Looting and Gambling in Banking Crises*

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Abstract: We construct a model of the banking firm and use it to study bank behavior and bank regulatory policy during crises. In our model, a bank can increase the risk of its asset portfolio ("risk shift"), convert bank assets to the personal benefit of the bank manager ("loot"), or do both. Each action is socially costly. To mitigate such actions, a regulator has three policy tools: it can impose a penalty on risk-shifting; it can impose a penalty on looting; and it can force banks to hold more equity capital.

We study two models of the banking firm – a standard one with a single class of owner, and a modified one with two classes of owners: inside (informed) owner-managers and outside equity investors. Policy implications of the two models are quite different, suggesting that corporate governance is critical in determining good regulatory policy. With the one-class-of-equity model, either capital regulation or theft penalties can work to simultaneously contain both risk-shifting and looting. When two classes of shareholders are present, however, there is no panacea policy and all policies have trade-offs for different objectives or non-monotonic effects. When owner managers can loot the bank in bad states of the world, this worsens their incentive to take on risk. However, when owner-managers can consume perks in good states of the world (at the expense of outside shareholders) this diminishes their incentive to take on risk.

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1 Introduction

There is a large theory literature on banking crises and how banks respond when they are close to or in bankruptcy. Most of this work has focused on "risk shifting," also sometimes known in the literature as "gambling for redemption." The idea is that in a crisis and with its equity depleted, a bank may willingly take on large risks even if these risks are associated with low expected returns. If these low probability, high return gambles pay off, the bank may survive; if they do not, the bank was broke anyway. Thus, from the bank's perspective there may be little downside risk to such gambles. In the literature, such risk-shifting behavior is usually studied as an off-shoot of a more general moral hazard problem induced by deposit insurance or the Discount Window. There is also a very large literature on that topic, beginning with the seminal work of Kareken and Wallace (1978).[1]

An interesting and probably under-appreciated study by Akerlof and Romer (1993) argues that much of the theoretical work on banking crises has essentially missed the boat. They argue that bank managers in crises are frequently interested in personally taking as much from the bank as they can (hereafter "looting"), and their risk-shifting actions are primarily intended to facilitate such looting. In such circumstances, there is often a fine line between activities that raise eyebrows, and those that are criminal. An example may help to clarify. Consider a savings and loan association in a crisis, which issues a large volume of fixed rate mortgages financed with short maturity liabilities having a much lower rate of interest. Now, this action produces an extreme maturity mismatch, is inherently risky, and might be interpreted as the risk-shifting action predicted by standard theory. Akerlof and Romer observe, however, that this portfolio allocation also substantially increases short run profits which may allow bank owner-managers to pay themselves large salaries and bonuses, consume perks, and so on, without violating regulation or attracting shareholder attention.

In essence, the Akerlof-Romer argument is that risk-shifting need not be an end to itself, but rather may be a device to facilitate looting. Their study puts a new perspective on a large literature; however, it stops short of providing a fully-specified model of banks' actions when risk-shifting and looting are both possible. Nor could we find such a model elsewhere in the literature, and that led to our writing the present study. Next, we briefly discuss some case-study evidence on banks' behavior during crises.

[1] See Gorton and Winton (2003, section V) for a literature review.

Evidence. There is not a large case-study literature on bank actions during crises, but there are a few useful papers including Akerlof and Romer.[2] Our review of this literature, and confidential conversations with World Bank officials, led us to several tentative conclusions. Risk-shifting and looting are frequently observed simultaneously, suggesting that the two activities may be complementary. However, experience across countries has been varied in terms of bank's end-game strategies.

In the developing world looting seems to have been the more usual strategy and in some instances was a spectacular element of the crisis. Such looting frequently occurred without any smoke-screen of artificially inflated profits. Venezuela (1993) and Dominican Republic (2003) were high profile cases that involved the "diverted deposits" fraud wherein the bank managers kept part of the bank off the balance sheet so that the supervisors could not observe self-lending. It is suspected that supervisor collusion may have been involved in one or both of these crises. The famous failure of BCCI in 1991 also involved the diverted deposits scheme and featured massive looting.

Obviously, such tactics are little more than outright theft. One possible explanation for their frequency is that when legal protections of shareholders and creditors are weak, supervisors are corrupt(ible), and accounting standards are lax, the easiest course is to take the money and run. With a better institutional and legal environment, however, blatant looting is likely to be more costly. In the United States, bank managers seem to have gone to more effort to stay within the confines of the law when possible, and employed risk shifting strategies either to pump up short run profits, gamble for redemption, or both. The Japanese banking crisis experience was quite different, but also instructive. In that case, there is scant evidence of either risk-shifting or looting, even though the Japanese crisis was one of the longest and most costly on record. Indeed, the Japanese banks mostly did nothing, even though they were clearly bankrupt in the sense that the value of their liabilities exceeded that of their assets. A plausible explanation is that in most cases Japan officials were not threatened with immediate bank closure or job loss; thus they were not in a true end-game situation that called for high risk strategies.

[2] Johnson, Boone, Breach, and Friedman (2000) show that countries whose legal systems restrict looting of firms had milder financial crises in 1997–1998. Johnson, Porta, Lopez-de-Silanes, and Shleifer (2000) give some examples for looting (which they call tunneling) in Western European firms, and discuss forms of looting, such as self-dealing transactions, theft or fraud, asset sales and advantageous transfer pricing to the controlling shareholder, excessive executive compensation, loan guarantees, and so on.

Modeling Strategy. Case studies suggest that in crises there are extreme conflicts of interest – not just between the regulator and the bank – but between the bank's different classes of owners. This regularity importantly guided our modeling strategy, for it implies that standard banking theory models, those with one class of equity, are likely to be inadequate for modeling financial crises.[3] Now, when the possibility of looting is ignored (as is the norm in the literature), the interests of bank owner-managers and outside equity investors are generally well-aligned. Both are shareholders, and both aim at maximizing the value of their claims. However, if an inside owner-manager loots the bank, she damages not just depositors but also the other equity investors. In order to analyze the potential implications of such actions, it is essential to differentiate, as we do, between classes of owners. This adds some complexity to the model but provides several new insights. Moreover, recent empirical work by Laeven and Levine (2007) suggests that such "corporate governance" issues may be critically important in determining the the best conduct of bank regulation: *"... we show that the relation between bank risk and capital regulations, deposit insurance policies, and restrictions on bank activities depends critically on each bank's ownership structure, such that the actual sign of the marginal effect of regulation on risk varies with ownership concentration. These findings have important policy implications as they imply that the same regulation will have different effects on bank risk taking depending on the bank's corporate governance structure." (Abstract)*

As will become apparent, the above statement, based on empirical findings, also describes some important implications of our theory. For purposes of comparison, we begin with a standard banking model (one class of equity claimants), but modified to allow for the possibility of looting. The two-classes-of-equity model is analyzed in Section 4.

2 Theft by the Manager

2.1 Model Environment

Consider an economy with two dates, 0 and 1. There are two types of agents; a bank owner-manager and depositors.

[3] One-class of equity models have dominated banking theory, see Shleifer and Vishny (1997), Gorton and Winton (2003), notable exceptions being Burkart, Gromb, and Panunzi (1998) and Besanko and Kanatas (1996).

Figure 1: Time Structure

$t = 0$	The bank manager collects deposits d, leading to liabilities of $D = r_d\, d$.
·	The bank manager injects $e_i = 1 - d$ of inside equity.
·	The bank manager invests in the loan portfolio.
$t = 1$	The portfolio return a stochastic Y.
·	The bank manager decides how much to loot.
·	From the remaining return, the bank manager pays back deposits. If the bank remains solvent, the bank manager gets the continuation value V.

The Bank Owner-Manager. There is a bank owner-manager who has access to a risky loan portfolio. The portfolio size is normalized to 1, it returns a stochastic Y which is distributed on $\mathbb{R}_+$ with a density function $f(Y)$. Later, for a parameterized example, we will make more specific assumptions on $f(Y)$. The bank's assets are financed with deposits d. If $d < 1$, then the bank manager must put in some own resources $e_i = 1 - d$ as equity.[4] A unit of equity has an opportunity cost of r_i. We assume that this opportunity cost exceeds the expected return of the loans, $r_i > \mathrm{E}Y$, hence equity is expensive, and the bank manager will be reluctant to use it. The balance sheet of the bank thus contains three items: equity e_i and deposits d on the liability side, and the loan portfolio of size 1 on the asset side. We will for now treat the capital structure of the bank as exogenous, and potentially imposed by a regulator. Finally, let us assume that, if the bank remains solvent, the bank manager gets future profits that lead to a continuation value (or charter value) of V.

The Depositors. The bank manager collects d deposits from the depositors. Depositors demand a return of r_d which is taken as exogenously given. Depositors are covered by deposit insurance with a flat fee, which is already contained in r_d. Hence, depositors do not care about the bank's default risk. The future liability of the bank is thus $D := r_d\, d$, but d is the position on the liability side of the bank manager's balance sheet.

[4]Hence the bank manager is also the owner of the bank. We will discuss the role of outside equity/outside ownership below. Note that, because bank managers are "endowed" with the bank, they can earn supernormal returns above r_i.

The Theft Technology. In most models, it is assumed that the return from the loan portfolio is public information and hence cannot be diverted. Other models explicitly model the hold-up problem and assume that bank managers can personally take the return, at no cost.[5] We take an intermediate approach. Assume that the bank manager can appropriate L from the bank at date 1, after the return Y is realized and observed. That is, he can take L directly from the portfolio return for his own consumption, *before* deposits are repaid and dividends are distributed. However, the bank manager gets only $g(L) < L$. Assume that $g(0) = 0$; if the bank manager takes nothing, he has no benefits from stealing; $g'(0) = 1$; if the bank manager takes only very little, the distortions from stealing are negligible; $g''(L) < 0$ for all $L \geq 0$; the more the bank manager appropriates, the larger are the distortions. The justification for why the bank manager gets only $g(L)$ instead of L from such theft is that it is illegal. Hence, the function $g(\cdot)$ is a policy variable, representing the stringency of the legal system, enforcement, and so on.[6]

2.2 Equilibrium and Comparative Statics

Potentially, there are two ways in which the bank manager can engage in theft. First, even if the bank is healthy, the bank manager might want to steal some amount for personal needs, (hereafter, "*perks* consumption"). From consuming some $L > 0$, the bank manager ends up getting $g(L) < L$ directly. However, the bank manager's profits decrease. If the bank remains solvent, the bank managers profits decrease by $L - g(L) > 0$. Hence in this first model with only one class of equity claimants the bank manager will never steal in this manner. That will change in Section 4. where we consider a model with two classes of equity.

If the loan portfolio yields a low return Y, the manager may want to just loot everything, setting $L = Y$. This is the kind of behavior, discussed above and observed in many banking crises; in dire circumstances the manager simple

[5] Hart and Moore (1998) have an optimal contracting model, however they look at debt-contracts only. All variables are (or can be) stochastic, therefore things like inefficient liquidation can occur. In comparison to Bolton and Scharfstein (1990), there is no commitment from the investors to refinance in the second period. Povel and Raith (2004) analyze a contracting problem where the investment (effort/risk) is not contractible.

[6] In effect, we are assuming the the authorities cannot absolutely deter looting, but can make it difficult or costly for the bank manager. This depends on the legal system, such as the conduct of law enforcement, or the magnitude of potential punishment.

steals as much as possible (loots) from the bank, and runs. When looting occurs, the bank pays nothing to depositors.[7] The owner-manager's return is then $g(Y)$. Hence, the owner-manager will loot whenever

$$g(Y) > Y - D + V. \tag{1}$$

Let Y_{crit} be the critical yield Y such that the above holds with equality. Then the owner-manager will loot the complete return if $Y < Y_{\text{crit}}$. Note that, because the owner-manager loots her bank if and only if $Y < Y_{\text{crit}}$, Y_{crit} can be interpreted as the propensity to loot. If the probability distribution of the portfolio return remains unchanged, a higher Y_{crit} increases the probability of looting.

The owner-manager's expected profit is

$$\begin{aligned} E\Pi &= \int_0^\infty \max\left\{g(Y), Y - D + V\right\} f(Y)\, dY \\ &= \int_0^{Y_{\text{crit}}} g(Y)\, f(Y)\, dY + \int_{Y_{\text{crit}}}^\infty (Y - D + V)\, f(Y)\, dY. \end{aligned} \tag{2}$$

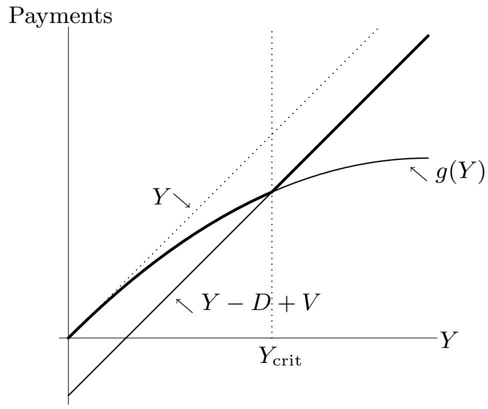
Let us discuss the endogenous variable, Y_{crit}, which is determined by (1), hence by the implicit equation $\bar{G} = g(Y_{\text{crit}}) - (Y_{\text{crit}} - D + V) = 0$. The implicit function theorem yields:

Proposition 1 (Propensity to Loot) *Ceteris paribus, a high leverage D increases the owner-manager's propensity to loot,* $\mathrm{d}Y_{\text{crit}}/\mathrm{d}D > 0$. *A high continuation value decreases it,* $\mathrm{d}Y_{\text{crit}}/\mathrm{d}V < 0$.

For a fixed probability distribution, a high leverage increases the *probability* of looting, a high continuation value decreases it. The intuition is straightforward. Given that the repayment to depositors $D = r_d\, d$ is high, if the owner-manager is honest and does not loot, he may keep rather little (only $Y - D + V$). If the bank manager loots, her profits are $g(Y)$, independent of the amount of deposits. As a result, for higher D, the owner-manager will loot more often. A higher continuation value makes the owner-manager loot less often for if she loots she looses the continuation value.

[7] Because of the assumption that $g'(L) > 0$, a bank manager who loots will leave nothing for depositors. One could weaken this extreme result by assuming that $g(L)$ becomes maximal for some $\bar{L}$, in which case the bank manager would never take more than $\bar{L}$ and leave the remaining $Y - \bar{L}$ to the depositors.

Figure 2: Decision on Looting



The bank manager's actual profit function follows the bold curve. For small Y, the bank manager takes the complete return, hence he gets $g(Y)$. For larger Y, the bank manager does not loot, hence he gets the return net of repayments to depositors, plus the continuation value.

2.3 Deterring Banks from Looting

Looting is unlawful, therefore it comes at a cost for the owner-manager. Instead of L, she gets only $g(L) \leq L$. The shape of the function $g(\cdot)$ is a policy variable. In the extreme case, the regulator can punish looting heavily (and hence set an extremely low $g(L) \ll L$), or he can *de facto* legalize looting by putting $g(L) = L$. To keep the model simple, assume that the regulator fixes a parameter c, and that the costs of looting are $g_c(L) = g(c\,L)/c$ for some concave monotonically increasing function $g(\cdot)$ with $g(0) = 0$, $g'(0) = 1$ and $g'(\infty) \to 0$. Then $g_c(0) = 0$ and $g'_c(0) = 1$. Furthermore, for the limit $c \to 0$, one gets $g_c(L) \to L$, hence the regulator is extremely mild, and looting is legal. For the limit $c \to \infty$, one gets $g_c(L) \to 0$; the regulator is extremely strict. The critical Y_{crit} is then given by the implicit equation $\bar{G} = g(c\,Y_{\text{crit}})/c - (Y_{\text{crit}} - D + V) = 0$.

Proposition 2 (Deterring Banks from Looting) *A strict looting policy c decreases the owner-manager's propensity to loot,* $\mathrm{d}Y_{\text{crit}}/\mathrm{d}c \leq 0$.

For a fixed return distribution, a strict looting policy decreases the probability of theft. Note that the introduction of the parameter c leaves the comparative statics of Proposition 1 unchanged.

3 Risk-Shifting

Up to now, we have considered only the bank manager's ability to loot. However, as we have argued in the introduction, we must also consider the possibility that the owner-manager may choose a high-risk investment. In our model, we will consider looting and risk shifting simultaneously. Now what is the interdependence of looting with risk shifting? And how does a policy that is designed to address one problem influence a bank manager's behavior towards the other? Those questions are addressed in this section.

3.1 Model Environment

Typically, the owner-manager's propensity to gamble comes from her limited liability, and from the resulting convexity of the return function. From Figure 2, however, it becomes clear that with the possibility of looting, the bank manager's decision on gambling becomes more interesting; the profit function is concave for $Y < Y_{\text{crit}}$, convex around Y_{crit}, and linear above Y_{crit}. To simplify, assume that the good state occurs with probability $p(Y_1)$, in which case the loan portfolio returns Y_1, and that the bad state occurs with probability $1-p(Y_1)$, in which case the portfolio returns Y_0. Hence, the bad-state return Y_0 is fixed, and the owner-manager trades off the good-state return Y_1 against to probability of success, $p(Y_1)$. We further assume that $p'(Y_1) < 0$ and that $p''(Y_1) \leq 0$. By choosing Y_1, the owner-manager can thus influence the risk-return structure of the loan portfolio. The expected return of the portfolio is maximized for $Y_1\, p(Y_1)+Y_0\,(1-p(Y_1)) = \max$, hence $p(Y_1)+(Y_1-Y_0)\,p'(Y_1) = 0$. This kind of degenerate return distribution has been widely employed in the banking and corporate finance literature (see, e. g., Allen and Gale, 2000, 2004).

3.2 Equilibrium and Comparative Statics

We are interested in return distributions where the bank goes bankrupt in some states, and remains solvent in others. Hence, we restrict our attention to cases where the owner-manager loots if the outcome is low ($Y_0 < Y_{\text{crit}}$), and does not loot if the return is high ($Y_1 > Y_{\text{crit}}$). She chooses Y_1 to maximize

$$E\Pi = (1 - p(Y_1))\, g(Y_0) + p(Y_1)\, (Y_1 - D + V), \tag{3}$$

$$\frac{dE\Pi}{dY_1} = p(Y_1) + p'(Y_1)\, (Y_1 - D + V - g(Y_0)) = 0. \tag{4}$$

We use (4) to derive comparative statics and (in the Appendix) prove the following proposition.

Proposition 3 (Risk-Shifting) *High leverage induces the owner-manager to take more risk,* $dY_1/dD > 0$*. A high continuation value deters the owner-manager from taking risk,* $dY_1/dV < 0$*. The penalty on looting deters the owner-manager not only from looting, but also from risk shifting,* $dY_1/dc \leq 0$*.*

The first two parts of the proposition are intuitive. If the bank is highly leveraged, then the bank manager exploits the deposit insurance in the bad state. As a consequence, the higher the leverage, the more risk the bank manager wants to take. On the other hand, the owner-manager looses the continuation value V in the bad state. Hence, the higher V, the less risk the owner-manager wants to take.

The effect of c, the strictness of the regulator with respect to looting, is less obvious. In the good state, the owner-manager does not loot, hence c does not influence profits. In the bad state, the owner-manager loots the bank and gets $g(c\,Y_0)/c$. If the regulator is strict and sets a high c, the owner-manager gets less from looting, hence the bankruptcy states of nature are less valuable to her. Consequently, for higher c, the owner-manager takes less risk. This is an interesting result. It suggests that a policy of deterring looting has a beneficial side-effect of also deterring risk-shifting. Unfortunately, this win-win outcome does not necessarily hold up in the more general model to be discussed later.

3.3 Deterring Banks from Risk-shifting

There are two natural regulatory instruments that may deter the owner-manager from taking too much risk: capital regulation and legal restrictions. Let us start with *capital regulation*. The bank's capital ratio is simply $e_i =$

$1-d$. Thus if the regulator forces the bank to hold more capital, e_i rises, and d drops, which according to Proposition 3 makes the owner-manager want to take less risk. As a second beneficial effect, lowering leverage decreases Y_{crit} according to Proposition 1. This decreases the range of returns in which theft will occur. Thus capital regulation has twin benefits in that it reduces the incentive to risk-shift and also reduces the probability of looting.

There is a second policy that can influence the owner-manager's risk-shifting behavior: similar to penalizing looting, the regulator can penalize risk-shifting directly. In reality, the policy maker can ban banks from certain actions, for example from certain off-balance sheet transactions. However, the regulator cannot ban the bank from any kind of risk taking in general. Risk is an inherent component of banking, and only the owner-manager can realistically specify the riskiness of a bank. Thus, our strategy is to model an environment in which the regulator can penalize risk-shifting, but cannot directly control it. In the language of our model, the owner-manager's possible investments are characterized by the set $\{Y_0, Y_1, p(Y_1)\}_{Y_1}$. In the bad state the portfolio yields Y_0 and the complete return is looted by the owner-manager. To concentrate on the set of tuples $\{Y_1, p(Y_1)\}_{Y_1}$, we simply set $Y_0 = 0$. The regulator's ban on certain banking activities is equivalent to influencing the set of possible investments. Without loss of generality, one can assume that the regulator can change the set of investments from $\{Y_1, p(Y_1)\}_{Y_1}$ to $\{Y_1 - t(Y_1), p(Y_1)\}_{Y_1}$, with $t(\cdot) \geq 0$.[8]

Proposition 4 (Deterring Banks from Risk-shifting) *If*

$$\frac{t'(Y_1)}{t(Y_1)} > -\frac{p'(Y_1)}{p(Y_1)} \tag{5}$$

for all Y_1, then restricting the bank's set of possible investments (e. g. increasing t) induces the owner-manager to take less risk.

Condition (5) implies that the elasticity of the penalty t with respect to the risk parameter Y_1 must exceed the elasticity of the success probability p.

[8]Note that from the viewpoint of a bank manager, $t(Y_1)$ has the same effect as a tax on revenues. However, it differs from a tax in two dimensions. First, from the viewpoint of the regulator, the revenues from taxation would flow to the state; if instead the regulator bans certain investments, there are no tax-like revenues at all. Second, taxing the return would mean that the return were observable and contractible – a contradiction to the model assumptions.

The limiting case would be the one in which the elasticities are equal, hence the factor $p(Y_1)\,t(Y_1)$ would be a constant, which would be deducted from the owner-manager's profits and not influence her actions.

Note that t also influences Y_{crit}, the critical return below which the owner-manager will loot. If the bank manager fixes Y_1, the return is in fact only $Y_1 - t(Y_1)$ in the good state. Hence Y_{crit} is now determined by the implicit equation $g(Y_{\text{crit}}) = Y_{\text{crit}} - t(Y_{\text{crit}}) - D + V$, instead of equation (1). The set $[0, Y_{\text{crit}})$ expands and the bank manager loots for more potential outcomes. Thus, restricting the possible set of investments will reduce risk-shifting if (4) holds, but will have the unwanted side effect of increasing the probability of looting.

An Aside on Penalizing Risk-shifting. As we have seen, restricting the set of possible risky investments does not always induce the owner-manager to take less risk, even when $t'(Y_1) > 0$. To give a specific but interesting example, continue to assume that $Y_0 = 0$, assume further that $t(Y_1) = \tau\, Y_1$, and neglect the possibility of looting for a moment. Then the higher τ, the more difficult it becomes to obtain high profits (for the same return Y, the owner-manager needs to accept a higher probability of default). Still under these assumptions the owner-manager takes more risk and chooses a higher Y_1. To see this formally, consider the bank's expected profits in the absence of looting, $E\Pi = p(Y_1)\,[Y_1 - \tau\, Y_1 - D] + V$, leading to the first order condition $p'(Y_1)\,[(1-\tau)\,Y - D] + (1-\tau)\,p(Y_1) = 0$, or equivalently $p'(Y_1)\,[Y - D/(1-\tau)] + p(Y_1) = 0$. A tax on risk taking τ has hence the same effect as higher leverage D, i. e. the bank manager will end up taking on more risk.

The intuition for this result is straightforward. Regulatory attempts to directly control risk-shifting may "backfire" when the owner-manager can respond to policy. Specifically, the owner-manager may optimally respond to risk-limiting regulation by choosing a strategy that is even riskier, if one is available. This finding has interesting implications that are somewhat peripheral to the present study. In brief, we have not seen this "backfire" possibility discussed elsewhere in the literature. There is an interesting and useful sequence of papers on the ex-post taxation of bank returns as a tool to control risk-shifting (see Marshall and Prescott, 2006). However, these authors examine a narrow set of policies and in all their examples such perverse results are never obtained. Yet, the above example producing the perverse result is a linear tax on revenues; about as simple an ex-post penalty as imaginable. The new Basel II regulatory initiatives call (in general terms) for ex-post penalties on high realized returns, and apparently are unaware of the possibility of perverse effects. More work on this topic might be useful.

In the next section, we turn to a richer model that allows for two classes of equity holders. Before turning to that task, we briefly summarize results so far. First, a strict looting policy (high c) results in less looting in equilibrium. As a side benefit, it also results in less risk-shifting. Second, strict capital regulation (high e) has a similar pair of beneficials; it results in less risk-shifting and also less looting in equilibrium. Third, a strict policy of prohibiting risky activities (high t) may backfire, inducing the bank to take even more risk. Even if the policy does succeed in reducing risk shifting, it will increase the probability of looting.

4 Allowing for Two Classes of Equity

So far, our extension of the existing literature has been to allow for the simultaneous possibility of risk shifting and looting, in essence modeling the environment proposed by Akerlof and Romer (1993). We have so far employed a standard model with a single class of equity holders. However, our earlier discussion of case studies suggests that a richer model would be more appropriate for our purposes. Now for smallish closely-held banks, the assumption of a single class of owner-manager may be reasonable. However, for large banks or bank holding companies most equity investment actually comes from outside equity investors.

In this section, we present a richer model with two classes of equity investors: inside owner-managers as we had before, and outside equity investors.[9] This generalization will have several important implications. First, two kinds of stealing may now occur in equilibrium. One kind is as before in which an owner-manager loots everything in bad states of the world. Additionally, there may now be another form of theft in which the owner-manager steals a lesser amount without causing bankruptcy. We call this action “perk consumption.” To keep things simple, for most of the analysis we assume that the same policy variable c represents a regulatory penalty on both forms of theft.

[9] We will not attempt to prove the optimality of this contractual arrangement with two classes of equity. This has been done elsewhere in a different but related environment Boyd and Smith (1999).

In addition, we will show that in the new model raising c deters the owner-manager from looting and from consuming perks, but may encourage risk-shifting. Now, increasing the capital requirement also has mixed effects. It reduces risk-shifting incentives as before, but it now encourages perk consumption. As will become apparent, in the new model environment incentives of owner-managers are sometimes aligned with those of outside equity holders and sometimes not.

4.1 Model Environment

Outside-Equity Investors. Consider now a third type of agents, a continuum of outside equity investors. As an alternative source of financing, an owner-manager can collect e_o from outside equity investors by selling a fraction η of the bank's shares, keeping a fraction $1-\eta$ of the shares for herself. If the return from the loan portfolio is Y, the owner-manager must pay $D = d\,r_d$ to depositors and deposit insurance, leaving $\max\{0,\, Y - D\}$ for both classes of shareholders. The outside equity investor gets $\eta \max\{0,\, Y - D\}$, and the owner-manager keeps $(1-\eta)\max\{0,\, Y - D\}$. By assumption, outside equity investors demand an expected rate of return of r_o. Therefore, the expected return from the equity investors' shares must be at least $e_o\, r_o$. We further assume that $r_o > \mathrm{E}Y$ so that the owner-manager will not raise outside equity unless she is forced. For convenience, set $E_o := e_o\, r_o$.

In this environment, we can think of owner-managers as being endowed with bank charters that are in short supply. Thus, we fix the amount of owner-manager equity e_i and assume that if regulation forces banks to hold capital exceeding e_i this will be strictly in the form of outside equity, e_o. Importantly, we assume that if either looting or perk consumption occurs it is done by the owner-manager. None of the proceeds go to outside shareholders. Finally, a new balance sheet identity must hold, $d + e_i + e_o = 1$.

4.2 Equilibrium and Comparative Statics

As we saw in the previous section, without outside equity the owner-manager loots only in the case of default. In the presence of outside equity investors, however, the owner-manager may want to take some lesser amount, allowing the bank to remain solvent. Define L the amount that the owner-manager takes in the form of perk consumption. Then bank profits drop by L. The owner-manager gains $g(L)$ from perk consumption, but loses $(1-\eta)\,L$ because bank profits drop. Hence the owner-manager will consume perks such that the marginal benefits equal the marginal loss,[10]

$$g'(L^*) = 1 - \eta. \tag{6}$$

Without perk consumption, in non-default states the profits for an owner-manager would be $(1-\eta)(Y-D)$. With perk consumption, the owner-manager's returns are adjusted to

$$g(L^*) + (1-\eta)\,(Y - L^* - D) + V \tag{7}$$

Now let us analyze how the owner-manager's attitude towards looting changes in the presence of outside equity. Just as before, if the bank's loans yield a low return Y, the owner-manager may want to loot everything. In the case of looting, the bank pays nothing to depositors or outside equity investors. The owner-manager's profit is then simply $g(Y)$. Hence, she will loot whenever

$$g(Y) > g(L^*) + (1-\eta)\,(Y - L^* - D) + V. \tag{8}$$

As before, let Y_{crit} be the critical value of Y such that the above holds with equality. Then the owner-manager will consume some perks if $Y \geq Y_{\text{crit}}$, and will loot the bank if $Y < Y_{\text{crit}}$. The outside equity investors' aggregate expected profit is thus

$$\Pi_o = \int_{Y_{\text{crit}}}^{\infty} \eta\,(Y - L^* - D)\,f(Y)\,dY - E_o = 0. \tag{9}$$

where $E_o = e_o\,r_o$ is the opportunity cost of investing in bank shares. We assume that the owner-manager has the necessary bargaining power to drive the outside equity investor's expected surplus to zero, $\Pi_o = 0$, so that the equity investors' participation constraint is just binding. This gives us a function η, depending most importantly on e_o. The owner-manager's expected profit is then

$$\begin{aligned} E\Pi = &\int_0^{Y_{\text{crit}}} g(Y)\,f(Y)\,dY \\ &+ \int_{Y_{\text{crit}}}^{\infty} \Big(g(L^*) + (1-\eta)\,(Y - L^* - D) + V\Big)\,f(Y)\,dY. \end{aligned} \tag{10}$$

[10] Here, the amount of perk consumptions L^* depends only on the fraction of outside shares η and the penalty function g. In an alternative way of modeling, perk consumption might depend positively on the return Y.

For a given return distribution $f(Y)$, the equilibrium is determined by the endogenous variables η, L^*, and Y_{crit} and the equilibrium conditions are (6), (8) (at equality), and (9). In order to analyze the equilibrium, let us return to the two-point return distribution of Section 3.3. We arrive at the following proposition.[11]

Proposition 5 (Capital Requirements) *In equilibrium, an increase in capital requirements raises the fraction of outside equity ($d\eta/de_o > 0$), mitigates risk shifting, $dY_1/de_o < 0$, and increases perk consumption, $dL^*/de_o > 0$. The effect on the probability of looting, dY_{crit}/de_o, is ambiguous.*

Proposition 5 is illustrated in the left column of Figure 1, which is based on a numerical simulation. Let us analyze the comparative statics. As capital requirements increase and e_o rises, the bank manager sells more shares η and the amount of perk consumption L^* increases. More equity finance reduces leverage, hence the bank manager takes less risk; Y_1 is unambiguously reduced.

Proposition 5 states that the effect of capital regulation on the propensity to loot Y_{crit} is ambiguous and this is also visible in the example in Figure 2. This is different from results obtained with the simpler model, in which increasing the capital requirement unambiguously discouraged looting. The new result is obtained because owner-managers' incentives have changed. First, note that selling all shares ($\eta = 1$) is impossible. If the owner-manager sold all shares, he would not be left with any incentive to limit perk consumption. Outside equity investors would anticipate this behavior, they would not be willing to pay anything for the shares. Hence, there is a maximum amount of outside equity $\bar{e}_o$ that can be raised. Now consider the case $e_o < \bar{e}_o$. Then more outside shares η induce the bank manager to consume more perks, which in turn reduces the price that outside equity investors are willing to pay for the shares: the cost of outside equity increases. This effect is small if e_o is small, but it becomes larger for increasing e_o, and it explodes at $\bar{e}_o$. The possibility of perk consumption leads to increasing costs of outside equity finance and at $\bar{e}_o$, the marginal cost of outside equity becomes infinite. This point $\bar{e}_o$ is clearly visible in Figure 1 (third row).

[11] As proved in the Appendix, Proposition 5 still holds under the much weaker condition $g(Y_0) < V + g(L^*)$. So does the following Proposition 6. Here, we assume $Y_0 = 0$ because it greatly simplifies presentation and does not affect the intuition.

Now, more outside shares η increase the bank manager's propensity to loot Y_{crit}. Consequently, for e_o close to $\bar{e}_o$, an increase in equity must lead to an increase in the propensity to loot Y_{crit}. For smaller e_o, however, there is another channel that can be dominant. More equity means less leverage. Because leverage increases the propensity to loot, more equity can lead to a drop in the propensity to loot. Putting the two channels together, we find that more equity always increases Y_{crit} for sufficiently large equity ratios, but may decrease Y_{crit} for small equity ratios. All this is made more precise in the appendix.

What is producing these interesting results is the somewhat differing interests of inside owner-managers and outside shareholders. With respect to the shares' payments, interests of the two are perfectly aligned. However, the owner-manager also gets the continuation value V plus his perk consumption $g(L^*)$ in the good state. Consequently, the owner-manager manager is less willing to take risk than is the outside equity investor. These conflicting incentives are affected by capital regulation since it affects the relative magnitudes of the different kinds of returns to the owner manager.

There is an important implication here. The effect of capital regulation can be quite different, depending on the ownership structure of the bank. If it has a single class of owner-managers, tighter capital regulation will unambiguously result in less looting. If it has both owner-managers and outside equity investors, the effect of capital regulation on looting is non-monotone and a sufficiently high capital requirement may have the unintended consequence of encouraging looting. This does not imply that capital regulation is necessarily ineffective, but rather that too aggressive a capital policy may have an unintended and undesirable effect on looting behavior.

4.3 Deterring Bankers from Theft

We have assumed that both looting and perk consumption are unlawful, and come at a cost for the owner-manager. Recall that c is a policy variable and by varying c, the regulator can make either form of theft more or less costly. The equilibrium effects of the regulator's policy on looting, risk-shifting, and perk consumption are shown in the following proposition.

Proposition 6 (Deterring Bankers from Theft) *Increasing the penalty c on theft induces the bank manager to consume fewer perks in equilibrium,*

$dL^*/dc < 0$. Furthermore, Proposition 2 holds true, $dY_{\text{crit}}/dc < 0$: the manager is less likely to loot. Finally, for $Y_0 = 0$, the last statement of Proposition 3 is reversed, $dY_1/dc > 0$.

The first two results are not surprising. Increasing the penalty on theft increases both the marginal costs of perk consumption and of looting, so both are reduced in equilibrium. However, the third result, $dY_1/dc > 0$, reverses the finding obtained earlier with the one-class-of-equity model. Actually, this change in Proposition 3 is entirely due to changes in model assumptions.

In Proposition 3, the bank made positive profits in the bad state (Y_0 was assumed to be weakly positive), but there was no outside equity, $\eta = 0$, and hence no perk consumption. Consequently, an increase in c decreased the value of looting to the bank manager, and unambiguously decreased the owner-manager's incentive to risk shift. With the present model, in Proposition 6, by assumption the bank earns nothing in the bad state ($Y_0 = 0$), but it does hold outside equity. $Y_0 = 0$ implies $g(Y_0) = 0$, and the owner-manager gets nothing in the bad state, irrespective of the regulator's policy c. Hence, the channel which produced the Proposition 3 result is "switched of" in the present model, allowing us to concentrate on the perk consumption channel.

Now, a change in c has two effects. First, a higher c means that the value of perk consumption decreases. Because perks are consumed only in the good state, the value of the good state for the owner-manager decreases, hence she will shift risk, increase Y_1 in the good state and accept a lower success probability. Second, there is an indirect effect. A higher c means that the banker consumes fewer perks. Outside equity investors anticipate this, the share price increases, and η drops. Because risk shifting is in the interest of outside equity investors, and because keeping more shares aligns the manager's incentives more strongly with those of outside investors, a lower η implies that risk-shifting increases. Both effects go into the same direction.[12]

In the general case, with both channels open – e. g. $Y_0 > 0$ and outside equity present, both effects are present. Consequently, if downside risk is

[12]In the general case, with $Y_0 > 0$ and outside equity, both effects prevail at the same time. Consequently, if downside risk is large (small Y_0), a stricter looting policy c has the negative side effect of increasing risk shifting (close to Proposition 6). Only if downside risk is small (large Y_0) can the looting policy c have the positive side effect of also reducing gambling.

large (small Y_0), a stricter anti-theft policy c has the negative side effect of increasing risk shifting. If downside risk is small (large Y_0) a stricter anti-theft policy c has the positive side-effect of also reducing risk-shifting. This raises the logical possibility of different regulatory policies to deal with the two different forms of theft. For example, if the regulator were primarily seeking to deter risk-shifting, an appropriate policy would be to tolerate perk consumption, but strictly penalize looting. For brevity we do not formally analyze such a pair of policy instruments, but the logic should be apparent.

Proposition 6 is illustrated by the middle column of Figure 1 maintaining the important assumption discussed earlier that $Y_0 = 0$. We know the effects of a stricter crime policy (higher c): the bank manager will risk-shift more (higher Y_1), will loot less, and will consume fewer perks (lower Y_{crit} and L^*). All these predictions are confirmed by the numerical simulation in Figure 1. To sum up, increasing the penalty on theft increases both the marginal costs of perk consumption and of looting, so both are reduced in equilibrium. However, when the bank has both owner-managers and outside equity investors a stricter regulation c may (but need not) exacerbate risk-shifting. If the regulator is primarily concerned about containing risk shifting, an appropriate policy might be to tolerate perk consumption but strictly punish looting.[13]

5 Conclusion

We have studied a theoretical environment first suggested by Akerlof and Romer (1993) in which, during banking crises, both risk-shifting and managerial theft are possible. We treat bank ownership both in the conventional way – with one class of equity holders – and with an augmented model allowing for two classes of equity. The augmented model is dictated by our review of banking crisis case studies where conflicts between equity classes are commonly observed.

[13]Finally, for completeness, we consider the effects of a tax t on the bank manager's choice of risky investments. We parameterize the function $t(Y)$, choosing $t(Y) = \tau Y^2$ and using τ for a comparative static. Hence a high τ means that the regulator heavily restricts the set of possible investments for the bank manager. One can conjecture that a higher τ should make the bank manager gamble less (lower Y_1). As a consequence, the bank manager should sell more shares η, and hence he should gamble more and consume more perks (higher Y_{crit} and L^*). Again, these predictions are confirmed by the numerical simulation in Figure 1.

Providing for two classes of shareholders provides insights that are totally invisible in a more conventional one-class-of-equity setup. The interests of inside owner-managers are in some ways aligned with those of outside equity holders and in other ways are not aligned. Both groups share when returns are high, and this tends to make both groups like risk-shifting at the expense of the deposit insurer. Depending on parameters, however, owner-managers may be more or less averse to risk than outside equity investors. Owner-managers can appropriate the continuation value of the firm and consume perks, and both activities make them relatively less willing to take risk. On the other hand, owner-managers can loot the bank in bad return states and that makes them relatively more willing to take risk.

The policy implications of the two theoretical environments are quite different. With the one-class-of-equity model, comparative statics are relatively straightforward and two policies are shown to be effective at simultaneously combating risk-shifting and theft: those policies are capital requirements and anti-theft penalties. With the two-classes of equity model things get more complicated and no single "panacea policy" exists. All policies either have ambiguous (unsigned) results, or exhibit undesirable trade-offs between objectives. For example, penalizing theft reduces incentives to consume perks and to loot, but may increase incentives to risk-shift. Capital requirements will deter risk-shifting but they inherently encourage perk consumption. Similarly, if the regulator tries to control risk-shifting by prohibiting certain risky portfolio choices, risk-shifting may (but need not not) be reduced. However, even if the policy is effective at containing risk-shifting, it will encourage perk consumption and raise the probability of looting. Finally, we have shown that the policy of prohibiting high risk strategies may "backfire," causing banks to take even more risk.[14]

Fortunately, the analysis has at least three clear and unambiguous implications that should be of interest to bank regulators. (i) We have shown that with either model capital regulation can be an effective tool to contain both risk-shifting and theft, as long as capital standards are not set "too high." (ii) The two different forms of theft by owner-managers (Perk consumption and looting) have very different implications for bank behavior. Perk consumption discourages risk-shifting, whereas looting encourages it. Thus, if the regulator were particularly concerned about risk-shifting, it would be

[14]The new Basel II capital requirements heavily depend on ex-post identification of excessive risk-shifting exposures through backtesting, and then penalizing the cheaters. Although it is peripheral to the present study, our results might suggest that the success of the program will depend on the exact form of the ex-post taxation.

appropriate to tolerate perk consumption but heavily penalize looting. (iii) Perhaps most fundamentally, the effects of regulation inherently depend on a bank's ownership structure or "corporate governance." Our findings are theoretical, of course, but the same conclusion is fully supported by recent empirical work in banking (Laeven and Levine, 2007). An immediate consequence is that the optimal regulatory policy is likely to vary systematically by size of bank. The one-class-of-equity model will usually be appropriate for small, closely held banks. The two-classes-of-equity model will almost always be appropriate for large, publicly traded banks or bank holding companies. We are aware that some existing regulatory policies depend on size of bank; for example, because it is believed that the large banks can better diversify than small ones. However, both theory and empirics suggest a different reason why "size should matter" to the bank policy-maker.

Finally, we admit that our findings depend on modeling strategy and might not be robust to different assumptions. However, our key assumptions are reasonable, we think. To a first order, it is plausible that owner-managers can loot the bank or consume perks, but that outside equity holders cannot. Similarly, it is reasonable to assume that rents from bank ownership go primarily to informed owner-managers. Tweaking model assumptions can undoubtedly change some comparative statics, but is unlikely to overturn any of the basic conclusions we have reported.

A Proofs

Proof of Proposition 1 (Propensity to Loot): Let $\bar{G}$ be the implicit equation for Y_{crit}, defined by (1). Then the implicit function theorem yields

$$\frac{\mathrm{d}Y_{\text{crit}}}{\mathrm{d}D} = -\frac{\partial \bar{G}/\partial D}{\partial \bar{G}/\partial Y_{\text{crit}}} = -\frac{1}{g'(Y_{\text{crit}}) - 1}. \tag{11}$$

We have assumed that $g'(0) = 1$ and $g''(\cdot) < 0$ everywhere, hence $g'(\cdot) \leq 1$ everywhere. As a consequence, the denominator is negative, and the whole term is positive.[15] Now the probability of looting is given by $F(Y_{\text{crit}})$, hence the reaction of this probability with respect to a change in D is $\partial F(Y_{\text{crit}})/\partial D = f(Y_{\text{crit}})\, \partial Y_{\text{crit}}/\partial d$. So whenever $f(Y_{\text{crit}}) > 0$, this derivative is strictly positive. When there is no probability mass at the point Y_{crit},

[15]Note that $\mathrm{d}Y_{\text{crit}}/\mathrm{d}d = r_d\, \mathrm{d}Y_{\text{crit}}/\mathrm{d}D$ has identical sign, and so has $\mathrm{d}Y_{\text{crit}}/\mathrm{d}r_d$.

then the derivative is zero. Along the same line,

$$\frac{\mathrm{d}Y_{\mathrm{crit}}}{\mathrm{d}V} = -\frac{\partial \bar{G}/\partial D}{\partial \bar{G}/\partial Y_{\mathrm{crit}}} = -\frac{-1}{g'(Y_{\mathrm{crit}}) - 1} \tag{12}$$

which is negative. ■

Proof of Proposition 2 (Deterring Banks from Looting): Consider again (1), the implicit equation that defines Y_{crit}, but with $g(Y)$ replaced by $g(cY)/c$. The implicit function theorem now yields

$$\frac{\mathrm{d}Y_{\mathrm{crit}}}{\mathrm{d}c} = -\frac{1}{c^2}\,\frac{-[g(c\,Y_{\mathrm{crit}}) - c\,Y_{\mathrm{crit}}\,g'(c\,Y_{\mathrm{crit}})]}{g'(c\,Y_{\mathrm{crit}}) - 1}. \tag{13}$$

From Proposition 1, we already know that the denominator is negative. Furthermore, $g''(\cdot) < 0$ implies $Y\,g'(Y) < g(Y)$ for all $Y > 0$, hence the numerator is also negative. Consequently, the whole term is negative. ■

Proof of Proposition 3 (Risk-Shifting): Consider (4), the implicit equation that defines Y_1. The implicit function theorem now yields

$$\frac{\mathrm{d}Y_1}{\mathrm{d}D} = -\frac{-p'(Y_1)}{\partial^2 E\Pi/\partial Y^2}. \tag{14}$$

The denominator must be negative, otherwise Y_1 would not maximize, but minimize the bank manager's expected profits. The numerator is positive because $p'(\cdot) < 0$. Hence the whole derivative is positive. Next,

$$\frac{\partial Y_1}{\partial V} = -\frac{p'(Y_1)}{\partial^2 E\Pi/\partial Y_1^2}, \tag{15}$$

which is negative for analogous reasons. Finally,

$$\frac{\partial Y_1}{\partial c} = -\frac{p'(Y_1)}{c^2}\,\frac{g(c\,Y_0) - c\,Y_0\,g'(cY_0)}{\partial^2 E\Pi/\partial Y_1^2} \tag{16}$$

We have argued for Proposition 2 that $g(Y) > Y\,g'(Y)$, hence the denominator of the second fraction is positive (and zero for $Y_0 = 0$). Consequently, the whole term is negative. ■

Proof of Proposition 4 (Deterring Banks from Risk-Shifting): Note that (5) defines a differential inequality for $t(\cdot)$. If the inequality is strict, we obtain a first order differential equation, $t'(Y_1) = -t(Y_1)\, p'(Y_1)/p(Y_1)$. The solution to this equation is $t(Y_1) = C/p(Y_1)$, where C is an integration constant. This solution is not surprising; if the product of $t(Y_1)$ and $p(Y_1)$ is a constant, then the sum of the relative changes of both must add up to zero; this is exactly the differential equality. Now if indeed $t(Y_1) = C/p(Y_1)$, then the bank manager's profit function (see (3)) becomes

$$\begin{aligned} E\Pi &= (1 - p(Y_1))\, g(Y_0) + p(Y_1)\left(Y_1 - C/p(Y_1) - D + V\right) \\ &= (1 - p(Y_1))\, g(Y_0) + p(Y_1)\left(Y_1 - D + V\right) - C. \end{aligned} \tag{17}$$

Thus, the bank manager's expected profits do depend on the reduction of the set of possible investments. However, the bank manager's decision on risk, which is determined by the first order condition $\partial E\Pi/\partial Y_1 = 0$, does not. Hence, if inequality (5) holds, then taking risk becomes more costly for the bank manager in comparison to the above differential equation; the bank manager will take less risk in equilibrium. If the reverse of (5) holds true for all Y_1, then the bank manager will take more risk. If (5) holds only for some Y_1, then the effect on the regulation on the bank manager's risk choice is ambiguous. ■

Proof of Proposition 5 (Capital Requirements): In order to derive the absolute derivatives of the endogenous variables, we first prove two lemmata that consider the direct influences of variables on one another.

Lemma 1 (Outside Equity) *Ceteris paribus, more outside equity makes the bank manager consume more perks, $\partial L^*/\partial\eta > 0$, and it increases the range of possible returns in which the bank manager wants to loot the bank, $\partial Y_{\text{crit}}/\partial\eta > 0$. The statements of Proposition 1 hold true in the presence of outside equity ($\partial Y_{\text{crit}}/\partial D > 0$ and $\partial Y_{\text{crit}}/\partial V < 0$). Perk consumption does not influence the bank manager's looting decision, $\partial Y_{\text{crit}}/\partial L^* = 0$. Finally, the fraction of outside equity increases if the bank manager consumes more perks, $\partial\eta/\partial L^* > 0$, and it weakly increases if the bank manager loots more often, $\partial\eta/\partial Y_{\text{crit}} \geq 0$.*

Proof of Lemma 1 (Outside Equity): Start with the discussion of L^*, which is determined by (6), hence by the implicit equation $G = g'(L^*) -$

$(1-\eta)=0$. The implicit function theorem yields

$$\frac{\partial L^*}{\partial \eta} = -\frac{\partial G/\partial \eta}{\partial G/\partial L^*} = -\frac{1}{g''(L^*)} > 0. \tag{18}$$

We obtain the very natural result that the higher the participation of the equity investor, the more the bank manager will consume perks. The higher the bank manager's own participation in profits $(1-\eta)$, the less he will consume perks.

Now come to the discussion of Y_{crit}, which is determined by (8), hence by the implicit equation $\bar{G} = g(Y_{\text{crit}}) - g(L^*) - (1-\eta)(Y_{\text{crit}} - L^* - D) - V = 0$. The implicit function theorem yields

$$\frac{\partial Y_{\text{crit}}}{\partial \eta} = -\frac{\partial \bar{G}/\partial \eta}{\partial \bar{G}/\partial Y_{\text{crit}}} = -\frac{Y_{\text{crit}} - L^* - D}{g'(Y_{\text{crit}}) - (1-\eta)} > 0. \tag{19}$$

The numerator is positive: If the portfolio returns only $D + L^*$, hence debt plus the amount that the bank manager would consume perks anyway, he would clearly prefer to steal the complete return, hence $Y_{\text{crit}} > L^* + D$. The denominator is negative because $Y_{\text{crit}} > L^*$, and $g'(L^*) = 1-\eta$, and $g'' < 0$. As a consequence, the whole derivative is positive. If the equity investor gets a higher fraction of the cake, the bank manager loots the bank already at a rather high Y_{crit}. Ceteris paribus, with a higher η, the probability of looting increases. Along the same line,

$$\frac{\partial Y_{\text{crit}}}{\partial D} = -\frac{\partial \bar{G}/\partial D}{\partial \bar{G}/\partial Y_{\text{crit}}} = -\frac{1-\eta}{g'(Y_{\text{crit}}) - (1-\eta)} > 0. \tag{20}$$

The more deposits, the higher the debt of the bank manager, the more likely he is to loot the bank.

$$\frac{\partial Y_{\text{crit}}}{\partial V} = -\frac{\partial \bar{G}/\partial V}{\partial \bar{G}/\partial Y_{\text{crit}}} = -\frac{-1}{g'(Y_{\text{crit}}) - (1-\eta)} < 0. \tag{21}$$

The bank manager is not very likely to loot the bank if its continuation value is high.

$$\frac{\partial Y_{\text{crit}}}{\partial L^*} = -\frac{\partial \bar{G}/\partial L^*}{\partial \bar{G}/\partial Y_{\text{crit}}} = -\frac{-g'(L^*) + (1-\eta)}{g'(Y_{\text{crit}}) - (1-\eta)} = 0. \tag{22}$$

The numerator is zero because of (6). A marginal change in the amount of perk consumption L^* does not make the bank manager want to loot more or less often.

Finally, let us come to the discussion of η, which is determined by the equity investors' participation constraint, hence $\hat{G} = \Pi_o = 0$ with Π_o as in (9). C. p., we get the comparative statics

$$\frac{\partial \eta}{\partial L^*} = -\frac{\partial \hat{G}/\partial L^*}{\partial \hat{G}/\partial \eta} = -\frac{-\int_{Y_{\text{crit}}}^{\infty} \eta\, f(Y)\, dY}{\int_{Y_{\text{crit}}}^{\infty} (Y - L^* - D)\, f(Y)\, dY} > 0. \tag{23}$$

If the bank manager consumes more perks, the equity investor wants a higher fraction η of profits, in order to still get the same expected return. The derivative $\partial \eta/\partial D$ is exactly the same; the equity investor does not care whether he gets less money because the bank manager consumes more perks, or if he gets less money because the bank manager must repay more to depositors. Next,

$$\frac{\partial \eta}{\partial Y_{\text{crit}}} = -\frac{\partial \hat{G}/\partial Y_{\text{crit}}}{\partial \hat{G}/\partial \eta} = -\frac{-\eta\, (Y_{\text{crit}} - L^* - D)\, f(Y_{\text{crit}})}{\int_{Y_{\text{crit}}}^{\infty} (Y - L^* - D)\, f(Y)\, dY} \geq 0. \tag{24}$$

The numerator is negative because $Y_{\text{crit}} > L^* + D$ (as discussed above), it is zero if $f(Y_{\text{crit}}) = 0$ (which would typically be the case in a model with discrete outcomes. The denominator is positive, hence the complete fraction is positive: If the probability of looting increases (hence if the critical Y_{crit} below which the bank manager will loot the bank) increases, the equity investor expects a lower repayment from the bank manager, hence he needs a higher η in order to be compensated. Finally, and quite trivially so, $\partial \eta/\partial E_o > 0$. □

From this lemma, it becomes already apparent that equity regulation (leading to a higher η) can backfire with respect to perk consumption and looting; a high capitalization ratio is not necessarily a good thing. This reality is invisible in models with only one class of equity.

Interestingly, the bank manager's decision on gambling does not influence perk consumption. Consider again a two-state distribution function, the portfolio yields Y_1 with probability $p(Y_1)$, and otherwise Y_0, with $Y_1 > Y_{\text{crit}} > Y_0$. Then if the return is low (Y_0), the bank manager will loot the bank, if the return is high (Y_1), he will just consume some perks, independent of the size of returns (Y_1) and of the probability of success ($p(Y_1)$).

On the other hand, if the bank manager has the option to consume perks, he will get more out of the good state of nature, hence he will choose to take less risk Y_1. However, because L^* is chosen optimally in equilibrium, a marginal change in L does not affect the bank manager's profits in the high state. As a consequence, a marginal change in L would not change the bank manager's risk taking decision Y_1.

Lemma 2 (Outside Equity and Risk-Shifting) *If $V > g(Y_0) - g(L^*)$ holds, then in equilibrium, a larger fraction of outside equity η makes the bank manager gamble less, $\partial Y_1/\partial\eta < 0$, and more gambling makes equity investors demand a smaller fraction of the shares, $\partial\eta/\partial Y_1 < 0$. If $V < g(Y_0) - g(L^*)$, then both inequalities are reversed.*

Proof of Lemma 2 (Outside Equity and Risk-Shifting): First, look at the reaction of risk Y_1 to an increase in the fraction of outside shares η. The bank manager's expected profit is given by

$$E\Pi = (1 - p(Y_1))\, g(Y_0) + p(Y_1)\left(g(L^*) + (1-\eta)\,(Y_1 - L^* - D) + V\right). \tag{25}$$

The first order condition $\partial E\Pi/\partial Y_1 = 0$ determines the bank manager's risk choice Y_1, and especially defines an implicit function $Y_1(\eta)$. The implicit function theorem yields

$$\frac{\partial Y_1}{\partial \eta} = -\frac{p'(Y_1)\left(g(L^*) - g(Y_0) + V\right)/(1-\eta)}{\partial^2 E\Pi/\partial Y_1^2} \tag{26}$$

The denominator must be negative. If $g(Y_0) < g(L^*) + V$, then the numerator is negative, and the whole fraction is negative: if investors hold a larger fraction η of shares, the bank manager wants to take less risk. However, if $g(Y_0) > g(L^*) + V$, then the numerator is positive, hence the whole fraction becomes positive; the bank manager takes more risk if investors hold more shares.

In the other direction, Y_1 also influences η. Equity investors may or may not appreciate that the bank manager takes more risk; in reaction, they may demand a higher or smaller share η of the bank's profits. η is determined by the equation

$$\Pi_o = p(Y_1)\,\eta\,(Y_1 - L^* - D) - e_o\, r_o, \tag{27}$$

which defines an implicit function $\eta(Y_1)$. The implicit function theorem yields

$$\begin{aligned}\frac{\partial \eta}{\partial Y_1} &= -\eta\,\frac{p'(Y_1)\,(Y_1 - L^* - D) + p(Y_1)}{p(Y_1)\,(Y_1 - L^* - D)}\\ &= -\eta\,\frac{-p'(Y_1)\left(g(L^*) - g(Y_0) + V\right)/(1-\eta)}{p(Y_1)\,(Y_1 - L^* - D)}.\end{aligned} \tag{28}$$

If $g(Y_0) < g(L^*) + V$, the bank manager takes less risk than the equity investor would like him to, hence $\partial\Pi_o/\partial Y_1 > 0$. As a consequence, the complete derivative is negative, more risk makes the equity investor demand a lower compensation η. If $g(Y_0) > g(L^*) + V$, the bank manager is too prudent from the eyes of the equity investor, hence an increase in risk Y_1 increases η. $\square$

According to Lemma 2, a high V implies that the bank manager likes risk taking less than outside equity investors. Hence, if for some reason the bank manager is anticipated to take marginally more risk, then the price of shares increases, and the bank needs to issue fewer shares in order to get the same amount of outside equity, $\partial\eta/\partial Y_1 < 0$.

The condition in the lemma is equivalent to $g(L^*) + V > g(Y_0)$. These are the hypothetical profits of a bank manager, net of compensation through shares. Under failure, the bank manager loots and hence gets $g(Y_0)$. Under success, he gets $g(L^*)$ from perk consumption, plus he keeps the charter value V. Hence reformulating Lemma 2, if the bank manager prefers to be successful even without taking the profits from his inside equity shares into account, then the fact that he does hold inside equity makes him gamble more (because it increases the attractiveness of the successful states). Furthermore, outside equity investors dislike this risk shifting behavior, so the bank manager will have to issue more shares if investors anticipate him to take on more risk.

Note that there is always an amplifying multiplier between η and Y_1. If $g(Y_0) < g(L^*) + V$, then a larger fraction of outside equity η induces less risk taking Y_1, which in turn increases η. If on the other hand $g(Y_0) > g(L^*)+V$, then a larger fraction of outside equity η induces *more* risk taking Y_1, which in turn increases η. Hence the answer to the question whether capital regulation is effective depends on whether the bank manager gains a lot from looting in the bad state of the world, $g(Y_0)$. If the proceeds from looting $g(Y_0)$ are very high, then capital regulation is detrimental for risk taking. Especially when the regulator does not know the exact V, or if V itself is a stochastic variable, capital regulation may be a risky strategy for the regulator as it may increase the bank's risk choice.

Now let us come back to the proof of Proposition 5. The equilibrium is defined by four equations. (4) defines Y_1, (6) defines L^*, (8) defines Y_{crit}, and (9) defines η. For simplicity, consider $Y_0 = 0$ as an extreme example for the condition $g(Y_0) < g(L^*) + V$. We have hence four implicit equations that define the equilibrium,

$$\mathcal{E}_{Y_1} = (1-\eta)\,p(Y_1) + p'(Y_1)\big(g(L^*) + (1-\eta)(Y_1 - L^* - D) + V\big) = 0, \tag{29}$$
$$\mathcal{E}_{L^*} = g'(L^*) - (1-\eta) = 0, \tag{30}$$
$$\mathcal{E}_{Y_c} = g(L^*) + (1-\eta)\,(Y_c - L^* - D) + V - g(Y_c) = 0, \quad \text{and} \tag{31}$$
$$\mathcal{E}_{\eta} = \eta\, p(Y_1)(Y_1 - L^* - D) - E_o = 0. \tag{32}$$

We already know that η influences L^* positively, and vice versa L^* increases η. Neither Y_1 nor Y_c have a direct influence on L^*. As a consequence, we can (temporarily) ignore L^* in our discussion, and bear in mind that any effect on η will have to multiplied due to repercussions through L^*. We are left with three implicit equations for three variables.

Because E_o is defined as $E_o = r_o\, e_o$, we have to look at the comparative statics with respect to E_o. Furthermore, note that $1 = d + e_i + e_o = D/r_d + e_i + E_o/r_o$, and hence $D = r_d\,(1 - e_i - E_o/r_o)$. Hence through D, also (29) and (31) depend immediately on E_o. Substitute D through E_o and apply the implicit function theorem to get

$$\frac{d\eta}{dE_o} = \left(\frac{\partial\mathcal{E}_{Y_1}}{\partial Y_1}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial E_o} - \frac{\partial\mathcal{E}_{Y_1}}{\partial E_o}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial Y_1}\right)\Big/\left(\frac{\partial\mathcal{E}_{Y_1}}{\partial \eta}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial Y_1} - \frac{\partial\mathcal{E}_{\eta}}{\partial \eta}\cdot\frac{\partial\mathcal{E}_{Y_1}}{\partial Y_1}\right), \tag{33}$$
$$\frac{dY_1}{dE_o} = \left(\frac{\partial\mathcal{E}_{Y_1}}{\partial \eta}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial E_o} - \frac{\partial\mathcal{E}_{Y_1}}{\partial E_o}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial \eta}\right)\Big/\left(\frac{\partial\mathcal{E}_{\eta}}{\partial \eta}\cdot\frac{\partial\mathcal{E}_{Y_1}}{\partial Y_1} - \frac{\partial\mathcal{E}_{Y_1}}{\partial \eta}\cdot\frac{\partial\mathcal{E}_{\eta}}{\partial Y_1}\right), \tag{34}$$
$$\frac{dY_c}{dE_o} = -\left(\frac{\partial\mathcal{E}_{Y_c}}{\partial E_o} + \frac{\partial\mathcal{E}_{Y_c}}{\partial \eta}\cdot\frac{d\eta}{dE_o}\right)\Big/\frac{\partial\mathcal{E}_{Y_c}}{\partial Y_c}. \tag{35}$$

The sign of $d\eta/dE_o$ must be positive. More outside equity means that the bank manager must sell more shares to outsiders. If the bank manager could increase the raised outside equity by selling fewer shares, then the capital regulation rules could not be binding because equity would be cheap (in fact, it would even bear a negative cost). As a direct consequence, due to (30), the derivative $dL^*/de_o > 0$.

Taking derivatives of (29), $\partial\mathcal{E}_{Y_1}/\partial Y_1 < 0$, $\partial\mathcal{E}_{Y_1}/\partial\eta < 0$, and $\partial\mathcal{E}_{Y_1}/\partial E_o < 0$. Taking derivatives of (32), $\partial\mathcal{E}_{\eta}/\partial\eta > 0$, $\partial\mathcal{E}_{\eta}/\partial E_o < 0$, and

$$\partial\mathcal{E}_{\eta}/\partial Y_1 = \eta\, p(Y_1) + \eta\, p'(Y_1)\,(Y_1 - L^* - D),$$

which is equal to $-p'(Y_1)\,(V + g(L^*))\,\eta/(1-\eta)$ due to (29), which is positive. (For large positive Y_0, the term might turn negative.) As a consequence, the numerator of (33) is negative. As argued above, the whole fraction must be positive, hence also the denominator must be negative. Now the denominator of (34) is exactly the negative of the denominator of (33), hence it is positive. The numerator of (34) is positive, hence the aggregate fraction of (34) is negative. Hence stricter capital requirements induce the bank manager to take less risk in equilibrium.

Now let us discuss (35). Taking derivatives of (31), $\partial\mathcal{E}_{Y_c}/\partial E_o > 0$ and $\partial\mathcal{E}_{Y_c}/\partial\eta < 0$, furthermore $\partial\mathcal{E}_{Y_c}/\partial Y_c > 0$. As a consequence, the sign of (35) is indeterminate. However, we can conjecture that for large E_o, as the problem of perk consumption becomes more pronounced, $d\eta/dE_o$ increases. Hence the sign of $\partial\mathcal{E}_{Y_c}/\partial\eta < 0$ will be dominant, thus $dY_c/dE_o > 0$. ■

Proof of Proposition 6 (Deterring Bankers from Perk Consumption): The level of perk consumption is now given by a modification of (6), by $g'(c\,L^*) - (1-\eta) = 0$. As a consequence,

$$\frac{\partial L^*}{\partial c} = -\frac{c\,g'(c\,L^*)}{L^*\,g'(c\,L^*)} = -\frac{c}{L^*} < 0. \tag{36}$$

The total derivative, dL^*/dc, will also be influenced by the share of outside equity η. An increasing c will decrease η, this will reinforce the partial effect, leading to a negative total derivative. Quite naturally, a higher penalty on looting (of any kind) makes the bank manager want to consume fewer perks.

The critical Y_{crit} is now given by $g(c\,Y_{\text{crit}})/c - g(c\,L^*)/c - (1-\eta)\,(Y_{\text{crit}} - L^* - D) = 0$. As a consequence,

$$\frac{\partial Y_{\text{crit}}}{\partial c} = -\frac{1}{c^2}\,\frac{[g(c\,L^*) - c\,L^*\,g'(c\,L^*)] - [g(c\,Y_{\text{crit}}) - c\,Y_{\text{crit}}\,g'(c\,Y_{\text{crit}})]}{g'(c\,Y_{\text{crit}}) - (1-\eta)}. \tag{37}$$

Now $Y_{\text{crit}} > L^*$, and $g(c\,Y) - c\,Y\,g'(c\,Y)$ is a strictly increasing function in Y, hence the numerator is negative. The denominator is also negative, because the derivative of g equals $1-\eta$ already at L^*, and g' is a decreasing function. Summing up, the whole partial derivative is negative. Again, partial effects are reinforced by a decrease in η, leading to a negative total derivative. The higher the costs of looting c, the smaller the critical Y_{crit} below the bank manager will loot; the smaller the probability of looting. Finally, there is no direct effect on η, the fraction of shares that the equity investor buys.

Finally, let us show that $\partial Y_1/\partial c > 0$ if and only if $Y_0 < L^*$. Using the implicit function theorem, we know that the sign of $\partial Y_1/\partial c$ is identical to that of

$$\frac{\partial^2 E\Pi}{\partial Y_1 \partial c} = \frac{p'(Y_1)}{c^2}\big(g(c\,Y_0) - g(c\,L^*) - c\,Y_0\,g'(c\,Y_0) + c\,L^*\,g'(c\,L^*)\big). \tag{38}$$

Because $g(c\,Y) - c\,Y\,g'(c\,Y)$ is a strictly increasing function in Y, the whole term is positive if and only if $Y_0 < L^*$. Again, there are second-order effects through η. An increase in c lowers η in equilibrium, leading to an increase in Y_1. Consequently, the total derivative dY_1/dc is positive. ■

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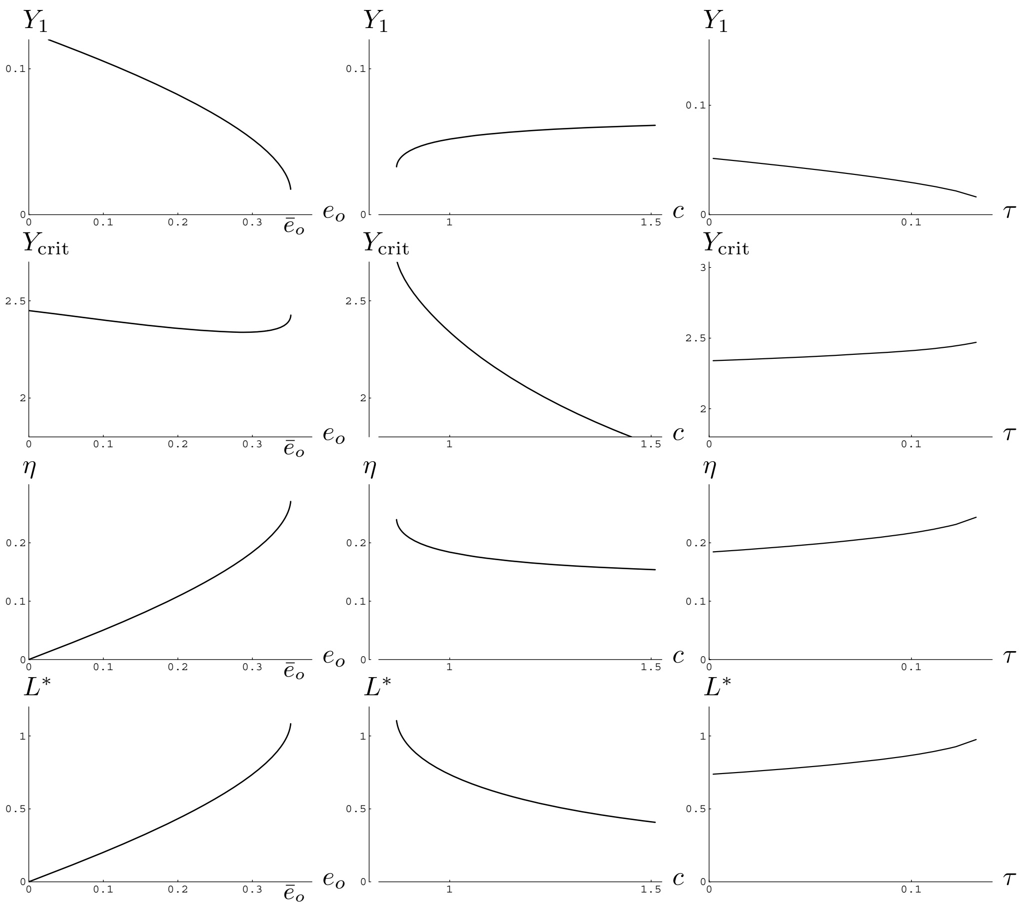
Table 1: Numerical Example



We have plotted endogenous variables (Y_1, Y_{crit}, η and λ) for changing policy parameters (capital requirements e, penalty on looting c, and penalty on risk shifting t). The numerical examples have $p(Y_1) = 2 - Y_1/3$, $g(L) = L - L^2/8$, $t(Y) = \tau Y^2$, $r_E = 1$, $r_d = 1$, $Y_0 = 0$, and $V = 0.25$. Furthermore, $e = 0.3$ (except in the left column where it varies), $c = 1$ (except in the middle column) and $t = 0$ (except in the right column). The scales of three adjacent plots are identical and hence directly comparable. Hence reading the functions at $e = 0.3$, $c = 1$ and $t = 0$ yields identical values in each column.