

Bank Culture*

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Abstract

We develop a model in which bank culture improves upon outcomes attainable with incentive contracting. The bank designs a second-best incentive contract to induce the desired managerial effort allocation across growth and safety, but this induces excessive growth relative to the first best, a distortion exacerbated by interbank competition. Bank culture has two effects: it matches managers to banks with similar beliefs, and a safety-oriented culture reduces the competition-induced excessive growth focus. Culture is also contagious – a safety-oriented culture in some banks causes others to follow suit – this effect strengthens with higher bank capital and weakens with stronger safety nets.

Keywords: Bank culture, Multi-tasking problem, Competition, Bank capital, Safety nets

JEL: G21, M14

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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, condoned and perhaps even encouraged by the culture in these 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 and socially inefficient risk taking. 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 the glue that binds individuals to an institution; it creates a consistent framework for behaviors and business practices.” The report goes on to state that a bank’s risk is an inevitable consequence of its culture: “First, a bank’s risk culture cannot be isolated from its overall culture.” 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 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), Hermalin (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.¹ 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 focus first on the problem of motivating the manager (agent) to expend effort, and then on the tradeoff involved in the allocation of this effort – safety can only be enhanced by sacrificing growth, and vice versa. We think this tradeoff is an essential aspect of bank culture choice.² Indeed, this has been emphasized quite a bit recently. In a report based on a global survey of banks, Ernst & Young (2014) reports:

“The new message this year is the almost universal focus on risk culture, with the emphasis on conduct... This has shaken boards’ certainty that they know the prevailing culture across a whole firm and has raised fundamental concerns about the quality of business-line controls and risk accountability... At the same time, the industry is trying to deal with a seismic shift in business models caused by the reluctance of investors to accept the lower ROEs resulting from Basel III.”

¹Holmstrom and Milgrom (1991) formalized the notion of multi-tasking in an agency model. Garicano and Rayo (2016) link a flawed allocation of authority in multi-tasking problems to culture-related organizational failures.

²The 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.

Thus, while the cultural focus is shifting toward enhanced safety, there is also concern about possibly diminished growth and ROE. Indeed, the tension between growth and safety in banking shows up time and again in different contexts.³ For example, [Fahlenbrach, Prilmeier, and Stulz \(2016\)](#) document that during 1973-2014, high-growth U.S. banks exhibited significantly higher crash risk. The banks that grew their loan portfolios faster made riskier loans and failed to adequately price this risk, indicating a weak focus on safety. Similarly, the empirical results in [Popadak \(2014\)](#) also highlight the tension between growth (“results-orientation” in her paper) and safety (“integrity” in her paper). [Popadak \(2014\)](#) and [Fiordelisi and Ricci \(2014\)](#) are part of an emerging literature that attempts to empirically “measure” culture.

The growth versus safety tradeoff we model is similar in spirit to, but yet distinct from, the tradeoff between return and risk. In Finance, risk is typically thought of as variance or covariance with some aggregate shock. In banking, the focus is typically on *downside* risk, as opposed to covariance with aggregate risk. As [Rancière, Tornell, and Westermann \(2008\)](#) point out, downside risk in banking is better measured by the skewness of credit growth.⁴ We thus prefer to use the terms “growth” and “safety” to indicate the bank’s choice between a higher profit and a lower downside risk.

The second pillar in our model 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 idea that beliefs play a central role in culture is familiar from earlier work, where culture has been defined as shared beliefs or shared preferences (see [Crémer \(1993\)](#), [Lazear \(1995\)](#), and [Van den Steen \(2010a, 2010b\)](#)). The notion of culture interacting with heterogeneous beliefs has been introduced in earlier work as well. [Van den Steen \(2010a\)](#) argues that corporate culture “homogenizes” *a priori* heterogeneous beliefs via employee screening, self-selection and joint learning. There is now an extensive literature that explains how heterogeneous prior beliefs can be rational, and examines the many implications of heterogeneous priors (e.g., [Boot, Gopalan, and Thakor \(2006, 2008\)](#), [Kurz \(1994a, 1994b\)](#), and [Van den Steen \(2010a, 2010b, 2010c\)](#)).

³For example, this tension has also been explored in the context of international finance (see [Rancière, Tornell, and Westermann \(2008\)](#)). [Rancière and Tornell \(2016\)](#) examine the role of regulation in affecting the growth-safety tradeoff.

⁴[Rancière, Tornell, and Westermann \(2008\)](#) explain that: “Unlike variance, negative skewness isolates the impact of the large, infrequent, and abrupt credit busts associated with crises.” In our model, an increase in what we refer to as “safety” (the probability of loan repayment) may actually imply higher variance of bank return for some parameter values.

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 (unverifiable) action by an employee that is not consonant with the culture generates a disutility for the employee.⁵ This is meant to capture the idea that “culture is what people do when no one is watching,”⁶ 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 explicit contracting or direct and intrusive monitoring of actions. In addition to modeling culture, we also solve endogenously for the optimal managerial wage contract in the multi-tasking environment, so the role of culture in going beyond explicit wage contracting can be analyzed. 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. Our analysis of the model begins with a hypothetical benchmark case in which there is no investment in culture. We call this case “hypothetical” because, in reality, every organization invests (more or less) in culture. The analysis of this case, however, serves as a useful benchmark that helps us assess the *incremental* value of bank investment in culture from some base level that we normalize to zero. Three main results emerge from the benchmark analysis:

1. 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.
2. Interbank competition exacerbates this excessive focus on growth, so banks herd even more on growth, increasing systemic risk.
3. A mismatch 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.

The next step of our analysis introduces culture by allowing banks to choose what cost to incur to develop culture. This generates three more key results:

⁵It 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 that rely on verifiability.

⁶See [Group of Thirty \(2015\)](#).

4. 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.
5. 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.”
6. This contagion effect of culture is stronger when banks have more capital and weaker when the public safety net is stronger.

Our paper has implications for bank regulatory policy. First, the contagious nature of culture (Result 5) 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. Second, 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. The idea is that if big banks lose more from their own failures, as in the cases with higher bank capital levels and weaker public safety nets, they will react by allocating more resources toward safety (Result 6); this, in turn, diminishes the competition-induced excessive growth focus in culture choice, inducing other (smaller) banks to also focus more on safety (Result 5). Our policy recommendation is that, at least at the outset, contemplating how these familiar regulatory tools might be deployed differently from current practice may be more fruitful than nailing down culture measurement issues. Third, 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. This means that there is an inherent *culture-driven* tension between the current regulatory focus on strengthening bank risk culture to improve safety on the one hand and the push to elevate economic growth by stimulating bank lending on the other.

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, and shows that culture can reduce belief heterogeneity among employees, thereby reducing disagreement about the right course of action. 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.

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, so we examine a different set of issues.

Our approach in modeling the bank's choice between growth and safety is somewhat related to [Heider and Inderst \(2012\)](#), who also analyze a multi-tasking agency problem in which a loan officer performs two tasks: prospecting for borrowers and (truthfully) reporting to the bank the soft information about the borrower that she possesses. Their focus is on how the inherent conflict between the two tasks may induce the loan officer to misreport the soft information. By contrast, our focus is on bank culture choice and the consequent resource allocation between growth and safety, with an analysis of how (endogenously-determined) culture can reduce misallocation.

The setup in our model that culture is determined from the top and that employees respond to organization culture is consistent with the empirical evidence (e.g., [Guiso, Sapienza, and Zingales \(2015\)](#)), 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 implication of 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 is organized as follows. Section 2 develops the base multi-tasking model. Section 3 analyzes 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 and empirical predictions of the analysis. 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 either growth-focused or safety-focused. This cultural choice then determines the optimal wage contract the bank designs to first elicit managerial effort and then to induce the desired allocation of this effort to growth and safety. Given a choice of high total effort, 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.⁷ In the base model developed here, we simply model the multi-tasking agency problem in the bank. That is, as mentioned in the Introduction, we keep culture out of the picture for now

⁷The 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.

and consider a hypothetical benchmark case with no investment in culture. We 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).

One might argue that modern banks explicitly separate the loan origination function from the credit analysis function in order to overcome the tension between growth and safety that we focus on. The loan originators can focus on growth and those involved in credit analysis and loan approval can focus on safety. However, from this perspective, our modeling of these two functions as being entrusted to the same agent should not be taken too literally. Rather, one should view it as a bank with limited human and capital resources recognizing a tradeoff – the more resources it allocates to prospecting for loans, the less resources it has available for ensuring safety. Our model captures this essential tradeoff.

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 $c > 0$. Thus, the manager is effort averse and the first task of the incentive contract is to induce the manager to choose $e = 1$ and not shirk. Once the manager chooses $e = 1$, she can allocate effort between growth (e_g) and safety (e_s), where $e_g + e_s = 1$. Conditional on a choice of high effort, its allocation across growth and safety is the multi-tasking aspect of the model and is the second task of the incentive contract. 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](#).

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.⁸ 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)

⁸We 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 $\epsilon(1 - e_g) + e_g$.

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 $w_0 = 0$.⁹

Bank Culture: Although the base model deals with a hypothetical case with no investment in culture, we think it is helpful to define our notion of bank culture upfront. Our view is that culture is developed through reward and punishment mechanisms linked to employee behavior (see, for example, [Thakor \(forthcoming\)](#)). If the manager chooses an action that deviates from the bank’s culture-dictated preferred behavior, she may suffer implicit (non-pecuniary) punishments such as denial of promotion or interesting/meaningful task assignments, social ostracization and so on. A key is that these implicit rewards and punishments can rely on (noisily) observable signals of performance that are *not* verifiable (by a third party) for contracting purposes. In other words, they cannot be used to write explicit wage contracts, but nonetheless serve as useful indicators for implicit contracting.

Specifically, suppose the manager’s effort allocation between growth and safety, $\{e_g, e_s\}$, deviates from a benchmark allocation set by the bank, $\{e_g^B, e_s^B\}$, where the deviation is:

$$|e_g - e_g^B| + |e_s - e_s^B| \in [0, 2]. \quad (1)$$

A larger e_g^B represents a more growth-oriented culture, and a larger e_s^B represents a more safety-oriented culture. The bank’s investment in culture allows it to generate a private signal $d \in \{0, 1\}$ that probabilistically detects such deviation, where $d = 1$ indicates detection and $d = 0$ indicates no detection. Detection only informs that a deviation has occurred but does not reveal the magnitude of the deviation. Assume $\Pr(d = 1) = \alpha(|e_g - e_g^B| + |e_s - e_s^B|)$, where $\alpha \in [0, 1/2]$ measures the strength of bank culture, with a bigger α corresponding to a stronger culture. The idea is that the stronger is the bank’s culture and the larger is the manager’s effort-allocation deviation, the more likely it is that the deviation will be detected.¹⁰ We can interpret α as the bank’s investment in culture; examples include building an organization with a clear set of rules and procedures that ensure these rules are followed, and fostering an environment that encourages and rewards internal flag-raising and whistleblowing that help detect managerial behaviors that are incompatible with the organization’s culture.¹¹ Such investments are costly; assume that the cost for the bank to

⁹The manager would deliberately reject a good loan if $w_X < w_\emptyset$, and accept a bad loan rather than rejecting it if $w_\emptyset < w_0$.

¹⁰This specification implies that while it is possible that a deviation will go undetected, the bank will never observe a signal indicating a deviation when there is none.

¹¹The [Group of Thirty \(2015\)](#) report refers to this as “escalation.”

develop a culture with strength α is $\frac{1}{2}\beta\alpha^2$, where the marginal cost is driven by the parameter $\beta > 0$ (which may vary in the cross-section of banks).

A Microfoundation for Culture Compliance Rewards: As an integral part of its culture, the bank then decides whether to increase the manager’s job scope by m as a reward to a manager whose action is consistent with the organization’s culture. Examples include giving the manager a broader set of responsibilities, greater organizational support and (internal) prestige. The benefit to the manager from such a scope increase is simply m , reflecting a utility enhancement due to increased status and respect by others. For the bank, the benefit is $\theta(1 - d)m$, where $\theta \in \{0, 1\}$ is a state variable privately observed by the bank: $\theta = 1$ indicates a good market condition, and $\theta = 0$ indicates a bad market condition.¹² Assume $\Pr(\theta = 0) = \Pr(\theta = 1) = \frac{1}{2}$, which is common knowledge. Therefore, the bank perceives a benefit from the scope increase only when the market condition is good ($\theta = 1$) and an allocation deviation by the manager is not detected ($d = 0$). A scope increase of m costs the bank $\frac{m^2}{2}$, which can be interpreted as the cost incurred by the bank in broadening the manager’s span of control. The bank thus chooses m to maximize $\theta(1 - d)m - \frac{m^2}{2}$, the solution to which is $m = \theta(1 - d) \in \{0, 1\}$.

Both θ and d are privately known to the bank and hence not contractible. These pieces of information can be viewed as soft information. Although the scope increase m is publicly observable, a third party (e.g., court) cannot unambiguously infer managerial effort, θ or d from m and hence contract on it: $m = 0$ could be due to a bad market condition ($\theta = 0$) unobservable to the third party. The expected gain to the manager from a potential job scope increase is:

$$\mathbb{E}[m] = \Pr(\theta = 1) \Pr(d = 0) = \frac{1}{2} - \frac{\alpha(|e_g - e_g^B| + |e_s - e_s^B|)}{2}. \quad (2)$$

Culture and Identity Economics: One may interpret our notion of culture as a source of “identity” for the manager, where the term “identity” is used in the sense of [Akerlof and Kranton \(2005\)](#). In their paper, the manager suffers a disutility when she acts in a way that deviates from the firm’s desired benchmark. In our model, this corresponds to the potential denial of job scope increase when the manager chooses an action that is incompatible with the culture.¹³

¹²Even though d is a noisy signal, we can write the benefit function as $\theta(1 - d)m$ because the posterior probability $\Pr(\text{no deviation} | d = 0) = 1$.

¹³We may interpret this as resulting from an implicit organizational sanction or disapproval of a manager who violates “trust.” In other words, a mechanism like trust to enforce desirable behavior can only be sustained if there are suitable sanctions for violating trust. In the absence of such sanctions, we would need to rely on some emotion like “guilt” for violating trust (e.g., [Elster \(1998\)](#)).

Acquiring soft information about the manager’s effort deviation from the bank’s “norms” does not help the bank with writing a more effective wage contract, but it does help it to decide whether to expand the manager’s decisionmaking authority in a visible way that generates more (utility-enhancing) prestige for the manager. We can think of this as the bank shaping the manager’s “identity.” Doing this costs the bank something, because the idea is that the manager is allowed to do more and this consumes the bank’s resources. But there is a benefit to the bank too from allowing the manager to do more. So this specification is best thought of as allowing the manager to make previously-unavailable real decisions that have payoff consequences for the bank, e.g., giving the manager authority to acquire additional branches or engage in trading activities previously not permitted. These kinds of actions are ubiquitous in organizations. When an employee displays behavior that is consistent with the culture of the organization and is highly valued, recognition and other forms of rewards like promotions that expand job scope often follow. Because this scope increase occurs only when the bank detects no deviation from its norms in the manager’s decisions,¹⁴ this effect of culture is essentially to promote “we thinking” in Akerlof’s (2016) terminology. In a sense, our setup provides a microfoundation for how culture can be created and how it promotes “we thinking” in ways other than explicit wage contracting.

Put a bit differently, our specification provides a culture-based microfoundation for the standard assumption in identity economics that an agent suffers disutility in deviating from organizational norms or expectations. That is, in identity economics the assumption is that preferences are not located exclusively in the individual, but rather are the outcome of the interaction between the individual and the social environment.¹⁵ What our analysis shows is that similar behavior can be produced even if preferences are located exclusively in the individual, as long as culture plays a role in shaping the individual’s behavior, i.e., a disutility for deviation from organizational norms need not be placed directly in the individual’s utility function.

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 Δ if its loan defaults and the government does not

¹⁴Note that this action by the bank is not just an ex ante precommitment to induce a certain behavior. Rather, it is subgame perfect for the bank to expand the manager’s job scope.

¹⁵See Snower and Bosworth (2016).

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

In our analysis of the base model, we shut down the culture channel by assuming that the bank does not invest in culture and does not link implicit rewards and punishments to managerial behavior.

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:

$$\pi = e_g[\lambda(X - I - w_X) + (1 - \lambda)e_s(-w_\emptyset) + (1 - \lambda)(1 - e_s)(-E - \delta\Delta)] + (1 - e_g)(-w_\emptyset). \quad (3)$$

The bank has a loan w.p. e_g , in which case: (i) w.p. λ the loan is good, which yields the bank a net profit $X - I - w_X$ after repaying depositors and compensating the manager (w_X);¹⁶ (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 $(-w_\emptyset)$ 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 Δ , 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 $(-w_\emptyset)$ after compensating the manager.

The manager's expected utility from working is:

$$u = e_g[\lambda w_X + (1 - \lambda)e_s w_\emptyset] + (1 - e_g)w_\emptyset - c. \quad (4)$$

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

$$u \geq 0. \quad (5)$$

¹⁶The 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 $X - D - E - w_X = X - I - w_X$.

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

$$u \geq w_\emptyset \Rightarrow \lambda \frac{w_X}{w_\emptyset} \geq 1 - (1 - \lambda)e_s + \frac{c}{e_g w_\emptyset}. \quad (6)$$

The right-hand side (RHS) of (6), w_\emptyset , 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 (6) is satisfied, (5) will be automatically satisfied, given that $w_\emptyset \geq 0$.¹⁷

Third, the manager's IC constraint related to effort allocation (conditional on working):

$$\{e_g, e_s\} \in \underset{\{e_g + e_s = 1\}}{\operatorname{argmax}} u \Rightarrow e_g = \frac{\lambda}{2(1 - \lambda)} \left(\frac{w_X}{w_\emptyset} - 1 \right) \text{ and } e_s = \frac{\lambda}{2(1 - \lambda)} \left(\frac{2 - \lambda}{\lambda} - \frac{w_X}{w_\emptyset} \right). \quad (7)$$

Substituting (7) into (6), we can rewrite (6) as:

$$\frac{w_X}{w_\emptyset} \geq 1 + \frac{4(1 - \lambda)}{\lambda^2} \frac{c}{w_X - w_\emptyset}. \quad (8)$$

Below are some useful observations that can be made by examining (7) and (8).

Observation 1: We see from (7) 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,

¹⁷If 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 (6) 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).

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., λ 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 (8) 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, we first characterize the 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 its expected net profit:

$$\max_{\{e_g+e_s=1\}} \pi = e_g[\lambda(X - I) - (1 - \lambda)(1 - e_s)(E + \delta\Delta)] - c. \quad (9)$$

The solutions are:

$$e_g^* = \frac{\lambda}{2(1 - \lambda)} \frac{X - I}{E + \delta\Delta} \text{ and } e_s^* = 1 - e_g^*. \quad (10)$$

This first-best effort allocation balances the need for growth (to reap the gain from financing a good loan, $X - I$) and the need for safety (to avoid the loss from loan default, $E + \delta\Delta$).¹⁸ It has many intuitive properties. First, e_s^* is increasing (hence e_g^* is decreasing) in E and δ . Safety is relatively more important than growth when the bank has higher capital (larger E) and the odds that there

¹⁸In designating the allocation in (10) as the first-best allocation, we assume that the expected net bank profit obtained under such an allocation exceeds that without managerial effort ($e = 0$), which is simply zero; this holds if c is not too big.

will be no government rescue are higher (larger δ). Second, e_s^* is decreasing (hence e_g^* is increasing) in λ . The effort allocated to safety is lower when the borrower pool quality is better (larger λ).

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 (5) matters (and it must be binding), while the IC constraint of effort exertion (6) is irrelevant. As a result, the bank's problem is the same as the one stated in (9). 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 (10) by carefully selecting $\frac{w_X}{w_\emptyset}$ according to the IC constraint of effort allocation (7).

Proposition 1 (First best). *The first-best outcome in (10) 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:*

$$w_\emptyset^* = \frac{c}{1 + (1 - \lambda)(e_g^*)^2} \text{ and } w_X^* = \left[1 + \frac{2(1 - \lambda)}{\lambda} e_g^* \right] w_\emptyset^*. \quad (11)$$

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 (10) 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 (7) 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 (6) also needs to be satisfied ((5) is now redundant). Given that the first best can be obtained as long as effort exertion is observable and contractible (see Proposition 1), we designate the outcome in this case as the second best. First of all, (6) must be binding. Combining (6) and (7) yields:

$$w_\emptyset = \frac{c}{(1 - \lambda)e_g^2}. \quad (12)$$

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 .¹⁹ 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.

Then, we can rewrite the bank’s problem as:

$$\max_{\{e_g+e_s=1\}} \pi = e_g[\lambda(X - I) - (1 - \lambda)(1 - e_s)(E + \delta\Delta)] - \frac{c}{(1 - \lambda)e_g^2} - c. \quad (13)$$

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 (13) and comparing the second-best outcome (labeled using the superscript “**”) 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., $\frac{w_X^{**}}{w_\emptyset^{**}} > \frac{w_X^*}{w_\emptyset^*}$, 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 (5) needs to be satisfied, while in the second best the IC constraint (6) needs to be satisfied to elicit hidden managerial effort,

¹⁹This 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 .

which is harder than just satisfying (5).²⁰ 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.

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 (12), which links w_\emptyset to e_g), a bigger e_g 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_g), the occurrence of the no-loan state $\{\emptyset\}$ is more likely to be due to the manager shirking. That is, a bigger e_g 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 wage cost. Of course, an excessively large value of e_g 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_g 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 $w_\emptyset^{**} = \frac{c}{(1-\lambda)(e_g^{**})^2}$, the rent enjoyed by the manager.

²⁰Here again, as explained earlier in footnote 17, 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.

4 Bank-Manager Beliefs and 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 culture developed in Section 2. We continue to mute the culture channel in Sections 4.1 and 4.2, and open it up in Section 4.3. Suppose agents believe that the loan success probability is $\lambda \in \{\bar{\lambda}, \underline{\lambda}\}$, where $1 > \bar{\lambda} > \underline{\lambda} > 0$. 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 $\lambda = \underline{\lambda}$. There are several cases to consider, each indicated by the pair $\{\lambda_B, \lambda_M\}$, where λ_B and λ_M denote the bank’s belief and the manager’s belief about λ , respectively. λ_B and λ_M may be the same or they may be different.

Like Van den Steen (2010a), we have a model with differing priors, so when we refer to the “bank’s beliefs,” we mean the beliefs of the CEO and the Board of Directors.²¹ As Van den Steen (2010a) notes, it is natural to posit that such a group will develop homogeneous beliefs through two mechanisms – screening and shared learning via observations of outcomes.²² The manager is a loan officer the bank hires to locate and screen loans. We allow the manager’s beliefs to be possibly different from the bank’s beliefs in order to analyze the importance of culture in playing a sorting role in employee selection. In other words, we are examining the role of bank culture in the process of selecting a *de novo* manager, one whose beliefs cannot be assumed to be the same as the bank’s. Even if a manager with different beliefs is selected by the bank, over time the process of “belief homogenization” that culture induces may result in the manager’s beliefs converging to those of the bank.

4.1 Cases with Homogeneous (Matched) Beliefs

We first consider two cases in which the bank and the manager have homogenous beliefs about λ : $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$ 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 λ there with $\underline{\lambda}$ and $\bar{\lambda}$, respectively. The result below follows immediately from Proposition 2:

²¹We abstract from the process by which shareholders, with potentially divergent beliefs, select the CEO. See Boot, Gopalan, and Thakor (2008) for a model of the interaction between the beliefs of the CEO and the (possibly different) beliefs of shareholders who are themselves heterogeneous in their beliefs.

²²We do not explicitly model this belief convergence process. While we expect beliefs among this group to be relatively homogeneous, we acknowledge that in practice there may be disagreement among group members. This raises a host of interesting governance issues that we do not address here.

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 $\underline{\lambda}$ 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 $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$, denote the second-best effort allocations to growth and safety as $e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$ and $e_{s\{\underline{\lambda}, \underline{\lambda}\}}^{**}$, respectively. Similarly, for the case $\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}$, denote the second-best effort allocations to growth and safety as $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ and $e_{s\{\bar{\lambda}, \bar{\lambda}\}}^{**}$, respectively. Clearly, $e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**} < e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ and $e_{s\{\underline{\lambda}, \underline{\lambda}\}}^{**} > e_{s\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ – safety becomes more important than growth when the bank and the manager believe the borrower pool quality is worse.²³

Definition (Safety-focused versus growth-focused): *The bank in the case $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$ is called safety-focused as it allocates relatively more effort to safety; the bank in the case $\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}$ 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: $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$ and $\{\lambda_B = \bar{\lambda}, \lambda_M = \underline{\lambda}\}$. In the former case $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$, the manager is more prone to growth than the bank; we will compare it with the case with matched beliefs $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$, wherein both the bank and the manager are pro-safety. In the latter case $\{\lambda_B = \bar{\lambda}, \lambda_M = \underline{\lambda}\}$, 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 pro-growth.

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 $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$. The constraints are computed using the manager's belief ($\lambda_M = \bar{\lambda}$). Denote the manager's expected utility from working as $u_{\{\bar{\lambda}\}}$, which is (replacing λ in (4) with $\bar{\lambda}$):

$$u_{\{\bar{\lambda}\}} = e_g[\bar{\lambda}w_X + (1 - \bar{\lambda})e_s w_\emptyset] + (1 - e_g)w_\emptyset - c. \quad (14)$$

²³We can solve for $e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$ and $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ by replacing λ in (A2) in the Appendix with $\underline{\lambda}$ and $\bar{\lambda}$, respectively.

The manager's IC constraint to exert effort is:

$$u_{\{\bar{\lambda}\}} \geq w_\emptyset \Rightarrow \bar{\lambda} \frac{w_X}{w_\emptyset} \geq 1 - (1 - \bar{\lambda})e_s + \frac{c}{e_g w_\emptyset}. \quad (15)$$

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

$$\{e_g, e_s\} \in \underset{\{e_g + e_s = 1\}}{\operatorname{argmax}} u_{\{\bar{\lambda}\}} \Rightarrow e_g = \frac{\bar{\lambda}}{2(1 - \bar{\lambda})} \left(\frac{w_X}{w_\emptyset} - 1 \right) \text{ and } e_s = \frac{\bar{\lambda}}{2(1 - \bar{\lambda})} \left(\frac{2 - \bar{\lambda}}{\bar{\lambda}} - \frac{w_X}{w_\emptyset} \right). \quad (16)$$

Combining (15) and (16) yields:

$$w_\emptyset = \frac{c}{(1 - \bar{\lambda})e_g^2}. \quad (17)$$

Note (15), (16) and (17) correspond to (6), (7) and (12) in the base model, respectively, except that we use $\bar{\lambda}$ to replace λ in previous equations.

We now analyze the bank's problem. From the bank's perspective, using its own belief $\lambda_B = \lambda$, its expected pay to the manager is:

$$e_g[\lambda w_X + (1 - \lambda)e_s w_\emptyset] + (1 - e_g)w_\emptyset. \quad (18)$$

Comparing it with the manager's binding IC constraint (15) (using the manager's belief),

$$e_g[\bar{\lambda} w_X + (1 - \bar{\lambda})e_s w_\emptyset] + (1 - e_g)w_\emptyset = w_\emptyset + c, \quad (19)$$

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

$$w_\emptyset + c - e_g(\bar{\lambda} - \lambda)(w_X - e_s w_\emptyset). \quad (20)$$

Combining (16) and (17), we can rewrite the last term in (20) as $e_g(\bar{\lambda} - \lambda)(w_X - e_s w_\emptyset) = \frac{c(\bar{\lambda} - \lambda)(2 - \bar{\lambda})}{\lambda(1 - \lambda)}$.

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

$$\max_{\{e_g + e_s = 1\}} e_g[\lambda(X - I) - (1 - \lambda)(1 - e_s)(E + \delta\Delta)] - \frac{c}{(1 - \bar{\lambda})e_g^2} - c + \frac{c(\bar{\lambda} - \lambda)(2 - \bar{\lambda})}{\bar{\lambda}(1 - \bar{\lambda})}. \quad (21)$$

We denote the optimal solutions to (21) as $e_{g\{\lambda, \bar{\lambda}\}}^{**}$ and $e_{s\{\lambda, \bar{\lambda}\}}^{**}$, 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 pro-growth than bank). *Without investment in culture, there is more growth relative to safety in the case with mismatched beliefs, $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$, than in the case with matched beliefs, $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$, i.e., $e_{g\{\underline{\lambda}, \bar{\lambda}\}}^{**} > e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$ (hence $e_{s\{\underline{\lambda}, \bar{\lambda}\}}^{**} < e_{s\{\underline{\lambda}, \underline{\lambda}\}}^{**}$), despite a lower pay wedge $\frac{w_X}{w_\theta}$ in the former case. Moreover, the difference $e_{g\{\underline{\lambda}, \bar{\lambda}\}}^{**} - e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$ is increasing in $\bar{\lambda} - \underline{\lambda}$.*

The intuition is as follows. Consider first $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$. 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 $\frac{w_X}{w_\theta}$ in this case with mismatched beliefs relative to the case with matched beliefs, $\{\lambda_B = \underline{\lambda}, \lambda_M = \underline{\lambda}\}$, 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 $\frac{w_X}{w_\theta}$ will also weaken the manager’s incentive to exert effort in the first place.* Thus, there is an incentive-constraint-driven lower bound on $\frac{w_X}{w_\theta}$, and this explains why there is still excessive growth (from the bank’s perspective, i.e., $e_{g\{\underline{\lambda}, \bar{\lambda}\}}^{**} > e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$) even after the equilibrium wage contract is implemented in the case $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$. Clearly, as the belief divergence $\bar{\lambda} - \underline{\lambda}$ becomes bigger, the problem of excessive growth becomes more significant for the bank (i.e., $e_{g\{\underline{\lambda}, \bar{\lambda}\}}^{**} - e_{g\{\underline{\lambda}, \underline{\lambda}\}}^{**}$ 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 show later, to reduce the distortion due to a bank-manager belief mismatch. Put a little differently, **Proposition 4** offers an endogenous reason for culture: it 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 $\{\lambda_B = \bar{\lambda}, \lambda_M = \underline{\lambda}\}$, wherein the bank is more optimistic than the manager about the borrower pool quality. The analysis is similar to the previous mismatched-beliefs case, $\{\lambda_B = \underline{\lambda}, \lambda_M = \bar{\lambda}\}$, examined in Section 4.2.1, so we do not repeat it here. Denote the manager’s effort allocations to growth and safety as $e_{g\{\bar{\lambda}, \underline{\lambda}\}}^{**}$ and $e_{s\{\bar{\lambda}, \underline{\lambda}\}}^{**}$, 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 $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ and $e_{s\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ (see Section 4.1). The comparison leads to the following result:

Proposition 5 (Growth versus safety with no investment in culture – bank more pro-growth than manager). *Without investment in culture, there is less growth relative to safety in the case with mismatched beliefs, $\{\lambda_B = \bar{\lambda}, \lambda_M = \underline{\lambda}\}$, than in the case with matched beliefs, $\{\lambda_B = \bar{\lambda}, \lambda_M = \bar{\lambda}\}$, i.e., $e_{g\{\bar{\lambda}, \underline{\lambda}\}}^{**} < e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ (hence $e_{s\{\bar{\lambda}, \underline{\lambda}\}}^{**} > e_{s\{\bar{\lambda}, \bar{\lambda}\}}^{**}$), despite a higher pay wedge $\frac{w_X}{w_\theta}$ in the former case. Moreover, the difference $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**} - e_{g\{\bar{\lambda}, \underline{\lambda}\}}^{**}$ is increasing in $\bar{\lambda} - \underline{\lambda}$.*

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 $\frac{w_X}{w_\theta}$ in this mismatched-beliefs case, $\{\lambda_B = \bar{\lambda}, \lambda_M = \underline{\lambda}\}$, 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 $\frac{w_X}{w_\theta}$, and this explains why $e_{g\{\bar{\lambda}, \underline{\lambda}\}}^{**} < e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$, 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 $\bar{\lambda} - \underline{\lambda}$ becomes larger, the problem of excessive safety becomes more significant as viewed by the bank (i.e., the shortage of growth $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**} - e_{g\{\bar{\lambda}, \underline{\lambda}\}}^{**}$ 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 open up the culture channel. We assume that the bank and the manager do not observe each other’s beliefs. Thus, a belief mismatch 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, as defined in Section 2 where we lay out the base model, 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).

Before proceeding to the analysis, a few comments to our notion of bank culture are warranted. Although neither the bank’s belief nor the manager’s belief is observable, both the bank’s choice of culture and its strength (i.e., the benchmark allocation $\{e_g^B, e_s^B\}$ and α , respectively) are publicly observable.²⁴ The idea is that organizations with stronger cultures (i.e., bigger α) 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 higher punishment when she takes an action inconsistent with the values and norms of the organization. The punishment can be generated by a variety of subtle and not-so-subtle mechanisms, including reprimands, social ostracization, and lack of rewards. We have specified it as a lack of rewards (see (2)).²⁵

Our specification of culture also has the flavor of culture being an “experience good” in the sense that it has to be experienced in order to learn what it is in the specific context of the underlying beliefs that generate the norms that constitute the culture. Although we assume that the manager knows the bank’s culture and thus the e_g and e_s the bank wants, one can imagine a situation in which this knowledge is acquired not at the outset but via experimentation after joining the bank. Over time the manager will learn about the e_g and e_s the bank wants because the manager will be rewarded with a job scope increase – say through a promotion – only when the desired effort allocations have been made. Such a dynamic story is beyond the scope of this paper, but our specification can be thought of as the steady state of that dynamic process.

Having said this, firms that develop strong cultures also develop visible reputations for having those cultures and certain aspects of culture become salient and observable to outsiders. This may be due to word-of-mouth dissemination or media accounts. For example, GE’s highly competitive culture as well as its focus on growth (mainly through acquisitions) and leadership development under Jack Welch were well known features of the firm’s operating environment. Similarly, Emerson Electric is well known for having a strong process-oriented culture that focuses on efficiency, coordination, cost productivity and safety. Commerce Bank has a culture focused on safety, cost productivity and prudent management of credit risks. While external perceptions of culture based on observable indicators may not be perfect, in many cases they provide useful glimpses at the norms, values and beliefs that guide the firm’s decisionmaking.

²⁴This 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.

²⁵See [Cameron and Quinn \(2011\)](#), and [Cameron et al. \(2014\)](#).

4.3.1 Self-Sorting and Matching

Van den Steen (2010a) and others have argued that culture can induce self-selection in the labor market, so that employees are sorted across firms in a way that reduces heterogeneity in beliefs between firms and employees. We have formally verified two key results on this issue in our context. Because these results are very intuitive, we skip many of the formal details in the interest of space, listing only one formal result.²⁶ These details are available from the authors upon request.

First, without investment in culture (i.e., $\alpha = 0$), for any wage contract offered 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 $\lambda_M = \underline{\lambda}$. 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 ($\lambda_M = \underline{\lambda}$). The reason is twofold. The first part of the reasoning is that, for any given effort allocation between growth and safety, the manager's optimistic belief about the borrower pool quality 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 . The other part of the reasoning is that, 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. This means that a belief mismatch will be an issue for a bank with the pessimistic belief ($\lambda_B = \underline{\lambda}$), as it is not able to hire a manager possessing the same belief.

Second, we show that a sufficiently strong culture (i.e., α big enough) helps a bank with the pessimistic belief (and a safety-focused culture) 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, which, in turn, facilitates bank-manager matching.

The idea is as follows. Compared to the manager with the pessimistic belief, the manager with the optimistic belief is more likely to be denied a job scope increase if the manager is working for a bank that has the pessimistic belief. The reason is that the manager's 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-oriented bank culture (bigger α) has the following effects: (i) holding the allocation deviation fixed, a bigger α magnifies the deviation-induced utility loss; (ii) we can also show that when α becomes bigger, holding the wage contract (w_X and w_θ) fixed, the optimistic manager will react by lowering the effort allocated to growth (i.e., reduce e_g)

²⁶This formal result that we list is used heavily in the subsequent analysis.

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 (as she becomes less likely to be paid w_X). The combined net effect of all the three factors is that a bigger α lowers the optimistic manager’s utility from working for the safety-focused bank, generating a lower job utility for such a manager than for the pessimistic manager.

Proposition 6 (Sorting with investment in culture). *If the safety-focused bank with the pessimistic belief ($\lambda_B = \lambda$) develops a sufficiently strong culture (i.e., α is above some cutoff α^B , determined by (A14) in the Appendix), 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 same pro-safety (pessimistic) belief is an “insider” while a manager with the pro-growth (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-oriented culture achieves is a self-sorting of managers, with those holding the pro-safety belief working for banks sharing that belief, and those holding the pro-growth belief choosing to work for banks that also have the pro-growth belief. In other words, with strong culture banks hire only “insiders” whose beliefs are aligned with those of the bank.²⁷

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 ($\lambda_B = \bar{\lambda}$). Section 4.3.1 shows that such a growth-focused bank will be able to match exclusively with an optimistic manager ($\lambda_M = \bar{\lambda}$), who 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 $\{e_g^B, e_s^B\}$ is irrelevant, because the manager will always choose the second-best allocation given $\alpha = 0$ (so she

²⁷A key assumption that leads to this assortative matching is that every bank’s chosen culture (i.e., the benchmark allocation $\{e_g^B, e_s^B\}$) and its strength (i.e., α) are commonly observable, as emphasized at the beginning of Section 4.3.

does not suffer any utility loss from allocation deviation (if any)). We assume that the bank just sets its benchmark allocation same as the second-best allocation, i.e., $e_g^B = e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ and $e_s^B = e_{s\{\bar{\lambda}, \bar{\lambda}\}}^{**}$.

Now, consider a bank endowed with the pessimistic belief ($\lambda_B = \lambda$). We see from [Proposition 6](#) 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, i.e., $\{\lambda_B = \lambda, \lambda_M = \lambda\}$, we know from the analysis in [Section 4.1](#) that the pessimistic 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., $e_g^B = e_{g\{\lambda, \lambda\}}^{**}$ and $e_s^B = e_{s\{\lambda, \lambda\}}^{**}$. If that is the case, the manager suffers no culture-induced utility loss, because her effort allocation is always consistent with the benchmark. Given that any culture-induced utility loss suffered by the manager will eventually be compensated by the bank through higher wages (because the manager's IC constraint 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 to choose a strong enough safety-oriented culture, i.e., $\alpha = \alpha^B$, to discourage an optimistic manager from applying for the job.²⁸

The safety-focused bank, however, may not always be able to choose $\alpha = \alpha^B$ to achieve assortative matching with a pessimistic manager. The bank faces the following tradeoff – while a bigger α pulls managerial effort allocation closer to the benchmark $\{e_{g\{\lambda, \lambda\}}^{**}, e_{s\{\lambda, \lambda\}}^{**}\}$ (see discussions in [Section 4.3.1](#); in the extreme case with assortative matching when $\alpha = \alpha^B$, there is no effort deviation by the matched pessimistic manager), it also entails an increasingly higher marginal cost to the bank (the marginal cost to develop a culture with strength α is $\beta\alpha$). Thus, when β is sufficiently low, the bank will choose $\alpha = \alpha^B$; otherwise, the bank will choose some $\alpha < \alpha^B$, resulting in belief mismatching, i.e., $\{\lambda_B = \lambda, \lambda_M = \bar{\lambda}\}$. In the latter case, the bank's choice of α equates the marginal benefit of a stronger culture in pulling the (mismatched) optimistic manager's effort allocation closer to the safety-focused bank's benchmark with its marginal cost (i.e., $\beta\alpha$).

Proposition 7 (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 pro-growth 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 [\(A13\)](#). The bank's choice of the benchmark allocation $\{e_g^B, e_s^B\}$ is irrelevant. For a safety-focused bank ($\lambda_B = \lambda$), if β is sufficiently low, it invests in a strong safety-oriented culture by choosing $\alpha = \alpha^B$, given by [\(A14\)](#), so as to match with a manager sharing the same pro-safety pessimistic belief ($\lambda_M = \lambda$).*

²⁸Given 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. We assume that the safety-focused bank will be matched with a pro-safety pessimistic manager in this indifference case.

The manager chooses an effort allocation $\{e_{g\{\lambda,\lambda\}}^{**}, e_{s\{\lambda,\lambda\}}^{**}\}$, given by (A15), identical to the bank's choice of the benchmark allocation $\{e_g^B, e_s^B\}$. If β is not sufficiently low, then the safety-focused bank chooses $\alpha \in (0, \alpha^B)$, which is decreasing in β while increasing in $\bar{\lambda} - \lambda$.

This proposition shows that the challenge of developing a culture through a costly investment is present for the safety-focused bank only because it needs to use culture to achieve assortative matching. However, if the cost of developing a strong safety-oriented culture is too high, such a bank may have to tolerate the inefficiency of hiring a manager whose beliefs are (at least initially) not consonant with the bank's. Over time, we would expect belief convergence, but inefficiencies may persist in the interim.

What kinds of banks will invest more in culture? Our analysis implies that when there is a great deal of homogeneity in beliefs in general, investment in culture will be lower. So a small or mid-sized U.S. community bank that draws its employees mainly from the local community is unlikely to need a significant investment in culture. Similarly, banks in small, relatively homogeneous countries (e.g., Scandinavian countries) may not need to invest much in culture. By contrast, urban U.S. banks, especially money-center banks that draw employees from diverse backgrounds and ethnicities, will need larger cultural investments. Along the dimension of strategy, growth-focused banks will tend to invest less in culture, *ceteris paribus*, than safety-focused banks. Finally, along the size and complexity dimensions, larger banks – especially those with more organizational complexity and a greater range of activities – will need to invest more in culture. This is because greater size and complexity create a greater possibility of attracting employees with divergent beliefs.

We can also say something about the need for culture based on the business strategy of the firm. Assortative matching is more important as a source of value arising from culture when the bank has distinct strategy choices and the manager can make a choice of effort allocation across growth and safety that cannot be readily monitored. Commercial and investment banks are good examples. It is likely to be less important in brokerage firms where strategic choice has lesser influence on growth versus safety.

4.4 Additional Remarks

Before closing Section 4, we make two additional remarks on our model of bank culture.

The Value of Culture beyond Assortative Matching: Our analysis in Section 4.3 highlights the value of culture in assortatively matching managers (whose beliefs are unobservable) with banks

that share their beliefs. While this is an important aspect of bank culture, it is not essential for culture to have value. To see this, suppose all banks could observe managerial beliefs and hence achieve assortative matching automatically. What would be the value of culture in this special case? Take a safety-focused bank (i.e., bank with the pro-safety pessimistic belief $\lambda_B = \lambda$) for example (the reasoning is similar for a growth-focused bank). Without investment in culture, the manager chooses the second-best effort allocation $\{e_{g\{\lambda,\lambda\}}^{**}, e_{s\{\lambda,\lambda\}}^{**}\}$. The outcome is obviously worse than what could be obtained under the first-best allocation $\{e_{g\{\lambda,\lambda\}}^*, e_{s\{\lambda,\lambda\}}^*\}$.

Now imagine the bank invests in culture by setting a benchmark, denoted by $\{e_{g\{\lambda,\lambda\}}^B, e_{s\{\lambda,\lambda\}}^B\}$, that is close to the first-best allocation, and choosing the corresponding strength of the culture as α . The benefit to the bank in doing so is that this pushes managerial effort allocation toward the first best by generating an allocation-deviation-induced utility loss to the manager (from the denial of a job scope increase). This benefit is traded off against the cost of the investment in culture plus the bank's higher wage cost in compensating the manager for any deviation-induced utility loss; these costs are higher with a larger α and a benchmark $\{e_{g\{\lambda,\lambda\}}^B, e_{s\{\lambda,\lambda\}}^B\}$ that is closer to the first best. As a result, there are multiple pairs of α and $\{e_{g\{\lambda,\lambda\}}^B, e_{s\{\lambda,\lambda\}}^B\}$ that will improve bank payoff upon the second best. In other words, the optimal bank culture is not uniquely determined. Nonetheless, culture is valuable to the bank even absent assortative matching.

Beliefs and Culture Evolution: Our analysis has taken agents' beliefs as given in a static setting. In reality, beliefs change over time. It is reasonable to imagine that, in a richer dynamic setting, a long sequence of favorable loan outcomes (like those prior to the 2007-09 financial crisis) leads all agents, especially banks, to elevate their beliefs about the quality of the borrower pool. This consequently causes banks to become more pro-growth and invest less in a safety-oriented culture. Conversely, after a long string of bad banking outcomes or upon observing unexpectedly high defaults, banks lower their assessments of the borrower pool quality and become more safety-focused.²⁹ Therefore, bank culture may evolve over business cycles – economic booms lead to aggressive risk-taking and pro-growth banking cultures, contributing to busts (as suggested by the empirical evidence in [Fahlenbrach, Prilmeier, and Stulz \(2016\)](#)), which are then followed by conservative and pro-safety bank cultures.

²⁹See [Gennaioli, Shleifer, and Vishny \(2015\)](#) for a model of (non-Bayesian) belief formation in which this happens. [Thakor \(2016\)](#) develops a model in which such belief revision dynamics occur even with Bayesian rationality.

5 Two Banks

In this section, we extend the analysis to examine the implications of interbank competition for culture. Same as the analysis in Section 4, we shut down the culture channel in Sections 5.1 and 5.2 and enable the channel in Section 5.3.

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 λ) 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.³⁰

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.³¹

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

³⁰Since both banks fail together, this elevates systemic risk.

³¹There 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 δ (recall δ 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.

be thought of as the degree of competition, with a larger κ 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):

$$\begin{aligned} \pi_1 = & (e_{g[1]} - \kappa e_{g[2]})[\lambda(X - I - w_X) + (1 - \lambda)e_{s[1]}(-w_\emptyset) + (1 - \lambda)(1 - e_{s[1]})(-E - \delta\Delta)] \\ & + [1 - (e_{g[1]} - \kappa e_{g[2]})](-w_\emptyset). \end{aligned} \quad (22)$$

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

$$u_1 = (e_{g[1]} - \kappa e_{g[2]})[\lambda w_X + (1 - \lambda)e_{s[1]}w_\emptyset] + [1 - (e_{g[1]} - \kappa e_{g[2]})]w_\emptyset - c. \quad (23)$$

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

$$u_1 \geq w_\emptyset \Rightarrow \lambda \frac{w_X}{w_\emptyset} \geq 1 - (1 - \lambda)e_{s[1]} + \frac{c}{(e_{g[1]} - \kappa e_{g[2]})w_\emptyset}. \quad (24)$$

Second, the IC constraint for effort allocation (conditional on working):

$$\begin{aligned} \{e_{g[1]}, e_{s[1]}\} \in & \underset{\{e_{g[1]} + e_{s[1]} = 1\}}{\operatorname{argmax}} u_1 \Rightarrow \\ e_{g[1]} - \frac{\kappa}{2}e_{g[2]} = & \frac{\lambda}{2(1 - \lambda)} \left(\frac{w_X}{w_\emptyset} - 1 \right), \\ e_{s[1]} + \frac{\kappa}{2}e_{g[2]} = & \frac{\lambda}{2(1 - \lambda)} \left(\frac{2 - \lambda}{\lambda} - \frac{w_X}{w_\emptyset} \right). \end{aligned} \quad (25)$$

Equations (22), (23), (24) and (25) can be understood in the same way as for (3), (4), (6) and (7) in the base model, 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 (25) with (7), 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 $\frac{w_X}{w_\emptyset}$. That is, if we fix $\frac{w_X}{w_\emptyset}$ 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 $\frac{w_X}{w_\emptyset}$), 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, $\frac{w_X}{w_\emptyset}$ has to be higher in the two-bank case. To see this informally, substitute (25) into (24), and note that $e_{g[1]} = e_{g[2]}$ in a symmetric equilibrium, so we can rewrite (24) as:

$$\frac{w_X}{w_\emptyset} \geq 1 + \left(\frac{2-\kappa}{1-\kappa}\right)^2 \frac{1-\lambda}{\lambda^2} \frac{c}{w_X - w_\emptyset}. \quad (26)$$

Comparing (26) with (8) 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 (26) shows that $\frac{w_X}{w_\emptyset}$ should be bigger for the two-bank case.

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

Proposition 8 (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 $\frac{w_X}{w_\emptyset}$; 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. This is related to the fact that prior to the 2007-09 crisis, depository institutions in the U.S. faced increasing competitive pressure from shadow banks, which may have induced these depository institutions to develop more aggressive growth-oriented cultures. In his letter to JPMorgan Chase shareholders in 2013, Jamie Dimon describes shadow banks as one main source of competition. He writes:

“We really should not call them ‘shadow’ banks – they do not operate in shadows. They are non-bank financial competitors, and there is a wide set of them. They range from money-market funds and asset managers, mortgage real-estate investment trusts and mortgage servicers and middle-market lending funds to PayPal and clearing houses. Many of these institutions are smart and sophisticated... Non-bank financial competitors will look at every product we price, and if they can do it cheaper with their set of capital providers, they will.”

Such competitive pressure faced by regulated financial institutions may cause them to engage in more risk-taking (e.g., reaching for yield as documented by [Becker and Ivashina \(2015\)](#)).

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 ($\lambda_{B[2]} = \underline{\lambda}$). Managers are also endowed with either the optimistic or 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 8](#) (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-oriented culture (i.e., $\alpha = 0$ for bank 2); note that bank 1 always chooses $\alpha = 0$ (see [Proposition 7](#)). 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 $\{\lambda_{B[2]} = \underline{\lambda}, \lambda_{M[2]} = \bar{\lambda}\}$.

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

$$\begin{aligned} \pi_i = & (e_{g[i]} - \kappa e_{g[j]})[\lambda_{B[i]}(X - I - w_{X[i]}) + (1 - \lambda_{B[i]})e_{s[i]}(-w_{\emptyset[i]}) + (1 - \lambda_{B[i]})(1 - e_{s[i]})(-E - \delta\Delta)] \\ & + [1 - (e_{g[i]} - \kappa e_{g[j]})](-w_{\emptyset[i]}). \end{aligned} \quad (27)$$

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

$$u_i = (e_{g[i]} - \kappa e_{g[j]})[\lambda_{M[i]}w_{X[i]} + (1 - \lambda_{M[i]})e_{s[i]}w_{\emptyset[i]}] + [1 - (e_{g[i]} - \kappa e_{g[j]})]w_{\emptyset[i]} - c. \quad (28)$$

Bank i 's problem can be written as:

$$\begin{aligned}
& \max_{\{w_X[i], w_\emptyset[i]\}} \pi_i, \\
& \text{subject to } u_i \geq w_\emptyset[i], \\
& \{e_g[i], e_s[i]\} \in \underset{\{e_g[i] + e_s[i] = 1\}}{\text{argmax}} u_i.
\end{aligned} \tag{29}$$

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

$$\lambda_{M[i]} \frac{w_X[i]}{w_\emptyset[i]} \geq 1 - (1 - \lambda_{M[i]})e_s[i] + \frac{c}{(e_g[i] - \kappa e_g[j])w_\emptyset[i]}. \tag{30}$$

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

$$\begin{aligned}
e_g[i] - \frac{\kappa}{2}e_g[j] &= \frac{\lambda_{M[i]}}{2(1 - \lambda_{M[i]})} \left(\frac{w_X[i]}{w_\emptyset[i]} - 1 \right), \\
e_s[i] + \frac{\kappa}{2}e_g[j] &= \frac{\lambda_{M[i]}}{2(1 - \lambda_{M[i]})} \left(\frac{2 - \lambda_{M[i]}}{\lambda_{M[i]}} - \frac{w_X[i]}{w_\emptyset[i]} \right).
\end{aligned} \tag{31}$$

The optimization problem above can be understood in the same way as the one 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 9 (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., κ sufficiently big).*

What is a little surprising about this result is that, in the two-bank case, in the absence of investment in culture even the bank with the pessimistic (pro-safety) belief may have its manager allocate more effort to growth than the optimistic (pro-growth) 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 Investment in Culture: How Culture Can Reduce Herding

We now introduce culture in the two-bank case with heterogeneous beliefs. Our goal is to show that a strong safety culture developed by bank 2 will reduce bank 2's effort allocation to growth: if the safety culture is sufficiently strong, bank 2 will be able to hire a manager who shares the bank's pessimistic pro-safety belief; even if such assortative matching is not achieved so bank 2 hires a pro-growth manager with the optimistic belief, a stronger safety culture reduces the manager's effort allocation to growth (see [Proposition 7](#)). This, 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 thus contagious in its effect – a safety-oriented culture developed in one bank can affect other banks by attenuating to some extent the competition-induced externality among banks in the system.

Analysis: Suppose bank 2 develops a sufficiently strong safety culture and matches with a manager sharing the bank's pro-safety belief. 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 $u_2 \geq w_{\emptyset[2]} - \frac{\alpha}{2}$ to reflect the utility loss $\frac{\alpha}{2}$ incurred by the manager if she shirks. If the safety culture in bank 2 is not strong enough to lead to assortative matching, bank 2 hires a pro-growth manager (so $\lambda_{M[2]} = \bar{\lambda}$); the problem again can be stated as in [Section 5.2](#), with some modifications to bank 2 manager's IC constraints of effort exertion and allocation to reflect the effect of culture (see the [Appendix](#)). This leads to our last result:

Proposition 10 (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 safety culture leads to both banks allocating less effort to growth and more to safety. The stronger is the bank 2's safety culture, the larger are the shifts to safety by both banks.*

This result shows that a strong 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 invest to develop a safety-oriented 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.³²

Remarks: Although [Proposition 10](#) highlights the contagious nature of a safety-oriented culture, the opposite is also true in that a growth-oriented culture can be infectious as well, as implied by [Proposition 9](#). This infectious nature of the growth culture may lead possibly to overlending by the entire banking system, thereby causing asset price bubbles. For example, if a few prominent large banks adopt aggressive risk-taking and growth-oriented culture (say, due to too-big-to-fail guarantees), then other banks may well follow suit. Consequently, the growth culture dominates the financial system, lending expands, prices soar, risk accumulates, and eventually a crisis is triggered. Some of the regulatory initiative we discuss to influence culture may be useful in counteracting this.

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.*

In stating the above result, note that 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

³²Another 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.

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 and Empirical Predictions

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 10](#) 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.

Empirical Predictions: The analysis has three testable predictions. First, there should be stronger safety-oriented bank cultures in countries with weaker safety nets (deposit insurance, too-big-to-fail guarantees, etc.) and higher capital requirements. This prediction can be tested using international data, with culture proxies such as those in [Cerqueti, Fiordelisi, and Rau \(2016\)](#), for example. Second, there should be a higher correlation in cultural orientation (growth versus safety) across banks when they are competing rather than across banks that are not competing with each

other. Third, a positive (exogenous) shock to a bank’s loan pool quality should lead to a shift away from safety and toward a growth-oriented culture; the opposite cultural shift should be observed upon a negative shock.

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.

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.³³

We have scratched only the surface of this important topic. Many interesting issues remain for future research. For example, what is the effect of organizational form/ownership structure on culture? Many claim that U.S. investment banks were far more prudent in their risk-taking behaviors when they were partnerships than they were after going public. This raises an interesting question about how public ownership influences corporate culture. One possibility is that public companies face greater shareholder pressure and hence become more aggressive in pursuit of growth. Another important question is about how “subcultures” develop in organizations with multiple business units and how they affect the overall culture of the organization. For example, a universal bank has units engaging in commercial banking, investment banking, trading and market making, and insurance. Each unit may have its own subculture. One tentative implication of our analysis is that if the opportunities that these units can pursue are substitutes – that is, resources are constrained and any resource allocated to support the pursuit of growth by one unit is not available to another – then there will be a competition-induced externality in the subculture choices. This can be explored more deeply. Finally, 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.

³³[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. [Cerqueti, Fiordelisi, and Rau \(2016\)](#) document that regulatory enforcement actions in the U.S. between 2006 and 2013 influenced bank behavior in both sanctioned and non-sanctioned banks and corporate culture played an important role in moderating this relationship.

Appendix

Proof of Proposition 1. The first-best effort allocation in (10) follows from the first-order condition (FOC) to the bank's problem in (9):

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

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 (7) that $\frac{w_X}{w_\theta} = 1 + \frac{2(1-\lambda)}{\lambda}e_g^*$. Substituting this into the manager's binding IR constraint in (5) yields the wages in (11). \square

Proof of Proposition 2. The second-best effort e_g^{**} is given by the FOC to the bank's problem in (13):

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

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 (7) that $\frac{w_X}{w_\theta} = 1 + \frac{2(1-\lambda)}{\lambda}e_g$, which leads to $\frac{w_X^{**}}{w_\theta^{**}} > \frac{w_X^*}{w_\theta^*}$ given that $e_g^{**} > e_g^*$. Finally, the expected managerial pay is $w_\theta^{**} + c$ in the second best, bigger than that in the first best (which is c). \square

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

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 (21)) is:

$$f_{\{\lambda, \bar{\lambda}\}}(e_{g\{\lambda, \bar{\lambda}\}}^{**}) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta\Delta)e_{g\{\lambda, \bar{\lambda}\}}^{**} + \frac{2c}{1 - \lambda}(e_{g\{\lambda, \bar{\lambda}\}}^{**})^{-3} = 0. \quad (\text{A3})$$

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

$$f_{\{\lambda, \lambda\}}(e_{g\{\lambda, \lambda\}}^{**}) \equiv \lambda(X - I) - 2(1 - \lambda)(E + \delta\Delta)e_{g\{\lambda, \lambda\}}^{**} + \frac{2c}{1 - \lambda}(e_{g\{\lambda, \lambda\}}^{**})^{-3} = 0. \quad (\text{A4})$$

The difference between the two FOCs lies in the last term: $\frac{2c}{1-\bar{\lambda}}$ 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 $f_{\{\lambda, \bar{\lambda}\}}(z) > f_{\{\lambda, \lambda\}}(z)$ for $\forall z$, we must have $e_{g\{\lambda, \bar{\lambda}\}}^{**} > e_{g\{\lambda, \lambda\}}^{**}$, and hence $e_{s\{\lambda, \bar{\lambda}\}}^{**} < e_{s\{\lambda, \lambda\}}^{**}$. The result that $e_{g\{\lambda, \bar{\lambda}\}}^{**} - e_{g\{\lambda, \lambda\}}^{**}$ and $e_{s\{\lambda, \lambda\}}^{**} - e_{s\{\lambda, \bar{\lambda}\}}^{**}$ 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 $\frac{w_X}{w_\emptyset} = 1 + \frac{2(1-\bar{\lambda})}{\bar{\lambda}} e_{g\{\lambda, \bar{\lambda}\}}^{**}$ for the case with mismatched beliefs, and $\frac{w_X}{w_\emptyset} = 1 + \frac{2(1-\lambda)}{\lambda} e_{g\{\lambda, \lambda\}}^{**}$ for the case with matched beliefs. Thus, to show that $\frac{w_X}{w_\emptyset}$ is lower in the former case, we only need to show:³⁴

$$e_{g\{\lambda, \bar{\lambda}\}}^{**} < \frac{\bar{\lambda}}{1-\bar{\lambda}} \frac{1-\lambda}{\lambda} e_{g\{\lambda, \lambda\}}^{**}. \quad (\text{A5})$$

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

$$\begin{aligned} f_{\{\lambda, \bar{\lambda}\}}\left(\frac{\bar{\lambda}}{1-\bar{\lambda}} \frac{1-\lambda}{\lambda} z\right) &= \lambda(X-I) - 2(1-\lambda)(E+\delta\Delta) \left(\frac{\bar{\lambda}}{1-\bar{\lambda}} \frac{1-\lambda}{\lambda} z\right) + \frac{2c}{1-\bar{\lambda}} \left(\frac{\lambda}{1-\lambda} \frac{1-\bar{\lambda}}{\bar{\lambda}}\right)^3 z^{-3} \\ &< \lambda(X-I) - 2(1-\lambda)(E+\delta\Delta)z + \frac{2c}{1-\bar{\lambda}} \left(\frac{\lambda}{1-\lambda} \frac{1-\bar{\lambda}}{\bar{\lambda}}\right)^3 z^{-3} \\ &< \lambda(X-I) - 2(1-\lambda)(E+\delta\Delta)z + \frac{2c}{1-\lambda} z^{-3} \\ &= f_{\{\lambda, \lambda\}}(z), \end{aligned} \quad (\text{A6})$$

where the second inequality follows from the fact that $\frac{1}{1-\bar{\lambda}} \left(\frac{\lambda}{1-\lambda} \frac{1-\bar{\lambda}}{\bar{\lambda}}\right)^3 < \frac{1}{1-\lambda}$.³⁵ □

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

Proof of Proposition 6. For a given wage contract $(w_X$ and $w_\emptyset)$, the manager's utility from working is:

$$u_{\{\lambda_M\}} + \frac{1}{2} - \frac{\alpha(|e_g - e_g^B| + |e_s - e_s^B|)}{2}, \quad (\text{A7})$$

where

$$u_{\{\lambda_M\}} = e_g[\lambda_M w_X + (1-\lambda_M)e_s w_\emptyset] + (1-e_g)w_\emptyset - c, \quad (\text{A8})$$

which is the manager's utility excluding the culture-induced component (replacing λ in (4) with λ_M).

The IC constraint for the manager to exert effort is:³⁶

$$u_{\{\lambda_M\}} + \frac{1}{2} - \alpha|e_g - e_g^B| \geq w_\emptyset + \frac{1}{2} - \frac{\alpha}{2} \Rightarrow \lambda_M \frac{w_X}{w_\emptyset} \geq 1 - (1-\lambda_M)e_s + \frac{c}{e_g w_\emptyset} + \alpha \frac{2|e_g - e_g^B| - 1}{2e_g w_\emptyset}. \quad (\text{A9})$$

³⁴Note $\frac{\bar{\lambda}}{1-\bar{\lambda}} \frac{1-\lambda}{\lambda} > 1$, so the inequality does not conflict with $e_{g\{\lambda, \bar{\lambda}\}}^{**} > e_{g\{\lambda, \lambda\}}^{**}$.

³⁵Note $\frac{1}{1-\bar{\lambda}} \left(\frac{\lambda}{1-\lambda} \frac{1-\bar{\lambda}}{\bar{\lambda}}\right)^3 < \frac{1}{1-\lambda} \Leftrightarrow \left(\frac{\lambda}{\bar{\lambda}}\right)^3 < \left(\frac{1-\lambda}{1-\bar{\lambda}}\right)^2$, which is obvious since $\frac{\lambda}{\bar{\lambda}} < 1$ while $\frac{1-\lambda}{1-\bar{\lambda}} > 1$.

³⁶To understand (A9), note that if the manager shirks (i.e., choosing $e_g = e_s = 0$), her culture-induced utility is $\frac{1}{2} - \frac{\alpha(|0 - e_g^B| + |0 - e_s^B|)}{2} = \frac{1}{2} - \frac{\alpha}{2}$, since $e_g^B + e_s^B = 1$; if she works (i.e., choosing $e_g + e_s = 1$), her culture-induced utility is $\frac{1}{2} - \frac{\alpha(|e_g - e_g^B| + |e_s - e_s^B|)}{2} = \frac{1}{2} - \alpha|e_g - e_g^B|$.

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

$$\begin{aligned} \{e_g, e_s\} &\in \operatorname{argmax}_{\{e_g+e_s=1\}} u_{\{\lambda_M\}} + \frac{1}{2} - \alpha|e_g - e_g^B| \Rightarrow \\ e_g &= \frac{\lambda_M}{2(1-\lambda_M)} \left(\frac{w_X}{w_\emptyset} - 1 \right) - \frac{\alpha \times 1_{\{e_g > e_g^B\}}}{2(1-\lambda_M)w_\emptyset}, \\ e_s &= \frac{\lambda_M}{2(1-\lambda_M)} \left(\frac{2-\lambda_M}{\lambda_M} - \frac{w_X}{w_\emptyset} \right) + \frac{\alpha \times 1_{\{e_g > e_g^B\}}}{2(1-\lambda_M)w_\emptyset}. \end{aligned} \quad (\text{A10})$$

The function $1_{\{e_g > e_g^B\}}$ is an indicator function defined below:

$$1_{\{e_g > e_g^B\}} = \begin{cases} 1 & \text{if } e_g > e_g^B \\ 0 & \text{if } e_g = e_g^B \\ -1 & \text{if } e_g < e_g^B \end{cases}. \quad (\text{A11})$$

Substituting (A10) into (A7), we can write the manager's utility (with $\alpha > 0$) as:

$$\begin{aligned} \hat{u}_{\{\lambda_M\}} &\equiv u_{\{\lambda_M\}} + \frac{1}{2} - \alpha|e_g - e_g^B| \\ &= e_g[\lambda_M w_X + (1-\lambda_M)e_s w_\emptyset - w_\emptyset] + (w_\emptyset - c) + \frac{1}{2} - \alpha|e_g - e_g^B| \\ &= \frac{1}{(1-\lambda_M)w_\emptyset} \left[\frac{\lambda_M^2 (w_X - w_\emptyset)^2}{4} - \frac{\alpha^2}{4} \right] + (w_\emptyset - c) + \frac{1}{2} - \alpha \left| \frac{\lambda_M (w_X - w_\emptyset) - \alpha \times 1_{\{e_g > e_g^B\}}}{2(1-\lambda_M)w_\emptyset} - e_g^B \right| \\ &\Downarrow \\ \frac{\partial \hat{u}_{\{\lambda_M\}}}{\partial \alpha} &= -\frac{\alpha}{2(1-\lambda_M)w_\emptyset} + \frac{\alpha}{2(1-\lambda_M)w_\emptyset} - \left| \frac{\lambda_M (w_X - w_\emptyset) - \alpha \times 1_{\{e_g > e_g^B\}}}{2(1-\lambda_M)w_\emptyset} - e_g^B \right| \\ &= -\left| \frac{\lambda_M (w_X - w_\emptyset) - \alpha \times 1_{\{e_g > e_g^B\}}}{2(1-\lambda_M)w_\emptyset} - e_g^B \right| \\ &= -|e_g - e_g^B| < 0. \end{aligned} \quad (\text{A12})$$

It is clear that $\left| \frac{\partial \hat{u}_{\{\bar{\lambda}\}}}{\partial \alpha} \right| > \left| \frac{\partial \hat{u}_{\{\lambda\}}}{\partial \alpha} \right|$ (note that (i) e_g is bigger when $\lambda_M = \bar{\lambda}$ than when $\lambda_M = \lambda$, and (ii) both e_g when $\lambda_M = \bar{\lambda}$ and e_g when $\lambda_M = \lambda$ are bigger than the safety-focused bank's benchmark e_g^B). Therefore, there exists a cutoff value of α , denoted as α^B , such that $\hat{u}_{\{\bar{\lambda}\}} > \hat{u}_{\{\lambda\}}$ if $\alpha < \alpha^B$, $\hat{u}_{\{\bar{\lambda}\}} = \hat{u}_{\{\lambda\}}$ if $\alpha = \alpha^B$, and $\hat{u}_{\{\bar{\lambda}\}} < \hat{u}_{\{\lambda\}}$ if $\alpha > \alpha^B$. \square

Proof of Proposition 7. First, for a bank with the optimistic belief $\lambda_B = \bar{\lambda}$, $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$ is uniquely given by (replacing λ in (A2) with $\bar{\lambda}$):

$$\bar{\lambda}(X - I) - 2(1 - \bar{\lambda})(E + \delta\Delta)e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**} + \frac{2c}{1 - \bar{\lambda}}(e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**})^{-3} = 0. \quad (\text{A13})$$

The rest follows from the discussions in the text.

Next, consider a bank with the pessimistic belief $\lambda_B = \lambda$. We first determine the cutoff α^B (to achieve assortative matching with a pessimistic manager with belief $\lambda_M = \lambda$) by setting $\hat{u}_{\{\bar{\lambda}\}} = \hat{u}_{\{\lambda\}}$:

$$u_{\{\bar{\lambda}\}} - \alpha \left| \frac{\bar{\lambda}(w_X - w_\theta) - \alpha \times 1_{\{e_g > e_g^B\}}}{2(1 - \bar{\lambda})w_\theta} - e_g^B \right| = u_{\{\lambda\}}, \quad (\text{A14})$$

where we note that: (i) $e_g^B = e_{g\{\lambda, \lambda\}}^{**}$, which is uniquely determined by (replacing λ in (A2) with λ):

$$\lambda(X - I) - 2(1 - \lambda)(E + \delta\Delta)e_{g\{\lambda, \lambda\}}^{**} + \frac{2c}{1 - \lambda}(e_{g\{\lambda, \lambda\}}^{**})^{-3} = 0; \quad (\text{A15})$$

(ii) the manager with belief $\lambda_M = \lambda$ chooses an effort allocation identical to the benchmark and hence suffers no utility loss from effort-allocation deviation; (iii) the wages w_X and w_θ are jointly determined by:

$$\frac{w_X}{w_\theta} = 1 + \frac{2(1 - \lambda)}{\lambda} e_{g\{\lambda, \lambda\}}^{**}, \quad (\text{A16})$$

$$\frac{w_X}{w_\theta} = 1 + \frac{4(1 - \lambda)}{\lambda^2} \frac{c}{w_X - w_\theta}, \quad (\text{A17})$$

which are the IC constraints of effort allocation and exertion, respectively, for a manager with belief $\lambda_M = \lambda$; and (iv) $u_{\{\bar{\lambda}\}}$ and $u_{\{\lambda\}}$ are given by (4), by replacing λ with $\bar{\lambda}$ and λ , respectively. Note that in (A14), the right-hand side $u_{\{\lambda\}}$ is not a function of α , while the left-hand side is a decreasing function of α with the first-order derivative being:

$$\begin{aligned} & -\frac{\alpha}{2(1 - \bar{\lambda})w_\theta} + \frac{\alpha}{2(1 - \bar{\lambda})w_\theta} - \left| \frac{\bar{\lambda}(w_X - w_\theta) - \alpha \times 1_{\{e_g > e_g^B\}}}{2(1 - \bar{\lambda})w_\theta} - e_g^B \right| \\ & = - \left| \frac{\bar{\lambda}(w_X - w_\theta) - \alpha \times 1_{\{e_g > e_{g\{\lambda, \lambda\}}^{**}\}}}{2(1 - \bar{\lambda})w_\theta} - e_{g\{\lambda, \lambda\}}^{**} \right| < 0. \end{aligned} \quad (\text{A18})$$

Thus, α^B is uniquely determined by (A14) by letting $\alpha = \alpha^B$.

We now analyze the bank's optimal choice of α . Clearly, if β is sufficiently low, the bank chooses $\alpha = \alpha^B$ and matches with a pessimistic manager ($\lambda_M = \lambda$). Otherwise, the bank is mismatched with an optimistic manager ($\lambda_M = \bar{\lambda}$). In the latter case, the bank's expected net payoff is:

$$\pi(\alpha) + \frac{1 - 2\alpha|e_{g\{\lambda, \bar{\lambda}\}}^{**} - e_{g\{\lambda, \lambda\}}^{**}|}{4} - \frac{1}{2}\beta\alpha^2, \quad (\text{A19})$$

where (i) $e_{g\{\lambda, \bar{\lambda}\}}^{**}$ is the optimistic manager's effort allocation to growth, which differs from the bank's benchmark, $e_{g\{\lambda, \lambda\}}^{**}$; (ii) $\pi(\alpha) = e_{g\{\lambda, \bar{\lambda}\}}^{**}[\lambda(X - I) - (1 - \lambda)e_{g\{\lambda, \bar{\lambda}\}}^{**}(E + \delta\Delta)] - \frac{c}{(1 - \bar{\lambda})(e_{g\{\lambda, \bar{\lambda}\}}^{**})^2} - c + \frac{c(\bar{\lambda} - \lambda)(2 - \bar{\lambda})}{\lambda(1 - \bar{\lambda})}$ is the bank's net profit from the loan (replacing e_g in (21) with $e_{g\{\lambda, \bar{\lambda}\}}^{**}$); (iii) the bank invests in scope increase (i.e., choosing $m = 1$) w.p. $\frac{1 - 2\alpha|e_{g\{\lambda, \bar{\lambda}\}}^{**} - e_{g\{\lambda, \lambda\}}^{**}|}{2}$, with a net profit $1 - \frac{m^2}{2} = \frac{1}{2}$; and (iv) $\frac{1}{2}\beta\alpha^2$ is the cost of the investment in culture. It is clear that $\pi'(\alpha) > 0$, since a bigger α pulls $e_{g\{\lambda, \bar{\lambda}\}}^{**}$ closer to $e_{g\{\lambda, \lambda\}}^{**}$.

Moreover, we know from (A10) that $|e_{g\{\lambda, \bar{\lambda}\}}^{**} - e_{g\{\lambda, \lambda\}}^{**}| = \frac{\bar{\lambda} - \lambda}{2(1-\bar{\lambda})(1-\lambda)} \left(\frac{w_X}{w_\emptyset} - 1 \right) - \frac{\alpha}{2(1-\bar{\lambda})w_\phi}$. Thus, the FOC to (A19) can be written as:

$$\pi'(\alpha) + \frac{\alpha}{2(1-\bar{\lambda})w_\phi} - \frac{\bar{\lambda} - \lambda}{4(1-\bar{\lambda})(1-\lambda)} \left(\frac{w_X}{w_\emptyset} - 1 \right) - \beta\alpha = 0, \quad (\text{A20})$$

where the second-order condition (SOC), $\pi''(\alpha) + \frac{1}{2(1-\bar{\lambda})w_\phi} - \beta < 0$, holds as long as β is high enough. The comparative statics results follow directly by applying the Implicit Function Theorem to the FOC. \square

Proof of Proposition 8. Combining (25) and (24), we have:

$$w_\emptyset = \frac{c}{(1-\lambda)(e_{g[1]} - \kappa e_{g[2]})(e_{g[1]} - \frac{\kappa}{2}e_{g[2]})} \frac{1 - \frac{\kappa}{2}}{1 - \kappa}. \quad (\text{A21})$$

Bank 1's problem can be written as:

$$\begin{aligned} \max_{\{e_{g[1]}\}} \pi_1 &= (e_{g[1]} - \kappa e_{g[2]})[\lambda(X - I) - (1-\lambda)e_{g[1]}(E + \delta\Delta)] \\ &\quad - \frac{c}{(1-\lambda)(e_{g[1]} - \kappa e_{g[2]})(e_{g[1]} - \frac{\kappa}{2}e_{g[2]})} \frac{1 - \frac{\kappa}{2}}{1 - \kappa} - c. \end{aligned} \quad (\text{A22})$$

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

$$\widehat{f}_2(e_{g[1]}^{**}) \equiv \lambda(X - I) - (2 - \kappa)(1 - \lambda)(E + \delta\Delta)e_{g[1]}^{**} + \frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \lambda} (e_{g[1]}^{**})^{-3} = 0. \quad (\text{A23})$$

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 $\widehat{f}'_2 < 0$. We claim

$$e_{g[1]}^{**} > \frac{2}{2 - \kappa} e_g^{**} > e_g^{**}. \quad (\text{A24})$$

To see this, note

$$\begin{aligned} \widehat{f}_2\left(\frac{2}{2 - \kappa}z\right) &= \lambda(X - I) - (2 - \kappa)(1 - \lambda)(E + \delta\Delta) \left(\frac{2}{2 - \kappa}z\right) + \frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{(2 - \kappa)^3}{8} \frac{2c}{1 - \lambda} z^{-3} \\ &> f_2(z), \end{aligned} \quad (\text{A25})$$

where the inequality holds, since $\frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{(2 - \kappa)^3}{8} > 1$.³⁷ Thus, we must have $e_{g[1]}^{**} = e_{g[2]}^{**} > \frac{2}{2 - \kappa} e_g^{**}$.

Next, we know from (25) that

$$\frac{w_X}{w_\emptyset} = 1 + \frac{(2 - \kappa)(1 - \lambda)}{\lambda} e_{g[1]}^{**} > 1 + \frac{2(1 - \lambda)}{\lambda} e_g^{**}. \quad (\text{A26})$$

³⁷This is equivalent to $(2 - \kappa)^2(4 - 3\kappa) > 16(1 - \kappa)^3 \Leftrightarrow 13\kappa^2 - 32\kappa + 20 > 0 \Leftrightarrow \left(\kappa - \frac{16}{13}\right)^2 + \frac{4}{169} > 0$.

We know that the pay wedge, $\frac{w_X}{w_0}$, in the one-bank case equals $1 + \frac{2(1-\lambda)}{\lambda}e_g^{**}$ (see (7)). Thus, $\frac{w_X}{w_0}$ must be bigger in the two-bank case.

Finally, we compare pay levels. The expected pay in the one-bank case is $\frac{c}{(1-\lambda)(e_g^{**})^2} + c$. The expected pay in the two-bank case is:

$$\frac{c}{(1-\lambda)(e_{g[1]}^{**} - \kappa e_{g[2]}^{**})(e_{g[1]}^{**} - \frac{\kappa}{2}e_{g[2]}^{**})} \frac{1 - \frac{\kappa}{2}}{1 - \kappa} = \frac{c}{(1-\lambda)(1-\kappa)^2(e_{g[1]}^{**})^2}. \quad (\text{A27})$$

So we only need to show $e_{g[1]}^{**} < \frac{1}{1-\kappa}e_g^{**}$.³⁸ To see this, note that:

$$\widehat{f}_2\left(\frac{1}{1-\kappa}z\right) = \lambda(X - I) - \frac{2-\kappa}{1-\kappa}(1-\lambda)(E + \delta\Delta)z + \frac{2-\frac{3}{2}\kappa}{2-\kappa} \frac{2c}{1-\lambda} z^{-3} < f_2(z). \quad (\text{A28})$$

Thus, we must have $e_{g[1]}^{**} < \frac{1}{1-\kappa}e_g^{**}$. \square

Proof of Proposition 9. Denote bank i 's optimal effort allocation to growth as $e_{g[i]}^{**}$. Following the same analysis as in the proof of Proposition 8, 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:

$$\begin{aligned} \widehat{f}_{\{\bar{\lambda}, \bar{\lambda}\}}(e_{g[1]}^{**}) &\equiv \bar{\lambda}(X - I) - (1 - \bar{\lambda})(E + \delta\Delta)(2e_{g[1]}^{**} - \kappa e_{g[2]}^{**}) + \frac{1 - \frac{\kappa}{2}}{1 - \kappa} \frac{c}{1 - \bar{\lambda}} \frac{(e_{g[1]}^{**} - \kappa e_{g[2]}^{**}) + (e_{g[1]}^{**} - \frac{\kappa}{2}e_{g[2]}^{**})}{(e_{g[1]}^{**} - \kappa e_{g[2]}^{**})^2 (e_{g[1]}^{**} - \frac{\kappa}{2}e_{g[2]}^{**})^2} \\ &= 0, \end{aligned} \quad (\text{A29})$$

and

$$\begin{aligned} \widehat{f}_{\{\lambda, \bar{\lambda}\}}(e_{g[2]}^{**}) &\equiv \lambda(X - I) - (1 - \lambda)(E + \delta\Delta)(2e_{g[2]}^{**} - \kappa e_{g[1]}^{**}) + \frac{1 - \frac{\kappa}{2}}{1 - \kappa} \frac{c}{1 - \bar{\lambda}} \frac{(e_{g[2]}^{**} - \kappa e_{g[1]}^{**}) + (e_{g[2]}^{**} - \frac{\kappa}{2}e_{g[1]}^{**})}{(e_{g[2]}^{**} - \kappa e_{g[1]}^{**})^2 (e_{g[2]}^{**} - \frac{\kappa}{2}e_{g[1]}^{**})^2} \\ &= 0, \end{aligned} \quad (\text{A30})$$

respectively. It can be shown that $e_{g[1]}^{**} > e_{g[2]}^{**}$,³⁹ so we only need to prove the result for bank 2.

We compare (A30) with the FOC that determines the bank's effort allocation to growth, $e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$, in the one-bank case with both the bank and its manager having optimistic beliefs (replacing λ in (A2) with $\bar{\lambda}$):

$$f_{\{\bar{\lambda}, \bar{\lambda}\}}(e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}) \equiv \bar{\lambda}(X - I) - 2(1 - \bar{\lambda})(E + \delta\Delta)e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**} + \frac{2c}{1 - \bar{\lambda}}(e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**})^{-3} = 0. \quad (\text{A31})$$

Note that $\widehat{f}_{\{\lambda, \bar{\lambda}\}}(e_{g[2]}^{**})$ is increasing in $e_{g[1]}^{**}$. 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 (A30) as:

$$\widehat{f}_{\{\lambda, \bar{\lambda}\}}(e_{g[2]}^{**}) \equiv \lambda(X - I) - (2 - \kappa)(1 - \lambda)(E + \delta\Delta)e_{g[2]}^{**} + \frac{2 - \frac{3}{2}\kappa}{(2 - \kappa)(1 - \kappa)^3} \frac{2c}{1 - \bar{\lambda}} (e_{g[2]}^{**})^3 = 0. \quad (\text{A32})$$

³⁸Note $\frac{1}{1-\kappa} > \frac{2}{2-\kappa}$, so this does not violate the previously established condition that $e_{g[1]}^{**} > \frac{2}{2-\kappa}e_g^{**}$

³⁹Note if $e_{g[1]}^{**} = e_{g[2]}^{**}$, we will have $\widehat{f}_{\{\bar{\lambda}, \bar{\lambda}\}}(e_{g[1]}^{**}) > \widehat{f}_{\{\lambda, \bar{\lambda}\}}(e_{g[2]}^{**})$.

We note that: (i) $\hat{f}'_{\{\lambda, \bar{\lambda}\}} < 0$ and $f'_{\{\bar{\lambda}, \bar{\lambda}\}} < 0$; and (ii) $\hat{f}_{\{\lambda, \bar{\lambda}\}}(z) > f_{\{\bar{\lambda}, \bar{\lambda}\}}(z)$ for $\forall z$, when κ is sufficiently large,⁴⁰ in which case we have $e_{g[2]}^{**} > e_{g\{\bar{\lambda}, \bar{\lambda}\}}^{**}$. \square

Proof of Proposition 10. Suppose the bank 2's safety culture is sufficiently strong (α big enough) to lead to assortative matching. 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 (A29). Note that $\hat{f}_{\{\bar{\lambda}, \bar{\lambda}\}}(e_{g[1]}^{**})$ in (A29) is increasing in $e_{g[2]}^{**}$ while decreasing in $e_{g[1]}^{**}$. So, as $e_{g[2]}^{**}$ decreases due to the bank 2's safety culture, $e_{g[1]}^{**}$ has to decrease as well. If the bank 2's safety culture is not strong enough, so it hires a manager with the optimistic belief (i.e., $\lambda_{M[2]} = \bar{\lambda}$), the problem can be analyzed similarly, except two modifications to bank 2 manager's IC constraints for effort exertion and allocation. The former IC constraint becomes $u_2 - \alpha|e_{g[2]} - e_{g[2]}^B| \geq w_{\theta[2]} - \frac{\alpha}{2}$, and latter IC constraint becomes $\{e_{g[2]}, e_{s[2]}\} \in \operatorname{argmax} \left(u_2 + \frac{1}{2} - \alpha|e_{g[2]} - e_{g[2]}^B| \right)$. \square

Proof of Corollary 1. The result follows directly from the fact that the FOC that determines bank 2's effort allocation to growth (see (A30)) is decreasing in E and $\delta\Delta$: as E and/or $\delta\Delta$ increases, $e_{g[2]}^{**}$ decreases; as a result, $e_{g[1]}^{**}$ decreases as well, following the same argument as in the proof of Proposition 10. \square

⁴⁰For this, we only need to show that $\frac{2-\frac{3}{2}\kappa}{(2-\kappa)(1-\kappa)^3}$ is increasing in κ : it is straightforward to check that the first-order derivative of this term w.r.t. κ is proportional to $9\kappa^2 - 28\kappa + 22 = (3\kappa - \frac{14}{3})^2 + \frac{2}{9} > 0$.

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