. This initial generation faces the possibility (with probability ν) that the project matures in $T = 2$, in which case the problem is identical to the one in the benchmark model. In this case, these first consumers receive k in $t = 1$ (to implement the first best allocation) and $r_2^E(g)$ or $r_2^E(b) = 0$, depending on the result of the project, in $t = 2$.

However, in this setting, with the complementary probability $1 - \nu$, the project does not mature in period $T = 2$, in which case the payment to these first consumers in $t = 2$ is non-contingent on the realization of the project, which is information the bank does not have. In this situation, since the consumer already obtained k in period $t = 1$ the bank has to compensate the consumer with $e - k$ in $t = 2$.

Is this feasible? When projects do not mature in period $t = 2$, conditional on consumers born in $t = 2$ depositing e (we next check that this is the case), the bank can always pay $e - k$ to consumers who deposited in $t = 0$ and k to consumers who deposited in $t = 1$. In this sense, when projects do not mature, the bank that keeps secrets allows for overlapping generations to rollover funds optimally over time.

Now we show that the promise $r_2^E(g)$ that banks have to make to induce consumers born in period $t = 0$ to deposit is identical to the promise to late consumers in the benchmark. Assuming $r_2^E(b) = 0$, which is the payment that minimizes the incentives to acquire information about the bank's secrets, consumers born in period $t = 0$ are indifferent between depositing or not when

$$\nu\left[(1+\alpha)k + \lambda r_2^E(g)\right] + (1-\nu)\left[(1+\alpha)k + e - k\right] = e + \alpha k$$

or similarly, when

$$\nu\left[(1+\alpha)k + \lambda r_2^E(g)\right] = \nu[e + \alpha k]$$

which is exactly the equation that determines $r_2^E(g) = \frac{e-k}{\lambda}$ in the benchmark model. Recall this result is independent of the probability the project matures in $T = 2$.

Now we can focus on all other consumers, who born at $t > 0$. These consumers face the probability the projects mature in $t + 1$ and, if not, that they mature in $t + 2$. If the project matures in $t+1$, consumers' problem becomes that of late consumers in the benchmark as they immediate receive either $r^L_{t+1}(g)$ or $r^L_{t+1}(b)$, depending on the realization of the project. If the project matures in $t+2$, then the consumers' problem becomes that of early consumers as we described above; they receive k in $t+1$ and either $r^E_{t+2}(g)$ or $r^E_{t+2}(b) = 0$, depending on the realization of the project. Finally, if the project does not mature in either $t+1$ or $t+2$ consumers receive non contingent payments k in $t+1$ and $e-k$ in $t+2$, which is feasible as previously discussed.

At the moment T in which the project matures there are always two generations participating in the banking contract. Generation $T-1$ takes the place of "late" consumers, and we denote their payments as $r^L_t(i)$, while generation $T-2$ takes the place of "early" consumers, and we denote their payments as $r^E_t(i)$, with $i \in \{b, g\}$.

Now we show that the promises that banks have to make to induce consumers who born in period $t > 0$ to deposit are identical to the promises to early and late consumers in the benchmark. Assuming $r^E_{t+1}(b) = 0$, by the resource constraint $r^L_{t+1}(b) = A_b$. Then, consumers that are born in period $t > 0$ are indifferent between depositing or not when

$$\begin{gathered}\nu\left[(1+\alpha)k + \lambda(r^L_{t+1}(g) - k) + (1-\lambda)(A_b - k)\right] + \\ (1-\nu)\left[(1+\alpha)k + \left(\nu\lambda r^E_{t+2}(g) + (1-\nu)(e-k)\right)\right] = e + \alpha k\end{gathered}$$

From the previous analysis $r^E_{t+2}(g) = \frac{e-k}{\lambda}$, and then this condition is simply

$$\nu\left[(1+\alpha)k + \lambda(r^L_{t+1}(g) - k) + (1-\lambda)(A_b - k)\right] = \nu[e + \alpha k]$$

which determines

$$r^L_{t+1}(g) = e + \frac{(1-\lambda)}{\lambda}[w + k - e] > e, \tag{4}$$

exactly as $r^L_2(g)$ in the benchmark model. Recall this result is also independent of the probability ν that the project matures in future periods. Q.E.D.

Even though the promises that implement the first best allocation do not depend on the probability that a project matures during the next period, depositors' incentives to acquire information about the bank's portfolio do depend on such probability. Given the promises obtained above, the expected gains for a consumer to deposit his endowment in the bank at time t without producing information is

$$\begin{gathered}\nu\left[(1+\alpha)k + \lambda(r^L_{t+1}(g) - k) + (1-\lambda)(A_b - k)\right] + \\ (1-\nu)\left[(1+\alpha)k + \nu\lambda r^E_{t+2}(g) + (1-\nu)(e-k)\right] = e + \alpha k.\end{gathered}$$

In contrast, the net expected gains from producing information at a cost γ is

$$\begin{gathered}\nu\left[(1+\alpha)k + \lambda(r^L_{t+1}(g) - k) + (1-\lambda)(e - k)\right] + \\ (1-\nu)\left[(1+\alpha)k + \nu\left(\lambda r^E_{t+2}(g) + (1-\lambda)(e-k)\right) + (1-\nu)(e-k)\right] - \gamma.\end{gathered}$$

Hence, there are no incentives to produce information (the first expression is larger than the second) as long as

$$\nu(1-\lambda)\left[(e-A_b)+(1-\nu)(e-k)\right]<\gamma.$$

This leads to the next Proposition.

Proposition 2.2 *When consumers are able to learn privately about the quality of the project at a cost γ, banks can implement the first best allocation only if*

$$\nu\left[(k-z)+(1-\nu)(e-k)\right]\leq\frac{\gamma}{1-\lambda}.$$

This condition for information acquisition differs from the manuscript benchmark as it allows for the possibility that the project does not mature before the depositor dies. In the benchmark only late consumers had the potential to acquire information because the information accrues in $t=1$, while in this extension consumers act potentially both as late consumers (if projects mature the period after depositing, with probability ν) and as early consumers (if projects mature two periods after depositing, with probability ν^2). Both possibilities introduce incentives to learn about the bank's portfolio, depositing when projects are good and not depositing when projects are bad.

The incentives to acquire information increase with the probability the project matures in the foreseeable future. A simple inspection of the condition in Proposition 2.2 shows that there is a low enough $\bar{\nu}>0$ such that for all $\nu<\bar{\nu}$ there is no information acquisition and the first-best allocation is implementable. Interestingly, since the payments that sustain the first best allocation do not depend on ν, the perceptions about the likelihood that projects mature can vary over time, only affecting the incentives to acquire information over time and then the need for distortions.

This result is consistent with Hanson et al. (2014). They show empirically that banks focus on illiquid, longer-term assets with no terminal risk, but possibly substantial intermediate market risk. Low terminal risk maps into low ν in our model, then reducing the incentives to acquire information and increasing the chances banks implement the first-best allocation.

3 Aggregate Shocks.

Here we introduce the possibility of many aggregate states. We show that aggregate shocks change the composition of banks portfolios and the types of distortions introduced to avoid information acquisition by late consumers.

We model aggregate shocks by letting the probability of success λ take on a finite number of values, but the same for all firms. Denote by λ_l the lowest realization of λ and call it the "worst aggregate state." The aggregate state λ is realized at $t = 1$. The expected value of λ (the probability of success for a project at $t = 0$) is denoted as $\overline{\lambda}$. We assume that contracts cannot be contingent on the aggregate state. A "recession" is not a contractible state even if it can be imperfectly described by a rise in unemployment, for example. First, we show that capital market distortions only depend on $\overline{\lambda}$. Then, we show that distortions in the banks' money provision only depend on the worst state, λ_l, while distortions in bank investments depend both on λ_l and $\overline{\lambda}$. Finally, we show that, as λ_l declines (maintaining fixed $\overline{\lambda}$), capital markets finance a larger set of projects.

Lemma 3.1 *The welfare loss of capital markets only depends on the expected aggregate state $\overline{\lambda}$.*

Proof Since there is no need to avoid information acquisition in capital markets, early consumers only have to break even at $t = 0$ based on $\overline{\lambda}$. Therefore,

$$(1 + \alpha)z + \overline{\lambda}s^M(g) + \overline{\lambda}\alpha(k - z) = e + \alpha k$$

This equation determines $s^M(g)$. The welfare cost in capital markets is therefore

$$E(U_F^{FB}) - E(U_F^M) = \overline{\lambda}s^M(g) - w = \min\{\alpha(1 - \overline{\lambda})(k - z), \overline{\lambda} - w\} \equiv \Omega(\overline{\lambda})$$

Q.E.D.

Lemma 3.2 *The welfare loss of banks distorting money provision only depends on the worst aggregate state, λ_l.*

Proof Recall that the incentives for information acquisition by late consumers in each aggregate state is

$$\Psi_l \equiv k - z - \frac{\gamma}{1 - \lambda_l}$$

Since banks cannot offer contingent payments, distortions will be given by the most binding aggregate state, which is the state with the highest Ψ. This state is λ_l (the lowest probability of success) and we denote the corresponding incentive Ψ_l. Then banks will be able to implement the unconstrained first best as long as $\Psi_l \leq 0$.

If $\Psi_l > 0$, banks must distort money provision so that in case the firm fails late consumers will be paid

$$r_2^L(b) = e - \frac{\gamma}{1 - \lambda_l},$$

(from equation (8) in the main text). The maximum that the bank can then pay the early consumer at $t = 1$, without inducing information acquisition in the lowest aggregate state (and therefore in any aggregate state) is

$$r_1^E = \frac{\gamma}{1-\lambda_l} + z < k$$

(from equation (10) in the main text). The indifference condition for the early consumer then implies that,

$$r_2^E(g) = \frac{e-k}{\overline{\lambda}} + \frac{(1+\alpha)}{\overline{\lambda}}\left[k - z - \frac{\gamma}{1-\lambda_l}\right]$$

(from equation (11) in the main text), with λ set at $\overline{\lambda}$. Similarly, from the indifference condition for the late consumer,

$$r_2^L(g) = e + \frac{(1-\overline{\lambda})}{(1-\lambda_l)}\frac{\gamma}{\overline{\lambda}}$$

(from equation (12) in the main text), also evaluated at $\overline{\lambda}$.

These results are intuitive. The payments when the firm fails are determined by λ_l because this is the binding state to avoid information acquisition. The extra expected gains from a better aggregate state are used to compensate investors in the case the firm succeeds. In the final step, we compute the minimum promise that firms have to make in case of success in order to raise funds. Analogously to equation (8), the resource constraint in the good state implies that,

$$s^B(g) = \frac{w}{\overline{\lambda}} + \frac{\alpha}{\overline{\lambda}}\left[k - z - \frac{\gamma}{1-\lambda_l}\right]$$

The welfare cost of distorting money provision is then

$$E(U_F^{FB}) - E(U_F^{MP}) = \overline{\lambda}x - w = \alpha\left[k - z - \frac{\gamma}{1-\lambda_l}\right] = \alpha\Psi_l$$

which only depends on λ_l and not on $\overline{\lambda}$. Q.E.D.

Lemma 3.3 *The welfare loss of banks distorting investment depend on the worst aggregate state λ_l as well as the expected aggregate state $\overline{\lambda}$.*

Proof When banks have to distort investments to avoid information acquisition in all aggregate states they must promise late consumers at least $r_2^L(b) = e - \frac{\gamma}{1-\lambda_l}$ in the worst aggregate state (this amount will suffice in all other states as well). This is only feasible if $\eta = 1 - \frac{\Psi_l}{w}$ in the worst state (see equation (5)). The welfare cost of distorting investments is then

$$E(U_F^{FB}) - E(U_F^I) = (1-\eta)(\overline{\lambda}x - w) = \frac{\Psi_l}{w}(\overline{\lambda}x - w)$$

which depends both on λ_l from the distortion and $\overline{\lambda}$ from the value of investment. Q.E.D.

Intuitively, the three lemmas in this section show that the strength of bank distortions depend only on the worst aggregate state as captured by Ψ_l, while the welfare costs of distortions depend on $\overline{\lambda}$. Using these lemmas, λ in Proposition 3 in the main text can be interpreted as the expected aggregate state $\overline{\lambda}$, while Ψ corresponds to the incentive in the worst state λ_l. In the model without aggregate shocks there is only a single state and therefore $\lambda = \overline{\lambda} = \lambda_l$.

Figure 1: Regions of Financing - Reduction in Worst Aggregate State γ_l

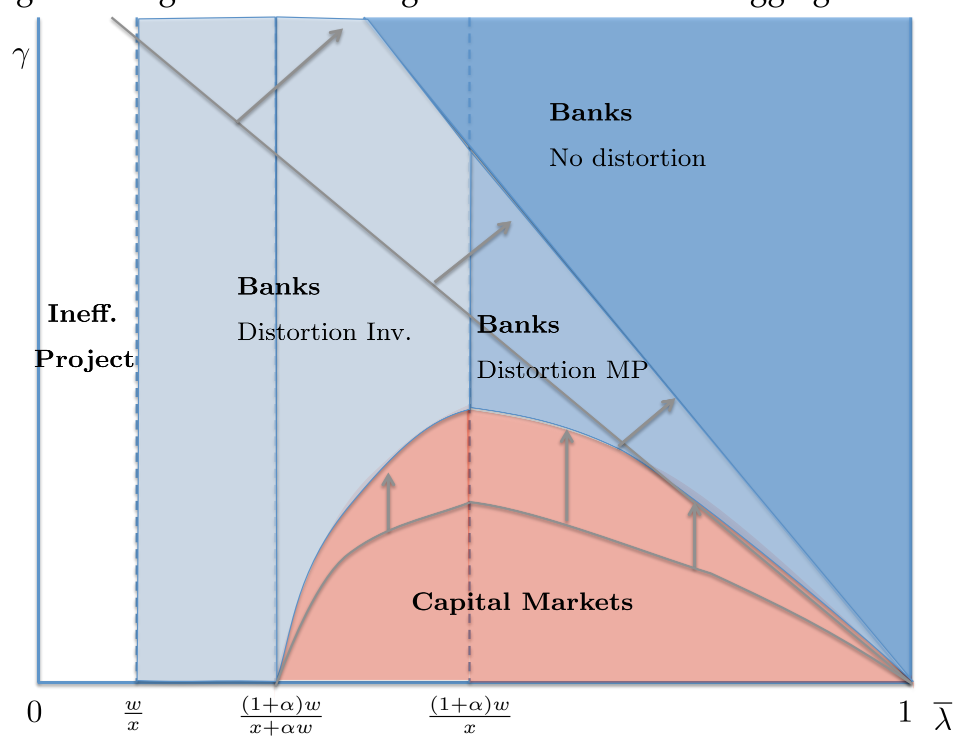

Figure 1 shows an example of how the regions from Figure 3 in the main text change as we move from $\lambda_l = \overline{\lambda}$ to $\lambda_l < \overline{\lambda}$. Decreasing λ_l while maintaining $\overline{\lambda}$ fixed (by increasing λ in other states) represents a mean-preserving increase in "uncertainty" in the economy. Our results show that more uncertainty increases the range of projects that are financed in capital markets, reduces the participation of banks in funding projects, and decreases the aggregate volume of safe liquidity that banks provide.

4 Opportunity Cost of Banking.

Here we extend the model to study the decision of an agent to set up a bank. We assume that at $t = 0$ there is also an individual in the economy, which we denote by B, who does not have any endowment but who can work at an exogenous wage ϕ at $t = 0$. For simplicity we assume B only values consumption at $t = 0$. This individual can choose at $t = 0$ to set up a bank or to be a worker, but cannot endeavor in both activities.

Conditional on setting up a bank individual B is subject to the same assumptions we impose on banks, in particular he does not have the expertise to interpret detailed information about the project and is able to maintain this information in secret if he wants. As B has to resign the outside labor option to set up a bank, under our maintained assumption that the firm has all the bargaining power in the economy, B will only set up a bank if he is compensated exactly by his opportunity cost ϕ at $t = 0$.

The first best allocation with the addition of individual B is given by $E(U_F^{FB}) = \lambda x - w$, $E(U_E^{FB}) = E(U_L^{FB}) = e + \alpha k$ (as in the main text) plus $E(U_B^{FB}) = \phi$.

When the firm obtains funds in capital markets the analysis remains identical as in the main text (as B does not participate), with welfare that is $\min\{\alpha(1-\lambda)(k-z), \lambda x - w\}$ lower than first best allocation (as in Proposition 1 of the main text).

When the firm obtains funds from a bank that is stablished by B, we assume first, as in the main text's benchmark case, that L cannot find the bank's secrets at any cost (or $\gamma = \infty$). In this case, however, banks cannot implement the first best allocation (as in Proposition 2 of the main text) because the firm has to compensate B for his opportunity cost ϕ. Then, when the firm obtains a loan from a bank welfare is $\min\{\phi, \lambda x - w\}$ lower than the first best allocation.

In contrast to the main text, in which banks always dominate capital markets as they implement the first best allocation, here this is the case only if the opportunity cost of setting up a bank is smaller than the risk-sharing welfare losses from capital markets,

Proposition 4.1 *Banks dominate capital markets if and only if $\phi < \alpha(1-\lambda)(k-z)$.*

The proof follows trivially from comparing the welfare losses in both cases.

How does the bank distort contracts in case the late consumer can acquire information about the bank's secret at a cost γ? The next Proposition shows that a banking contract without distortions is more difficult to implement than the main model,

Proposition 4.2 *When banks have to be compensated for opportunity costs ϕ, a non-distortionary banking contract can be implemented only if $\Psi + \phi \leq 0$.*

Proof The late consumer would not acquire information if an only if

$$(1-\lambda)[e - r_2^L(b)] \leq \gamma$$

as in equation (5) of the main text. The payment $r_2^L(b)$ that the bank can promise, however, cannot be more than the available assets $e + z$ minus the promise to the early consumer k at $t = 1$ minus the payment ϕ to the banker at $t = 0$. Then $r_2^L(b) \leq e + z - k - \phi$. We complete the proof by substituting $r_2^L(b)$ in the previous expression and using the definition of Ψ from the main text. Q.E.D.

Intuitively, as the bank obtains compensation in $t = 0$ there are less resources available for the late consumer in the bad state, and then his incentives to acquire information are larger. As in the main text, when the previous condition is not met banks can introduce distortions either to investment or liquidity provision. The next Proposition describe the conditions under which banks still dominate capital markets when introducing distortions.

Proposition 4.3 *Suppose* $\Psi + \phi > 0$*.*

Banks that distort investment dominate capital markets iff $\Omega \geq \phi + \left(\frac{\lambda x}{w} - 1\right)[\Psi + \phi] > 0$*.*

Banks that distort money provision dominate capital markets iff $\Omega \geq \phi + \alpha\,[\Psi + \phi] > 0$*.*

Proof As in the main text, to avoid information acquisition banks have to promise the late consumer at least

$$r_2^L(b) = e - \frac{\gamma}{1-\lambda}.$$

When banks distort investments (only invest in a fraction η of the project), what remains to pay L at $t = 2$ in the bad state, after paying $r_1^E = k$ to E at $t = 1$ and ϕ to B at $t = 0$ is

$$\eta(e + z - k - \phi) + (1-\eta)(e + z - k - \phi + w) = e + z - k - \phi + (1-\eta)w.$$

Hence, promising $r_2^L(b)$ to the late consumer to avoid information acquisition is feasible only if

$$e - \frac{\gamma}{1-\lambda} \leq e + z - k - \phi + (1-\eta)w.$$

Then, as banks want to maximize η conditional on this restriction

$$\eta = 1 - \frac{k + \phi - z}{w} + \frac{\gamma}{w(1-\lambda)} = 1 - \frac{\Psi + \phi}{w} < 1. \tag{5}$$

Since the rest of the original contract and the utilities of the two consumers remain unchanged, by construction, the firm's loss relative to the first best is

$$E(U_F^{FB}) - E(U_F^I) = \lambda s^B(g) - w + (1-\eta)(\lambda x - w) = \phi + \frac{\Psi + \phi}{w}(\lambda x - w).$$

because $s^B(g) = \frac{w+\phi}{\lambda}$ in the non-distorted contract with banks. Since the welfare loss from market financing (when it is feasible to invest in a fraction of the project) is defined by Ω as in the Proposition 1 of the main text, the first part of the Proposition follows.

When banks distort money provision (promise non-contingent $r_1^E < k$ at $t = 1$ to early consumers), promising $r_2^L(b)$ to the late consumer to avoid information acquisition is feasible only if

$$e - \frac{\gamma}{1-\lambda} \leq e + z - r_1^E - \phi.$$

Then, as banks want to maximize r_1^E conditional on this restriction

$$r_1^E = \frac{\gamma}{1-\lambda} + z - \phi < k. \tag{6}$$

The early consumer will be indifferent between storing and depositing in the bank if

$$(1+\alpha)r_1^E + \lambda r_2^E(g) = e + \alpha k.$$

Replacing r_1^E (from equation 6) above, we get

$$r_2^E(g) = \frac{e-k}{\lambda} + \frac{(1+\alpha)}{\lambda}\left[k + \phi - z - \frac{\gamma}{1-\lambda}\right]. \tag{7}$$

The promises for the late consumer will be identical as in the main text (equations 8 and 12). These payments are feasible in the good state if and only if

$$r_2^E(g) + r_2^L(g) \leq e + z - r_1^E + s^B(g).$$

Because the firm has all the bargaining power, $s^B(g)$ is minimized conditional on the above restriction and then

$$s^B(g) = \frac{w+\phi}{\lambda} + \frac{\alpha}{\lambda}\left[k + \phi - z - \frac{\gamma}{1-\lambda}\right]. \tag{8}$$

Since investment is optimal and the utilities of the two consumers remain unchanged, by construction, the firm's loss relative to the first best is

$$E(U_F^{FB}) - E(U_F^{LP}) = \lambda s^B(g) - w = \phi + \alpha\left[k + \phi - z - \frac{\gamma}{1-\lambda}\right].$$

Since the welfare loss from market financing is again defined by Ω, the second part of the Proposition follows. Q.E.D.

Based on the previous results the next Proposition shows how projects are funded as a function of project characteristics.

Proposition 4.4 *Coexistence of Banks and Capital Markets*

Projects are not financed if $\lambda_i < \frac{w}{x}$ (that is, projects are ex-ante inefficient).

Projects are financed by banks without distortions if $(\Psi_i + \phi) \leq 0$.

Projects are financed by banks that distort investment if

$$\Omega_i \geq \phi + \left(\frac{\lambda_i x}{w} - 1\right)(\Psi_i + \phi) > 0 \qquad \textit{and} \qquad \frac{\lambda_i x}{w} - 1 < \alpha.$$

Projects are financed by banks that distort money provision if

$$\Omega_i \geq \phi + \alpha(\Psi_i + \phi) > 0 \qquad \textit{and} \qquad \frac{\lambda_i x}{w} - 1 \geq \alpha;$$

Finally, projects are financed in capital markets if

$$\phi + \min\left\{\alpha, \frac{\lambda_i x}{w} - 1\right\}(\Psi_i + \phi) > \Omega_i > 0.$$

These regions follow directly from Propositions 4.1, 4.2 and 4.3 above. Figure 2 displays the regions as a function of the projects' characteristics λ_i and γ_i when there are opportunity costs ϕ.

This Figure is similar to Figure 3 in the main text with the difference that the region dominated by capital markets is larger, as now banks are more expensive in terms of opportunity costs. Furthermore, the larger the opportunity cost ϕ of running a bank, capital markets dominate banks for a larger set of projects.

Notice that agent B would never choose to set up a bank for projects in the the region where capital markets dominate. Even if the bank is successful in replicating markets by disclosing detailed information to L at $t = 1$ at no cost, and L cannot take advantage of its superior ability to interpret detailed information of the projects, still has to be compensated by the opportunity cost ϕ. This implies that the rate banks charge to firms when they disclose information is larger than those capital markets charge. Then firms with projects that lie in the capital markets region would self-select into capital markets, and individual B would not choose to enter the banking industry as his occupation.

References

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Figure 2: Regions of Financing - Positive Relative Cost of Banking