Bankers and Regulators *

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We propose a career choice model in which agents of differential ability levels choose to work as bankers or as financial regulators. When workers receive intrinsic benefits from working in regulation (such as public-sector motivation or human capital improvement), our model predicts that bankers are, on average, more skilled than regulators and their compensation is more sensitive to performance. During financial booms, banks draw the best workers away from the regulatory sector and misbehavior increases. In a dynamic extension of our model, young regulators accumulate human capital and the best ones switch to banking in mid-career.

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" Does it really matter who is in charge of the regulators? The grunt work of supervision depends on more junior staff, who will always struggle to keep tabs on smarter, better-paid types in the firms they regulate. "

The Economist, September 30th 2010

There is a widespread perception that, on average, financial regulators are not as skilled as the bankers and traders they are charged with overseeing — and moreover, that this discrepancy in ability widens significantly when the financial sector booms, or when regulatory resources shrink. In addition, jobs in financial regulatory agencies offer compensation that is low and insensitive to performance, relative to the financial sector being supervised.[1] These observations raise a number of questions. Why is the regulatory sector less prepared to pay for skill relative to the private sector? Why does this discrepancy worsen when the financial sector booms and how does it affect the efficacy of regulation? And why do regulatory agencies make comparatively little use of performance pay?

In this paper we offer a unified and parsimonious rationale for these observations. We propose a career choice model where workers of differential ability levels can choose to work as bankers, responding to a demand function for banking services, or as regulators, monitoring the behavior of bankers. Our model predicts that bankers are, on average, more skilled than regulators and their compensation is more sensitive to performance. We draw on a recent literature in economics that studies the consequences of public-sector motivation: see, for example, Dewatripont, Jewitt, and Tirole (1999), Francois (2007), Delfgaauw and Dur (2008), or Delfgaauw and Dur (2010). Drawing on extensive empirical evidence (see Perry and Hondeghem (2008) for a survey), this literature posits that many workers derive utility from working in public service. In a recent article in Investment News, Laura Anne Corsell, a former attorney in the SEC investment management division, acknowledges the role of public-sector motivation in attracting workers to the SEC:[2]

[1] See, for example, Motley Fool's interview of Assistant Treasury Secretary Michael Barr titled "Treasury on Regulatory Failure and 'Too Big to Fail' "where the interviewer, Ilan Moscovitz, mentions related observations. Available at http://www.fool.com/investing/general/2010/08/23/treasury-on-regulatory-failure-and-too-big-to-fail.aspx.

[2] See "Budget battles could crimp SEC's plans" by Mark Schoeff, published on August 29, 2010, in Investment News.

" 'These are all people who could be making a lot more money doing something else,' Ms. Corsell said. Working at the SEC 'is an opportunity to make policy and participate in the way in which the financial system works and, at this point in time, is rebuilt. That's a pretty powerful draw to a lot of people.' "

When workers' intrinsic benefit from working in regulation is relatively independent from their skill levels, it is cheaper for a regulatory agency aiming to achieve a given degree of monitoring to hire a group of low-skill workers than a smaller group of high-skill workers. The intrinsic benefit serves as a savings on wages being paid to employees and makes less skilled workers more productive per dollar than high-skill workers. Hence, allocating less skilled workers to regulatory tasks and more skilled workers to banking tasks is the efficient response to the presence of an intrinsic benefit of working in regulation. If given the same resources, a social planner would allocate workers in exactly the same way in the risk-neutral setting and very similarly in the risk-averse setting. Relatedly, our analysis shows that, contrary to the popular view, a highly profitable banking sector and a very poor regulatory sector are neither sufficient nor necessary conditions to generate relatively low skill levels for regulators.

As will be clear, we abstract from any institutional failings of either regulators or banks that may affect labor market outcomes. While such failings doubtless exist, our main argument in this paper is that intrinsic benefits, by themselves, can account for many of the outcomes we observe.

Note that although the intrinsic benefit we assume in our model may resemble altruism (see, e.g., Becker (1974)), it may also stem entirely from a desire for power; for our purposes, the distinction is unimportant. Moreover, and as we show in the paper, it is possible to reinterpret the intrinsic benefit as an improvement in human capital. We provide an analysis of how human capital considerations might affect the allocation of workers between the two sectors when working in regulation improves future career opportunities. This corresponds to the widespread notion that working at the SEC, for example, enhances an individual's future career prospects. We are able to construct an equilibrium where the banking sector attracts workers that are, on average, more skilled than those in the regulatory sector for all age groups.

Our paper adds to the academic literature by analyzing how intrinsic benefits such as public-

sector motivation affect the equilibrium assignment of heterogeneously-skilled workers to different jobs in a regulation context. In our model the intrinsic motivation of working in regulation can be mitigated by the opportunities for fraudulent gains in the banking sector. The potential for misbehavior depends on the quality and intensity of regulatory work, hence the value of the intrinsic benefit, net of misbehavior gains available in banking, is endogenously determined in equilibrium. We show that in equilibrium the skill allocation will be tilted towards the banking sector, even when regulatory budgets are large compared to profits in the banking sector. We discuss the related literature in more detail in the next section.

We use our model of the financial-sector labor market to analyze how equilibrium misbehavior responds to financial-sector booms and to reductions in regulatory resources. In both cases, and as one would expect, the regulatory sector struggles to hire workers, and loses workers to the private sector, consistent with the following excerpt from a recent Financial Times article:[3]

> *"Staff resignations doubled at the Financial Services Authority in the second quarter as the government announced plans to split up the embattled regulator and as revived private sector recruitment lured away managers and frontline supervisors."*

Perhaps less obvious, we show that it is the highest-ability workers that they lose, consistent with Harry Markopolos's memorable description of the Securities and Exchange Commission (SEC) as "a group of 3,500 chickens tasked to chase down and catch foxes which are faster, stronger and smarter than they are."[4] Both effects make regulation less effective: there are fewer regulators, supervising more bankers, and the average regulator is now less skilled. Consequently, equilibrium misbehavior by bankers increases in financial-sector booms.

The paper is organized as follows. In the next section, we compare our paper to closely related papers. Section 2 introduces the general environment and Section 3 develops the model's main implications in a risk-neutral setting. In Section 4, we show that these implications also hold when workers are risk averse and that pay for performance is more prevalent in the banking sector than in

[3]See "FSA exodus adds to concern over regulation" by Brooke Masters in the August 8, 2010 issue of the Financial Times.

[4]Harry Markopolos is best known for his (ignored) warnings to the SEC concerning Bernard Madoff. His description of the SEC is from a testimony to the U.S. House of Representatives, available in full at http://www.sec.gov/news/studies/2009/oig-509/exhibit-0269.pdf.

the regulatory sector. We develop a dynamic version of our model and interpret the intrinsic benefit of working in regulation as an improvement in human capital in Section 5. Section 6 concludes.

1 Literature Review

Our paper is closely related to Povel, Singh and Winton (2007) who also find a relationship between equilibrium fraud and business conditions. Their model focuses on firms soliciting capital from investors who are able to monitor the information that firm managers disclose. The overall profitability of the sector affects investors' beliefs about the quantity of (bad) firms that might want to produce fraudulent information in hopes of being financed. The endogenous monitoring of firms by investors then feeds back into firm managers' decision whether to commit fraud or not. We instead focus on the labor market for financial workers. In our model, business conditions in the banking sector dictate the compensation that banks offer to potential employees. The better compensation banks offer, the harder it is for regulatory agencies to prevent skilled workers from leaving for the banking sector. As the number and average skill of regulators decrease, the quality of the monitoring also decreases, making the expected cost of misbehaving lower and misbehavior more prevalent in the banking sector.

Our paper also relates to the literature about the effect of non-pecuniary incentives on employment. Brennan (1994) highlights that rational agents may derive utility from being virtuous or altruistic. Carlin and Gervais (2009) focus on work ethic and model a firm's hiring decisions when facing a pool of workers with heterogenous levels of work ethics — some workers being self-interested as in most agency models, while some workers exert effort without the need for extra incentives. Both the type (i.e., egoistic vs. virtuous) and skill (i.e., high vs. low) of workers is unobservable; the authors solve for the optimal contracts a firm will offer and show that perfect screening of virtuous agents is never achieved. Carlin and Gervais (2009) assume an exogenously given reservation utility for each worker who consider working for the firm. Our paper instead focuses on the effect of a *job-specific* intrinsic motivation on labor matching, when a worker's reservation utility is endogenously determined based on the allocation of workers among jobs. In that sense, our paper is closely related to the labor matching literature on public-sector careers. Theoretical papers that

focus on issues related to working in the public sector include Dewatripont, Jewitt, and Tirole (1999) who study career concerns in organizations with multiple missions and/or a lack of focus, Francois (2007) who studies how a free-rider problem in an organization that produces a good valuable to several, but not all, of its employees could lead some employees to "donate" their time to ensure that the good is produced, and Prendergast (2003) and Prendergast (2007) who study the inefficiencies of bureaucratic organizations and how exploiting workers' biases can reduce these inefficiencies. Unlike our paper, these papers do not study employment in the public and private sectors simultaneously and the career choices by workers who enter the labor force.

To the best of our knowledge, only two other papers propose career choice models with workers of different ability levels choosing between working in the private sector and in the public sector. Delfgaauw and Dur (2008) study a model with three types of worker: a benchmark type, a dedicated type that has a lower cost of effort in the public sector, and a lazy type that has a higher cost. As in the current paper, a worker's type is private information.[5] Dedicated workers display a form of public-sector motivation. As in our model, and others, this implies that they can be paid less. When the public sector needs only a few workers, it hires only dedicated workers. It also demands little work from each of them, since it is cheaper to increase output by hiring more workers than by extracting more effort from existing workers. If instead the public sector needs many workers, it hires a mix of dedicated and lazy workers, since the contract offered to lazy workers is not very tempting for dedicated workers, and so is less distorting. The second case, in which the public sector hires lazy workers, is similar to our result that the public sector hires the worst workers. However, the model is such that it cannot say anything on why the best workers in the economy end up in the private sector, which is a key prediction of our model. Moreover, the model is silent on incentive pay and human capital formation.[6]

In a second paper, Delfgaauw and Dur (2010) again study an economy with multiple worker types, which this time are public information. They observe that public-sector motivation essentially lowers the marginal cost of the inputs for the public sector. In the economy they study, the

[5] Although, in our paper, most of our results do not rely on the assumption of private worker's types.

[6] The authors briefly consider a case in which effort is unverifiable. Since output is deterministic, the contracts in this case are simple forcing contracts, which pay a worker only if output reaches some critical level.

private and public sectors are completely separate. It then follows that, at the social optimum the marginal product in the public sector should be lower. In their model, it then follows that the return to skill is lower in the public sector, and hence the most talented workers should work in the private sector. Our paper complements Delfgaauw and Dur (2010) by describing a different mechanism that pushes the most talented workers into the private sector. In contrast to their paper, our mechanism does not rely on the marginal product being higher in the private sector. So in particular, even if regulators are underfunded, and the marginal product of regulatory resources is consequently high, our results still apply, and regulators are still best off using their limited resources to employ lower-skilled workers. In addition, this second paper is again silent on incentive pay and human capital formation.

2 Model

We assume a continuum of workers who can be employed as bankers or as regulators. There are two types of workers: low-skill and high-skill. There is a mass 1 of low-skill workers and a mass η of high-skill workers. What differentiates these two types of workers is the probability of succeeding in their work-related tasks. To avoid hard-wiring any particular allocation of workers into our model, we assume that the probability of success for each worker type is the same in both jobs: q_L for the low-skill worker and q_H for the high-skill worker, where $q_L < q_H$. Equivalently, we could allow these success probabilities to change with the sector as long as the ratio of productivity for the high type over the low type is constant across sectors.

Workers of skill level $i \in \{L, H\}$ who become bankers produce a payoff p with probability q_i and zero with probability $(1 - q_i)$. As explained below, the payoff p is determined in equilibrium and depends on the total output from the banking sector. A worker's skill is only known by the worker himself. Hence, when hired bankers are offered a menu of performance-contingent compensation contracts, where each menu item is denoted $w_B = (w_{BS}, w_{BF})$, where w_{BS} is the payment after success and w_{BF} is the payment after failure. By standard arguments, we can assume the menu contains just two contracts, one intended for high-skill workers, w_B^H, and one intended for low-skill workers, w_B^L.

Bankers can also decide to misbehave. This misbehavior could represent anything regulators are responsible for monitoring and preventing. In order to derive comparative statics, we model this misbehavior as defrauding the bank's customers, but it could be something more benign such as, for example, holding less capital than required by regulatory bodies. As will be evident later, the way we model this misbehavior does not affect any of our main results about worker allocation. What really matters is how much the opportunity to misbehave is worth for workers, compared to the intrinsic benefit of working in regulation, when they try to decide on a career.[7]

When a banker misbehaves, we assume that he collects a payoff z, which differs across individuals following a continuous distribution. Each individual learns about his opportunities for fraud only after deciding whether to become a banker.[8] It simplifies considerably the algebra in the risk-averse setting to assume, moreover, that an individual learns z only after finding out whether he succeeded or failed on his main banking task.

When effectively monitored by a regulator, fraud results in a (possibly non-monetary) fine K, which may depend continuously on z (if, e.g., the fine entails repayment of fraudulent gains). Let r denote the probability of being effectively investigated, which is determined in equilibrium based on the ratio of bankers to regulators, and the average skill of regulators.

Workers who become regulators receive an intrinsic benefit Δ, due for example to the recognition from being a public servant. As we show later, Δ can alternatively be interpreted as coming from the acquisition of human capital while working in regulation. Regulators investigate bankers to check if they misbehave. With probability q_i a regulator of skill level $i \in \{L, H\}$ determines the truth, i.e., whether or not a banker misbehaved. We describe this outcome as a *useful report*, since the information generated can be used to prosecute a banker. With probability $1 - q_i$ the regulator learns nothing.

Exactly as for bankers, when hired regulators are offered a menu of two performance-contingent compensation contracts $\{w_R^H, w_R^L\}$: for $i \in \{H, L\}$, $w_R^i = \left(w_{RS}^i, w_{RF}^i\right)$, where w_{RS}^i is the payment for a useful report and w_{RF}^i is the payment otherwise. A regulatory agency aims to learn as much

[7] In that sense, a slightly modified version of our model could help us understand the allocation of workers between financial firms and the rating agencies that monitor them.

[8] Consequently, we only need to consider two worker-types, low-skill and high-skill, in the analysis of the labor market.

as it can about the actions of bankers, so it attempts to maximize the number of useful reports given a fixed budget that we denote by M.

A worker's utility from being a regulator is $u(w+\Delta)$. A worker's utility from being a banker is $u(w+z-K(z))$ if he commits fraud and it is detected; $u(w+z)$ if he commits fraud and it is not detected; and $u(w)$ if he abstains from fraud.

Define $U^i\left(w_B^j\right)$ as the expected utility for a worker of type i from accepting the banking contract intended for type j. Likewise, define $U^i\left(w_R^j\right)$ as the utility for a worker of type i from accepting the regulator contract intended for type j. Since we assume the fraud decision takes place after the banker observes whether he has succeeded or failed,

$$\begin{aligned} U^i\left(w_B^j\right) &= q_i E_z\left[\max\left\{(1-r)\,u\left(w_{BS}^j+z\right)+ru\left(w_{BS}^j+z-K(z)\right), u\left(w_{BS}^j\right)\right\}\right] \\ &\quad +(1-q_i)\,E_z\left[\max\left\{(1-r)\,u\left(w_{BF}^j+z\right)+ru\left(w_{BF}^j+z-K(z)\right), u\left(w_{BF}^j\right)\right\}\right] \\ U^i\left(w_R^j\right) &= q_i u(w_{RS}^j+\Delta)+(1-q_i)\,u(w_{RF}^j+\Delta). \end{aligned}$$

We assume that there are at least two regulatory agencies and two banks, and focus on symmetric equilibria in which all regulatory agencies offer the same contracts, and likewise, all banks do also. Having two employers in each sector ensures that if an employer deviates and offers a contract other than the equilibrium contract, the equilibrium contract is still available. When multiple employers offer the same contract, we assume that workers randomize among them with equal probability. To determine the equilibrium size of the banking sector, we assume that the payoff p is strictly decreasing in the total output of the banking sector, i.e., is $p=P(Y)$, where Y is total banking output and P is a continuous and decreasing function. To ensure that there are at least some bankers in equilibrium, we assume that $\lim_{Y\to 0} P(Y)=\infty$. We also assume free-entry into the banking sector, so in equilibrium all banks must make zero profits; other assumptions on the competitive structure of industry would leave our results qualitatively unchanged, though would generally complicate the analysis.

Labor market outcomes are summarized by the fraction of workers of each skill level who enter each of the two sectors. For $i\in\{H,L\}$, let α^i denote the fraction of workers with skill level i who

become bankers; hence a fraction $1-\alpha^i$ become regulatory workers.

To close the model, we need to relate labor-market outcomes to the efficacy of regulators, that is, to the equilibrium probability r of misbehavior detection. Assume that each regulator can monitor a measure $\lambda > 0$ of bankers and that monitoring occurs successively, so that two useful reports are never produced on the same banker (unless the number of regulators is so large that a useful report is produced on *every* banker). So regulators discover the truth about a total of $\min\left\{\lambda\left[\left(1-\alpha^L\right)q_L+\eta\left(1-\alpha^H\right)q_H\right],\alpha^L+\eta\alpha^H\right\}$ of the $\alpha^L+\eta\alpha^H$ bankers. Hence the probability that misbehavior is detected is given by

$$G\left(\left(1-\alpha^L\right)q_L+\eta\left(1-\alpha^H\right)q_H,\alpha^L+\eta\alpha^H\right)\equiv\min\left\{1,\lambda\frac{\left(1-\alpha^L\right)q_L+\eta\left(1-\alpha^H\right)q_H}{\alpha^L+\eta\alpha^H}\right\}.$$

It is worth stressing that our results hold for many other parameterizations of the misbehavior-detection function G; all we require is that G is continuous in its two arguments, weakly increasing in the total number of useful reports, and weakly decreasing in the total number of bankers.

Define $\Pi^i\left(w_B\right)$ as a bank's per-worker profits from employing a type-i worker using contract w_B. Define $\rho^i\left(w_R\right)=\frac{q_i}{q_i w_{RS}+(1-q_i)w_{RF}}$ as a regulator's productivity (i.e., the ratio of the number of useful reports to wage bill) from employing a type i worker using contract w_R. Then an equilibrium of our economy is defined as follows:

Definition 1 *An equilibrium is vector* $\left(w_B^H,w_B^L,w_R^H,w_R^L,\alpha^H,\alpha^L,p,r\right)$ *satisfying:*

- *Labor market: utility maximization by workers among contracts*
  - *If* $\alpha^i>0$ *(i.e., some workers of type* i *become bankers), then:*

$$U^i\left(w_B^i\right)\geq\max\left\{U^i\left(w_B^j\right),U^i\left(w_R^i\right),U^i\left(w_R^j\right)\right\}$$

  - *If* $\alpha^i<1$ *(i.e., some workers of type* i *become regulators), then:*

$$U^i\left(w_R^i\right)\geq\max\left\{U^i\left(w_R^j\right),U^i\left(w_B^i\right),U^i\left(w_B^j\right)\right\}$$

- *For banks: There is no deviation* $\left\{\tilde{w}_B^H, \tilde{w}_B^L\right\}$ *such that, taking all other contracts as fixed, a fraction* $\tilde{\alpha}^i$ *of skill level* i *accepts contract* $\tilde{w}_B^i$*, and the bank strictly increases its profits,*

$$\tilde{\alpha}^L \Pi^L\left(\tilde{w}_B^L\right) + \tilde{\alpha}^H \eta \Pi^H\left(\tilde{w}_B^H\right) > \alpha^L \Pi^L\left(w_B^L\right) + \alpha^H \eta \Pi^H\left(w_B^H\right).$$

- *For regulatory agencies: There is no deviation* $\left\{\tilde{w}_R^H, \tilde{w}_R^L\right\}$ *such that, taking all other contracts as fixed, a fraction* $1-\tilde{\alpha}^i$ *of skill level* i *accepts contract* $\tilde{w}_R^i$*, and the regulatory agency strictly increases its productivity,*

$$\begin{aligned} & \frac{\left(1-\tilde{\alpha}^L\right) q_L + \left(1-\tilde{\alpha}_H\right) \eta q_H}{\left(1-\tilde{\alpha}^L\right)\left(q_L \tilde{w}_{RS}^L + \left(1-q_L\right) \tilde{w}_{RF}^L\right) + \left(1-\tilde{\alpha}_H\right) \eta \left(q_H \tilde{w}_{RS}^H + \left(1-q_H\right) \tilde{w}_{RF}^H\right)} \\ > & \frac{\left(1-\alpha^L\right) q_L + \left(1-\alpha_H\right) \eta q_H}{\left(1-\alpha^L\right)\left(q_L w_{RS}^L + \left(1-q_L\right) w_{RF}^L\right) + \left(1-\alpha_H\right) \eta \left(q_H w_{RS}^H + \left(1-q_H\right) w_{RF}^H\right)}. \end{aligned}$$

- *Banking output price is consistent with total banking output, i.e.,* $p = P(\alpha^L q_L + \eta \alpha^H q_H)$*; total regulatory expenditure equals their budget,* $M = \left(1-\alpha^L\right)\left(q_L w_{RS}^L + \left(1-q_L\right) w_{RF}^L\right) + \left(1-\alpha^H\right) \eta \left(q_H w_{RS}^H + \left(1-q_H\right) w_{RF}^H\right)$*; and the probability* r *that misbehavior is detected is consistent with the labor market outcome,* $r = G\left(\left(1-\alpha^L\right) q_L + \eta\left(1-\alpha^H\right) q_H; \alpha^L + \eta \alpha^H\right)$.

The following result, which is standard from models of competition and adverse selection, helps simplify the analysis. Unless otherwise stated, proofs are relegated to the Appendix.

Lemma 1 *In equilibrium, banks extract zero profits from each type of workers they employ, i.e.,* $\Pi^i\left(w_B^i\right) = 0$ *if* $\alpha^i > 0$*, and regulatory agencies extract the same productivity from each type of workers they employ, i.e.,* $\rho^H\left(w_R^H\right) = \rho^L\left(w_R^L\right)$ *if* $\alpha^L < 1$*, and* $\alpha^H < 1$*.*

3 Risk-Neutral Workers

In this section, we assume that all agents are risk neutral. To ease the notation, we define $\phi(r) \equiv E_z\left[\max\left(z - rK(z), 0\right)\right]$, representing the expected payoff from the opportunity to misbehave while being a banker. Since we assume workers are risk neutral in this section, the unobservability of skill has no effect on equilibrium outcomes. In particular, bankers can simply be paid their marginal

product using a contract that pays the output value p in the case of success, and nothing in the case of failure. Similarly, without loss of generality we can assume that regulators are paid only after success. In the next section, we will allow for risk-averse workers and the private information about skill levels will generate sensible predictions about the performance sensitivity of contracts.

Now we investigate how workers will be allocated between the two sectors. In order to convince a worker of type i to become a regulator, regulatory agencies need to offer him at least as much as he would get in the competitive banking sector, i.e., $pq_i + \phi(r)$. The lowest wage that satisfies this condition is:

$$w_{RS}^i = p - \frac{\Delta - \phi(r)}{q_i},$$

and regulatory agencies extract a productivity per dollar of wage of:

$$\frac{q_i}{pq_i - \Delta + \phi(r)}.$$

If $\Delta > \phi(r)$, then the productivity as regulators of low-skill workers will dominate that of high-skill workers:

$$\frac{q_L}{pq_L - \Delta + \phi(r)} > \frac{q_H}{pq_H - \Delta + \phi(r)}. \tag{1}$$

So if they have to pay workers the wage that makes them indifferent with working in banking, regulatory agencies prefer to hire low-skill workers than high-skill workers, because they get more output per dollar paid. When the regulatory budget M is relatively low (i.e., $M \leq pq_L - \Delta + \phi(r)$ where p is determined in equilibrium), regulatory agencies maximize their productivity by only hiring some low-skill workers at the wage $w_{RS}^L = p - \frac{\Delta - \phi(r)}{q_L}$ and offering high-skill workers a wage $w_{RS}^H < p - \frac{\Delta - \phi(r)}{q_H}$ that will not be accepted. The banking sector then attracts all the high-skill workers and maybe even some low-skill workers whereas the regulatory sector only attracts some low-skill workers. The precise size of the budget M determines how many low-skill workers the regulatory sector can employ. The low-skill workers who cannot be hired by regulatory agencies because M is too small enter the banking sector, which makes them indifferent.

If the regulatory budget M is relatively high (i.e., $M > pq_L - \Delta + \phi(r)$ where p is determined in equilibrium), regulatory agencies are able to hire all the low-skill workers and they might also

be able to hire some high-skill workers. In order to reach an equilibrium where some high-skill workers become bankers, some high-skill workers become regulators and all low-skill workers become regulators, high-skill workers need to be indifferent between the two jobs, $w_{RS}^H = p - \frac{\Delta - \phi(r)}{q_H}$, and the productivity of both types of regulators needs to be the same, which implies that they both receive the same payoff w_{RS}^H after success. Note that in this case, in equilibrium low-skill workers are strictly better off in the regulatory sector than in the banking sector.

Whenever the benefit of regulation, Δ, is sufficiently large compared to the net gain from misbehavior, $\phi(r)$, regulators are, on average, less skilled than bankers. We formalize this result in the following proposition and the short proof that follows it.

Proposition 1 *In any equilibrium with risk-neutral workers and $\Delta > \phi(r)$, bankers are more skilled than regulators. Formally, there is no equilibrium in which some high-skill agents are regulators ($\alpha^H < 1$) and some low-skill agents are bankers ($\alpha^L > 0$).*

Proof of Proposition 1: Suppose, contrary to the claimed result, that an equilibrium exists with some low-skill workers in the banking sector and some high-skill workers in the regulatory sector. The low-skill bankers must be paid pq_L in expectation. The high-skill regulatory workers must be paid at least $pq_H - \Delta + \phi(r)$ in expectation, since otherwise banks could profitably poach them by offering compensation just below pq_H in expectation. Consequently, the productivity of high-skill regulatory workers is at most $\frac{q_H}{pq_H - \Delta + \phi(r)}$. But then a regulator would do strictly better by poaching the low-skill bankers with an offer where the expected compensation is just above $pq_L - \Delta + \phi(r)$, thereby attaining productivity which by condition (1) strictly exceeds the productivity of the existing high-skill regulatory workers. Given Lemma 1, this contradicts the supposed equilibrium, completing the proof. ∎

The proposition above formally shows that an equilibrium where the average regulator is at least as skilled as the average banker cannot exist when the intrinsic benefit of being a regulator is greater than the net payoff from misbehavior. This result arises because all agents extract the same intrinsic benefit from working in regulation, but high-skill workers produce more than low-skill workers. Instead of hiring one high-skill worker, it is cheaper for a regulatory agency to hire

a mass $\frac{q_H}{q_L}$ of low-skill workers. The cost savings due to the positive net intrinsic benefit from working in regulation are greater when hiring $\frac{q_H}{q_L}$ low-skill workers than one high-skill worker. A large Δ makes the regulatory sector more productive per dollar, even though it also contributes to making low-skill workers more attractive to regulatory agencies than high-skill workers. Note that allocating less skilled workers to regulatory tasks and more skilled workers to banking tasks is the socially-efficient (as well as the privately-efficient) response to the presence of a positive (net) intrinsic benefit of working in regulation.

In equilibrium, the allocation of skilled workers is tilted towards the banking sector and, contrary to the popular view, a highly profitable banking sector and a very poor regulatory sector are neither sufficient nor necessary conditions for this outcome. It is not necessary because in our model, bankers are more skilled than regulators even when regulatory budgets are large compared to profits in the banking sector.

It is not sufficient because it would be straightforward to adapt the proof to establish the parallel result; if instead the expected gain from misbehavior is larger, then in equilibrium the most skilled workers become regulators. Hence, a small perturbation in parameter values such that $\phi(r)$ goes from below Δ to above it would generate drastic changes in the allocation of workers.

But for the remainder of the section, we assume:

Assumption 1 *The intrinsic benefit of regulation exceeds the expected gain from misbehavior (even with zero probability of punishment),* $\Delta > \phi(0)$.

Assumption 1 ensures that $\Delta > \phi(r)$ and so any equilibrium is of the form of Proposition 1. The reader should note that this assumption is stronger than what we really need, since for most parameter configurations the equilibrium detection probability r is strictly positive in any equilibrium and the average gain from misbehavior is smaller than $\phi(0)$.

Next, we prove the existence of an equilibrium along the lines of what we described above Proposition 1.

Proposition 2 *With risk-neutral agents, at least one equilibrium satisfying Definition 1 exists.*

Since wages for workers in the regulatory sector increase with p and the total wage bill of regulatory agencies needs to equal their budget M, the following comparative statics are immediate from the proof for Proposition 2:

Corollary 1 *In the risk-neutral setting, as either demand for banking services increases (i.e., $P(\cdot)$ increases), or the regulatory budget M of each agency decreases:*

(a) the banking sector grows and the regulatory sector shrinks,

(b) the average skill of either bankers or regulators falls while the average skill in the other sector remains unchanged,

(c) the probability that misbehavior is detected (weakly) falls,

(d) the incidence of misbehavior (weakly) increases.

(If there are multiple equilibria,[9] *these statements are all true for at least the equilibria with the smallest and largest banking sectors.*[10]

When banking output becomes more valuable or the regulatory budget decreases, a smaller number of workers can be attracted away from the banking sector by the regulatory sector. Since the workers transferring from regulation to banking are either less skilled than the average initial bankers and/or more skilled than the average remaining regulators, the average skill of workers in both jobs weakly falls.

Also, the equilibrium probability of misbehavior being detected weakly falls for two reasons.

[9] Multiple equilibria may arise as follows. The labor market equilibrium is determined by the regulatory agencies' budget constraint. Fix an equilibrium, and consider an exogenous increase in the number of regulatory workers. This has three effects on a regulatory agency's expenditure. First, the regulatory agency must spend more to employ the extra workers. Second, because the extra workers come from the banking sector, the equilibrium price of banking services rises, which feeds through to an increase in the equilibrium wage that must be offered to regulatory workers. This second effect also increases the regulatory agency's total expenditure. The third effect, however, operates in the opposite direction: the increase in the number of regulatory workers decreases a banker's potential gains from fraud. This effect acts to *reduce* the equilibrium wage that must be offered to regulatory workers. If this third effect is strong enough to be the dominant one, an exogenous increase in the number of regulatory workers may actually decrease a regulatory agency's total expenditure. In this case, one can show that there exists an interval of regulatory budgets M such that multiple equilibria exist. Conversely, one can show that the equilibrium is unique whenever the regulatory budget M is either sufficiently high; or sufficiently low; or if the the fraud detection function G is sufficient unresponsive to changes in the pools of bankers and regulatory workers. Finally, it is worth noting that a standard consequence of equilibrium multiplicity is that the equilibrium correspondence is discontinuous in the regulatory budget M and the banking demand function, implying that small changes may have very large effects on equilibrium outcomes.

[10] If there is complete segregation of types (i.e., the number of bankers exactly equals η) both before and after the change, all statements hold only weakly.

First, the number of bankers increases while the number of regulators decreases. Second, the workers moving from the regulatory sector to the banking sector are weakly more skilled than the remaining regulators, hence the average skill of regulators decreases. And unless the remaining regulators are still numerous enough to successfully monitor all bankers, misbehavior is then detected less often than before, implying that the equilibrium level of misbehavior increases with the demand for banking services. Banking booms are associated with periods of intense misbehavior, partly because the skill differential between bankers and regulators becomes greater than usual.

4 Risk-Averse Workers

In this section, we relax the risk-neutrality assumption and verify that the main results from the risk-neutral setting still hold. Risk aversion also allows us to derive implications about the performance sensitivity of regulators' and bankers' compensation. These implications are consistent with the general perception that regulators receive safer compensation than bankers.

A banker who receives compensation w and has an opportunity to gain z from committing fraud if and only if:

$$(1-r)\,u\,(w+z)+ru\,(w+z-K\,(z))>u\,(w)\,.$$

To eliminate wealth effects in a banker's decision of whether to misbehave or not, which are tangential to our main analysis, we assume that workers have constant absolute risk aversion (CARA), i.e., $u\,(c)\equiv -e^{-\gamma c}$, where γ is the coefficient of absolute risk aversion. The fraud decision rule reduces to

$$\left(1-r+re^{-\gamma K(z)}\right)e^{-\gamma z}u\,(w)>u\,(w)\,.$$

Since u is negative, this inequality says that the banker commits fraud if and only if the gain from fraud z exceeds some critical level. Moreover, by defining

$$\Phi\,(r)\equiv E_z\left[\min\left\{1,e^{-\gamma z}\left(1-r+re^{\gamma K(z)}\right)\right\}\right].$$

we can write a worker's utility from banking, $U^i\left(w_B^j\right)$, as[11]

$$U^i\left(w_B^j\right) = \left(q_i u\left(w_{BS}^j\right) + (1-q_i)\, u\left(w_{BF}^j\right)\right)\Phi\left(r\right).$$

Likewise, a worker's utility from regulation, $U^i\left(w_R^j\right)$, is

$$U^i\left(w_R^j\right) = \left(q_i u\left(w_{RS}^j\right) + (1-q_i)\, u\left(w_{RF}^j\right)\right)e^{-\gamma\Delta}.$$

Because of the exponential utility assumption, the utility the worker extracts from his job can be written as the expected utility from consuming the chosen wage contract times a multiplier that either adjusts for the extra benefits from committing fraud as a banker or from working as a regulator.

Our first main result for the risk-averse setting is that whenever the intrinsic benefit of working in regulation Δ is sufficiently large compared to the net payoff from the opportunity to misbehave, it is the least skilled workers who become regulators. The following proposition is the analog of Proposition 1 for the risk-averse setting.

Proposition 3 *In any equilibrium with risk-averse workers in which $\Delta > -\frac{1}{\gamma}\ln\Phi\left(r\right)$, bankers are more skilled than regulators. Formally, there is no equilibrium in which $\Delta > -\frac{1}{\gamma}\ln\Phi\left(r\right)$, some high-skill workers are regulators ($\alpha^H < 1$), and some low-skill workers are bankers ($\alpha^L > 0$).*

Proposition 3 is identical to Proposition 1, but for the risk-averse setting. As before, it would be straightforward to adapt the proof to establish the parallel result; if instead the average gain from misbehavior is larger, then in equilibrium the most skilled workers become regulators. But for the remainder of the section, we assume:

Assumption 2 *The intrinsic benefit of regulation exceeds the expected gain from misbehavior (even with zero probability of punishment), $-e^{-\gamma\Delta} > E_z\left[-e^{-\gamma z}\right]$.*

[11] Note that the ability to write $U^i\left(w_B^j\right)$ in this way is a consequence of our assumption that the fraud decision is taken after a banker observes whether he has succeeded or failed. While this assumption facilitates our analysis and exposition in the risk-averse setting, it is not required for any of our derivations in the risk-neutral setting.

Assumption 2 is equivalent to $\Delta > -\frac{1}{\gamma} \ln \Phi(0)$, and hence ensures that $\Delta > -\frac{1}{\gamma} \ln \Phi(r)$ and so any equilibrium is of the form of Proposition 3. The reader should note, again, that Assumption 2 is stronger than what we really need, since for most parameter configurations the equilibrium detection probability r is strictly positive in any equilibrium.

We now derive a result that is new to the risk-averse setting. The adverse selection problem now forces banks to offer wage contracts that are more sensitive to performance than those regulators offer. Because workers are strictly risk-averse, by a standard argument any equilibrium must entail full-insurance for the low-skill workers. Focusing on regulation contracts, suppose to the contrary that in equilibrium a low-skill worker is not fully insured, i.e., $w_{RS}^L \neq w_{RF}^L$. Then a regulator could offer a new full-insurance contract, $\tilde{w}_{RS} = \tilde{w}_{RS} = q_L w_{RS}^L + (1 - q_L) w_{RF}^L - \varepsilon$, where $\varepsilon > 0$. Provided ε is chosen sufficiently small, a low-skill worker strictly prefers this new contract to the equilibrium contract. Moreover, the contract strictly improves the regulator's productivity when accepted by low-skill workers; and productivity is higher if it is accepted by high-skill workers. But this contradicts the supposition that the original contract is part of an equilibrium. A parallel proof applies to banking contracts.

Given that low-skill workers are completely insured in equilibrium, high-skill workers cannot be — that is, high-skill workers must receive some degree of performance-based pay ($w_S \neq w_F$). For the case in which both high and low skill workers are bankers, this is easy to see. If high-skill workers were fully insured, they would receive exactly the same contract as low-skill workers working in the same sector, since otherwise all workers would opt for the more attractive of the two fixed-wage contracts. But then profits would not be zero for both types of workers in banking. An identical argument applies in the case in which both high and low skill workers are employed by regulators. That high-skill workers are not fully insured in equilibrium is the only difference between the equilibrium outcome and a socially first-best outcome (taking the budget as given) in our model.

The following result is then easily obtained:

Proposition 4 *In any equilibrium, compensation for regulation jobs is safer than for banking jobs: either all regulators receive a riskless compensation while some bankers do not, or all bankers receive*

a performance-based compensation while some regulators do not.

Here, the safer compensation contracts for regulation jobs is a direct consequence of the skill allocation in equilibrium. When the intrinsic benefit of working in regulation exceeds the expected misbehavior gain, regulators employ workers that are not as skilled as those that banks employ. We also know that workers' risk aversion coupled with adverse selection ensures that low-skill workers receive safer compensation contracts. Consequently, compensation in regulation is, on average, safer than compensation in banking as regulators are, on average, less skilled than bankers.

This result is different from the mechanism that Dixit (2002) suggests where the intrinsic benefit is increasing in effort. In that case, the more agents derive utility from exerting effort, the less sensitive to performance compensation has to be to secure a given level of effort. In our model, agents derive utility from being regulators, not from exerting effort, per se. Yet, regulators receive compensation that is less sensitive to performance than bankers because of a job selection mechanism. On average, regulators are less skilled than bankers. This result originates from the incentive compatibility condition for high-skill workers (bankers) and the risk-aversion of low-skill workers (regulators). Note that, taken more generally, our result suggests that public-sector motivation and unobservable ability levels might also explain why Burgess and Metcalfe (1999) find that incentive pay systems are far more widespread in the (British) private sector than in the public sector.

Both Propositions 3 and 4 are predicated on an equilibrium actually existing. We show that this is indeed the case, and at the same time, derive comparative statics. We relegate most of the details to the Appendix. However, one point that is worth describing in more detail is the determination of the level of compensation for regulatory workers.

The level of a banker's compensation is easy to describe—from Lemma 1, it simply equals the expected output of a banker. For the case in which the banking sector is relatively large, regulatory worker compensation follows easily: only low-skill workers are employed by regulatory agencies, and their expected compensation is determined by the indifference condition with the contract for low-skill bankers, which is a simple contract offering guaranteed pay.

The case in which the banking sector is small—relative to the supply of high-skill workers—is more complicated. Again, low-skill regulatory worker compensation is determined by the indiffer-

ence condition with banking contracts. The complication is that now the indifference condition entails the banking contract for high-skill workers, which, as discussed above, is distorted and features performance-based compensation. However, the size of the distortion depends on the employment conditions of low-skill regulatory workers. Lemma 4 in the Appendix establishes that it is possible to simultaneously (and uniquely) determine the level of regulatory worker compensation and the extent to which high-skill banking contracts are distorted.

Our formal result is that an equilibrium exists whenever the number of high-skill workers η is sufficiently low (as in Rothschild and Stiglitz (1976)).[12]

Proposition 5 *Provided the ratio of high-skill to low-skill workers η is not too large, at least one equilibrium exists.*

The comparative statics are immediate from the proof of Proposition 5:

Corollary 2 *The comparative statics identified in Corollary 1 for the risk-neutral setting also hold in the risk-averse setting.*

The intuition behind the comparative statics for the risk-averse setting is identical to that for the risk-neutral setting.

5 Human Capital Formation in a Two-Stage OLG Model

So far we have assumed that workers enjoy an exogenous gain by working in regulation. In this section, we extend our model to a two-stage overlapping generation model and analyze how a human capital interpretation of Δ might affect the allocation of workers between the two sectors. We assume that young workers extract benefits from working in regulation but old workers do

[12]The requirement that there are not too many high-skill workers is standard to the literature on competition under adverse selection: see, for example, Rothschild and Stiglitz (1976). In brief, the issue is that any candidate equilibrium entails different contracts for high- and low-skill workers, and the contracts for high-skill workers offer less than full insurance. So if most workers are high-skill, the following deviation is profitable: offer a contract that reduces the expected compensation of high-skill workers, but in return, features full insurance. All workers accept this contract, and provided that there are enough high-skill workers, the increase in profits from these workers more than offsets the losses from low-skill workers. As discussed by, for example, Bolton and Dewatripont (2005), there is some dissatisfaction with this equilibrium non-existence result that arises when there are many high-skill types, and a number of authors have offered possible solutions.

not. We start by keeping the value of these career benefits for young workers, denoted by Δ_y, as exogenous and equal among both types of young workers. These benefits could come from developing political connections, learning about regulators' practices or acquiring any knowledge useful for later stages of one's career. But later in this section, we endogenize Δ_y as the expected gain resulting from improved skills following employment in regulation, consistent with a human capital formation story.[13]

In addition, we assume that switching occupations in mid-career—i.e., moving from regulation to banking, or vice versa—carries some cost. For example, the worker's productivity may be negatively impacted; some human capital may be lost; or the worker may simply suffer some direct disutility from moving. The exact form of the cost is unimportant for our analysis, and so we assume simply that the worker bears a cost $c \geq 0$ from switching occupations in mid-career.

Since we wish to interpret Δ_y as stemming from human capital formation, we assume that old workers have no intrinsic preference between regulation and banking. Instead, their decision as to which sector to work in is determined solely by the compensation offered, the expected gains from available misbehavior opportunities in banking, and (in the case of positive switching cost) where they worked when young.

As in Section 3, we assume that workers are risk neutral. This greatly simplifies the algebra and allows us to focus on worker allocation issues at the cost of losing predictions about the sensitivity of pay to performance.

Given risk neutrality, as in the static model we can assume without loss of generality that banks offer a single simple contract that will pay p in the case of success, and nothing in the case of failure. Likewise, regulatory agencies offer a single simple contract to any type of workers that will pay some amount s in the case of success, and nothing in the case of failure. The value of s is determined in equilibrium, depending on who the marginal worker in the regulatory sector is.

Assuming that $\Delta_y > \phi(0)$, exactly the same argument as in the static model implies that, in equilibrium, regulatory agencies employ lower-skilled *young* workers than do banks, because of the young workers' preference for regulation. Moreover, this same condition also implies that regulatory

[13] Again, this interpretation for Δ_y would also be sensible in a career choice model that assumes the opportunity to work for rating agencies rather than for regulatory agencies.

agencies must employ at least some young workers, because their preference for regulation makes them cheaper to employ than old workers.

Given these observations, one possible equilibrium outcome is that regulatory agencies employ only a subset of young workers, all of whom then move to the banking sector when old. These observations also imply that, absent switching costs (i.e., $c = 0$) regulatory agencies employ old workers only after they have exhausted the supply of young workers. However, this implication strikes us as counterfactual.

In contrast, positive switching costs can lead naturally to an equilibrium in which low-skill old workers who started in regulation remain in regulation, while high-skill old workers who started in regulation move to banking. With $c > 0$, regulatory agencies do not have to pay old workers the wages that would make them indifferent between the two sectors in a frictionless labor market. Agencies still need to compete with banks on wages, but now they benefit from the fact that agents who worked in regulation in the past face a switching cost for moving to banking. On the other hand, it becomes more difficult to hire agents who worked in banking in the past.

Low-skill old workers who started as regulators prefer to remain as regulators as long as

$$sq_L \geq pq_L + \phi(r) - c, \tag{2}$$

while high-skill old workers who started as regulators prefer to switch to banking as long as

$$pq_H + \phi(r) - c \geq sq_H. \tag{3}$$

Any equilibrium in which only a subset of young workers become regulators must have regulatory agencies offering a wage $s < p$, since otherwise—given their preference for regulation—all young workers would prefer to be regulators. Consequently, there exists a range of switching costs such that both inequalities above are satisfied. In that case, the banking sector attracts workers that are, on average, more skilled than those in the regulatory sector for both age groups.

We conclude this section by closing the model and endogenously determining Δ_y as the gain in expected job market prospects when old. To capture human capital accumulation while preserving

our convenient two-type model, we assume that all workers have some probability of being high-skill when old, and some probability of being low-skill when old. Working in regulation when young increases by $\delta > 0$ the probability of being high-skill when old. For now, we assume that a worker's skill levels when young and old are uncorrelated: all workers who start as bankers have a probability α of being high-skill when old, while all workers who start in regulation have a probability $\alpha + \delta$ of being high-skill when old. We return to this point in more details below.

For specificity, we focus on an equilibrium in which only low-skill workers are regulators when young (i.e., M is relatively low). In such an equilibrium, the regulatory success payment s is

$$s = p - \frac{\Delta_y - \phi(r)}{q_L}.$$

Assuming the switching cost is such that inequalities (2) and (3) hold, a young worker starting in regulation has the following expected utility when old:

$$(\alpha + \delta)(pq_H + \phi(r) - c) + (1 - \alpha - \delta) sq_L.$$

And we know that since $s < p$ in equilibrium a worker who started in banking will not switch to the regulatory sector regardless of his skill level. A young worker starting in banking then has the following expected utility when old:

$$\alpha(pq_H + \phi(r)) + (1 - \alpha)(pq_L + \phi(r)).$$

Consequently, the gain in future payoff to working as a regulator when young is

$$\begin{aligned} \Delta_y &= (\alpha + \delta)(pq_H + \phi(r) - c) + (1 - \alpha - \delta) sq_L \\ &\quad -\alpha(pq_H + \phi(r)) - (1 - \alpha)(pq_L + \phi(r)). \end{aligned} \tag{4}$$

Inserting $s = p - \frac{\Delta_y - \phi(r)}{q_L}$ yields:

$$\Delta_y = \frac{1}{2 - \alpha - \delta}\left[\delta p(q_H - q_L) - (\alpha + \delta)c\right].$$

As noted, we have assumed above that a worker's skill level is uncorrelated over time. Now, assume that workers who are high-skilled when young have a higher probability, α_H say, of being high-skilled when old. From expression (4), one can see that this assumption would result in Δ_y varying with the worker's type when young. In an equilibrium such as the one above, the price s makes the low-skill young worker indifferent between the two sectors and does not depend on the level of α_H. The assumption that $\alpha_H > \alpha$ implies that high-skill young workers would benefit *less* from working in regulation than before. To see this, observe that the derivative of (4) with respect to α is

$$pq_H + \phi(r) - c - sq_L - pq_H - \phi(r) + pq_L + \phi(r) = pq_L + \phi(r) - c - sq_L,$$

which is negative by inequality (2). Consequently, a positive correlation of skill over time would actually reinforce our results, though at the cost of moving us away from the baseline model in which the benefit of working in regulation is independent of type.

6 Conclusion

We propose a career choice model in which workers of differential ability levels can choose to work as bankers, responding to a demand function for banking services, or as regulators, monitoring the behavior of bankers. The model allows us to shed some light on the interactions between the financial labor markets, the demand for financial services, and the degree of misbehavior in the financial sector. We assume that the intrinsic benefit from working as a regulator (e.g., recognition for being a social servant) is greater than the ex ante benefit a banker can expect to extract through fraud or other types of misbehavior. Our model predicts that bankers are, on average, more skilled than regulators and their compensation is more sensitive to performance. We show that during financial booms banks draw the best workers away from the regulatory sector and equilibrium misbehavior by bankers increases. We also provide an analysis of how human capital considerations might affect the allocation of workers between the two sectors when working in regulation improves future career opportunities. We construct an equilibrium where the banking sector attracts workers that are, on average, more skilled than those in the regulatory sector for all

age groups.

A Appendix

A.1 Results omitted from main text

The following result is standard to the analysis of competition subject to adverse selection. Note that the lemma is written so that it applies to case in which both types work in banking, or both types work in regulation.

Lemma 2 *Let $w_S^L = w_F^L$. Consider the problem:*

$$\sup_{w_S, w_F} q_H u\left(w_S^H\right) + (1 - q_H)\, u\left(w_F^H\right)$$

subject to the employer and incentive compatibility constraints

$$\begin{aligned} \frac{q_H}{q_H w_S^H + (1 - q_H)\, w_F^H} &\geq \frac{q_L}{w^L} \\ q_L u\left(w_S^H\right) + (1 - q_L)\, u\left(w_F^H\right) &\leq u\left(w^L\right). \end{aligned}$$

This problem has a solution. At the solution, both constraints hold with equality, $w_S^H > w_F^H$, and

$$q_H u\left(w_S^H\right) + (1 - q_H)\, u\left(w_F^H\right) > u\left(w^L\right).$$

Proof of Lemma 2: Observe that $w_S^H = w_F^H = w^L$ satisfies both constraints, and so utility $u\left(w^L\right)$ is obtainable. From the employer constraint, for any given w_F^H we know w_S^H is bounded above by $\frac{w^L}{q_L} - \frac{1-q_H}{q_H} w_F^H$, and so utility is bounded above by $q_H u\left(\frac{w^L}{q_L} - \frac{1-q_H}{q_H} w_F^H\right) + (1 - q_H)\, u\left(w_F^H\right)$. This expression goes to $-\infty$ as $w_F^H \to \pm\infty$; so without loss we can restrict attention to values of w_F^H drawn from some closed interval. A parallel argument implies that we can likewise without loss restrict attention to values of w_S^H drawn from some closed interval. Consequently, the problem has a well-defined maximum. Given this, both constraints must bind, as follows. Clearly at least one constraint must bind. If the employer constraint is non-binding, there is clearly some perturbation of the contract w^H that strictly increases utility while leaving the incentive compatibility constraint binding. Suppose instead that the employer constraint binds but the incentive compatibility

constraint does not. If $w_S^H = w_F^H$, then both must equal $\frac{q_H w^L}{q_L} > w^L$, but then the incentive compatibility constraint is violated. If instead $w_S^H \neq w_F^H$, there is a contract perturbation that strictly increases utility but leaves the incentive compatibility constraint satisfied: move the two payments w_S^H, w_F^H closer to each other, while leaving $q_H w_S^H + (1 - q_H) w_F^H$ unchanged.

The similar argument to the one at the start of the proof implies that there are at least two contracts w^H that satisfy both the employer and incentive compatibility constraints at equality, and at least one such contract has $w_S^H > w_F^H$. It is straightforward to show that, since $q_H > q_L$, the solution with the highest value of w_S^H (and hence the lowest value of w_F^H) is the one that maximizes the objective. Hence $w_S^H > w_F^H$. The final strict inequality follows easily from $w_S^H > w_F^H$, $q_H > q_L$, and the incentive constraint at equality. ∎

The following result replicates Lemma 2 for the case in which all low-skill workers work for regulators and all high-skill workers are bankers.

Lemma 3 *Let $w_{RS}^L = w_{RF}^L$. Consider the problem:*

$$\sup_{w_B^H} U^H\left(w_B^H\right)$$

subject to the employer and incentive compatibility constraints

$$\begin{aligned} \Pi^H\left(w_B^H\right) &\geq 0 \\ U^L\left(w_B^H\right) &\leq U^L\left(w_R^L\right). \end{aligned}$$

This problem has a solution. At the solution, either $w_{BS}^H = w_{BF}^H$; or both constraints hold with equality, $w_{BS}^H > w_{BF}^H$, and $U^H\left(w_B^H\right) > U^H\left(w_R^L\right)$.

Proof of Lemma 3: Parallel to the proof of Lemma 2.

Lemma 4 *The following system of equations :*
$w_{RS}^L = w_{RF}^L$;
$\max_{w_R^H} U^H\left(w_R^H\right)$ *such that* $U^L\left(w_R^H\right) = U^L\left(w_R^L\right)$ *and* $\rho^H\left(w_R^H\right) = \rho^L\left(w_R^L\right)$;

$\max_{w_B^H} U^H\left(w_B^H\right)$ *such that* $U^L\left(w_B^H\right) = U^L\left(w_R^L\right)$ *and* $\Pi^H\left(w_B^H\right) = 0$*;*
$U^H\left(w_R^H\right) = U^H\left(w_B^H\right)$,
has a unique solution.

Proof of Lemma 4: Throughout, we write w_R^L for $w_{RS}^L = w_{RF}^L$. First, we use the pair of equations $U^L\left(w_R^H\right) = U^L\left(w_R^L\right)$ and $\rho^H\left(w_R^H\right) = \rho^L\left(w_R^L\right)$, together with the fact that w_R^H is chosen to maximize $U^H\left(w_R^H\right)$, to solve for w_R^H in terms of w_R^L. Note that as $w_R^L \to -\infty$, $U^H\left(w_R^H\right) \to -\infty$ since $U^H\left(w_R^H\right)$ is bounded above by its value under the full-insurance contract $\left(\frac{q_H}{q_L} w_R^L, \frac{q_H}{q_L} w_R^L\right)$; while as $w_R^L \to \infty$ then $U^H\left(w_R^H\right) \geq U^L\left(w_R^H\right) \to 0$.

Next, we show that $U^H\left(w_R^H\right)$ is globally strictly increasing as a function of w_R^L. Note first that $w_{RS}^H > w_{RF}^H$ (see the proof of Lemma 2). Differentiation of $U^L\left(w_R^H\right) = U^L\left(w_R^L\right)$ and $\rho^H\left(w_R^H\right) = \rho^L\left(w_R^L\right)$ implies

$$\begin{aligned} q_L u'\left(w_{RS}^H\right) dw_{RS}^H + (1-q_L)\, u'\left(w_{RF}^H\right) dw_{RF}^H &= u'\left(w_R^L\right) dw_R^L \\ q_H dw_{RS}^H + (1-q_H)\, dw_{RF}^H &= \frac{q_H}{q_L} dw_R^L. \end{aligned}$$

So, it is possible to transform these two equations into the following two equations:

$$\begin{aligned} \left((1-q_H)\, q_L u'\left(w_{RS}^H\right) - q_H (1-q_L)\, u'\left(w_{RF}^H\right)\right) dw_{RS}^H &= \left((1-q_H)\, u'\left(w_R^L\right) - (1-q_L)\, u'\left(w_{RF}^H\right) \frac{q_H}{q_L}\right) dw_R^L \\ \left(q_H (1-q_L)\, u'\left(w_{RF}^H\right) - (1-q_H)\, q_L u'\left(w_{RS}^H\right)\right) dw_{RF}^H &= \left(q_H u'\left(w_R^L\right) - q_L u'\left(w_{RS}^H\right) \frac{q_H}{q_L}\right) dw_R^L. \end{aligned}$$

Define: $D = q_H (1-q_L) u'\left(w_{RF}^H\right) - (1-q_H) q_L u'\left(w_{RS}^H\right)$, and note that $D > 0$. Hence, the change in $u^H\left(w_R^H\right)$ is given by:

$$
\begin{aligned}
& q_H u'\left(w_{RS}^H\right) dw_{RS}^H + (1-q_H) u'\left(w_{RF}^H\right) dw_{RF}^H \\
= & \frac{1}{D}(1-q_H) u'\left(w_{RF}^H\right)\left(q_H u'\left(w_R^L\right) - q_L u'\left(w_{RS}^H\right)\frac{q_H}{q_L}\right) dw_R^L \\
& -\frac{1}{D} q_H u'\left(w_{RS}^H\right)\left((1-q_H) u'\left(w_R^L\right) - (1-q_L) u'\left(w_{RF}^H\right)\frac{q_H}{q_L}\right) dw_R^L \\
= & \frac{1}{D}(1-q_H) q_H \left(u'\left(w_{RF}^H\right) - u'\left(w_{RS}^H\right)\right) u'\left(w_R^L\right) dw_R^L \\
& +\frac{1}{D}\left(q_H (1-q_L)\frac{q_H}{q_L} - (1-q_H) q_H\right) u'\left(w_{RS}^H\right) u'\left(w_{RF}^H\right) dw_R^L \\
= & \frac{q_H}{D}\left((1-q_H)\left(u'\left(w_{RF}^H\right) - u'\left(w_{RS}^H\right)\right) u'\left(w_R^L\right) + \left(\frac{q_H}{q_L} - 1\right) u'\left(w_{RS}^H\right) u'\left(w_{RF}^H\right)\right) dw_R^L.
\end{aligned}
$$

The term multiplying dw_R^L is strictly positive, making $u^H\left(w_R^H\right)$ strictly increasing in w_R^L.

Second, we use the pair of equations $U^L\left(w_B^H\right) = U^L\left(w_R^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$, together with the fact that w_B^H is chosen to maximize $U^H\left(w_B^H\right)$, to solve for w_B^H in terms of w_R^L. First, observe that a solution only exists for w_R^L below some cutoff value. Moreover, when w_R^L equals this cutoff level, $U^H\left(w_B^H\right)$ is strictly negative.

We next show that $U^H\left(w_B^H\right)$ is globally strictly decreasing as a function of w_R^L. Note first that $w_{BS}^H \geq w_{BF}^H$ (see the proof of Lemma 2). Differentiation of $U^L\left(w_B^H\right) = U^L\left(w_R^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$ implies

$$
\begin{aligned}
q_L u'\left(w_{BS}^H\right) dw_{BS}^H + (1-q_L) u'\left(w_{BF}^H\right) dw_{BF}^H &= \frac{e^{-\gamma\Delta}}{\Phi} u'\left(w_R^L\right) dw_R^L \\
q_H dw_{BS}^H + (1-q_H) dw_{BF}^H &= 0.
\end{aligned}
$$

So, it is possible to transform these two equations into the following two equations:

$$
\begin{aligned}
\left((1-q_H) q_L u'\left(w_{BS}^H\right) - (1-q_L) q_H u'\left(w_{BF}^H\right)\right) dw_{BS}^H &= (1-q_H)\frac{e^{-\gamma\Delta}}{\Phi} u'\left(w_R^L\right) dw_R^L \\
\left(q_H (1-q_L) u'\left(w_{BF}^H\right) - (1-q_H) q_L u'\left(w_{BS}^H\right)\right) dw_{BF}^H &= -q_H \frac{e^{-\gamma\Delta}}{\Phi} u'\left(w_R^L\right) dw_R^L.
\end{aligned}
$$

Hence, the change in $U^H\left(w_B^H\right)$ is given by:

$$\begin{aligned} & q_H u'\left(w_{BS}^H\right)\Phi dw_{BS}^H + (1-q_H)\,u'\left(w_{BF}^H\right)\Phi dw_{BF}^H \\ = \; & \frac{-1}{e^{-\gamma\Delta}D}\left(q_H\,(1-q_H)\,u'\left(w_{BF}^H\right) + q_H\,(1-q_H)\,u'\left(w_{BS}^H\right)\right)u'\left(w_R^L\right)dw_R^L. \end{aligned}$$

The term multiplying dw_R^L is strictly negative, making $U^H\left(w_B^H\right)$ strictly decreasing in w_R^L.

Existence and uniqueness are then immediate from continuity. ∎

A.2 Proofs of results stated in main text

Proof of Lemma 1: Suppose to the contrary that an equilibrium in which banks extract strictly positive profits from a worker type i exists. Let w_B^L and w_B^H be the equilibrium contracts.

There cannot be an equilibrium in which a bank makes strictly positive profits from both types, i.e., $\Pi^L\left(w_B^L\right) > 0$ and $\Pi^H\left(w_B^H\right) > 0$, since in this case a bank can profitably deviate by making both contracts slightly more attractive and capturing the whole market. So the bank must make weakly negative profits from type $j \neq i$. (This includes the case in which type j works only for regulators.)

Next, let $\tilde{w}_B^i$ be a contract that strictly improves the utility of type i relative to w_B^i, but strictly worsens the utility of type j relative to w_B^i. Because the success probabilities differ, one can always construct such a contract, and moreover, can ensure that the profits $\Pi^i\left(\tilde{w}_B\right)$ are arbitrarily close to the profits $\Pi^i\left(w_B^i\right) > 0$. It is then a strictly profitable deviation for a bank to offer a single contract, $\tilde{w}_B^i$, in place of the menu of contracts, $\left\{w_B^H, w_B^L\right\}$, as follows. By construction, type i accepts the contract, and $\Pi^i\left(\tilde{w}_B\right) > 0$. Moreover, type j does not accept the contract, since in the conjectured equilibrium he is at most indifferent between selecting w_B^i and some other contract, which remains available; and $U^j\left(\tilde{w}_B^i\right) < U^j\left(w_B^i\right)$. The existence of a strictly profitable deviation contradicts the equilibrium definition, and establishes the result.

A similar proof by contradiction applies for regulatory agencies and the productivity per dollar of their workers. ∎

Proof of Proposition 2: For each possible number of bankers $n \in (0,\eta)\cup(\eta, 1+\eta)$, we construct a

candidate equilibrium that satisfies all the equilibrium conditions other than the regualtor budget constraint. We then calculate the regulatory sector's total compensation bill for each possible number of bankers n. Finally, we use a version of the intermediate-value theorem to show that at least one candidate equilibrium satisfies the regulator budget constraint.

Let $n \in [0, 1+\eta]$ be the total number of bankers. Let $Y(n)$ be the associated total output of the banking sector. From Proposition 1, we know

$$Y(n) = \begin{cases} nq_H & \text{if } n \leq \eta \\ \eta q_H + (n-\eta) q_L & \text{if } n > \eta \end{cases}.$$

Note that Y is continuous in n. The price of banking output is $p = P(Y(n))$ and is also continuous in n.

As discussed in the main text, we can assume without loss that banks offer contracts $\left(w_{BS}^L, w_{BF}^L\right) = \left(w_{BS}^H, w_{BF}^H\right) = (p, 0)$ and regulatory agencies offer copntracts $\left(w_{RS}^L, w_{RF}^L\right) = \left(w_{RS}^H, w_{RF}^H\right) = (w_{RS}, 0)$, where w_{RS} is as determined below:

Case: $n \in (0, \eta)$ When $n \in (0, \eta)$, all bankers have high skill and w_{RS} is determined by the high-skill workers' indifference condition such that $w_{RS} = p - \frac{\Delta - \phi(r)}{q_H}$. This wage satisfies utility-maximization, profit-maximization, and fraud minimization conditions. First, low-skill workers do not become bankers since

$$q_L w_{RS} + \Delta - \phi(r) = q_L p - \frac{q_L}{q_H}(\Delta - \phi(r)) + \Delta - \phi(r) > q_L p.$$

Second, each bank cannot raise profits by paying high-skill workers less since it would not be able to hire any. To hire a low-skill worker, a bank would have to offer expected compensation greater than $q_L w_{RS} + \Delta - \phi(r)$ and it would be unprofitable. Third, each regulatory agency hires both types of agents, and gets the same efficiency from both. So it cannot gain by dropping one of the types, and if it tries reducing wages it will not be able to hire anyone.

Case: $n \in (\eta, 1+\eta)$ When $n \in (\eta, 1+\eta)$, all bankers have low skill and w_{RS} is determined by the low-skill workers' indifference condition such that $w_{RS} = p - \frac{\Delta - \phi(r)}{q_L}$. This wage satisfies utility-

maximization, profit-maximization, and fraud minimization conditions. First, high-skill workers do not become regulators since

$$q_H w_{RS} + \Delta - \phi(r) = q_H p - \frac{q_H}{q_L}(\Delta - \phi(r)) + \Delta - \phi(r) < q_H p.$$

Second, each bank hires both types of agents, and cannot raise profits by paying any agent less since it would not be able to hire them. Third, each regulatory agency hires only low-skill workers. To hire high-skill workers, it would need to pay them $p - \frac{\Delta - \phi(r)}{q_H}$, which would make them less productive at catching fraud per expected dollar paid than low-skill workers earning $w_{RS} = p - \frac{\Delta - \phi(r)}{q_L}$.

Case: $n = \eta$ When $n = \eta$, any value of w_{RS} in the closed interval

$$\left[p - \frac{\Delta - \phi(r)}{q_L}, p - \frac{\Delta - \phi(r)}{q_H}\right]$$

is consistent with the equilibrium conditions. These values for w_{RN} satisfy utility-maximization, profit-maximization, and fraud minimization conditions. First, high-skill workers do not become regulators and low-skill workers do not become bankers since $q_H p \geq q_H w_{RS} + \Delta - \phi(r)$ and $q_L p \leq q_L w_{RS} + \Delta - \phi(r)$. Second, each bank cannot raise profits by paying high-skill workers less since it would not be able to hire any. To hire a low-skill worker, a bank would have to offer expected compensation of at least $q_L w_{RS} + \Delta - \phi(r)$, and would yield at most zero profits (and potentially less). Third, each regulatory agency hires only low-skill workers. To hire high-skill workers, it would need to pay them $p - \frac{\Delta - \phi(r)}{q_H}$, which would make them at most as productive at catching fraud per expected dollar paid than low-skill workers and potentially less.

For any n, let $W(n)$ be the total regulator wage bills associated with the candidate equilibrium characterized above. Since for $n = \eta$ the candidate equilibrium is not unique, in this case $W(n)$ is a set. Hence W defines a correspondence from $[0, 1 + \eta]$ into $\Re$. Susbstituting in the above

characterization of contracts,

$$W(n) = \begin{cases} ((\eta - n) q_H + q_L) \left(p - \frac{\Delta - \phi(r)}{q_H}\right) & \text{if } n < \eta \\ \left\{ q_L \left(p - \frac{\Delta - \phi(r)}{\chi}\right) : \chi \in [q_L, q_H] \right\} & \text{if } n = \eta \\ (1 - (n - \eta)) q_L \left(p - \frac{\Delta - \phi(r)}{q_L}\right) & \text{if } n > \eta \end{cases}.$$

Note that $\lim_{n \to 0} W(n) = \infty$ since $\lim_{Y \to 0} P(Y) = \infty$, and so banking and hence regulator compensation must grow arbitrarily large. Moreover, $\lim_{n \to 1+\eta} W(n) = 0$, since in this case regulators do not employ anyone (and compensation is bounded, since banker compensation is bounded). Since the detection probability r and hence $\phi(r)$ are continuous in n, the function $W(n)$ is continuous over each of $(0, \eta)$ and $(\eta, 1 + \eta)$.

Moreover, $Y(\eta) = \left[q_L \left(p - \frac{\Delta - \phi(r)}{q_L}\right), q_L \left(p - \frac{\Delta - \phi(r)}{q_H}\right)\right]$, $\lim_{n \nearrow \eta} W(n) = q_L \left(p - \frac{\Delta - \phi(r)}{q_H}\right)$ and $\lim_{n \searrow \eta} W(n) = q_L \left(p - \frac{\Delta - \phi(r)}{q_L}\right)$. So by an obvious extension of the mean-value theorem,[14] there exists $n \in (0, 1 + \eta)$ such that $W(n) = M$. ∎

Proof of Proposition 3: Suppose to the contrary that such an equilibrium exists. Consider first the deviation in which a bank offers the contract $(\tilde{w}_{BS}, \tilde{w}_{BF}) = \left(w_{RS}^H + \lambda + \varepsilon_S, w_{RF}^H + \lambda - \varepsilon_F\right)$, where λ is such that, if $\varepsilon_S = \varepsilon_F = 0$, the new contract offers to any worker exactly the same utility as the regulator contract $\left(w_{RS}^H, w_{RF}^H\right)$ offers, i.e.,

$$u(w + \lambda) \Phi(r) = u(w + \Delta) \text{ for all } w,$$

or equivalently,

$$\Delta - \lambda = -\frac{1}{\gamma} \ln \Phi(r).$$

For use below, note that, from the condition stated in the proposition, $\lambda > 0$: in words, if offered the same wages, workers prefer regulation to banking, and so a bank must raise wages by λ above a regulator if it is to offer the same utility. Choose ε_S and ε_F such that the new contract offers strictly more utility to high-skill workers but strictly less utility to low-skill workers than the regulator

[14] More formally, W is upper hemi-continuous, and Lemma 4.1 of John (1999) applies.

contract $\left(w_{RS}^{H}, w_{RF}^{H}\right)$. Consequently, high-skill workers in regulation will accept this contract, while no low-skill workers will accept this contract, since it is strictly worse than a contract they already reject.

By supposition, the original set of contracts is an equilibrium, and so any deviation of the type just described must deliver weakly negative profits for the bank offering it, i.e., $q_H \tilde{w}_{BS} + (1 - q_H)\, \tilde{w}_{BF} \geq q_H p$. If that was not the case, the original set of contracts could not be part of an equilibrium. It follows that

$$q_H w_{RS}^{H} + (1 - q_H)\, w_{RF}^{H} + \lambda \geq q_H p. \tag{5}$$

Next, consider a deviation by a regulatory agency to $(\tilde{w}_{RS}, \tilde{w}_{RF}) = \left(w_{BS}^{L} - \lambda - \varepsilon_S', w_{BF}^{L} - \lambda + \varepsilon_F'\right)$, where λ is as defined above. Given CARA utility,

$$u(w)\, \Phi(r) = u(w - \lambda + \Delta) \text{ for all } w.$$

Consequently, when $\varepsilon_S' = \varepsilon_F' = 0$, the new contract offers exactly the same utility as the bank contract $\left(w_{BS}^{L}, w_{BF}^{L}\right)$. Let ε_S' and ε_F' be such that the new contract offers strictly more utility to low-skill workers but strictly less utility to high-skill workers than the banker contract $\left(w_{BS}^{L}, w_{BF}^{L}\right)$. Consequently, low-skill workers working in banking will accept this contract, while no high-skill worker will accept this contract, since it is strictly worse than a contract they already reject.

The productivity of this deviation contract (i.e., useful reports per dollar spent in expectation) is

$$\frac{q_L}{q_L \tilde{w}_{RS} + (1 - q_L)\, \tilde{w}_{RF}}.$$

By setting ε_S' and ε_F' small, this can be made arbitrarily close to

$$\frac{q_L}{q_L w_{BS}^{L} + (1 - q_L)\, w_{BF}^{L} - \lambda}.$$

By supposition $\left(w_{BS}^{L}, w_{BF}^{L}\right)$ is an equilibrium contract, and since $\alpha^L > 0$, is accepted by some low-skill workers. So the zero-profit condition for banks implies that this ratio equals $\frac{q_L}{q_L p - \lambda}$, which

since $\lambda > 0$ is strictly greater than $\frac{q_H}{q_H p - \lambda}$, which by (5) is weakly greater than

$$\frac{q_H}{q_H w_{RS}^H + (1 - q_H) w_{RF}^H},$$

the productivity of the equilibrium contract for high-skill regulators, $\left(w_{RS}^H, w_{RF}^H\right)$. Hence there exists a deviation that strictly raises the regulator's productivity, contradicting the supposition that the original set of contracts was an equilibrium, and completing the proof. ∎

Proof of Proposition 4: The main text deals with the cases in which both types of worker are in employed by banks, in which both types of worker are employed by regulators. The only remaining case is that all regulatory workers are low-skill, and all bankers are high-skill. Suppose that, contrary to the claimed result, the banking contracts have fixed wages, i.e., $w_{BS}^H = w_{BF}^H = w_B^H$. From the main text, low-skill regulatory workers have a fixed wage, i.e., $w_{RS}^L = w_{RF}^L = w_R^L$. So for both worker types $i = \{L, H\}$, $U^i\left(w_B^H\right) = u\left(w_B^H\right)\Phi(r)$ and $U^i\left(w_R^L\right) = u\left(w_R^L\right)e^{-\gamma\Delta}$. From the utility maximization constraints, $u\left(w_B^H\right)\Phi(r) = u\left(w_R^L\right)e^{-\gamma\Delta}$. But then a regulator could strictly increase its productivity by offering a fixed wage just above w_R^L and attracting both types of worker. ∎

Proof of Proposition 5: The structure of the proof is similar to that of Proposition 2. For each $n \in (0, \eta) \cup (\eta, 1 + \eta)$, we construct a candidate equilibrium. We also show that, given n, the candidate equilibrium is unique; this matters for comparative statics, though not for equilibrium existence. We then calculate the regulatory sector's total compensation bill for each possible number of bankers n. Finally, we use a version of the intermediate-value theorem to show that at least one candidate equilibrium exists. The only equilibrium condition we then need to check is that there is no "pooling" deviation in which an employer offers an alternate contract that attracts *both* types of workers, as in Rothschild and Stiglitz (1976). Finally, the comparative statics follow straightforwardly from the mapping used to establish equilibrium existence.

We start by considering, in turn, the cases $n \in (0, \eta)$ and $n \in (\eta, 1 + \eta)$. Banking output $Y(n)$ is defined as in the proof of Proposition 2. Likewise, as in the proof of Proposition 2 we construct a correspondence $W : [0, 1 + \eta] \rightarrow\rightarrow \Re$ giving the total regulator wage bill for each candidate number

of bankers n.

Case: $n \in (0, \eta)$

When the number of bankers $n < \eta$, all bankers have high skill. So the contracts accepted in equilibrium are w_R^L, w_R^H, w_B^H. From the text prior to Proposition 4, $w_{RS}^L = w_{RF}^L$. From Lemma 2, w_R^H solves $\max_{w_R^H} U^H\left(w_R^H\right)$ such that $U^L\left(w_R^H\right) = U^L\left(w_R^L\right)$ and $\rho^H\left(w_R^H\right) = \rho^L\left(w_R^L\right)$. Note that from Lemma 2, $w_{RS}^H > w_{RF}^H$ and $U^H\left(w_R^H\right) = U^H\left(w_B^H\right)$, since otherwise either banks or regulators could profitably reduce the compensation of high-skill workers. Full-insurance for the contract w_B^H is impossible in equilibrium, since in this case, $U^L\left(w_B^H\right) = U^H\left(w_B^H\right) = U^H\left(w_R^H\right) > U^H\left(w_R^L\right) = U^L\left(w_R^L\right)$, implying no low-skill worker would accept the regulation contract intended for him. So Lemma 3 implies that w_B^H solves $\max_{w_B^H} U^H\left(w_B^H\right)$ such that $U^L\left(w_B^H\right) = U^L\left(w_R^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$. From Lemma 4, this system of equations has a unique solution. In this case, the total wage bill of the regulatory sector is $W(n) = (\eta - n)\left(q_H w_{RS}^H + (1 - q_H) w_{RF}^H\right) + w_{RS}^L$.

Case: $n \in (\eta, 1 + \eta)$

When the number of bankers $n > \eta$, all regulators have low skill. So the contracts accepted in equilibrium are w_R^L, w_B^L, w_B^H. From the text prior to Proposition 4, $w_{RS}^L = w_{RF}^L$ and $w_{BS}^L = w_{BF}^L$. From Lemma 2, w_B^H solves $\max_{w_B^H} U^H\left(w_B^H\right)$ such that $U^L\left(w_B^H\right) = U^L\left(w_B^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$. Finally, $\Pi^L\left(w_B^L\right) = 0$ and $U^L\left(w_B^L\right) = U^L\left(w_R^L\right)$.

Note that $\Pi^L\left(w_B^L\right) = 0$ and $w_{BS}^L = w_{BF}^L$ uniquely determines w_B^L, and that $\max_{w_B^H} U^H\left(w_B^H\right)$ such that $U^L\left(w_B^H\right) = U^L\left(w_B^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$ then uniquely determines w_B^H. Finally, $w_{RS}^L = w_{RF}^L$ and $U^L\left(w_B^L\right) = U^L\left(w_R^L\right)$ uniquely determines w_R^L. In this case, the total wage bill of the regulatory sector is $W(n) = (1 + \eta - n) w_{RS}^L$.

Existence of candidate equilibrium n such that $W(n) = M$:

Note that $\lim_{n \to 0} W(n) = \infty$ since $\lim_{Y \to 0} P(Y) = \infty$, and so banking and hence regulator compensation must grow arbitrarily large. Moreover, $\lim_{n \to 1+\eta} W(n) = 0$, since in this case regulators do not employ anyone (and compensation is bounded, since banker compensation is bounded). Since the detection probability r and hence $\Phi(r)$ are continuous in n, the function $W(n)$ is continuous over each of $(0, \eta)$ and $(\eta, 1 + \eta)$.

Define w_R^{-L} as the limiting value of w_R^L in the case $n < \eta$ as $n \nearrow \eta$, and w_R^{+L} as the limiting value of w_R^L in the case $n > \eta$ as $n \searrow \eta$.

If $w_R^{-L} < w_R^{+L}$, then $\lim_{n \nearrow \eta} W(n) < \lim_{n \searrow \eta} W(n)$. If $\lim_{n \nearrow \eta} W(n) < M$ then by the intermediate value theorem there exists at least one $n \in (0, \eta)$ such that $W(n) = M$. If instead $\lim_{n \nearrow \eta} W(n) \geq M$ then $\lim_{n \searrow \eta} W(n) > M$, and by the intermediate value theorem there exists at least one $n \in (\eta, 1+\eta)$ such that $W(n) = M$.

Next, we turn to the harder case in which $w_R^{-L} \geq w_R^{+L}$. For this case, we consider the possible equilibria when the number of bankers $n = \eta$, and so all regulators have low skill and all bankers have high skill. So the contracts accepted in equilibrium are w_R^L, w_B^H. From the text prior to Proposition 4, $w_{RS}^L = w_{RF}^L$.

There is no equilibrium with $w_R^L < w_R^{+L}$, as follows. By the definition of w_R^{+L}, there exists a contract w_B^L that banks can offer to low-skill workers such that $U^L\left(w_B^L\right) = U^L\left(w_R^{+L}\right)$ and $\Pi^L\left(w_B^L\right) = 0$. Hence there is a contract $\tilde{w}_B^L$ that banks can offer to low-skill workers such that $U^L\left(\tilde{w}_B^L\right) > U^L\left(w_R^L\right)$ and $\Pi^L\left(w_B^L\right) > 0$.

There is no equilibrium with $w_R^L > w_R^{-L}$, as follows. By the definition of w_R^{-L}, and from the proof of Lemma 4, there exists a contract w_R^H that regulators can offer to high-skill workers such that $U^H\left(w_R^H\right) > U^H\left(w_B^H\right)$ and $\rho^H\left(w_R^H\right) = \rho^H\left(w_R^L\right)$, and such that only high-skill workers accept the contract. Hence there is a contract $\tilde{w}_R^H$ that regulators can offer to high-skill workers such that $U^L\left(\tilde{w}_B^L\right) > U^L\left(w_R^L\right)$ and $\rho^H\left(w_R^H\right) > \rho^H\left(w_R^L\right)$, and such that only high-skill workers accept the contract.

Consider any w_R^L in $\left[w_R^{+L}, w_R^{-L}\right]$. Full insurance in the contract w_B^H is impossible in equilibrium: in this case, $U^L\left(w_B^H\right) = U^H\left(w_B^H\right)$; since $w_R^L \leq w_R^{-L}$, the proof of Lemma 4 implies $U^H\left(w_B^H\right) \geq U^H\left(w_R^H\right)$, and also $w_{RS}^H > w_{RF}^H$, and hence $U^H\left(w_B^H\right) > U^L\left(w_R^H\right)$; but then $U^L\left(w_B^H\right) > U^L\left(w_R^H\right)$, a contradiction. Lemma 3 then implies that in any candidate equilibrium, w_B^H solves $\max_{w_B^H} U^H\left(w_B^H\right)$ such that $U^L\left(w_B^H\right) = U^L\left(w_R^L\right)$ and $\Pi^H\left(w_B^H\right) = 0$. This ensures that no bank can profitably poach the high-skill workers employed by other banks. Moreover, straightforward adaptation of the arguments in the last two paragraphs implies that no bank can profitably poach the low-skill workers employed by regulators, and no regulator can profitably poach the high-skill

workers employed by banks. So for any value of w_R^L in $\left[w_R^{+L}, w_R^{-L}\right]$, there is a candidate equilibrium.

In this case, W is a correspondence, since it takes multiple values at $n = \eta$. Moreover, $W(\eta) = \left[w_R^{+L}, w_R^{-L}\right]$, $\lim_{n \nearrow \eta} W(n) = w_R^{-L}$ and $\lim_{n \searrow \eta} W(n) = w_R^{+L}$. So by an obvious extension of the mean-value theorem,[15] there exists $n \in (0, 1+\eta)$ such that $W(n) = M$.

The arguments above establish the existence of a candidate equilibrium in which no bank or regulator can profitably deviate by offering a contract that is accepted by just one type. It remains to check that there is no profitable deviation involving a contract that is accepted by both types. The most profitable deviation of this type entails a full-insurance contract, since workers are strictly risk-averse. Since high-skill workers strictly prefer their contracts to the low-skill worker contracts (see above), the deviation must entail a discrete increase in the utility of low-skill workers. So the deviation results in losses from the low-skill workers who accept it. Provided the fraction of high-skill workers η is sufficiently small, it follows that the deviation is unprofitable. ∎

[15] More formally, W is upper hemi-continuous, and Lemma 4.1 of John (1999) applies.

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