Abstract
This paper develops a theoretical model of bank culture. The model is based on a multi-tasking problem within a bank that involves the bank designing an optimal incentive contract to induce the desired allocation of managerial effort across growth and safety. There is always excessive growth in the second best relative to the first best. Moreover, interbank competition exacerbates this excessive focus on growth at the expense of safety as competing banks all herd on this focus. When culture is introduced as a bank choice, it has two effects. First, when the bank and the manager a bank could hire have possibly different beliefs regarding whether the focus should be on growth or safety, culture assortatively matches managers (whose beliefs are unobservable) with banks that share their beliefs. Second, a strong safety-focused culture reduces the competition-induced excessive focus on growth as well as the herding on growth. Interestingly, the effect of culture is contagious – a strong safety-focused culture in a subset of banks induces even banks without such a culture to increase their emphasis on safety. This effect of culture becomes stronger with higher bank capital levels and weaker with stronger safety nets.

Keywords: Bank culture, Multi-tasking problem, Competition, Bank capital, Safety nets
JEL: G21, M14
Bank Culture

“Banks and banking rely on trust. And while trust takes years to establish, it can be lost in a moment through failures caused by problematic ethics, values, and behaviors. Events that precipitated the global financial crisis and the subsequent issues that have emerged have revealed a multitude of cultural failures... A great deal rests on a firm’s culture... The banking community as a whole needs to repair the damage done by failures in culture, values, and behaviors, and should tackle the challenge with renewed vigor and purpose to achieve tangible improvements in outcomes and reputation.”

– Group of Thirty, Washington, D.C., July 2015

1 Introduction

Largely ignored for decades in public discourse about banking risks and financial stability, the issue of bank culture has emerged as an important topic of discussion since the 2007-09 financial crisis (e.g., Dudley (2014), Group of Thirty (2015), and Ochs (2014)). Banking failures that elevate systemic risk are no longer viewed as isolated events attributable to a handful of rogue employees who took unsanctioned risks that turned out badly. Rather, many now believe that these are systematic lapses that are condoned and perhaps even encouraged by the culture in the failing banks. In this view, there is tacit acknowledgement of the limitations of explicit intra-firm mechanisms like wage contracts and prudential regulation tools like capital requirements and portfolio restrictions to control excessive risk taking that exposes the safety net to seemingly unbounded levels of exposure. Given these limitations, it seems natural to turn to culture, which is widely acknowledged as an influential factor in the behavior of individual employees. As the Group of Thirty (2015) report points out: “Culture is defined as ‘the ideas, customs, and social behavior of a particular people or society...’ Culture is what people do when no one is watching.” Thus, bank regulators should (and do) care about bank culture because it may affect bank risk.

But what is bank culture, in a formal economic sense, and how do we use this economic view of bank culture to improve our understanding of how banks choose culture, how it affects the behavior of their employees, and how it interacts with forces like interbank competition, safety nets and bank capital? Our goal in this paper is to address these questions theoretically.

While there is a long-standing literature on corporate culture in organization behavior (e.g., Cameron and Quinn (2011), Cameron et al. (2014), Cartwright and Cooper (1993), and Quinn and
Rohrbaugh (1983)), the literature in economics is more recent and less voluminous (e.g., Crémer (1993), Guiso, Sapienza, and Zingales (2015a), Hermelin (2001), Kreps (1990), and Van den Steen (2010a, 2010b)). Thakor (forthcoming) discusses the connections between these two strands of literature. We know of no formal theoretical model of bank culture, however. While the economic insights from theories of corporate culture developed for firms in general are obviously useful in thinking about bank culture, there are numerous special features of banks that require a specialized model of bank culture. Public safety nets that distort bank risk taking represent the most prominent of these features, so not surprisingly much of the focus in discussions of bank culture is on the safety and soundness of banks, and this is what bank regulators are focused on too. Features like capital requirements also come up as essential aspects of banking. Because culture is a somewhat nebulous concept, in the absence of a formal theory of bank culture it is difficult to understand how these features interact to affect bank culture and consequently employee behavior in banking.

We develop a theoretical model of bank culture in a principal-agent setting that rests on three important pillars. The first pillar is the modeling of a multi-tasking problem within the bank. Our view is that corporate culture is a choice, and for banks the most pertinent choice is between growth and safety. By introducing a multi-tasking problem, we are capturing a tradeoff – safety can only be enhanced by sacrificing growth, and vice versa. We think this tradeoff is an essential aspect of bank culture choice.\(^1\) The second pillar is that both the manager a bank could hire as well as the bank itself have beliefs about the quality of the borrower pool that determine the optimal allocation of effort across the pursuit of growth and the pursuit of safety, and these beliefs may be different. The third pillar is our use of the Akerlof and Kranton (2005, 2010) notion of “identity economics.” A bank’s culture creates an identity for its employees, so that a choice of (unobservable) action by an employee that is not consonant with the culture generates a disutility for the employee.\(^2\) This is meant to capture the idea that “culture is what people do when no one is watching,” which we interpret in our context to mean that culture induces employees to act in a way consistent with the norms of the organization, even when such behavior is not driven by direct and intrusive monitoring of actions. In addition to modeling culture, we also solve endogenously for the optimal managerial

\(^1\)The tension between growth and safety is a recurring theme in banking. For example, the proposals designed to improve bank safety in Hoenig and Morris (2012) have the explicit feature that they limit bank growth in certain areas.

\(^2\)It may seem a bit unusual to assume that the employee’s effort is unobservable and yet actions that deviate from the bank’s culture norms can generate a negative utility for the employee. The idea here is that the employee’s actions may be noisily observed by others – as is typical in most organizations – but are not verifiable for contracting purposes. Thus, inferred deviations from what the bank’s culture requires may be sanctioned in ways other than through compensation or other contractual mechanisms.
wage contract in the multi-tasking environment. Developing a culture in our model is costly for the bank; it requires an investment and the bigger the investment, the stronger the culture.

These three pillars lead to a simple model of bank culture that generates the following key results. First, with no investment in culture, the second best always involves an excessive focus on growth at the expense of safety, i.e., the second-best wage contract has an inefficiency associated with it. Second, this excessive focus on growth is exacerbated by interbank competition, so banks herd even more on growth, increasing systemic risk. Third, a mismatching of beliefs (about the quality of the borrower pool) between the bank and its manager increases the focus on growth in the absence of an investment in culture when the manager is more optimistic than the bank. Fourth, a sufficiently large investment in bank culture induces managers to sort themselves, so that in equilibrium the beliefs of the bank match those of its manager. Fifth, culture can reduce the growth-focused herding behavior induced by interbank competition. The development of a strong safety culture by one bank induces a competing bank to also reduce its focus on growth and increase its focus on safety. That is, culture is “contagious.” Finally, this spillover effect of culture is stronger when banks have more capital and weaker when the public safety net is stronger.

Our paper has possible implications for bank regulatory policy. First, even though bank regulators have recognized the importance of bank culture, it is difficult to know how to condition regulatory policy on it, especially given measurement difficulties and cross-sectional comparison challenges related to culture. Our analysis indicates, however, that existing regulatory tools like capital requirements and bailout policies can be used to influence bank culture. At least at the outset, contemplating how these tools might be deployed differently from current practice may be more fruitful than grappling with daunting culture measurement issues. Second, our model implies that the choice of culture involves a tradeoff. If regulators take steps to induce a stronger safety-oriented culture in banking, it will be at the expense of lending growth in banks. Third, the contagious nature of culture means that not all banks in the economy need to be targeted by regulators. If regulators can influence a change in culture at just a few highly visible banks – these would typically be the largest banks – it will have a ripple effect on culture at other banks as well.

This paper is related to previous work on organization culture and builds on the many insights provided by that literature. Kreps (1990) develops a model in which a strong organization culture can help eliminate undesirable Nash equilibria, so it can work as a “coordination” mechanism. Lo (2015) provides an “Adaptive Market Hypothesis” view of corporate culture as something that survives evolution and discusses its risk management implications. Crémer (1993) views culture as
knowledge shared by members of the organization that is unavailable to those outside it. Hermalin (2001) models the decision about the strength of culture as a choice between high fixed cost and low marginal cost (strong culture) on the one hand and low fixed cost and high marginal cost (weak culture) on the other hand. In his model, competition affects the benefit of developing a strong culture. Van den Steen (2010a) views culture as being about shared values and beliefs. He allows beliefs to be heterogeneous, in which case there may be disagreement about the right course of action. He shows that culture can reduce belief heterogeneity among employees through screening in hiring, self-sorting, and joint learning. In a companion paper, Van den Steen (2010b) shows that shared beliefs (fostered by culture) lead to increased delegation, higher utility and greater effort, and goes on to examine the implications of cultural differences between merging firms.\footnote{The idea that culture affects behavior is also echoed in Guiso, Sapienza, and Zingales (2015b) who argue that corporate culture can foster cooperation and is a laboratory to study the role of societal culture and how it can be changed.}

The similarities between these papers and ours are that we also endogenize the strength of the firm’s culture and the impact of competition on this choice, as Hermalin (2001) does, and we also view culture as being about shared beliefs and values, with possibly heterogeneous beliefs, as in Van den Steen (2010a). However, there are numerous significant differences as well. Our definition of the strength of culture is different from Hermalin’s (2001), and we show in contrast that a strong culture attenuates the competition-induced propensity for banks to focus excessively on growth at the expense of safety. And unlike Van den Steen (2010a, 2010b), we focus on the growth versus safety choice aspect of bank culture, and therefore examine a different set of issues.

The setup in our model that culture is determined from the top and that employees respond to the culture of the organization is consistent with the empirical evidence (e.g., Guiso, Sapienza, and Zingales (2015a)), recent survey evidence (e.g., Graham et al. (2015)), as well as evidence based on experiments (e.g., Cohn, Fehr, and Maréchal (2014)). In particular, the view in our model that organization culture can shape an employee’s identity and influence that employee’s decisions is echoed in the findings of Cohn, Fehr, and Maréchal (2014). They conducted an experiment in a large international bank and showed that although employees behaved honestly on average in a control condition, they became dishonest when their professional identity as bank employees was rendered salient. They conclude that the prevailing business culture in banking weakens the honesty norm. This is also consistent with Lo’s (2015) view that culture matters in banking and that it can be changed to improve risk management. He also emphasizes the roles of leadership and the external environment in shaping the transmission of culture, ideas that are consistent with our
model. Many of the case studies of bank failures that he provides correspond to an excessive focus on growth (at the expense of safety) in our theory. Indeed, if we interpret a safety-focused culture in our model more broadly as one that focuses on curbing wrong/reckless employee behavior, then Lo’s prescriptions are in line with the adoption of a safety-focused culture. Our results are also consistent with the empirical evidence in Ellul and Yerramilli (2013) that a strong and independent risk management function in banks – which we interpret as being a component of a strong safety-oriented culture – leads to lower risk exposure at banks (see also Ellul (2015)).

The rest of the paper is organized as follows. Section 2 develops the base multi-tasking model. Section 3 provides an analysis of the model. Section 4 extends the model to analyze bank culture in the single-bank case. Section 5 introduces two competing banks to study the effect of competition, as well as the mediating role of culture and its contagious nature. Section 6 discusses regulatory policy implications. Section 7 concludes. All proofs are in the Appendix.

2 Base Model

_Model Overview:_ We will develop a model in which the bank’s choice of culture is to be either growth-focused or safety-focused. This choice of culture then determines the optimal wage contract the bank designs to elicit managerial effort allocation to growth and safety. Higher effort allocation to growth increases the probability that the bank will find a loan to make. Higher effort allocation to safety means a lower probability of loan default. This introduces a tradeoff which is a key element in our modeling of culture, namely that, given a total amount of effort elicited, there is a tension between growth and safety. A greater allocation of effort to growth means a smaller allocation to safety, and vice versa. In the base model developed here, we simply model the multi-tasking agency problem in the bank. That is, we keep culture out of the picture, and solve the bank’s optimal effort allocation problem in the first-best and second-best cases with the loan production function the bank is endowed with. After completing our analysis of this base model with a single bank (Section 3), we introduce culture (Section 4) and multiple banks (Section 5).

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4The decision of how to allocate effort across growth and safety in a multi-tasking framework is similar to the problem studied in Aghion and Stein (2008), in which the relative emphasis the stock market puts on growth versus cost productivity affects the firm’s strategic focus. Another way to think about the choice of culture is along the time dimension, i.e., the choice of culture may be a choice of the “internal discount rate” for future payoffs, so that some firms tend to have shorter time horizons over which they maximize an objective function compared to other firms. We leave an analysis of this aspect of culture for future research.
**Model Specifics:** The model has three dates \((t = 0, 1, 2)\) with the following timeline: the bank decides on its culture at \(t = 0\) (whether it is growth-focused or safety-focused and the investment in the culture, which determines the “strength” of the culture; we formalize this later), and then designs a wage contract to elicit managerial effort at \(t = 1\); at \(t = 2\) payoff is realized and agents get paid off.

The manager chooses effort \(e \in \{0, 1\}\) at \(t = 1\), where \(e = 0\) means shirking and \(e = 1\) means working. The manager’s personal cost of effort is \(c > 0\). Once the manager chooses \(e = 1\), she can allocate effort between growth \((e_g)\) and safety \((e_s)\), where \(e_g + e_s = 1\). Obviously, if \(e = 0\), then \(e_g = e_s = 0\). The bank may locate a loan opportunity, the probability of which is \(e_g\). If a loan is made, the financing need is \(I\). The sequence of events is summarized in Figure 1.

### Figure 1. Sequence of Events

- **\(t = 0\)**
  - Bank chooses either growth-focused or safety-focused culture and how much to invest in the culture which determines its strength.
  - Bank sets managerial wage contract.
  - Manager is hired.

- **\(t = 1\)**
  - Manager chooses effort \(e \in \{0, 1\}\) at a cost \(c\).
  - Given \(e = 1\), manager must allocate effort between growth \(e_g\) and safety \(e_s\).
  - \(\text{Pr}\text{(loan located)} = e_g\).
  - Conditional on having a loan, manager decides whether to make the loan by screening it.
  - \(\text{Pr}\text{(bad loan screened out)} = e_s\).
  - To make a loan, bank needs financing \(I\).

- **\(t = 2\)**
  - Payoffs occur: a good loan repays \(X\), while a bad loan repays nothing.
  - Manager is paid based on the wage contract.

We can visualize the growth versus safety allocation of effort as the bank manager being confronted with many urns, only one of which contains balls, with the rest being empty. The harder the manager works on growth (the higher is \(e_g\)), the higher is the probability \((e_g)\) with which she will locate the urn with the balls.\(^5\) Once such an urn is located, the manager has to expend effort \((e_s)\) to make sure that the bank is making a good loan. Imagine that all the balls (potential borrowers) in the urn look alike, and it takes effort to find out which ball represents a good borrower and which represents a bad borrower. A good borrower repays the bank \(X\) on the loan at \(t = 2\), whereas a bad borrower repays nothing. The prior probability of a borrower being good is \(\lambda \in (0, 1)\), and the probability of a borrower being bad is \(1 - \lambda\). In terms of the urn analogy, if there is a countably infinite number of balls in the urn, then \(\lambda\) is the fraction of balls that represent good borrowers.

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\(^5\)We could stipulate a positive probability, say \(\epsilon > 0\), of the manager finding a loan even with zero effort \((e_g = 0)\) and then write the probability of finding a loan as a function of \(e_g\) as \(\epsilon(1 - e_g) + e_g\).
We assume that the bank manager’s safety effort helps reduce type-II errors, i.e., it reduces the probability that the manager will mistakenly identify a bad borrower as good. Conditional on the borrower being bad, the probability that the bank will identify it as being bad is $e_s$. Confronted with a good borrower, the manager will identify the borrower as such almost surely. Thus, conditional on finding a loan, the probability the bank will make a good loan is $\lambda$, the probability it will make no loan is $(1 - \lambda)e_s$, and the probability it will make a bad loan is $(1 - \lambda)(1 - e_s)$. The bank raises financing $I$ only if it makes a loan.

When no loan is financed, it means three possibilities: (i) the manager did not work ($e = 0$), so there was no loan for sure; (ii) the manager worked ($e = 1$), but with probability (w.p.) $1 - e_g$ she failed to find a loan; or (iii) a loan was found but rejected because the manager discovered it was a bad loan. The bank cannot distinguish among these three possibilities, while the manager knows.

The bank designs its compensation for the manager to be different across the following three states that are observationally distinct to the bank: (i) no loan was made (state $\{\emptyset\}$); (ii) a loan was made and it paid off (state $\{X\}$); and (iii) a loan was made and it defaulted (state $\{0\}$). Therefore, there are three possible wage outcomes: $w_\emptyset$ in state $\{\emptyset\}$, $w_X$ in state $\{X\}$, and $w_0$ in state $\{0\}$. All agents are risk neutral, but the manager has limited liability (i.e., her pay cannot be negative), and her reservation utility is zero. Clearly, $w_X \geq w_\emptyset \geq w_0$, and the bank should set $w_0 = 0$.\(^6\)

**Special Banking Features:** The following two features capture the notion that it is a bank we are modeling: (i) financing comes from both (inside) equity capital ($E$) and deposits ($D$), so $I = D + E$, and $E$ is chosen by the regulator as a capital requirement; and (ii) there is full deposit insurance, but the bank suffers a loss of charter value $\Delta$ if its loan defaults and the government does not rescue the bank (though its deposit repayment is fully covered). We assume that the probability of the government not rescuing a failed bank is $\delta \in (0, 1)$.

3 Analysis of the Base Model

3.1 The Bank’s Problem

The bank chooses wages $w_X$ and $w_\emptyset$ (note $w_0 = 0$) to maximize its expected net profit:

$$
\pi = e_g[\lambda(X - I - w_X) + (1 - \lambda)e_s(-w_\emptyset) + (1 - \lambda)(1 - e_s)(-E - \delta \Delta)] + (1 - e_g)(-w_\emptyset).
$$

\(^6\)The manager would deliberately reject a good loan if $w_X < w_\emptyset$, and accept a bad loan rather than rejecting it if $w_0 < w_0$. 
The bank has a loan w.p. $e_g$, in which case: (i) w.p. $\lambda$ the loan is good, which yields the bank a net profit $X - I - w_X$ after repaying depositors and compensating the manager ($w_X$);\(^7\) (ii) w.p. $(1 - \lambda)e_s$ the borrower is bad but screened out by the manager, in which case no financing is raised and the bank’s net payoff is $(-w_0)$ after compensating the manager; and (iii) w.p. $(1 - \lambda)(1 - e_s)$ the borrower is bad but not screened out by the manager, in which case the bank pays nothing to the manager ($w_0 = 0$), its deposit repayment is covered by insurance but the bank loses its capital $E$ and suffers a loss of charter value $\Delta$, with an expected value $\delta \Delta$ (note the bank will be rescued w.p. $1 - \delta$ by the government). The second term corresponds to the case in which the bank does not have a loan (w.p. $1 - e_g$), so the bank’s net payoff is $(-w_0)$ after compensating the manager.

The manager’s expected utility from working is:

$$u = e_g [\lambda w_X + (1 - \lambda)e_s w_0] + (1 - e_g)w_0 - c. \quad (2)$$

The constraints are as follows. First, the manager’s individual rationality (IR) constraint to participate:

$$u \geq 0. \quad (3)$$

Second, the manager’s incentive compatibility (IC) constraint to exert effort:

$$u \geq w_0 \Rightarrow \frac{\lambda w_X}{w_0} \geq 1 - (1 - \lambda)e_s + \frac{c}{e_g w_0}. \quad (4)$$

The right-hand side (RHS) of (4), $w_0$, is what the manager would get even if she does not exert any effort, leading to the guaranteed absence of a loan. This is because in this case, without investment being made in any loan, the bank cannot tell whether it is because no loan was generated, or a loan was generated but was screened out as bad by the manager. Note that if (4) is satisfied, (3) will be automatically satisfied, given that $w_0 \geq 0$.\(^8\)

\(^{7}\)The bank contributes $E$ to loan financing and the repayment to depositors is $D$ given full deposit insurance, so the bank’s net profit in this case is $X - D - E - w_X = X - I - w_X$.

\(^{8}\)If the manager’s reservation utility is very high (much bigger than 0), her choice will be between working ($e = 1$) and her outside opportunity, rather than between working and shirking ($e = 0$). The IC constraint of effort exertion (4) would then be redundant in both the first-best and second-best cases; only the IR constraint binds (at that high reservation utility). As a result, the first-best and second-first outcomes would be identical. To avoid this trivial and uninteresting case, we assume a sufficiently low reservation utility (0 in our model).
Third, the manager’s IC constraint related to effort allocation (conditional on working):

$$\{e_g, e_s\} \in \arg\max \{e_g + e_s = 1\}$$

$$u \Rightarrow e_g = \frac{\lambda}{2(1 - \lambda)} \left( \frac{w_X}{w_\emptyset} - 1 \right)$$ and $$e_s = \frac{\lambda}{2(1 - \lambda)} \left( \frac{2 - \lambda}{\lambda} - \frac{w_X}{w_\emptyset} \right).$$ \hspace{1cm} (5)

Substituting (5) into (4), we can rewrite (4) as:

$$\frac{w_X}{w_\emptyset} \geq 1 + \frac{4(1 - \lambda)}{\lambda^2} \frac{c}{w_X - w_\emptyset}. \hspace{1cm} (6)$$

Below are some useful observations that can be made by examining (5) and (6).

**Observation 1:** We see from (5) that:

- The manager is paid more when a loan is made and it pays off than when no loan is made ($w_X > w_\emptyset$).

- What drives the manager’s effort allocation between growth and safety is the pay wedge $\frac{w_X}{w_\emptyset}$. When $\frac{w_X}{w_\emptyset}$ is larger, $e_g$ is higher while $e_s$ is lower. An increase in $\frac{w_X}{w_\emptyset}$ strengthens the manager’s incentive to shift her effort away from safety and toward growth, since she only gets paid $w_\emptyset$ even when she succeeds in screening out a bad loan (in which case the bank cannot tell whether it is because of no loan was generated in the first place, for which the manager should be punished, or a bad loan was successfully screened out, for which the manager should be rewarded). In other words, because of the bank’s inability to tell these possibilities apart, the manager is “not rewarded enough” – relative to the case in which the bank can distinguish between these possibilities – for focusing on safety.

- When the borrower pool quality becomes better (i.e., $\lambda$ is higher), $e_g$ is higher while $e_s$ is lower. This is fairly intuitive.

**Observation 2:** Although increasing $\frac{w_X}{w_\emptyset}$ induces more growth but less safety, we see from (6) that the bank has to maintain a certain wedge between $w_X$ and $w_\emptyset$ in order to induce managerial effort in the first place. If $\frac{w_X}{w_\emptyset}$ is too low, the manager has no incentive to work at all, since she gets paid $w_\emptyset$ anyway even if she did not generate a loan. Again, this is because the bank cannot tell whether the occurrence of the no-loan state $\{\emptyset\}$ is because the manager did not work or she worked and actually screened out a bad loan. Thus, the bank is confronted with a classic multi-tasking problem: higher $\frac{w_X}{w_\emptyset}$ induces effort but also shifts effort away from safety and toward growth.
3.2 First Best

Before analyzing the bank’s problem in Section 3.1, as a benchmark we first characterize the socially optimal (first-best) outcome, assuming the bank can observe and contract on both managerial effort exertion \( e \in \{0, 1\} \) and allocation (choices of \( e_g \) and \( e_s \)). To elicit effort \( (e = 1) \), the bank only needs to compensate for the manager’s effort cost, which can be implemented with a simple fixed wage (equal to \( c \)). The bank then dictates the manager’s allocation of her effort to maximize social surplus:

\[
\max_{\{e_g + e_s = 1\}} \pi = e_g[\lambda(X - I) - (1 - \lambda)(1 - e_s)(E + \delta\Delta)] - c. \tag{7}
\]

The solutions are:

\[
e_g^* = \frac{\lambda}{2(1 - \lambda)} \frac{X - I}{E + \delta\Delta} \quad \text{and} \quad e_s^* = 1 - e_g^*. \tag{8}
\]

This first-best effort allocation maximizes social surplus by balancing the need for growth (to reap the social gain from financing a good loan, \( X - I \)) and the need for safety (to avoid the social loss from loan default, \( E + \delta\Delta \)).\(^9\) It has many intuitive properties. First, \( e_s^* \) is increasing (hence \( e_g^* \) is decreasing) in \( E \) and \( \delta \). Safety is relatively more important than growth when the bank has higher capital (larger \( E \)) and the odds that there will be no government rescue are higher (larger \( \delta \)). Second, \( e_s^* \) is decreasing (hence \( e_g^* \) is increasing) in \( \lambda \). The effort allocated to safety is lower when the borrower pool quality is better (larger \( \lambda \)).

Our subsequent analysis of the bank’s problem stated in Section 3.1 crucially relies on the joint unobservability of managerial effort exertion and allocation. In particular, we show below that the first-best outcome is attainable as long as the bank can observe effort exertion \( (e \in \{0, 1\}) \) and write a contract on \( e \), even if it does not observe the manager’s allocation of \( e \) to \( e_g \) and \( e_s \). In this case, only the IR constraint (3) matters (and it must be binding), while the IC constraint of effort exertion (4) is irrelevant. As a result, the bank’s problem is the same as the one stated in (7). The only difference is that now the bank cannot dictate managerial effort allocation, but needs to incentivize the manager to choose the first-best allocation in (8) by carefully selecting \( \frac{w_X}{w_g} \) according to the IC constraint of effort allocation (5).

\(^9\)The compensation to the manager, \( c \), is a pure transfer from the bank and hence does not affect the allocation. Here, in designating the allocation in (8) as the first-best allocation, we assume that the social surplus obtained under such an allocation exceeds that without managerial effort \( (e = 0) \), which is simply zero; this holds if \( c \) is not too big.
Proposition 1 (First best). The first-best outcome in (8) can be obtained as long as the bank can observe and contract on managerial effort exertion, even if it cannot observe the manager’s effort allocation, in which case the wage contract is:

\[ w^\ast_\emptyset = \frac{c}{1 + (1 - \lambda)(e^\ast_g)^2} \quad \text{and} \quad w^\ast_X = \left[ 1 + \frac{2(1 - \lambda) e^\ast_g}{\lambda} \right] w^\ast_\emptyset. \] (9)

As will be shown in Section 3.3, if managerial effort exertion and allocation are both unobservable to the bank, the first-best allocation in (8) cannot be achieved. The key is that if the bank cannot directly observe effort exertion, the wage contract has to be designed to elicit effort in the first place. It turns out that this additional constraint on the wage contract interferes with the manager’s IC constraint of effort allocation (5) and results in an allocation that deviates from the first best.

3.3 Second-Best Wage and Effort Allocation

We now consider the case in which managerial effort exertion and allocation are jointly unobservable to the bank, so (4) also needs to be satisfied ((3) is now redundant). Given that the first best can be obtained as long as effort exertion is observable and contractible, we designate the outcome in this case as the second best. First of all, (4) must be binding. Combining (4) and (5) yields:

\[ w_\emptyset = \frac{c}{(1 - \lambda)e^2_g}. \] (10)

Note that \( w_\emptyset > 0 \). Again, this is because the no-loan outcome (state \( \emptyset \)) implies three possibilities: (i) the manager shirked so no loan was generated, in which case she should be punished, getting zero pay; (ii) the manager worked, but w.p. 1 - \( e_g \) she failed to find a loan; and (iii) the manager generated a loan, found it to be bad, and rejected it, in which case she should be rewarded substantially – even higher than \( w_X \).\(^{10}\) Because the bank cannot tell these possibilities apart, the pay is set at \( w_\emptyset \in (0, w_X) \). However, when \( e_g \) is bigger, i.e., the manager is known to focus more on growth and less on safety (conditional on working in the first place), then (i) becomes more likely, and hence the bank lowers \( w_\emptyset \). This is a very useful observation that will later help us understand the difference between the first-best and second-best outcomes.

\(^{10}\)This is because finding a good loan requires the manager to expend only \( e_g \), whereas avoiding a bad loan requires both \( e_g \) and \( e_s \).
Then, we can rewrite the bank’s problem as:

$$\max \{e_g + e_s = 1\} \pi = e_g [\lambda (X - I) - (1 - \lambda) (1 - e_s) (E + \delta \Delta)] - \frac{c}{(1 - \lambda) e_g^2} - c. \quad (11)$$

Because of the bank’s inability to observe managerial effort exertion (and hence its inability to pin down the cause of the no-loan outcome), the manager enjoys a rent equal to the wage $w_\emptyset = \frac{c}{(1 - \lambda) e_g^2}$, which she can secure even without working ($e = 0$). The bank’s expected wage cost thus equals $w_\emptyset + c$, including the compensation for the manager’s effort exertion $c$ and the rent $w_\emptyset$.

Analyzing the problem in (11) and comparing the outcome with that of the first best, we have:

**Proposition 2 (Second-best wage and effort allocation).** Compared to the first best, in the second best:

1. relatively more effort is allocated to growth while less effort is allocated to safety, i.e., $e_g^{**} > e_g^*$ and $e_s^{**} < e_s^*$, where $e_g^{**}$ and $e_s^{**}$ are given by (A2) in the Appendix;

2. the optimal wage contract involves a larger pay wedge, i.e., $\frac{w_X}{w_\emptyset} > \frac{w_\emptyset}{w_\emptyset}$, and a higher pay level.

Proposition 2 shows that there is excessive growth in the second best compared to the first best. The intuition is as follows. Inducing effort is harder in the second best due to effort unobservability. In the first best with effort exertion being observable, only the IR constraint (3) needs to be satisfied, while in the second best the IC constraint (4) needs to be satisfied to elicit hidden managerial effort, which is harder than just satisfying (3). To motivate effort in the second best, the pay wedge $\frac{w_X}{w_\emptyset}$ has to be big enough (note the manager would get paid $w_\emptyset$ even without working), but that unavoidably induces more effort to be shifted toward growth relative to the first best.

Again, importantly, this is due to the fact that the bank faces a multi-tasking problem in the second best, which is not present in the first best. Recall in the first best the bank chooses $\frac{w_X}{w_\emptyset}$ only to incentivize the manager to allocate her effort between growth and safety to achieve the first-best allocation. In the second best, the bank’s choice of $\frac{w_X}{w_\emptyset}$ also affects the manager’s incentive to exert hidden effort in the first place. The bank thus needs to strike a balance between effort elicitation and effort allocation to safety in the second best. The former needs a large enough $\frac{w_X}{w_\emptyset}$, which, inevitably, shifts effort away from safety and toward growth.

---

11Here again, as explained earlier in footnote 8, if the manager’s reservation utility were too high, then only the IR constraint would matter in both the first-best and second-best cases; as a result, the second-best outcome would coincide with that in the first best, which is a trivially uninteresting case.
There is a subtle but interesting fact that also explains the excessive growth in the second best. Due to effort unobservability in the second best, the manager is paid $w_\emptyset$ even if she shirked; the manager does not enjoy such a rent in the first best. As mentioned earlier (see the discussion following equation (10), which links $w_\emptyset$ to $e_\emptyset$), a bigger $e_\emptyset$ leads to a lower $w_\emptyset$. The reason is as follows. If the manager is known to focus more on growth, then conditional on a bigger equilibrium effort choice $(e_\emptyset)$, the occurrence of the no-loan state $\{\emptyset\}$ is more likely to be due to the manager shirking. That is, a bigger $e_\emptyset$ enables the bank to better distinguish among various possibilities that give rise to the no-loan outcome. This reduces the rent the manager extracts and helps lower the bank’s compensation cost. Of course, an excessively large value of $e_\emptyset$ results in too large a deviation from the first-best effort allocation, which reduces the bank’s net loan profit before compensating the manager. Therefore, the equilibrium choice of $e_\emptyset$ that is desirable to the bank in the second best represents a tradeoff between these two forces.

Finally, Proposition 2 states that the bank pays more to the manager in the second best. This is obviously due to the rent enjoyed by the manager because of effort unobservability – the second-best pay exceeds the first-best pay by exactly $w_\emptyset^{**} = \frac{c}{(1-\bar{\lambda})(e_\emptyset^{**})^2}$, the rent enjoyed by the manager.

4 The Role of Bank Culture in the One-Bank Case

In this section, we provide an endogenous rationale for bank culture, relying on the notion of “identity economics” developed by Akerlof and Kranton (2005). Suppose agents believe that the loan success probability is $\lambda \in \{\bar{\lambda}, \lambda\}$, where $1 > \bar{\lambda} > \lambda > 0$. Clearly, an agent with belief $\lambda = \bar{\lambda}$ views growth as relatively more important (and safety as relatively less important) than an agent whose belief is $\lambda = \lambda$. There are several cases to consider, each indicated by the pair $\{\lambda_B, \lambda_M\}$, where $\lambda_B$ and $\lambda_M$ denote the bank’s belief and the manager’s belief about $\lambda$, respectively.

4.1 Cases with Homogeneous (Matched) Beliefs

We first consider two cases in which the bank and the manager have homogenous beliefs about $\lambda$: $\{\lambda_B = \lambda, \lambda_M = \lambda\}$ and $\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}$. These two cases can be analyzed in the same way as in Section 3 by replacing $\lambda$ there with $\lambda$ and $\bar{\lambda}$, respectively. The result below follows immediately from Proposition 2:

Proposition 3 (Comparison of first-best and second-best wages and effort allocations with matched beliefs and no investment in culture). In the two cases with matched beliefs
between the bank and the manager (regardless of the belief being \( \lambda \) or \( \bar{\lambda} \)), compared to the first best, the second best always involves: (i) more effort being allocated to growth and less effort being allocated to safety; and (ii) a larger pay wedge and a higher pay level for the manager.

For the case \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \), denote the second-best effort allocations to growth and safety as \( e^{*\ast}_g(\lambda, \lambda) \) and \( e^{*\ast}_s(\lambda, \lambda) \), respectively. Similarly, for the case \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \lambda \} \), denote the second-best effort allocations to growth and safety as \( e^{*\ast}_g(\bar{\lambda}, \lambda) \) and \( e^{*\ast}_s(\bar{\lambda}, \lambda) \), respectively. Clearly, \( e^{*\ast}_g(\bar{\lambda}, \lambda) < e^{*\ast}_g(\lambda, \lambda) \) and \( e^{*\ast}_s(\bar{\lambda}, \lambda) > e^{*\ast}_s(\lambda, \lambda) \) – safety becomes more important than growth when the bank and the manager believe the borrower pool quality is worse.\(^{12}\)

**Definition (Safety-focused versus growth-focused):** The bank in the case \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \) is called safety-focused as it allocates relatively more effort to safety; the bank in the case \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \lambda \} \) is called growth-focused as it allocates relatively more effort to growth.

### 4.2 Cases with Heterogeneous (Mismatched) Beliefs

Next, we consider two cases with mismatched beliefs: \( \{ \lambda_B = \lambda, \lambda_M = \bar{\lambda} \} \) and \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \lambda \} \). In the former case \( \{ \lambda_B = \lambda, \lambda_M = \bar{\lambda} \} \), the manager is more prone to growth than the bank; we will compare it with the case with matched beliefs \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \), wherein both the bank and the manager are safety-focused. In the latter case \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \lambda \} \), the bank is more prone to growth than the manager; we will compare it with the case with matched beliefs \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda} \} \), wherein both the bank and the manager are growth-focused.

#### 4.2.1 The Limitation of Wage Incentives with Mismatched Beliefs and No Investment in Culture: Manager More Prone to Growth than Bank

This case is \( \{ \lambda_B = \lambda, \lambda_M = \bar{\lambda} \} \). The constraints are calculated using the manager’s belief (\( \lambda_M = \bar{\lambda} \)). Denote the manager’s expected utility from working as \( u(\bar{\lambda}) \), which is (replacing \( \lambda \) in (2) with \( \bar{\lambda} \)):

\[
u(\bar{\lambda}) = e_g(\bar{\lambda}w_X + (1 - \bar{\lambda})e_s w_0) + (1 - e_g)w_0 - c. \quad (12)
\]

The manager’s IC constraint to exert effort is:

\[
u(\bar{\lambda}) \geq w_0 \Rightarrow \bar{\lambda}w_X \geq 1 - (1 - \bar{\lambda})e_s + \frac{c}{e_g w_0}. \quad (13)
\]

\(^{12}\)We can solve for \( e^{*\ast}_g(\lambda, \lambda) \) and \( e^{*\ast}_g(\bar{\lambda}, \lambda) \) by replacing \( \lambda \) in (A2) in the Appendix with \( \lambda \) and \( \bar{\lambda} \), respectively.
The manager’s IC constraint for effort allocation between growth and safety is:

\[
\{e_g, e_s\} \in \text{argmax}_{\{e_g + e_s = 1\}} u(\lambda) \Rightarrow e_g = \frac{\bar{\lambda}}{2(1 - \bar{\lambda})} \left( \frac{w_X}{w_0} - 1 \right) \text{ and } e_s = \frac{\bar{\lambda}}{2(1 - \bar{\lambda})} \left( \frac{2 - \bar{\lambda}}{\lambda} - \frac{w_X}{w_0} \right). \tag{14}
\]

Combining (13) and (14) yields:

\[
w_0 = \frac{c}{(1 - \lambda)e_g^2}. \tag{15}
\]

Note (13), (14) and (15) are same as (4), (5) and (10), respectively, except that we use \(\bar{\lambda}\) to replace \(\lambda\) in previous equations.

We now analyze the bank’s problem. From the bank’s perspective, using its own belief \(\lambda_B = \bar{\lambda}\), its expected pay to the manager is:

\[
e_g[\bar{\lambda}w_X + (1 - \bar{\lambda})e_s w_\emptyset] + (1 - e_g)w_\emptyset. \tag{16}
\]

Comparing it with the manager’s binding IC constraint (13) (using the manager’s belief),

\[
e_g[\bar{\lambda}w_X + (1 - \bar{\lambda})e_s w_\emptyset] + (1 - e_g)w_\emptyset = w_\emptyset + c, \tag{17}
\]

we can rewrite the expected pay to the manager (viewed by the bank) as:

\[
w_\emptyset + c - e_g(\bar{\lambda} - \lambda)(w_X - e_s w_\emptyset). \tag{18}
\]

Combining (14) and (15), we can rewrite the last term in (18) as:

\[
e_g(\bar{\lambda} - \lambda)(w_X - e_s w_\emptyset) = \frac{c(\bar{\lambda} - \lambda)(2 - \bar{\lambda})}{\lambda(1 - \lambda)}. \tag{19}
\]

Thus, the bank’s problem can be written as:

\[
\max_{\{e_g + e_s = 1\}} e_g[\lambda(X - I) - (1 - \lambda)(1 - e_s)(E + \delta \Delta)] - \frac{c}{(1 - \lambda)e_g^2} - c + \frac{c(\bar{\lambda} - \lambda)(2 - \bar{\lambda})}{\lambda(1 - \lambda)}. \tag{20}
\]

We denote the optimal solutions to (20) as \(e^*_{g\{\bar{\lambda}, \lambda\}}\) and \(e^*_{s\{\bar{\lambda}, \lambda\}}\), which are then compared with the solutions in the case with matched beliefs \(\{\lambda_B = \lambda, \lambda_M = \lambda\}\). This leads to:
Proposition 4 (Growth versus safety with no investment in culture – manager more optimistic than bank). Without investment in culture, there is more growth relative to safety in the case with mismatched beliefs, \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda} \} \), than in the case with matched beliefs, \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \), i.e., \( e_{g(\bar{\lambda},\bar{\lambda})}^{**} > e_{g(\lambda,\lambda)}^{**} \) and \( e_{s(\bar{\lambda},\bar{\lambda})}^{**} < e_{s(\lambda,\lambda)}^{**} \), despite a lower pay wedge \( \frac{w_X}{w_0} \) in the former case. Moreover, the differences, \( e_{g(\bar{\lambda},\bar{\lambda})}^{**} - e_{g(\lambda,\lambda)}^{**} > 0 \) and \( e_{s(\bar{\lambda},\bar{\lambda})}^{**} - e_{s(\lambda,\lambda)}^{**} > 0 \), are increasing in \( \bar{\lambda} - \lambda \).

The intuition is as follows. Consider first \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \). In this case, since the manager has a more optimistic belief about the borrower pool quality than the bank, she thinks safety is relatively less important, and hence ceteris paribus allocates too much effort to growth from the bank’s perspective. Of course, the bank is aware of the manager’s propensity for excessive growth, and incorporates this into the wage contract design. The bank will lower the pay wedge \( \frac{w_X}{w_0} \) in this case with mismatched beliefs relative to the case with matched beliefs, \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda} \} \), in order to counteract the manager’s growth propensity. However, very importantly, what prevents the bank from completely undoing the manager’s growth tendency is that too low a \( \frac{w_X}{w_0} \) will also weaken the manager’s incentive to exert effort in the first place. Thus, there is an incentive-constraint-driven lower bound on \( \frac{w_X}{w_0} \), and this explains why there is still excessive growth (from the bank’s perspective, i.e., \( e_{g(\bar{\lambda},\bar{\lambda})}^{**} > e_{g(\lambda,\lambda)}^{**} \) even after the equilibrium wage contract is implemented in the case \( \{ \lambda_B = \lambda, \lambda_M = \lambda \} \). Clearly, as the belief difference \( \bar{\lambda} - \lambda \) becomes bigger, the problem of excessive growth becomes more significant for the bank (i.e., \( e_{g(\bar{\lambda},\bar{\lambda})}^{**} - e_{g(\lambda,\lambda)}^{**} \) gets bigger).

In other words, the multi-tasking agency problem is what prevents the bank from fully undoing the manager’s growth propensity by relying solely on financial incentives provided by the wage contract to fine tune the manager’s effort allocation between growth and safety. This leaves room for culture, as we shall model later, to reduce the distortion due to a belief mismatch between the bank and the manager. Put a little differently, Proposition 4 offers an endogenous reason for culture: culture arises because the problem cannot be fully resolved by relying only on wage incentives.

4.2.2 The Limitation of Wage Incentives with Mismatched Beliefs and No Investment in Culture: Bank More Prone to Growth than Manager

This case is \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \lambda \} \), wherein the bank is more optimistic than the manager about the borrower pool quality. The analysis is similar to the previous mismatched-beliefs case, \( \{ \lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda} \} \), examined in Section 4.2.1, so we do not repeat it here. Denote the manager’s effort
allocations to growth and safety as $e_{g}^{**}(\bar{\lambda}, \lambda)$ and $e_{s}^{**}(\bar{\lambda}, \lambda)$, respectively, under the optimal wage contract in this case. We compare these allocations with the outcomes in the case in which the manager has the same belief as the bank, $\{\lambda_{B} = \bar{\lambda}, \lambda_{M} = \bar{\lambda}\}$, the solutions to which are $e_{g}^{**}(\bar{\lambda}, \lambda)$ and $e_{s}^{**}(\bar{\lambda}, \lambda)$ (see Section 4.1). The comparison leads to the following result:

**Proposition 5 (Growth versus safety with no investment in culture – bank more optimistic than manager).** Without investment in culture, there is less growth relative to safety in the case with mismatched beliefs, $\{\lambda_{B} = \bar{\lambda}, \lambda_{M} = \lambda\}$, than in the case with matched beliefs, $\{\lambda_{B} = \bar{\lambda}, \lambda_{M} = \bar{\lambda}\}$, i.e., $e_{g}^{**}(\bar{\lambda}, \lambda) < e_{g}^{**}(\bar{\lambda}, \bar{\lambda})$ and $e_{s}^{**}(\bar{\lambda}, \lambda) > e_{s}^{**}(\bar{\lambda}, \bar{\lambda})$, despite a higher pay wedge $\frac{w_{X}}{w_{0}}$ in the former case. Moreover, the differences, $e_{s}^{**}(\bar{\lambda}, \lambda) - e_{s}^{**}(\bar{\lambda}, \bar{\lambda}) > 0$ and $e_{g}^{**}(\bar{\lambda}, \lambda) - e_{g}^{**}(\bar{\lambda}, \bar{\lambda}) > 0$, are increasing in $\bar{\lambda} - \lambda$.

The manager has a more pessimistic belief about the borrower pool quality than the bank, so she thinks safety is relatively more important, and ceteris paribus allocates less effort toward growth than the bank prefers. The bank is aware of the manager’s propensity for excessive safety, and incorporates this into the wage contract design. The bank will increase the pay wedge $\frac{w_{X}}{w_{0}}$ in this mismatched-beliefs case, $\{\lambda_{B} = \bar{\lambda}, \lambda_{M} = \lambda\}$, relative to the matched-beliefs case, $\{\lambda_{B} = \bar{\lambda}, \lambda_{M} = \bar{\lambda}\}$, in order to counteract the manager’s excessive-safety tendency. However, setting the pay wedge too high also increases the wage cost. Thus, there exists an endogenous upper bound on $\frac{w_{X}}{w_{0}}$, and this explains why $e_{g}^{**}(\bar{\lambda}, \lambda) < e_{g}^{**}(\bar{\lambda}, \bar{\lambda})$, i.e., there is still less growth than the bank would like even when the manager’s wage is optimally set in the mismatched-beliefs case. Moreover, as the belief difference $\bar{\lambda} - \lambda$ becomes larger, the problem of excessive safety becomes more significant as viewed by the bank (i.e., the shortage of growth $e_{g}^{**}(\bar{\lambda}, \lambda) - e_{g}^{**}(\bar{\lambda}, \bar{\lambda})$ is amplified).

Similar to the analysis in Section 4.2.1, we see again from this case that the bank is unable to fully undo the manager’s effort misallocation (as perceived by the bank using its own belief) by solely relying on wage contracts.

### 4.3 Culture as a Facilitator of Bank-Manager Matching

In what follows, we assume that the bank and the manager do not observe each other’s belief. Thus, belief mismatching may arise if banks and managers are randomly matched with each other. Given the manager’s misallocation of effort between growth and safety (from the bank’s perspective) in the cases with mismatched beliefs, as shown in **Proposition 4** and **Proposition 5**, we next show how bank culture can help improve outcomes by facilitating belief matching between the bank and
the manager. This gives an endogenous explanation for the rise of bank culture as a self-sorting mechanism that helps match managers with banks. This is along the lines of Van den Steen (2010a). In generating this sorting mechanism, what we rely on is the idea that the bank’s culture is a source of “identity” for the manager, where the term “identity” is used in the sense of Akerlof and Kranton (2005). This means the manager suffers a disutility when she chooses an action that is incompatible with the culture.

Suppose bank culture is such that the manager hired by the bank will suffer a disutility,

$$\alpha(|e_g - e^B_g| + |e_s - e^B_s|),$$

if her effort allocation between growth and safety, \(\{e_g, e_s\}\), deviates from the benchmark set by the bank, \(\{e^B_g, e^B_s\}\). Since \(e_g + e_s = e^B_g + e^B_s = 1\), we can rewrite the disutility as:

$$2\alpha|e_g - e^B_g|.$$  \hspace{1cm} (22)

Here, \(\alpha \geq 0\) is a measure of the bank’s investment in culture as well as the strength of bank culture, with a bigger \(\alpha\) corresponding to a stronger culture. The cost for the bank to develop a culture with strength \(\alpha\) is \(\beta(\alpha)\), where \(\beta(\cdot)\) is an increasing function with \(\beta(0) = 0\).

**Definition (Bank culture and the strength of bank culture):** Bank culture is captured by the pair \(\{e^B_g, e^B_s\}\), with a larger \(e^B_g\) representing a growth-focused culture, and a larger \(e^B_s\) representing a safety-focused culture.

Although neither the bank’s belief nor the manager’s belief is observable, both the bank’s choice of culture and its strength (\(\alpha\)) are publicly observable.\(^{13}\) The idea is that organizations with stronger cultures create a stronger sense of identity for the employee, i.e., an identity that is more strongly tied to the organization and its core values. Consequently, the employee suffers a larger disutility when she takes an action that is not consonant with the values and norms of the organization. This disutility can be generated by a variety of subtle and not-so-subtle mechanisms, including reprimands, social ostracization, lack of rewards, etc.\(^{14}\)

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\(^{13}\)This means we are abstracting from issues related to the misrepresentation of culture by the bank. Loughran, McDonald, and Yun (2007) provide evidence of possible misrepresentation. They show that managers who portray their firms as “ethical” in 10-K reports are more likely to be systematically misleading the public.

\(^{14}\)See Cameron and Quinn (2011), and Cameron et al. (2014). Guiso, Sapienza, and Zingales (2015a) provide a quote by a former Goldman Sachs employee who reminisces about how the bank’s teamwork-oriented culture influenced employee behavior when it was a partnership.
4.3.1 Self-Sorting and Matching

We show two things in this section. First, without bank culture (i.e., $\alpha = 0$), for any wage contract given by the bank, a manager with belief $\lambda_M = \bar{\lambda}$ is *always* more likely to apply for (and get) the bank job than a manager who believes $\lambda_M = \lambda$. We show this by proving that a manager with the optimistic belief about the borrower pool quality ($\lambda_M = \bar{\lambda}$) always derives higher utility from the bank job than a manager with the pessimistic belief ($\lambda_M = \lambda$). Obviously, belief mismatching will thus be an issue for a bank with the pessimistic belief ($\lambda_B = \lambda$), as it is not able to hire a manager possessing the same belief. We then show next, which is the second point we want to make, that a sufficiently strong culture (i.e., $\alpha$ big enough) helps such a bank (with the pessimistic belief) to attract a manager with the same belief and dissuade a manager with the optimistic belief from applying for the job. That is, culture facilitates self-sorting by the manager.

**Analysis:** For a given wage contract ($w_X$ and $w_\emptyset$), the manager’s utility from working is:

$$u_{\{\lambda_M\}} - 2\alpha|e_g - e^B_g|,$$  \hspace{1cm} (23)

where

$$u_{\{\lambda_M\}} = e_g[\lambda_M w_X + (1 - \lambda_M)e_s w_\emptyset] + (1 - e_g)w_\emptyset - c,$$  \hspace{1cm} (24)

which is the manager’s utility excluding the culture-induced disutility component (replacing $\lambda$ in (2) with $\lambda_M$). The term, $2\alpha|e_g - e^B_g|$, in (23) captures the manager’s disutility from choosing an effort allocation that deviates from the bank’s benchmark (conditional on working).

The IC constraint for the manager to exert effort is:

$$u_{\{\lambda_M\}} - 2\alpha|e_g - e^B_g| \geq w_\emptyset - \alpha \Rightarrow \lambda_M \frac{w_X}{w_\emptyset} \geq 1 - (1 - \lambda_M)e_s + \frac{c}{e_g w_\emptyset} + \alpha \frac{2|e_g - e^B_g| - 1}{e_g w_\emptyset}. \hspace{1cm} (25)$$

To understand (25), note that if the manager shirks (i.e., choosing $e_g = e_s = 0$), her disutility from such a deviation is $\alpha(|0 - e^B_g| + |0 - e^B_s|) = \alpha$. 

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The IC constraint for the manager’s effort allocation between growth and safety is:

$$\{e_g, e_s\} \in \text{argmax}_{\{e_g + e_s = 1\}} u(\lambda_M) - 2\alpha|e_g - e^B_g| \Rightarrow$$

$$e_g = \frac{\lambda_M}{2(1 - \lambda_M)} \left( \frac{w_X}{w_\emptyset} - 1 \right) - \frac{\alpha \times 1_{\{e_g > e^B_g\}}}{(1 - \lambda_M)w_\emptyset},$$

$$e_s = \frac{\lambda_M}{2(1 - \lambda_M)} \left( \frac{2 - \lambda_M}{\lambda_M} \frac{w_X}{w_\emptyset} \right) + \frac{\alpha \times 1_{\{e_g > e^B_g\}}}{1 - \lambda_M}.$$

(26)

The function $1_{\{e_g \geq e^B_g\}}$ is an indicator function defined below:

$$1_{\{e_g \geq e^B_g\}} = \begin{cases} 
1 & \text{if } e_g > e^B_g \\
0 & \text{if } e_g = e^B_g \\
-1 & \text{if } e_g < e^B_g 
\end{cases}. \tag{27}$$

The effect of bank culture in shaping managerial effort allocation can be seen from the term, $-\frac{\alpha \times 1_{\{e_g > e^B_g\}}}{(1 - \lambda_M)w_\emptyset}$, in the expression for $e_g$ in (26). Note that: (i) if the manager allocates more effort to growth than the benchmark ($e_g > e^B_g$), this term, which is negative, pulls $e_g$ lower and toward $e^B_g$; and (ii) if the manager allocates less effort to growth than the benchmark ($e_g < e^B_g$), this term, which now becomes positive, pulls $e_g$ higher and toward $e^B_g$. Similar observations can be made by examining $e_s$. The point is that culture pulls managerial effort allocation toward the bank’s benchmark, and a stronger culture (i.e., bigger $\alpha$) exerts a bigger influence ceteris paribus.

**Proposition 6 (Sorting with no investment in culture).** Without investment in bank culture ($\alpha = 0$), a manager with the optimistic belief about the borrower pool quality ($\lambda_M = \bar{\lambda}$) always perceives a higher expected utility from working for the bank than does a manager with the pessimistic belief ($\lambda_M = \lambda$).

Without investment in culture, the reason why a manager with the optimistic belief perceives a higher utility from the bank job is twofold. First, for any given effort allocation between growth and safety, the manager’s optimistic belief about the quality of the borrower pool leads her to believe that it is highly likely that the loan (conditional on being found) will pay off and hence she will get paid the high wage $w_X$. Second, again because of her optimistic belief, the manager will allocate more effort toward growth, which makes it more likely that a loan will be found in the first place. These two effects reinforce each other and result in a higher perceived utility for the optimistic manager.
Proposition 6 has the following noteworthy implications. First, without investment in culture, a safety-focused bank (with the pessimistic belief $\lambda_B = \bar{\lambda}$) is unable to match perfectly with a manager holding the same belief ($\lambda_M = \bar{\lambda}$), so the case with mismatched beliefs, $\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}$, examined in Section 4.2.1, is likely to arise. This is because whenever a manager with the pessimistic belief applies for a bank job, so does a manager with the optimistic belief. Second, such mismatching is a relatively small concern for a growth-focused bank (with the optimistic belief $\lambda_B = \bar{\lambda}$). This is because a manager with the optimistic belief ($\lambda_M = \bar{\lambda}$) is more likely to apply for a bank job than a manager with the pessimistic belief, so even random matching is likely to result in a matching of beliefs. Third, lack of culture is thus more of a problem for a safety-focused bank.

Next, we show how bank culture can facilitate matching. In particular, we show how a bank with the pessimistic belief can use a strong safety-focused culture to dissuade a manager with the optimistic belief from applying for a job at the bank, which, in turn, facilitates matching between that bank and a manager holding the same pessimistic belief.

The idea is as follows. Compared to the manager with the pessimistic belief, the manager with the optimistic belief will suffer a larger disutility from working for a bank that has the pessimistic belief, because her optimistic-belief-induced effort allocation deviates more from the bank’s benchmark allocation than does the effort allocation of the pessimistic manager. A stronger safety-focused bank culture (bigger $\alpha$) has the following effects: (i) holding the allocation deviation fixed, a bigger $\alpha$ magnifies the deviation-induced disutility; (ii) but we know from (26) that when $\alpha$ becomes bigger, holding the wage contract ($w_X$ and $w_\emptyset$) fixed, the optimistic manager will also react by lowering the effort allocated to growth (i.e., reduce $e_g$) so as to reduce the allocation deviation. The net effect of (i) and (ii) is not unambiguous. However, there is a third effect: (iii) when the manager reduces $e_g$, she will also become less likely to find a loan in the first place, which, in turn, will lower her expected pay (she becomes less likely to be paid $w_X$). The combined net effect of all the three factors is that a bigger $\alpha$ lowers the optimistic manager’s utility from working for the bank, generating a lower job utility for such a manager than for the pessimistic manager.

Proposition 7 (Sorting with culture). If the safety-focused bank with the pessimistic belief ($\lambda_B = \bar{\lambda}$) sets its benchmark effort allocation sufficiently toward safety (i.e., $e_g^B$ is sufficiently low) and develops a sufficiently strong culture (i.e., $\alpha$ is above some cutoff $\alpha^B$), then a manager with the optimistic belief ($\lambda_M = \bar{\lambda}$) will derive a lower utility from working for the bank than a manager with the pessimistic belief ($\lambda_M = \lambda$).
In the terminology of Akerlof and Kranton (2005), for a safety-focused bank, a manager with the pessimistic belief is an “insider” while a manager with the optimistic belief is an “outsider.” All else equal, the choice of effort allocation by an insider is closer to the bank’s desired allocation than the choice by an outsider. What a strong safety culture achieves is a self-sorting of managers, with those holding the pessimistic belief working for banks sharing that belief, and those holding the optimistic belief choosing to work for banks that also have the optimistic belief. In other words, with strong culture banks hire only “insiders” whose beliefs are aligned with those of the bank.\textsuperscript{15}

4.3.2 Optimal Bank Culture

We now solve explicitly for the optimal bank culture, i.e., how much a bank will wish to invest in the strength of its culture. First, consider a bank endowed with the optimistic belief (\(\lambda_B = \bar{\lambda}\)). We see from Proposition 6 that such a growth-focused bank will be able to match exclusively with an optimistic manager (\(\lambda_M = \bar{\lambda}\)), since such a manager enjoys a higher utility from working for a growth-focused bank than a pessimistic manager. The bank will thus avoid the cost of investing in culture (i.e., it chooses \(\alpha = 0\)). It will then hire a manager with belief \(\lambda_B = \bar{\lambda}\), resulting in matched beliefs, \(\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}\), already analyzed in Section 4.1. In that case, the second-best effort allocations to growth and safety are \(e^{**}_g\{\bar{\lambda}, \bar{\lambda}\}\) and \(e^{**}_s\{\bar{\lambda}, \bar{\lambda}\}\), respectively. The bank’s benchmark allocation \(\{e^B_g, e^B_s\}\) is irrelevant, because the manager will always choose the second-best effort allocation given that \(\alpha = 0\) (so she does not suffer any disutility from effort-allocation deviation (if any)). We assume that the bank just sets its benchmark allocation exactly the same as the second-best allocation, i.e., \(e^B_g = e^{**}_g\{\bar{\lambda}, \bar{\lambda}\}\) and \(e^B_s = e^{**}_s\{\bar{\lambda}, \bar{\lambda}\}\).

Now, consider a bank endowed with the pessimistic belief (\(\lambda_B = \lambda\)). We know from Proposition 7 that this safety-focused bank needs to develop a strong enough culture (\(\alpha \geq \alpha^B\)) in order to deter an optimistic manager from applying for the job, and induce only pessimistic managers to apply. With such a belief matching, \(\{\lambda_B = \lambda, \lambda_M = \lambda\}\), we know from the analysis in Section 4.1 that the manager will choose the second-best effort allocation, \(\{e^{**}_g\{\lambda, \lambda\}, e^{**}_s\{\lambda, \lambda\}\}\), if the bank sets its benchmark identical to that second-best allocation, i.e., \(e^B_g = e^{**}_g\{\lambda, \lambda\}\) and \(e^B_s = e^{**}_s\{\lambda, \lambda\}\). If that is the case, the manager suffers no disutility from choosing an allocation inconsistent with the culture, because there is no allocation deviation. Given that any disutility suffered by the manager will eventually be compensated by the bank through higher wages (because the manager’s IC constraint

\textsuperscript{15} A key assumption that leads to this assortative matching is that every bank’s chosen culture and its strength are commonly observable.
to exert effort needs to be satisfied), the bank will set its benchmark identical to the second-best allocation. What is left next is for the bank is to choose a strong enough safety-focused culture to discourage an optimistic manager from applying for the job. Given the cost of developing culture, the bank will choose exactly $\alpha = \alpha^B$, at which an optimistic manager derives the same utility from working for the safety-focused bank as a pessimistic manager. This leads to the following result:

Proposition 8 (Optimal bank culture). A growth-focused bank ($\lambda_B = \bar{\lambda}$) invests nothing in culture ($\alpha = 0$) but is able to match with a manager who shares the same optimistic belief ($\lambda_M = \bar{\lambda}$) and chooses an effort allocation $\{e^*_{g(\bar{\lambda},\bar{\lambda})}, e^*_{s(\bar{\lambda},\bar{\lambda})}\}$, given by (A9). The bank’s choice of the benchmark allocation $\{e^B_g, e^B_s\}$ is irrelevant. A safety-focused bank ($\lambda_B = \lambda$) invests in a safety culture by choosing $\alpha = \alpha^B > 0$, given by (A10), so as to match with a manager sharing the same pessimistic belief ($\lambda_M = \lambda$). The manager chooses an effort allocation $\{e^*_{g(\lambda,\lambda)}, e^*_{s(\lambda,\lambda)}\}$, given by (A11), identical to the bank’s choice of the benchmark allocation $\{e^B_g, e^B_s\}$.

5 Two Banks

In this section, we extend the analysis to examine the implications of interbank competition for culture.

5.1 Herding in Growth: Two Banks with Same Beliefs but No Investment in Culture

The analysis here extends the base model in Section 3 into two banks. Section 3 shows that, in the one-bank case, the manager allocates too much effort to growth relative to safety compared to the first best (see Proposition 2). We now show that with two banks with identical beliefs about the borrower pool quality (same belief about $\lambda$) and managers also being endowed with the same beliefs as banks, the externality that each bank exerts on the other bank due to interbank competition causes each bank to tilt even more toward growth, making the banking system more likely to fail.\footnote{Since both banks fail together, this elevates systemic risk.}

Before diving into the algebra, here is the intuition. For bank $i$, the probability that it locates a loan not only depends on its own growth effort $e_{g[i]}$, but also on bank $j$’s growth effort $e_{g[j]}$: a bigger $e_{g[j]}$ ceteris paribus lowers bank $i$’s ability to locate a loan due to competition. Then, bank $i$ will have to elicit a larger $e_{g[i]}$ from its own manager to counteract the effect of competition from bank $j$. In a symmetric equilibrium, the same happens to bank $j$. This is the first channel through
which the effect of competition is manifested. The second channel, which is more subtle, is that the value of safety to bank \( i \) is diminished as bank \( j \)'s increased growth focus causes bank \( i \) to lose more loans to bank \( j \). This is because bank \( i \) has fewer loans to apply its safety screening to. That is, the marginal value of safety is diminished in a more competitive growth-oriented environment.\footnote{There may be another channel, which is even more subtle and not modeled here. As bank \( i \) focuses more on growth and less on safety, it is more likely to fail, and bank \( j \) then fears less about its own failure, because bank \( j \) knows that if both banks fail altogether, the government will be more likely to rescue both, i.e., a lower \( \delta \) (recall \( \delta \) is the probability that the government does not rescue, which we take as exogenously given, but could be modeled as depending on the number of failing banks). This is a “too-many-to-fail” problem: more banks failing makes it more likely for the government to rescue. This third channel reinforces each bank’s incentive to invest more in growth (hence less in safety). This increases the odds that both banks fail altogether, systemic risk (if it can be simply defined as such) then goes up.}

**Model:** With two banks, there will be competition in finding a loan. Think of both banks searching for the urn with balls at the same time. The bank that finds it first gets to make the loan, and the other bank makes no loan. We label the banks as “bank 1” and “bank 2” and model competition as follows. Consider bank 1, whose probability of finding a loan is \( e_g[1] - \kappa e_g[2] \), where \( \kappa \in (0, 1) \) can be thought of as the degree of competition, with a larger \( \kappa \) corresponding to a more competitive loan market. This simple specification implies that as bank \( j \) engages more in growth (i.e., larger \( e_g[j] \)), bank \( i \)'s ability to locate a loan is lower ceteris paribus, with \( i \neq j \).

Bank 1 chooses wages \( w_X \) and \( w_\emptyset \) to maximize its net profit (bank 2’s problem is symmetric):

\[
\pi_1 = (e_g[1] - \kappa e_g[2])\left[\lambda(X - I - w_X) + (1 - \lambda)e_s[1](-w_\emptyset) + (1 - \lambda)(1 - e_s[1])(-E - \delta \Delta)\right] + [1 - (e_g[1] - \kappa e_g[2])][-w_\emptyset]. \tag{28}
\]

The utility derived by the manager of bank 1 from working is:

\[
u_1 = (e_g[1] - \kappa e_g[2])\left[\lambda w_X + (1 - \lambda)e_s[1]w_\emptyset\right] + [1 - (e_g[1] - \kappa e_g[2])]w_\emptyset - c. \tag{29}\]

The manager’s constraints are as follows. First, the IC constraint for effort exertion:

\[
u_1 \geq w_\emptyset \Rightarrow \lambda \frac{w_X}{w_\emptyset} \geq 1 - (1 - \lambda)e_s[1] + \frac{c}{(e_g[1] - \kappa e_g[2])w_\emptyset}. \tag{30}\]
Second, the IC constraint for effort allocation (conditional on working):

$$\{e_g[1], e_s[1]\} \in \text{argmax}_{\{e_g[1]+e_s[1]=1\}} u_1 \Rightarrow$$

$$e_g[1] - \frac{\kappa}{2} e_g[2] = \frac{\lambda}{2(1-\lambda)} \left( \frac{w_X}{w_0} - 1 \right),$$

$$e_s[1] + \frac{\kappa}{2} e_g[2] = \frac{\lambda}{2(1-\lambda)} \left( \frac{2-\lambda}{\lambda} - \frac{w_X}{w_0} \right).$$

(31)

Equations (28), (29), (30) and (31) can be understood in the same way as for (1), (2), (4) and (5), respectively, with $e_g$ there being replaced with $e_g[1] - \kappa e_g[2]$ here to reflect the effect of interbank competition on the loan generation probability.

**Analysis:** Comparing (31) with (5), we see that in a symmetric equilibrium, $e_g[1] = e_g[2] > e_g$ and $e_s[1] = e_s[2] < e_s$ for any given $\frac{w_X}{w_0}$. That is, if we fix $\frac{w_X}{w_0}$ across the one-bank and two-bank cases, the two-bank case will involve more growth but less safety for each bank. Intuitively, given the same pay wedge (i.e., same $\frac{w_X}{w_0}$), each manager in the two-bank case needs to work harder to counteract competition from the other bank: to get the high wage $w_X$, the manager would have to generate a loan and have it not taken away by the competitor in the first place.

However, $\frac{w_X}{w_0}$ has to be higher in the two-bank case. To see this informally, substitute (31) into (30), and note that $e_g[1] = e_g[2]$ in a symmetric equilibrium, so we can rewrite (30) as:

$$\frac{w_X}{w_0} \geq 1 + \left( \frac{2 - \kappa}{1 - \kappa} \right)^2 \frac{1 - \lambda}{\lambda^2} \frac{c}{w_X - w_0}.$$  

(32)

Comparing (32) with (6) in the one-bank case (both constraints must be binding), we see that the term $\left( \frac{2 - \kappa}{1 - \kappa} \right)^2 > 4$ in (32) shows that $\frac{w_X}{w_0}$ should be bigger for the two-bank case.

These lead to our first result in the two-bank case:

**Proposition 9 (Interbank competition-induced excessive growth – homogeneous beliefs with no investment in culture).** Compared to the one-bank case, each bank in the two-bank case (with both banks and managers having the same beliefs): (i) allocates more effort toward growth and less toward safety, i.e., $e_g^{**}[1] = e_g^{**}[2] > e_g^{*}$ and $e_s^{**}[1] = e_s^{**}[2] < e_s^{*}$; (ii) uses a steeper pay-for-performance wage contract, i.e., larger $\frac{w_X}{w_0}$; and (iii) pays more to its manager, i.e., higher pay level. Moreover, the banking system is more likely to suffer systemic risk wherein both banks fail altogether.
This proposition says that the competition externality between banks has two consequences. First, it causes each bank to engage more in growth but less in safety (which can be viewed as “herding in growth”), in order to counteract the effect of competition from the other bank(s). This leads to higher systemic risk. Second, managerial compensation will exhibit both higher pay level, and higher performance-based pay in the two-bank case with competition.

5.2 Herding with Two Banks with Different Beliefs and No Investment in Culture

Consider two banks (bank 1 and bank 2) endowed with different beliefs about the borrower pool quality; bank 1 has the optimistic belief \( \lambda_{B[1]} = \bar{\lambda} \) and bank 2 has the pessimistic belief \( \lambda_{B[2]} = \lambda \). Managers are also endowed with either the optimistic belief or the pessimistic belief; each manager’s belief is her private information. The goal of the analysis here is to show that, without a sufficiently strong safety culture being developed in bank 2, both banks hire a manager with the optimistic belief, each of whom will allocate relatively more effort toward growth than safety. This generates strong competition between the two banks, causing each to allocate even more effort to growth than in the stand-alone one-bank case. This result is similar to Proposition 9 (where we have two banks with managers holding the same beliefs), but it shows that a correlated emphasis on growth does not require banks to have homogeneous (optimistic) beliefs.

**Analysis:** Suppose bank 2 does not develop a safety culture (i.e., \( \alpha = 0 \) for bank 2); note that bank 1 always chooses \( \alpha = 0 \) (see Proposition 8). Therefore, both banks are matched with an optimistic manager. So, for bank 1 we have the matched-beliefs case \( \{ \lambda_{B[1]} = \bar{\lambda}, \lambda_{M[1]} = \bar{\lambda} \} \), while for bank 2 we have the mismatched-beliefs case \( \{ \lambda_{B[2]} = \lambda, \lambda_{M[2]} = \bar{\lambda} \} \).

The expected net profit for bank \( i, i \in \{1, 2\} \), is (where \( j \neq i, \lambda_{B[i]} = \bar{\lambda}, \) and \( \lambda_{B[2]} = \lambda \)):

\[
\pi_i = (e_{g[i]} - \kappa e_{g[j]})[\lambda_{B[i]}(X - I - wX[i]) + (1 - \lambda_{B[i]})e_{s[i]}(-w_\emptyset[i]) + (1 - \lambda_{B[i]})(1 - e_{s[i]})(-E - \delta\Delta)] + [1 - (e_{g[i]} - \kappa e_{g[j]})](-w_\emptyset[i]).
\]

(33)

The manager’s utility derived from working for bank \( i \) is (where \( \lambda_{M[1]} = \lambda_{M[2]} = \bar{\lambda} \)):

\[
u_i = (e_{g[i]} - \kappa e_{g[j]})[\lambda_{M[i]}wX[i] + (1 - \lambda_{M[i]})e_{s[i]}w_\emptyset[i]] + [1 - (e_{g[i]} - \kappa e_{g[j]})]w_\emptyset[i] - c.
\]

(34)
Bank $i$’s problem can be written as:

$$\max_{\{wX[i], w\emptyset[i]\}} \pi_i,$$

subject to

$$u_i \geq w\emptyset[i],$$

$$\{e_g[i], e_s[i]\} \in \arg\max_{\{e_g[i] + e_s[i]=1\}} u_i.$$ (35)

The first constraint is the manager’s IC constraint for effort exertion, which can be explicitly written as:

$$\lambda_{M[i]} \frac{wX[i]}{w\emptyset[i]} \geq 1 - (1 - \lambda_{M[i]})e_s[i] + \frac{c}{(e_g[i] - \kappa e_g[j])w\emptyset[i]}.$$ (36)

The second constraint is the manager’s IC constraint for effort allocation (conditional on effort exertion), which can be explicitly written as:

$$e_g[i] - \frac{\kappa}{2}e_g[j] = \frac{\lambda_{M[i]}}{2(1 - \lambda_{M[i]})} \left( \frac{wX[i]}{w\emptyset[i]} - 1 \right),$$

$$e_s[i] + \frac{\kappa}{2}e_g[j] = \frac{\lambda_{M[i]}}{2(1 - \lambda_{M[i]})} \left( \frac{2 - \lambda_{M[i]}}{\lambda_{M[i]}} - \frac{wX[i]}{w\emptyset[i]} \right).$$ (37)

The optimization problem above can be understood in the same way as the optimization problem stated in Section 5.1 (where two banks and managers have the same belief), except here banks’ beliefs are different and there is bank-manager belief mismatch in bank 2.

**Proposition 10** (Interbank competition-induced excessive growth – heterogeneous beliefs with no investment in culture). Compared to the one-bank case in which the bank and its manager both have optimistic beliefs, in the two-bank case without investment in culture and with one bank having optimistic beliefs and the other having pessimistic beliefs: (i) the bank with optimistic beliefs always allocates more managerial effort toward growth; and (ii) the bank with pessimistic beliefs allocates more effort toward growth if the interbank competition is sufficiently strong (i.e., $\kappa$ sufficiently big).

What is a little surprising about this result is that, in the two-bank case, in the absence of culture even the bank with the pessimistic belief may have its manager allocating more effort to growth than the optimistic bank in the single-bank case, if the interbank competition for loans is sufficiently strong. Thus, in the multi-bank case, what drives the greater emphasis on growth
is competition, not correlated optimism. The intuition is again related to the diminished value of safety for bank $i$ when bank $j$ pushes more aggressively for growth, as discussed earlier.

5.3 Two Banks with Different Beliefs and Culture: How Culture Can Reduce Herding

We now introduce culture in the two-bank case with heterogeneous beliefs. Our goal is to show that if bank 2 develops a sufficiently strong safety culture, it will be able to hire a manager who shares the bank’s pessimistic belief (see Proposition 8). This will reduce bank 2’s effort allocation to growth, which, in turn, reduces the competition externality exerted on bank 1. Consequently, each bank allocates less effort to growth than in the case without a strong safety culture in bank 2, and systemic risk is lowered. Bank culture is infectious in its effect – a safety-focused culture developed in one bank can affect other banks by attenuating to some extent the competition-induced externality among banks in the system.

**Analysis:** When bank 2 develops a sufficiently strong safety culture, it is able to match with a manager who shares the bank’s pessimistic belief about borrower quality. The problem can be stated as in Section 5.2, except that two modifications need to be made to bank 2’s problem: (i) $\lambda_{M[2]} = \lambda$; and (ii) the IC constraint of effort exertion for bank 2’s manager becomes $u_2 \geq w^0[2] - \alpha$ to reflect the disutility $\alpha$ incurred by the manager if she shirks. This leads to our last result:

**Proposition 11 (Mediating role of culture).** *Compared to the case in which bank 2 does not develop a safety culture, the case in which bank 2 develops a sufficiently strong safety culture leads to both banks allocating less effort to growth and more to safety.*

This result shows that a strong enough safety culture developed by a subset of banks in the banking system may attenuate the competition-induced growth externality, thereby reducing the growth tendency of other banks, including those that do not develop a culture. That is, just as a focus on a growth culture can be contagious through a competition-induced externality, the effect of a safety culture can also spill over to other banks, lowering systemic risk.\(^{18}\)

\(^{18}\)Another potential benefit has to do with how well banks serve their financing customers, namely (retail) depositors. Merton and Thakor (2015) argue that the optimal contract between the bank and its depositors should completely insulate depositors from the credit risk of the bank. Viewed in this light, a strong safety-oriented culture in a bank improves the efficiency of the contract between the bank and its depositors.
Corollary 1. *Holding the strength of bank 2’s safety culture fixed, when bank 2 has more capital and/or suffers a larger expected charter value loss upon failure, both banks will further allocate even less effort to growth and more to safety.*

Note when stating the above result, we hold bank 1’s capital and its expected charter value loss upon failure fixed. This shows that the spillover effect of bank 2’s safety culture becomes stronger when bank 2 has more capital and/or derives less protection from the public safety net. The idea is that if bank 2 loses more from its own failure, it will react by allocating even more effort toward safety, which, in turn, further alleviates the competition-induced externality on bank 1, inducing bank 1 to also further allocate effort away from growth and toward safety.

### 5.4 Role of Collateral

One issue that we have not considered is the role of collateral. The role of collateral in loan contracting has been analyzed from many perspectives in the literature (e.g., Besanko and Thakor (1987), and Inderst and Mueller (2007)). With collateral, higher interbank competition may lead to an increase in the supply of credit, which then increases the value of the collateral that the credit is used to purchase (e.g., houses), which can increase the safety of the bank’s loan, and induce more banks to enter. In such a circumstance, higher safety and higher growth may be possible simultaneously for banks. While this is an interesting possibility, it may also be the case that the higher value of collateral could induce banks to devote less resources to screening borrowers, leading to riskier lending. Analyzing these issues requires far more structure than our present model has, including endogenizing the interaction of credit supply and collateral values, and is beyond the scope of our analysis. It may be an interesting topic for future research.

### 6 Regulatory Implications

As we mentioned in the Introduction, there are three regulatory policy implications of the analysis that are worth noting. First, Corollary 1 implies that if regulators would like banks to have stronger safety-oriented culture, they should increase capital requirements and reduce the probability of bailing out distressed banks. This means that familiar regulatory tools can be used to influence bank culture. The importance of this observation is that regulators would not need to worry about how to measure bank culture, how to compare cultures across banks, and how to track the evolution a bank’s culture in response to regulatory exhortations for change. Given the nebulous nature of
organization culture and possible disagreement over how it should be measured, this provides a useful starting point.

Second, our analysis implies a tradeoff in the bank’s choice of culture. In choosing a stronger safety-oriented culture, the bank sacrifices some growth. This is something for regulators to note as they contemplate ways in which they would like to see bank culture change.

Third, Proposition 11 highlights the contagious nature of culture. This means regulators need not seek to monitor culture at all banks. Rather, attention can be focused on a subset of highly visible banks. These will typically be the largest banks. If steps are taken to make these banks develop stronger safety-oriented culture, then other banks will tend to do the same. In contrast to current policy – especially that related to TBTF – this will mean a lowering of the bailout probability for these banks. It will also mean higher capital requirements for these banks.

7 Conclusion

The issue of bank culture is now front and center in the minds of regulators, but a theoretical economics framework for analyzing bank culture is not available to think about bank culture in a systematic manner. This paper has attempted to fill that void.

We have sought to develop as simple a model as we could think of, while still capturing two essential ideas. One is that in a banking context, growth versus safety is a fundamental choice that shapes the bank’s strategy as well as culture. The other is that the competitive environment as well as the extent of the safety-net protection offered to banks should play prominent roles in examining both the bank’s relative emphasis on growth versus safety and the mediating role of culture in this choice.

Although simple, the model has yielded a rich harvest of results, and we hope it proves to be useful in future research. The key results can be summarized as follows. First, whenever there is a multi-tasking problem in a bank, it will tilt in favor of growth over safety. Second, competition among banks exacerbates this excessive focus on growth, and this leads to a competition-induced propensity to “herd” on growth. Third, bank culture can play two roles, one of which is a matching role, helping match employees with banks that share their beliefs, even when the beliefs of employees are unobservable. The second role is to possibly enhance the bank’s focus on safety. A strong safety culture can temper the bank’s competition-induced excessive growth focus. Fourth, culture is contagious – when one bank chooses a strong safety culture, it induces competing banks to focus
more on safety, including banks that do not themselves have a safety culture. Finally, higher bank capital increases the focus of the culture on safety, whereas a higher bailout probability decreases the focus of the culture on safety.

We have not analyzed the intertemporal dynamics of how culture evolves, but these may be interesting. For example, a small bank may start out with a safety-focused culture because the government bailout probability in the even of failure is very low. But when it is large enough and anticipates a higher bailout probability, it may switch to a growth-focused culture.

Our analysis has also generated regulatory policy implications. In particular, it shows how familiar regulatory tools like capital requirements and bank bailout policy can be used to influence bank culture, allowing regulators to sidestep thorny culture measurement issues, at least initially. An open question raised by our research is whether the importance of bank culture lessens or increases the need for regulatory supervision. On the one hand, if a sufficiently large number of banks develop strong safety cultures, bank supervisors and regulators will have less to worry about. On the other hand, the evidence seems to suggest that replacing trust with control can produce better outcomes (see Bengtsson and Engström (2014)), suggesting that a strong bank culture should be viewed more as a complement to regulatory supervision, rather than a substitute for it.\footnote{Bengtsson and Engström (2014) report the results of a randomized policy experiment in which replacing a trust-based contract with an increased level of monitoring by the principal led to lower costs and fewer financial irregularities.}
Appendix

Proof of Proposition 1. The first-best effort allocation in (8) follows from the first-order condition (FOC) to the bank’s problem in (7):

\[ f_1(e_g^*) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta)e_g^* = 0. \tag{A1} \]

Now suppose the bank can only observe managerial effort exertion but not allocation. To induce the first-best allocation, we know from the manager’s IC constraint of effort allocation in (5) that \( \frac{w_x}{w_0} = 1 + \frac{2(1-\lambda)}{\lambda}e_g^* \). Substituting this into the manager’s binding IR constraint in (3) yields the wages in (9).

Proof of Proposition 2. The second-best effort \( e_g^{**} \) is given by the FOC to the bank’s problem in (11):

\[ f_2(e_g^{**}) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta)e_g^{**} + \frac{2c}{1 - \lambda}(e_g^{**})^{-3} = 0. \tag{A2} \]

Compare (A2) with the first-best FOC in (A1), we note that \( f'_1 < 0 \), \( f'_2 < 0 \), and \( f_1(z) < f_2(z) \) for \( \forall z \). Thus, clearly we have \( e_g^{**} > e_g^* \) (hence \( e_s^{**} < e_s^* \)).

Next, we know from (5) that \( \frac{w_x}{w_0} = 1 + \frac{2(1-\lambda)}{\lambda}e_g, \) which leads to \( \frac{w_x^*}{w_0^*} > \frac{w_x}{w_0} \) given that \( e_g^{**} > e_g^* \). Finally, the expected managerial pay is \( w_0^* + c \) in the second best, bigger than that in the first best (which is \( c \)).

Proof of Proposition 3. The proposition can be proved by replacing \( \lambda \) in the proof of Proposition 2 with \( \bar{\lambda} \) for the case \( \{\lambda_B = \lambda, \lambda_M = \bar{\lambda}\} \) and \( \tilde{\lambda} \) for the case \( \{\lambda_B = \tilde{\lambda}, \lambda_M = \bar{\lambda}\} \).

Proof of Proposition 4. The FOC to the bank’s problem in the case with mismatched beliefs \( \{\lambda_B = \lambda, \lambda_M = \bar{\lambda}\} \) (stated in (20)) is:

\[ f_{(\lambda, \bar{\lambda})}(e_g^{**}) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta)e_g^{**} + \frac{2c}{1 - \lambda}(e_g^{**})^{-3} = 0. \tag{A3} \]

Replacing \( \lambda \) in (A2) with \( \bar{\lambda} \), we can write the FOC to the bank’s problem in the case with matched beliefs \( \{\lambda_B = \lambda, \lambda_M = \lambda\} \) as:

\[ f_{(\lambda, \lambda)}(e_g^{**}) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta)e_g^{**} + \frac{2c}{1 - \lambda}(e_g^{**})^{-3} = 0. \tag{A4} \]

The difference between the two FOCs lies in the last term: \( \frac{2c}{1 - \lambda} \) in \( f_{(\lambda, \bar{\lambda})} \), while \( \frac{2c}{1 - \lambda} \) in \( f_{(\lambda, \lambda)} \). Since \( f'_{(\lambda, \bar{\lambda})} < 0 \), \( f'_{(\lambda, \lambda)} < 0 \), and \( f_{(\lambda, \lambda)}(z) > f_{(\lambda, \bar{\lambda})}(z) \) for \( \forall z \), we must have \( e_g^{**} > e_g^{**} \) and hence \( e_s^{**} < e_s^{**} \).

The result that \( e_g^{**} - e_g^{**} \) and \( e_s^{**} - e_s^{**} \) are increasing in \( \bar{\lambda} - \lambda \) follows from the fact that \( f_{(\lambda, \bar{\lambda})}(z) - f_{(\lambda, \lambda)}(z) \) is increasing in \( \bar{\lambda} - \lambda \) for \( \forall z \).
To prove the last part of the proposition, note that \( \frac{wx}{w_\emptyset} = 1 + \frac{2(1-\lambda)}{\lambda} e_{g(\lambda, \tilde{\lambda})}^* \) for the case with mismatched beliefs, and \( \frac{wx}{w_\emptyset} = 1 + \frac{2(1-\lambda)}{\lambda} e_{g(\lambda, \lambda)}^* \) for the case with matched beliefs. Thus, to show that \( \frac{wx}{w_\emptyset} \) is lower in the former case, we only need to show:

\[
e_{g(\lambda, \tilde{\lambda})}^* < \frac{\lambda - 1 - \lambda}{1 - \lambda} e_{g(\lambda, \lambda)}^*.
\]

(A5)

For this, it is sufficient to show that \( f_{\{\lambda, \tilde{\lambda}\}}(\frac{\lambda - 1 - \lambda}{1 - \lambda} z) < f_{\{\lambda, \lambda\}}(z) \) for \( \forall z \). This is obvious:

\[
f_{\{\lambda, \tilde{\lambda}\}}(\frac{\lambda - 1 - \lambda}{1 - \lambda} z) = \frac{\lambda - 1 - \lambda}{1 - \lambda} \left[ \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta)(\frac{\lambda - 1 - \lambda}{\lambda}) z + \frac{2c}{1 - \lambda} \left( \frac{\lambda - 1 - \lambda}{\lambda} \right)^3 z^{-3}\right]< \frac{\lambda - 1 - \lambda}{1 - \lambda} \left[ \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta) z + \frac{2c}{1 - \lambda} \left( \frac{\lambda - 1 - \lambda}{\lambda} \right)^3 z^{-3}\right]< \frac{\lambda - 1 - \lambda}{1 - \lambda} \left[ \lambda(X - I) - 2(1 - \lambda)(E + \delta \Delta) z + \frac{2c}{1 - \lambda} z^{-3}\right] = f_{\{\lambda, \lambda\}}(z),
\]

(A6)

where the second inequality follows from the fact that \( \frac{1}{\lambda - 1} \frac{\lambda - 1}{\lambda} \frac{1}{\lambda - 1} < \frac{1}{\lambda - 1} \).

\( \square \)

**Proof of Proposition 5.** The proof mirrors that of Proposition 4.

\( \square \)

**Proof of Proposition 6.** Substituting (26) into (23), we can write the manager’s utility (with \( \alpha = 0 \)) as:

\[
u_{\{\lambda, \tilde{\lambda}\}} = e_g[\lambda_M w_X + (1 - \lambda_M) w_\emptyset - w_\emptyset] + (w_\emptyset - c)
\]

\[
= \frac{\lambda M}{2(1 - \lambda M)} \left[ \frac{w_X}{w_\emptyset} - 1 \right] \left[ \lambda_M w_X + (1 - \lambda_M) \frac{\lambda M}{2(1 - \lambda M)} \left( \frac{2 - \lambda M}{\lambda M} - \frac{w_X}{w_\emptyset} \right) w_\emptyset - w_\emptyset \right] + (w_\emptyset - c)
\]

\[
= \frac{\lambda M}{2(1 - \lambda M)} \left[ \frac{w_X}{w_\emptyset} - 1 \right] \frac{\lambda M}{2} \left( w_X - w_\emptyset \right) + (w_\emptyset - c) + (w_\emptyset - c),
\]

(A7)

which is clearly increasing in \( \lambda_M \) (note \( w_X > w_\emptyset \)). Thus, \( u_{\{\tilde{\lambda}\}} > u_{\{\lambda\}} \).

\( \square \)

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20Note \( \frac{1}{\lambda - 1} \frac{1 - \lambda}{\lambda} > 1 \), so the inequality does not conflict with \( e_{g(\lambda, \tilde{\lambda})}^* > e_{g(\lambda, \lambda)}^* \).

21Note \( \frac{1}{\lambda - 1} \frac{1 - \lambda}{\lambda} \frac{1}{\lambda - 1} < \frac{1}{\lambda - 1} \Leftrightarrow \frac{\lambda}{3} < \frac{1 - \lambda}{\lambda} < \frac{1}{\lambda - 1} \), which is obvious since \( \frac{\lambda}{3} < 1 \) while \( \frac{1 - \lambda}{\lambda} > 1 \).
Proof of Proposition 7. Substituting (26) into (23), we can write the manager’s utility (with \( \alpha > 0 \)) as:

\[
\hat{u}_{\{\lambda_M\}} = u_{\{\lambda_M\}} - 2\alpha |e_g - e_g^B| \\
= e_g[\lambda_M w_X + (1 - \lambda_M) - e_s w_\theta - w_\theta] + (w_\theta - c) - 2\alpha |e_g - e_g^B| \\
= \frac{1}{(1 - \lambda_M) w_\theta} \left[ \frac{\lambda_M^2 (w_X - w_\theta)^2}{4} - \alpha^2 \right] + (w_\theta - c) - 2\alpha \left| \frac{\lambda_M (w_X - w_\theta) - 2\alpha \times 1_{\{e_g > e_g^B\}} - e_g^B}{2(1 - \lambda_M) w_\theta} \right| \leq 0.
\]

Proof of Proposition 8. First, for a bank with the optimistic belief \( \lambda_B = \bar{\lambda} \), \( e^{**}_{g(\bar{\lambda},\bar{\lambda})} \) is uniquely given by (replacing \( \lambda \) in (A2) with \( \bar{\lambda} \)):

\[
\bar{\lambda} (X - I) - 2(1 - \bar{\lambda}) (E + \delta \Delta) e^{**}_{g(\bar{\lambda},\bar{\lambda})} + \frac{2c}{1 - \bar{\lambda}} (e^{**}_{g(\bar{\lambda},\bar{\lambda})})^{-3} = 0. \tag{A9}
\]

Next, for a bank with the pessimistic belief \( \lambda_B = \bar{\lambda} \), we determine the cutoff \( \alpha^B \) by setting \( \hat{u}_{\{\bar{\lambda}\}} = \hat{u}_{\{\bar{\lambda}\}} \):

\[
u_{\{\bar{\lambda}\}} - 2\alpha \left| \frac{\bar{\lambda} (w_X - w_\theta) - 2\alpha \times 1_{\{e_g > e_g^B\}} - e_g^B}{2(1 - \bar{\lambda}) w_\theta} \right| = u_{\{\bar{\lambda}\}}, \tag{A10}
\]

where we note: (i) \( e_g^B = e^{**}_{g(\bar{\lambda},\bar{\lambda})} \), which is uniquely determined by (replacing \( \lambda \) in (A2) with \( \bar{\lambda} \)):

\[
\bar{\lambda} (X - I) - 2(1 - \bar{\lambda}) (E + \delta \Delta) e^{**}_{g(\bar{\lambda},\bar{\lambda})} + \frac{2c}{1 - \bar{\lambda}} (e^{**}_{g(\bar{\lambda},\bar{\lambda})})^{-3} = 0; \tag{A11}
\]

(ii) the manager with belief \( \lambda_M = \bar{\lambda} \) chooses an effort allocation identical to the benchmark and hence suffers no disutility from effort-allocation deviation; and (iii) the wages \( w_X \) and \( w_\theta \) are jointly determined by:

\[
\frac{w_X}{w_\theta} = 1 + \frac{2(1 - \bar{\lambda})}{\bar{\lambda}} e^{**}_{g(\bar{\lambda},\bar{\lambda})}, \tag{A12}
\]

\[
\frac{w_X}{w_\theta} = 1 + \frac{4(1 - \bar{\lambda})}{\bar{\lambda}^2} \frac{c}{w_X - w_\theta}, \tag{A13}
\]

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which are the IC constraints of effort allocation and exertion, respectively, for a manager with belief $\lambda_M = \lambda$.

Note in (A10), $u(\lambda)$ is not a function of $\alpha$, while the left-hand side is a decreasing function of $\alpha$ with the first-order derivative being:

$$-\frac{2\alpha}{(1-\lambda)w_0} + \frac{2\alpha}{(1-\lambda)w_0} - 2|\tilde{\lambda}(w_X - w_0) - 2\alpha \times 1_{\{e_1 \geq e_2^B\}} - e_B|$$

$$= -2\frac{\tilde{\lambda}(w_X - w_0) - 2\alpha \times 1_{\{e_1 \geq e_2^B\}} - e_2^B}{2(1-\lambda)w_0} < 0. \quad \text{(A14)}$$

Thus, $\alpha^B$ is uniquely determined by (A10) by letting $\alpha = \alpha^B$.

**Proof of Proposition 9.** Combining (31) and (30), we have:

$$w_0 = \frac{c}{(1-\lambda)(e_{g[1]} - \kappa e_{g[2]})(e_{g[1]} - \frac{\kappa}{2} e_{g[2]})} \frac{1 - \frac{c}{2}}{1 - \kappa}. \quad \text{(A15)}$$

Bank 1’s problem can be written as:

$$\max_{\{e_{g[1]}\}} \pi_1 = (e_{g[1]} - \kappa e_{g[2]})[\lambda(X - I) - (1 - \lambda)e_{g[1]}(E + \delta \Delta)]$$

$$- \frac{c}{(1-\lambda)(e_{g[1]} - \kappa e_{g[2]})(e_{g[1]} - \frac{\kappa}{2} e_{g[2]})} \frac{1 - \frac{c}{2}}{1 - \kappa} - c. \quad \text{(A16)}$$

FOC w.r.t. $e_{g[1]}$ (and using $e_{g[1]} = e_{g[2]}$ in a symmetric equilibrium) is:

$$\hat{f}_2(e_{g[1]}^{**}) = \lambda(X - I) - (2 - \kappa)(1 - \lambda)(E + \delta \Delta)e_{g[1]}^{**} + \frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda} (e_{g[1]}^{**})^{-3} = 0. \quad \text{(A17)}$$

Comparing it with the FOC that determines $e_g^{**}$ in the one-bank case in (A2), $f_2(e_g^{**}) = 0$, we note that $f_2' < 0$ and $\hat{f}_2' < 0$.

We claim

$$e_{g[1]}^{**} > \frac{2}{2 - \kappa} e_g^{**} > e_g^{**}. \quad \text{(A18)}$$

To see this, note

$$\hat{f}_2\left(\frac{2}{2 - \kappa} z\right) = \lambda(X - I) - (2 - \kappa)(1 - \lambda)(E + \delta \Delta)\left(\frac{2}{2 - \kappa} z\right) + \frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda} z^{-3}$$

$$> f_2(z), \quad \text{(A19)}$$

where the inequality holds, since $\frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda} > 1.22$ Thus, we must have $e_{g[1]}^{**} = e_{g[2]}^{**} > \frac{2}{2 - \kappa} e_g^{**}$.

22 This is equivalent to $(2 - \kappa)^3(4 - 3\kappa) > 16(1 - \kappa)^3 \Leftrightarrow 13\kappa^2 - 32\kappa + 20 > 0 \Leftrightarrow (\kappa - \frac{16}{11})^2 + \frac{4}{199} > 0.$
Next, we know from (31) that
\[
\frac{w_X}{w_0} = 1 + \frac{(2 - \kappa)(1 - \lambda)}{\lambda} e_{g|1}^{**} > 1 + \frac{2(1 - \lambda)}{\lambda} e_{g|1}^{**}. \tag{A20}
\]
We know the pay wedge, \(\frac{w_X}{w_0}\), in the one-bank case equals \(1 + \frac{2(1 - \lambda)}{\lambda} e_{g|1}^{**}\) (see (5)). Thus, \(\frac{w_X}{w_0}\) must be bigger in the two-bank case.

Finally, we compare the pay level. The expected pay in the one-bank case is \(\frac{c}{(1 - \lambda)(e_{g|1}^{**} - \kappa e_{g|2}^{**})(e_{g|1}^{**} - \frac{\delta}{2} e_{g|2}^{**})} x (1 - \kappa)\). The expected pay in the two-bank case is:
\[
\frac{c}{(1 - \lambda)(e_{g|1}^{**} - \kappa e_{g|2}^{**})(e_{g|1}^{**} - \frac{\delta}{2} e_{g|2}^{**})} x (1 - \kappa) = \frac{c}{(1 - \lambda)(1 - \kappa)^2(e_{g|1}^{**})^2} \tag{A21}
\]
So we only need to show \(e_{g|1}^{**} < \frac{1}{1 - \kappa} e_{g|2}^{**}\). To see this, note that:
\[
\tilde{f}_2 \left( \frac{1}{1 - \kappa} z \right) = \lambda (X - I) - \frac{2 - \kappa}{1 - \kappa} (1 - \lambda)(E + \delta \Delta)z + \frac{2 - \frac{3}{2} \kappa}{2 - \kappa} \frac{2c}{1 - \lambda} z^{-3} < f_2(z). \tag{A22}
\]
Thus, we must have \(e_{g|1}^{**} < \frac{1}{1 - \kappa} e_{g|2}^{**}\). \hfill \square

**Proof of Proposition 10.** Denote bank \(i\)’s optimal effort allocation to growth as \(e_{g|i}^{**}\). Following the same analysis as in the proof of Proposition 9, we can show that the FOCs for bank 1’s problem (with the optimistic belief) and bank 2’s problem (with the pessimistic belief) can be written as:
\[
\tilde{f}_{\{\lambda, \hat{\lambda}\}}(e_{g|1}^{**}) \equiv \hat{\lambda}(X - I) - (1 - \hat{\lambda})(E + \delta \Delta)(2e_{g|1}^{**} - \kappa e_{g|2}^{**}) + \frac{1 - \frac{\kappa}{2}}{1 - \kappa} \frac{c}{1 - \lambda} \left(\frac{e_{g|1}^{**} - \kappa e_{g|2}^{**}}{e_{g|1}^{**} - \frac{\delta}{2} e_{g|2}^{**}}\right) \\
= 0, \tag{A23}
\]
and
\[
\tilde{f}_{\{\lambda, \hat{\lambda}\}}(e_{g|2}^{**}) \equiv \hat{\lambda}(X - I) - (1 - \hat{\lambda})(E + \delta \Delta)(2e_{g|2}^{**} - \kappa e_{g|1}^{**}) + \frac{1 - \frac{\kappa}{2}}{1 - \kappa} \frac{c}{1 - \lambda} \left(\frac{e_{g|2}^{**} - \kappa e_{g|1}^{**}}{e_{g|2}^{**} - \frac{\delta}{2} e_{g|1}^{**}}\right) \\
= 0, \tag{A24}
\]
respectively. It can be shown that \(e_{g|1}^{**} > e_{g|2}^{**}\), so we only need to prove the result for bank 2.

We compare (A24) with the FOC that determines the bank’s effort allocation to growth, \(e_{g|1, \hat{\lambda}}\), in the one-bank case with both the bank and its manager having optimistic beliefs (replacing \(\lambda\) in (A2) with \(\hat{\lambda}\)):
\[
f_{\{\lambda, \hat{\lambda}\}}(e_{g|1, \hat{\lambda}}) \equiv \hat{\lambda}(X - I) - 2(1 - \hat{\lambda})(E + \delta \Delta)e_{g|1, \hat{\lambda}} + \frac{2c}{1 - \lambda} (e_{g|1, \hat{\lambda}})^{-3} = 0. \tag{A25}
\]

\footnote{Note \(\frac{1}{1 - \kappa} > \frac{2}{2 - \kappa}\), so this does not violate the previously established condition that \(e_{g|1}^{**} > \frac{2}{2 - \kappa} e_{g|1}^{**}\).}

\footnote{If \(e_{g|1}^{**} = e_{g|2}^{**}\), we will have \(\tilde{f}_{\{\lambda, \hat{\lambda}\}}(e_{g|1}^{**}) > \tilde{f}_{\{\lambda, \hat{\lambda}\}}(e_{g|2}^{**})\).}
Note that $\hat{f}_{\{\lambda, \bar{\lambda}\}}(e^{**}_{g[2]})$ is increasing in $e^{**}_{g[2]}$. So, to establish the possibility of $e^{**}_{g[2]} > e^{**}_{g[\bar{\lambda}, \bar{\lambda}]}$, it is sufficient to examine the hypothetical case wherein $e^{**}_{g[1]} = e^{**}_{g[2]}$. If that were the case, we could rewrite (A24) as:

$$\hat{f}_{\{\lambda, \bar{\lambda}\}}(e^{**}_{g[2]}) \equiv \lambda (X - I) - (2 - \kappa)(1 - \lambda)(E + \delta \Delta) e^{**}_{g[2]} + \frac{2 - \frac{3}{2} \kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda} (e^{**}_{g[2]})^3 = 0. \tag{A26}$$

We note: (i) $\hat{f}_{\{\lambda, \bar{\lambda}\}}' < 0$ and $f_{\{\lambda, \bar{\lambda}\}}' < 0$; and (ii) $\hat{f}_{\{\lambda, \bar{\lambda}\}}(z) > f_{\{\lambda, \bar{\lambda}\}}(z)$ for $\forall z$, when $\kappa$ is sufficiently large, in which case we have $e^{**}_{g[2]} > e^{**}_{g[\bar{\lambda}, \bar{\lambda}]}$.

**Proof of Proposition 11.** The result for bank 2 is obvious: its own safety culture causes it to allocate less effort toward growth (lower $e^{**}_{g[2]}$). As for bank 1 which does not invest in culture, its effort allocation to growth, $e^{**}_{g[1]}$, is still given by (A23). Note that $\hat{f}_{\{\lambda, \bar{\lambda}\}}(e^{**}_{g[1]})$ in (A23) is increasing in $e^{**}_{g[2]}$ while decreasing in $e^{**}_{g[1]}$. So, as $e^{**}_{g[2]}$ decreases due to bank 2’s safety culture, $e^{**}_{g[1]}$ has to decrease as well.

**Proof of Corollary 1.** This result follows directly from the fact that the FOC that determines bank 2’s effort allocation to growth is decreasing in $E$ and $\delta \Delta$ (see (A24)): as $E$ and/or $\delta \Delta$ increases, $e^{**}_{g[2]}$ has to decrease; as a result, $e^{**}_{g[1]}$ decreases as well (following the same argument in the proof of Proposition 11).

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25 For this, we only need to show that $\frac{2 - \frac{3}{2} \kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda}$ is increasing in $\kappa$: it is straightforward to check that the first-order derivative of this term w.r.t. $\kappa$ is proportional to $9\kappa^2 - 28\kappa + 22 = (3\kappa - \frac{14}{3})^2 + \frac{2}{9} > 0$. 

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References


