Influence vs. Risk Weights: How to Address Optimistic Credit Ratings?

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Abstract: This paper is motivated to explain both why credit-rating agencies' ratings were excessively optimistic just before the Great Recession and why this excessive optimism was most pronounced for structured-finance (SF) ratings. We develop a principal-agent model of certification to assess the hypothesis that growing seller influence over SF ratings may have generated this excessive optimism. Consistent with this hypothesis, the model predicts that buyers' certification cutoffs are excessively pessimistic whereas sellers' cutoffs are excessively optimistic. In addition, this paper also discusses why stricter risk weights may better target the problem of overly optimistic SF ratings than switching to buyer certification. (JEL D82, G24, G28)

1. Introduction

It is well-known that overly optimistic credit ratings characterized the years just prior to the Great Recession. Less discussed, however, is the puzzling observation that this excessive optimism primarily characterized structured-finance (SF) credit ratings. In fact, SF ratings appear to have been excessively optimistic at an absolute level as well as relative to their corporate-finance (CF) counterparts. On an absolute level, White (2010) documents that the *majority of AAA-rated CDOs and traditional mortgage-backed securities issued on the eve of the crisis were later downgraded below investment grade*.[1] On a relative level, the IMF (2008) notes that mortgage-backed securities are more frequently downgraded than their CF counterparts.[2] In hindsight, the frequent SF downgrades should not be too surprising given the heightened frequency with which mortgage-backed securities were rated AAA. As noted by the Financial Crisis Inquiry Commission (2011), *Moody's rated thirty mortgage-related securities AAA during each business day in 2006 even though only six U.S. firms were rated AAA in 2010*.

This paper is motivated to explain why SF ratings might have been more optimistic than CF ratings, which may help us better understand one of the ten factors that the Financial Crisis Inquiry Commission attributed to causing the financial crisis. This paper considers White's

[1] Specifically, he notes that 80 percent of AAA-rated CDOs issued and rated between 2005 and 2007 were downgraded below investment grade by June 30, 2009, and for traditional mortgage-backed securities, such downgrades occurred with 52% frequency.

[2] As an illustration, they note that of the residential mortgage-backed securities rated BBB- to BBB+ by Standard and Poor's after 2005, 68% would be downgraded by one or more categories and 56% would be downgraded by more than two categories before February 25, 2008. By the end of 2001, the most recent year in which corporate downgrades had been frequently experienced, only 6% of BBB- to BBB+ corporate finance ratings would be downgraded by one or more categories.

(2010) claim that the seller-pays rating model caused SF credit ratings to be more optimistic than CF credit ratings because SF issuers' greater concentration allowed them greater influence over the ratings. White (2010) and Pagano and Volpin (2010) further claim that the problem of excessively optimistic credit ratings would be mitigated under a buyer-pays business model because buyers would have greater influence over the ratings process. Recent empirical findings support both claims that greater influence by sellers lead to more favorable ratings and that excessively optimistic ratings are more likely to occur under a seller-pays business model. For example, Efing and Hau (2015) find that credit-rating agencies give more favorable ratings for asset-backed and mortgage-backed securities issued by sellers who provide the credit-rating agencies more business. Similarly, Jiang, Stanford, and Xie (2012) document that Moody's credit ratings were *temporarily* more optimistic than Standard and Poor's during the few years that Standard and Poor's ratings operated under a buyer-pays model while Moody's ratings operated under a seller-pays model.

To conduct our analysis, we use a borrower-lender relationship in order to better develop policy implications for credit market certification. The agent (he), a borrower, has a security that only he can create, and the security's gross payout depends on its baseline quality and the agent's effort. For tractability, final payouts are non-stochastic, observable and verifiable, but the borrower is privately informed of the security's baseline quality. To produce the security, the agent also requires funding from the principal. The principal (she), a lender, may offer funding now in exchange for the security's payouts. Alternatively, the principal may have the opportunity to originate her own loans. Whether or not this non-strategic opportunity materializes is random and is only publicly observable after the agent is informed of his security's baseline quality.

Given the principal's outside opportunity, contracts now entail allocation rules that depend on the agent's announcement of type, and we show that all parties prefer allocation rules that can be replicated by a certification cutoff.[3] In particular, we identify the cutoffs preferred by the agent and the principal as well as the cutoffs preferred by an efficiency-maximizing certifier (it). Once the cutoffs are determined, type announcements exceeding the cutoff are allocated funding

[3] Such replication, however, requires an appropriate certification test: a test that fails all types below the certification cutoff but that allows all types above the cutoff to freely pass. In equilibrium, the principal must also find it worthwhile to hire agents passing the test and must incentivize capable agents to pass the test.

with certainty, whereas type announcements below the cutoff result in a type-invariant probability of non-allocation.

To study whether the cutoff is efficiently set, we compare the certification cutoffs preferred by an efficiency-maximizing certifier with the certification cutoffs preferred by the buyer and the seller to obtain three main theoretical finding. First, the model predicts that certification is excessively loose when the cutoff is chosen by the seller compared to the cutoffs chosen by both the efficiency-maximizing certifier and the buyer. In fact, the model predicts that if possible, sellers prefer certification cutoffs in which all sellers pass and certification is meaningless.[4] Second, the model favors buyer certification because seller certification can become meaningless whereas buyer certification cannot. Third, the model cautions that allowing the buyer to choose the certification cutoff introduces its own distortion. In the model, buyers will choose certification cutoffs that are more pessimistic than the efficiency-maximizing certifier's.[5] As a result, the paper suggests that allowing buyers too much influence over financial market certification may cause excessively optimistic ratings to be replaced by excessively pessimistic ratings.

These theoretical findings have three significant insights for policymakers. First, government intervention in the certification process may be necessary to address the distortions inherent in financial market certification. For example, the Dodd-Frank Wall Street Reform and Consumer Protection Act makes it easier for the SEC to sanction credit-rating agencies for overly optimistic ratings. Second, regulatory intervention should adjust the relative influence that buyers and sellers have over the certification process based on whether type I or type II errors are deemed more costly to society. Regulators primarily concerned that low-quality securities are inappropriately certified should favor greater buyer influence over the certification cutoff. Regulators primarily concerned that high-quality securities are not certified should favor greater seller influence over the certification cutoff. Third, to the extent that the ability of buyers and sellers to distort the certification cutoff depends on their market share within the specific

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4 This latter prediction may be consistent with Ashcraft, Goldsmith-Pinkham, and Vickery's (2010) and White's (2010) collective observations that 80 to 95% of alt-A and subprime mortgage-backed securities issued on the eve of the crisis received AAA ratings and that the majority of AAA-rated mortgage-backed securities during this time period would be rerated below investment-grade. Outside of financial market certification, two other examples of meaningless certification include the tenure system and the teacher ratings used in New York City public school districts prior to Mayor Bloomberg's reforms. Before Bloomberg's reforms, Brill (2009) states that ninety-seven percent of New York City public school teachers were given tenure after their third year and that teacher ratings followed a "satisfactory-unsatisfactory" system, in which ninety-nine percent of teachers received a satisfactory rating. Our model predicts that such extreme certification rates arise when sellers (e.g., issuers or teachers) have near total control over the certification process.

5 This prediction is consistent with White's (2010) observation that CF certification, over which sellers had less influence, had the perception of being excessively strict.

asset market, this paper suggests that the role for government intervention may vary by asset market. In particular, the potential for sellers in SF asset markets to use their greater issuance concentration and influence to distort credit ratings suggests that SEC sanctioning efforts should be more directed to detecting SF market distortions over CF market distortions.

In order to provide additional policy guidance, the paper attempts to assess whether stricter risk weights for purchases of certified SF assets might better target overly optimistic SF credit ratings than switching to buyer certification.[6] To study this issue, an extension in the paper uses taxes to model risk weights. In the extension, larger taxes are meant to capture stricter risk weights while smaller taxes are meant to capture more generous risk weights. When excessive seller influence results in an excessively optimistic cutoff, we show that higher cutoffs can be induced with a type-invariant tax on certified as well as non-certified products, and we characterize the tax that implements the cutoff that would be chosen by an efficiency-maximizing certifier. This extension suggests that regulators should combat excessively optimistic SF ratings using stricter risk weights instead of switching to a buyer-pays business model because risk weights can be targeted to SF asset markets while a buyer-pays business model would likely unnecessarily affect CF asset certification. A more targeted policy seems appropriate given the excessively frequent downgrades characterizing AAA-rated SF assets but not AAA-rated CF assets during the Great Recession. Yet, the proposal to apply stricter risk weights for AAA-rated SF assets compared to their CF counterparts runs counter to current proposals from the BIS' Basel Committee on Banking Supervision (BCBS 2015, 2016).[7]

The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature while Section 3 presents a benchmark borrowing-lending model with adverse selection but without certification. Section 4 introduces certification into the benchmark model and characterizes the optimal certification cutoff chosen by an efficiency-maximizing certifier. Section 5 presents the paper's main propositions regarding the cutoffs that would be chosen by both the buyer and the seller. To study how stricter regulatory risk weights might influence the optimal cutoff, a proposition in this section also shows how an excessively optimistic cutoff can

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[6] The risk weights of an institution's assets generally influence the minimum equity ratio that regulators require. Regulators generally require higher equity ratios for institutions with higher risk-weighted assets.

[7] The BCBS (2015, 2016) only proposes applying stricter risk weights to SF products rated below AAA relative to their CF counterparts. Before the Great Recession, the BCBS (2006, p. 23, 127) did not distinguish between the risk weights applied to SF and CF investment-grade ratings.

be addressed by taxing certified and non-certified assets produced by the agent. Finally, Section 6 offers some concluding comments.

2. Relationship to the Literature

Following the experiences of the Great Recession, the literature has proposed two types of explanations to account for the differences in CF and SF credit ratings. The first type of explanation attributes the differences in ratings to differences in asset complexity. For example, SF's optimistic ratings may result from a noisier ratings process in the presence of selective disclosure (Skreta and Veldkamp (2009)), from incentives that insufficiently motivated credit-rating agencies to exert effort and update their optimistic SF priors (see Kashyap and Kovrijnykh (2016)), or from the greater costs of generating SF ratings in the presence of regulatory advantages (see Opp, Opp, and Harris (2013)). This paper follows the second type of explanation (see Frenkel (2015) and White (2010)) and attributes SF's more optimistic ratings to differences in seller influence.

Within the literature, this paper is most similar to the papers of Frenkel (2015) and Kashyap and Kovrijnykh (2016). Like Frenkel, this paper is motivated by the claims of White (2010) and recent evidence that differences between CF and SF ratings may be caused by differences in seller influence. This paper contributes to Frenkel's analysis by explicitly contrasting buyer and seller certification to assess whether allowing buyers greater influence leads to less optimistic ratings, and this paper predicts that buyer certification is excessively pessimistic, a possibility ruled out by assumption in Frenkel's work. Furthermore, this paper also introduces certification taxes to assess the scope for stricter risk weights to combat certification distortions.

Like Kashyap and Kovrijnykh (2016), this paper attempts to explain the differences between CF and SF ratings and assess whether buyer certification may lead to more optimal ratings. Yet, there are two substantive differences between these two works. First, these two works assess credit ratings differently. This paper assesses the ratings process' accuracy based on the difference between the cutoff's first moment and its optimal level, whereas Kashyap and Kovrijnykh's work assess the process' precision based on the magnitude of its second moment. These different measures of efficiency lead to differences in predictions regarding the need for regulatory intervention. Kashyap and Kovrijnykh's findings suggest that regulatory intervention is not necessary because differences between CF and SF ratings should naturally disappear as the market provides stronger incentives for less noisy SF ratings. The results of this paper, however, suggest that regulatory intervention is necessary because optimistic certification ratings result from sellers having excessive influence over the SF ratings process and will persist until such influence is corrected. Second, these two papers differ regarding the relative efficiency of buyer and seller certification. Their work suggests that buyer certification is unambiguously optimal because it leads to less noisy ratings, but this paper's findings are more ambiguous. As buyer and seller certification each cause certification to be distorted in different directions, the findings of this paper suggest that the optimal form of certification may critically depend on society's tolerance for the resulting type I and type II errors.

This paper also contributes to the larger certification literature by suggesting that the relative imperfections of SF credit ratings may be more pervasive than commonly modeled. The existing literature often considers certification distortions resulting from imperfect third-party credit ratings in which:

1. Buyers may be naïve.[8]
2. Sellers may shop for ratings, disclosing only those most favorable.[9]
3. Certifiers may have their own explicit and independent strategic incentives.[10]
4. Certification may be costly for the buyer or seller and may also be noisy.[11]

In contrast, this model demonstrates that excessively optimistic certification may persist even when the buyer is sophisticated, there is a single certification test with public disclosure, the test is directly designed by the buyer, the seller, or a third-party certifier lacking strategic incentives, and the test produces free and noiseless certification. Instead, the certification cutoffs in this paper are biased because buyers and sellers fundamentally disagree over the certification cutoff's level in the presence of asymmetric information.

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8 On this, see Bolton, Freixas, and Shapiro (2012) and Skreta and Veldkamp (2009).

9 On this, see Bolton, Freixas, and Shapiro (2012), Bongaerts (2014), Farhi, Lerner, and Tirole (2013), Faure-Grimaud, Peyrache, and Quesada (2009), and Skreta and Veldkamp (2009).

10 On this, see Bolton, Freixas, and Shapiro (2012), Bongaerts (2014), Fasten and Hofmann (2010), Faure-Grimaud, Peyrache, and Quesada (2009), Frenkel (2015), Kashyap and Kovrijnykh (2016), Lizzeri (1999), Mathis, McAndrews, and Rochet (2009), Opp, Opp, and Harris (2013), Stahl and Strausz (2016).

11 These two assumptions frequently appear in the certification and credit ratings literature. For partial exceptions, Fasten and Hofmann (2010) and Faure-Grimaud, Peyrache, and Quesada (2009), and Lizzeri (1999) generally assume certification is costly but not noisy. For a complete exception, Farhi, Lerner, and Tirole (2013) assume that the certification fees in a competitive equilibrium are zero and without noise.

3. Benchmark Borrowing-Lending Model without Certification

In this section, we develop a benchmark borrowing-lending model with adverse selection. In this model, adverse selection manifests due to asymmetric information in the baseline (but not final) quality level of the security produced by the borrower. This section studies the optimal menu of contracts between the borrower and the lender in the absence of a need for certification, and the next section will introduce allocative concerns that justify the use of certification to replicate the optimal menu of contracts.

This benchmark model is based on the work of Laffont and Tirole (1993).[12] In this section's model, the principal (she) would like to purchase an asset that only the agent (he) can produce by investing cash $I > 0$. Because the agent is cash-poor, contracting is necessary for him to receive the necessary cash.

The asset's gross payout V is observable as well as verifiable and depends on both the asset's baseline quality β and the agent's effort e with $V = \beta + e$.[13] Baseline quality β is a random variable distributed over some compact interval $\left[\underline{\beta}, \overline{\beta}\right]$ with $\underline{\beta} \geq I$ and with $F(\beta)$ and $f(\beta)$ denoting the commonly-known cumulative distribution function and the probability density function, respectively. However, effort is costly for the agent, and the cost of effort $\psi(e)$ is strictly increasing in effort with $\psi'(e) > 0$ and convex with $\psi''(e) > 0$ for $e > 0$. The cost of effort $\psi(e)$ also satisfies the Inada conditions that $\psi(0) = 0$, $\psi'(0) = 0$, and $\psi''(0) = 0$ in order to ensure positive e for the least efficient type $\underline{\beta}$. Both effort e and baseline quality β remain the agent's private information, and this section will demonstrate how asymmetric information distorts the solicited effort from the full-information level e^* characterized by $\psi'(e^*) = 1$.

Before providing cash I, the principal designs a menu of contracts, which the agent may choose to accept or reject. The menu of contracts specifies the transfers for various (gross) payouts of the asset. Considering only the set of direct and truthful revelation mechanisms, the menu of contracts can be written as $\{t(\beta), V(\beta) = \beta + e(\beta)\}$. In these contracts $t(\beta)$ denotes

[12] In their Chapter 1 model, the agent's private information includes only baseline cost rather than baseline quality. This difference will mainly affect the interpretation of the efficient type (i.e., high baseline quality vs. low cost) and the monotone hazard rate property (MHRP). This article uses the MHRP $\frac{d}{d\beta}\left(\frac{1-F(\beta)}{f(\beta)}\right) \leq 0$ instead of the MHRP $\frac{d}{d\beta}\left(\frac{F(\beta)}{f(\beta)}\right) \geq 0$ of Laffont and Tirole (1993).

[13] The baseline quality of an asset is often thought to depend on the underlying assets' average baseline default rate d, baseline rate of return R, and baseline recovery rate r. Given $d, R,$ and r, the asset's baseline quality can be represented by the its (baseline) expected gross payout $(1 + R) * I * [1 - d(1 - r)]$.

the transfer to an agent with baseline quality β, $e(\beta) = V(\beta) - \beta$ denotes the effort required of an agent with baseline quality β, and $U(\beta) = t(\beta) - \psi\big(e(\beta)\big)$ denotes the rent accruing to an agent with baseline quality β.

The principal's objective is to maximize the expected net payout $E[\Pi]$ from the purchase of the agent's asset. Her realized net payout depends on the asset's gross payout $V(\beta)$, the initial required funding I, and the transfer to the agent $t(\beta)$. In a truth-telling equilibrium, a contract with an agent of type β will offer her the net payout $\Pi(\beta) = V(\beta) - \psi\big(e(\beta)\big) - U(\beta) - I$. Her optimization problem can therefore be represented as:

$$\max E[\Pi] = \int_{\underline{\beta}}^{\overline{\beta}} \Big(\beta + e(\beta) - \psi\big(e(\beta)\big) - U(\beta) - I\Big) f(\beta) d\beta, \qquad (P)$$

subject to the following constraints:[14]

$$U(\beta) = U\left(\underline{\beta}\right) + \int_{\underline{\beta}}^{\beta} \psi'\big(e(x)\big)\, dx, \qquad (3.1)$$

$$\dot{e}(\beta) \geq -1, \qquad (3.2)$$

$$U(\beta) \geq 0. \qquad (3.3)$$

The timing of arrangements is given below:

1. The principal desires the agent to produce an asset with gross payout $V = \beta + e$.
2. The agent is privately informed of the potential asset's baseline quality $\beta \in \left[\underline{\beta}, \overline{\beta}\right]$.
3. The principal and agent meet. The principal writes a menu of contracts stipulating transfers $t\big(\hat{\beta}\big)$ and asset payouts $V\big(\hat{\beta}\big)$ for every possible announcement $\hat{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$ by the agent.
4. The agent accepts or rejects the terms of the menu of contracts.
5. Contract execution: the agent announces $\hat{\beta}$, receives I and the corresponding transfer $t(\hat{\beta})$, and produces the asset by investing I and by exerting the necessary effort $e' = V\big(\hat{\beta}\big) - \beta$ at cost $\psi(e')$.
6. The asset pays out $V(\hat{\beta})$ to the principal.

[14] See Appendix A for the derivation of the constraints.

The solution to the principal's problem shows that effort is distorted below the first-best effort level e^* for all agents with baseline quality levels below the most efficient level $\overline{\beta}$. To solve for the optimal effort, we use pointwise differentiation after first simplifying the principal's problem. To simplify the principal's problem, note that $U\left(\underline{\beta}\right)$ will equal 0 in the optimal menu of contracts. Momentarily ignoring constraint (3.2), inserting constraint (3.1) into the principal's objective function transforms the principal's constrained problem (P) into the unconstrained objective function:

$$\int_{\underline{\beta}}^{\overline{\beta}} \left(\beta + e(\beta) - \psi\big(e(\beta)\big) - I - \int_{\underline{\beta}}^{\beta} \psi'\big(e(x)\big)\, dx \right) f(\beta) d\beta.$$

Using integration by parts, this simplifies to:

$$\int_{\underline{\beta}}^{\overline{\beta}} \left(\beta + e(\beta) - \psi\big(e(\beta)\big) - \frac{\big(1 - F(\beta)\big)}{f(\beta)} \psi'\big(e(\beta)\big) - I \right) f(\beta) d\beta, \tag{3.4}$$

which yields first-order condition for $e(\beta)$ under pointwise differentiation:[15]

$$\psi'\big(e(\beta)\big) = 1 - \frac{1 - F(\beta)}{f(\beta)} \psi''\big(e(\beta)\big). \tag{3.5}$$

Solution (3.5) will satisfy constraint (3.2) under the assumption that $\psi'''(\cdot) \geq 0$ and in the presence of the monotone hazard rate property (MHRP):

$$\frac{d}{d\beta}\left(\frac{1 - F(\beta)}{f(\beta)} \right) \leq 0. \tag{3.6}$$

When the MHRP is satisfied, Equation (3.5) characterizes the textbook second-best solution with $e(\beta)$ distorted below the first-best level e^*.

Equations (3.4) and (3.5) demonstrate that the principal's optimal menu of contracts critically depends on the *virtual payout* of the agent's asset, $\beta + e(\beta) - \psi\big(e(\beta)\big) - \frac{(1-F(\beta))}{f(\beta)} \psi'\big(e(\beta)\big) - I$.[16] This virtual payout is important. Not only does it influence the principal's optimal menu of contracts in the benchmark model, it will critically influence the principal's optimal allocation rules and certification cutoff when allocative concerns are introduced. In Section 5, we show that she will choose a certification cutoff $\tilde{\beta}$ that equates the

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[15] Aside from differences in the relevant hazard rate function, Equation (3.5) is almost identical to Equation (1.44) in Laffont and Tirole (1993).

[16] The *virtual payout* of an agent's asset with baseline quality β is defined as the net payout of the optimal contract adjusted for the rent this contract affords all more efficient types.

virtual payout of the marginal certifying agent with the actual payout of the principal's outside option.

4. The Optimal Certification Cutoff Chosen by an Efficiency-Maximizing Certifier

This section characterizes the optimal certification cutoff chosen by an efficiency-maximizing certifier (it) when an allocation problem justifies the use of certification. In this section, an allocation problem will arise because the principal will have the potential outside option of originating her own loans with the same fixed investment $I > 0$ required by the agent. Restricting the principal's funds below $2I$ will cause her choices to lend I to the agent or to originate her own loans at cost I to be mutually exclusive. With mutually exclusive choices, the optimal menu of contracts will involve allocation rules for allocating I between the principal and the agent, and this section will demonstrate that the efficiency-maximizing certifier's optimal allocation rule can be replicated by a certification cutoff.

The principal's ability to originate her own loans is stochastic. With probability ν, we say that the principal's outside opportunity materializes, allowing her to make a loan offering baseline quality $\beta_P < \overline{\beta}$.[17] When funded, her lending offers net payout $\Pi_P(e_P) = \beta_P + e_P - \psi(e_P) - I$, which is directly increasing in the principal's effort e_P but directly decreasing in her cost of effort $\psi(e_P)$. With probability $1 - \nu$, we say that her outside opportunity fails to materialize, and we normalize her net payout Π_P to zero.

The analysis of this subsection considers an environment in which the allocation rules are determined by an efficiency-maximizing third-party certifier (it) prior to contracting. Following materialization of the principal's outside option and the agent's type announcement $\hat{\beta}$, the certifier will choose allocation probability $\alpha(\hat{\beta}) \in [0,1]$ to maximize its objective function. To abstract away from redistribution concerns, the certifier will maximize the joint expected surplus associated with the potential lending opportunities. This objective will cause the certifier's objective function to place equal weights on the agent's and the principal's welfare.

The timing of the setup is as follows:

1. The principal desires the agent to (potentially) produce an asset with gross payout $V = \beta + e$.

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[17] This restriction ensures an interior certification cutoff $\tilde{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$.

2. The agent is privately informed of the potential asset's baseline quality $\beta \in \left[\underline{\beta}, \overline{\beta}\right]$.
3. The principal and agent meet. The principal writes a menu of contracts stipulating transfers $t(\hat{\beta})$ and asset payouts $V(\hat{\beta})$ for every possible announcement $\hat{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$ by the agent.
4. After observing the menu of contracts, the certifier chooses allocation probabilities $\alpha(\hat{\beta})$ for every possible announcement $\hat{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$ by the agent.[18]
5. The agent accepts or rejects the terms of the menu of contracts.
6. Contract execution: the agent announces $\hat{\beta}$ and the principal's outside opportunity materializes with probability ν and offers baseline quality β_P. Conditional on materializing, the agent receives I with probability $\alpha(\hat{\beta})$ and the principal receives I with probability $\left(1-\alpha(\hat{\beta})\right)$. With probability $1-\nu$, the principal's opportunity fails to materialize and the agent receives I with certainty.
    a. Upon receiving I, the agent produces the asset by investing I and exerting the necessary effort e' at cost $\psi(e')$. The principal receives the asset's payout while the agent receives $t(\hat{\beta})$.
    b. Upon receiving I, the principal conducts her own lending at cost I and exerts the full-information first-best level of effort e_P^* with $\psi'(e_P^*) = 1$. She receives the corresponding payout $V_P(e_P^*) = \beta_P + e_P^*$.

We first consider the principal's problem. In a truth-telling equilibrium, she solicits effort $e(\beta)$ to maximize her net payout given $\alpha(\beta) \in [0,1]$. Following a similar sequence of steps as in the benchmark model, the principal's optimization problem can be written as:

$$\max_{e(\beta)} \mathrm{E}[\Pi] = \int_{\underline{\beta}}^{\overline{\beta}} \left[\left(1-\nu\left(1-\alpha(\beta)\right)\right) * \left(\beta + e(\beta) - \psi\left(e(\beta)\right) - U(\beta)\right) + \nu\left(1-\alpha(\beta)\right)\right.$$

$$\left. * \left(\beta_P + e_P^* - \psi(e_P^*)\right) - I\right] * f(\beta)d\beta, \qquad (P')$$

subject to the constraints:[19]

[18] Lemma 1 will demonstrate that the exact order of steps 3 and 4 will not affect the results.

[19] See Appendix A for the derivation of these constraints.

$$\left(1-\nu\left(1-\alpha(\beta)\right)\right)U(\beta)$$

$$=\left(1-\nu\left(1-\alpha\left(\underline{\beta}\right)\right)\right)U\left(\underline{\beta}\right)+\int_{\underline{\beta}}^{\beta}\left(1-\nu\left(1-\alpha(x)\right)\right)*\psi'(e(x))dx, \quad (4.1)$$

$$\dot{e}(\beta)\geq -1, \quad (4.2)$$

$$\left(1-\nu\left(1-\alpha(\beta)\right)\right)U(\beta)\geq 0. \quad (4.3)$$

Given that $\left(1-\nu\left(1-\alpha\left(\underline{\beta}\right)\right)\right)U\left(\underline{\beta}\right)=0$ in the optimal menu of contracts, if the constraint (4.2) is momentarily ignored, then the principal's constrained problem (P') can be transformed into the following unconstrained objective function:

$$\mathrm{E}[\Pi]=\int_{\underline{\beta}}^{\overline{\beta}}\left[\left(1-\nu\left(1-\alpha(\beta)\right)\right)*\left(\beta+e(\beta)-\psi\left(e(\beta)\right)-\frac{\left(1-F(\beta)\right)}{f(\beta)}\psi'\left(e(\beta)\right)\right)\right.$$
$$\left.+\nu\left(1-\alpha(\beta)\right)*\left(\beta_P+e_P^*-\psi\left(e_P^*\right)\right)-I\right]*f(\beta)d\beta.$$

Under pointwise differentiation for $e(\beta)$, one obtains the following first-order condition:

$$\psi'\left(e(\beta)\right)=1-\frac{\left(1-F(\beta)\right)}{f(\beta)}\psi''\left(e(\beta)\right), \quad (4.4)$$

Result (4.4) demonstrates that incentives regarding $e(\beta)$ are independent of the allocation rule $\alpha(\beta)$, which critically simplifies the later analysis. We refer to this result as the Independence Lemma:

Lemma 1 (The Independence Lemma): In the presence of the principal's potential outside option, the level of effort $e(\beta)$ solicited in the principal's second-best menu of contracts is independent of the allocation probability $\alpha(\beta)\in[0,1]$ as long as $\dot{\alpha}(\beta)\geq 0$.[20]

Having considered the principal's problem, we now consider the certifier's problem. As previously mentioned, the efficiency-maximizing certifier's objective is to choose $\alpha(\beta)\in[0,1]$ to maximize the joint expected surplus of the lending opportunities:

[20] As shown in the appendix, $\dot{\alpha}(\beta)\geq 0$ will be necessary to guarantee that the agent's localized second-order condition is satisfied.

$$\max_{\alpha(\beta)} \mathrm{E}[S] = \int_{\underline{\beta}}^{\overline{\beta}} \Big[\Big(1 - \nu\big(1-\alpha(\beta)\big)\Big) * \Big(\beta + e(\beta) - \psi\big(e(\beta)\big)\Big) + \nu\big(1-\alpha(\beta)\big) * \big(\beta_P + e_P^* - \psi(e_P^*)\big) - I\Big] * f(\beta) d\beta, \qquad (C)$$

Because the principal incentivizes the optimal effort for herself but not for the agent, the certifier will require the agent to meet a certification cutoff $\tilde{\beta}$ above β_P. If $e(\beta)$ is given by Result (4.4), pointwise differentiation of (C) with respect to $\alpha(\beta)$ yields:

$$\nu\Big(\beta + e(\beta) - \psi\big(e(\beta)\big) - \big(\beta_P + e_P^* - \psi(e_P^*)\big)\Big). \qquad (4.5)$$

Expression (4.5) allows an interior solution for $\alpha(\beta) \in (0,1)$ only when the agent's baseline quality β satisfies $\beta + e(\beta) - \psi\big(e(\beta)\big) = \beta_P + e_P^* - \psi(e_P^*)$. Let $\tilde{\beta}^*$ denote this critical β. For $\beta > \tilde{\beta}^*$, the certifier's objective function is increasing in α, and $\alpha(\beta) = 1$ is optimal. For $\beta < \tilde{\beta}^*$, the certifier's objective function is decreasing in α, and $\alpha(\beta) = 0$ is optimal. This allocation rule can be replicated by a certification cutoff set at $\tilde{\beta}^*$ as suggested by Proposition 1.[21]

Proposition 1. The efficiency-maximizing certifier's optimal allocation rule $\alpha(\beta)$ can be replicated by designing a certification test with cutoff $\tilde{\beta}^*$ such that $\tilde{\beta}^* + e\big(\tilde{\beta}^*\big) - \psi\Big(e\big(\tilde{\beta}^*\big)\Big) = \beta_P + e_P^* - \psi(e_P^*)$. To replicate the allocation rule, all agents passing the test must be assigned allocation probability $\alpha = 1$ and all agents failing the test must be assigned allocation probability $\alpha = 0$.

Proposition 1 is important because it provides an important benchmark for the rest of the paper and because it establishes that the efficiency-maximizing certifier's optimal allocation rule can be replicated by a certification cutoff. Future propositions will demonstrate that the buyer's and seller's optimal allocation rules can also be replicated by appropriate certification cutoffs. Moreover, Proposition 1 demonstrates that the optimal certification rule is distorted by asymmetric information. If $e\big(\tilde{\beta}^*\big) - \psi\Big(e\big(\tilde{\beta}^*\big)\Big)$ were equal to $e_P^* - \psi(e_P^*)$, then the cutoff $\tilde{\beta}^*$ would equal β_P. Due to asymmetric information, however, $e\big(\tilde{\beta}^*\big) - \psi\Big(e\big(\tilde{\beta}^*\big)\Big) < e_P^* - \psi(e_P^*)$ and asymmetric information distorts $\tilde{\beta}^*$ above β_P.

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21 Note that all of the allocation rules characterized by similar certification cutoffs presented in the rest of the paper satisfy the condition in Lemma 1 that α be non-decreasing in β.

5. Buyer and Seller Certification Cutoffs

This section provides the main results of the paper regarding buyer and seller certification. The analysis of the first subsection characterizes the buyer's optimal certification cutoff and the analysis of the next two subsections characterizes the seller's optimal cutoffs. In fact, we show that the seller's preferred cutoff is meaningless, but this meaningless cutoff is only feasible when β_P is sufficiently low. The fourth subsection concludes the analysis by modeling stricter risk weights using taxes and shows how distortions in the certification cutoff can be reduced when the seller has excessive influence.

A. The Certification Cutoff Under Buyer Certification

The analysis of this section considers an environment in which the allocation rules are directly chosen by the buyer or the seller. In this subsection, the principal (i.e., the buyer) chooses both the allocation rule $\alpha(\beta)$ and effort $e(\beta)$ to maximize her expected net payout $E[\Pi]$. We show that the buyer's optimal allocation rule can be replicated by an excessively pessimistic certification cutoff that is distorted above $\tilde{\beta}^*$.

The timing of the setup is modified as follows:

1. The principal desires the agent to (potentially) produce an asset with gross payout $V = \beta + e$.
2. The agent is privately informed of the potential asset's baseline quality $\beta \in \left[\underline{\beta}, \overline{\beta}\right]$.
3. The principal and agent meet. The principal writes a menu of contracts stipulating transfers $t(\hat{\beta})$, asset payouts $V(\hat{\beta})$, and allocation probabilities $\alpha(\hat{\beta})$ for every possible announcement $\hat{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$ by the agent.
4. The agent accepts or rejects the terms of the menu of contracts.
5. Contract execution: the agent announces $\hat{\beta}$ and the principal's outside opportunity materializes with probability ν and offers baseline quality β_P. Conditional on materializing, the agent receives I with probability $\alpha(\hat{\beta})$ and the principal receives I with probability $\left(1 - \alpha(\hat{\beta})\right)$. With probability $1 - \nu$, the principal's opportunity fails to materialize and the agent receives I with certainty.

a. Upon receiving I, the agent produces the asset by investing I and exerting the necessary effort e' at cost $\psi(e')$. The principal receives the asset's payout while the agent receives $t(\hat{\beta})$.

b. Upon receiving I, the principal conducts her own lending at cost I and exerts the full-information first-best level of effort e_P^* with $\psi'(e_P^*) = 1$. She receives the corresponding payout $V_P(e_P^*) = \beta_P + e_P^*$.

The principal now chooses allocation probability $\alpha(\beta)$ and effort $e(\beta)$ to maximize her expected net payout. Her optimization problem is therefore:

$$\max_{e(\beta),\alpha(\beta)} \mathrm{E}[\Pi] = \int_{\underline{\beta}}^{\overline{\beta}} \Big[\Big(1-\nu\big(1-\alpha(\beta)\big)\Big) * \Big(\beta + e(\beta) - \psi\big(e(\beta)\big) - U(\beta)\Big) + \nu\big(1-\alpha(\beta)\big) * \big(\beta_P + e_P^* - \psi(e_P^*)\big) - I\Big] * f(\beta)d\beta, \qquad (P'')$$

subject to the constraints:[22]

$$\Big(1-\nu\big(1-\alpha(\beta)\big)\Big)U(\beta) = \left(1-\nu\left(1-\alpha\left(\underline{\beta}\right)\right)\right)U\left(\underline{\beta}\right) + \int_{\underline{\beta}}^{\beta}\Big(1-\nu\big(1-\alpha(x)\big)\Big) * \psi'(e(x))dx, \qquad (5.1)$$

$$\dot{e}(\beta) \geq -1, \qquad (5.2)$$

$$\dot{\alpha}(\beta) \geq 0, \qquad (5.3)$$

$$\Big(1-\nu\big(1-\alpha(\beta)\big)\Big)U(\beta) \geq 0, \qquad (5.4)$$

$$\alpha(\beta) \in [0,1]. \qquad (5.5)$$

Although Lemma 1 will still characterize the effort $e(\beta)$ induced by the second-best menu of contracts, the principal's allocation rule will differ from the efficiency-maximizing certifier's. Temporarily ignoring constraints (5.2), (5.3), and (5.5), the principal's constrained problem can be transformed into the following unconstrained objective function by recognizing that $\left(1-\nu\left(1-\alpha\left(\underline{\beta}\right)\right)\right)U\left(\underline{\beta}\right) = 0$ in the optimal contract:

22 See Appendix A for the derivation of these constraints.

$$\mathrm{E}[\Pi] = \int_{\underline{\beta}}^{\overline{\beta}} \left[\Big(1 - \nu\big(1 - \alpha(\beta)\big)\Big) * \left(\beta + e(\beta) - \psi\big(e(\beta)\big) - \frac{\big(1 - F(\beta)\big)}{f(\beta)} \psi'\big(e(\beta)\big) \right) \right.$$
$$\left. + \nu\big(1 - \alpha(\beta)\big) * \big(\beta_P + e_P^* - \psi(e_P^*)\big) - I \right] * f(\beta) d\beta.$$

Under pointwise differentiation with $\alpha(\beta)$, one obtains:

$$\nu \left(\beta + e(\beta) - \psi\big(e(\beta)\big) - \frac{\big(1 - F(\beta)\big)}{f(\beta)} \psi'\big(e(\beta)\big) - \big(\beta_P + e_P^* - \psi(e_P^*)\big) \right). \quad (5.6)$$

Expression (5.6) permits an interior solution for $\alpha(\beta)$ when $\beta + e(\beta) - \psi\big(e(\beta)\big) - \frac{(1-F(\beta))}{f(\beta)} \psi'\big(e(\beta)\big) = \beta_P + e_P^* - \psi(e_P^*)$. Let $\tilde{\beta}_B$ denote this critical β. For $\beta > \tilde{\beta}_B$, the principal's net payout is increasing in α, and $\alpha(\beta) = 1$ is optimal. For $\beta < \tilde{\beta}_B$, the principal's net payout is decreasing in α, and $\alpha(\beta) = 0$ is optimal. As before, this allocation rule can be replicated by a certification test with cutoff $\tilde{\beta}_B$ such that $\tilde{\beta}_B + e(\tilde{\beta}_B) - \psi\left(e(\tilde{\beta}_B)\right) - \frac{(1-F(\tilde{\beta}_B))}{f(\tilde{\beta}_B)} \psi'\left(e(\tilde{\beta}_B)\right) = \beta_P + e_P^* - \psi(e_P^*)$. To replicate this allocation rule, all agents passing the test must receive I with allocation probability $\alpha = 1$ and all agents failing the test must receive I with allocation probability $\alpha = 0$.

The principal's certification cutoff will be distorted above the efficiency-maximizing certifier's to account for the rent that contracting with the marginal certifying agent affords all more efficient types. Compared to $\tilde{\beta}^*$, the principal's optimal allocation rule equates the principal's net payout of her outside option with the virtual payout of the marginal certifying agent's asset. This certification cutoff is distorted above $\tilde{\beta}^*$ due to the presence of the rent accruing to more efficient types as represented by $\frac{(1-F(\tilde{\beta}_B))}{f(\tilde{\beta}_B)} \psi'\left(e(\tilde{\beta}_B)\right) > 0$. These findings are summarized in Proposition 2:

Proposition 2. The certification cutoff $\tilde{\beta}_B$ replicating the principal's optimal allocation rule is excessively pessimistic and is distorted above the certification cutoff $\tilde{\beta}^*$ that replicates the efficiency-maximizing certifier's optimal allocation rule.

Proposition 2 establishes that the cutoff under buyer certification is distorted above the efficiency-maximizing certifier's optimal cutoff. As a result, Proposition 2 demonstrates that allowing buyers complete influence over the certification cutoff results in excessively strict certification and type II errors: agents who should be certified under the efficiency-maximizing certifier's optimal cutoff are not certified under the principal's. This relative strictness of buyer certification is consistent with White's (2010) observation that credit ratings were seen as stricter during the years that buyers had relatively more influence over the credit-rating agencies.

B. The Unconstrained Seller Certification Cutoff

The analysis of this subsection considers the allocation rule that is optimal for the seller or agent. Two findings emerge. First, the agent's optimal allocation rule can be replicated by a certification cutoff $\tilde{\beta}_S$ that is excessively optimistic and below $\tilde{\beta}^*$. Second, the certification cutoff chosen by the agent has a tendency to become so optimistic that it is meaningless. Under the agent's preferred cutoff, all types are certified with probability 1. Given the possibility of meaningless certification, we also introduce a certification participation constraint (CPC_P) for the principal. This constraint will require that the principal's expected net payout from contracting with a certified agent be at least as large as the net payout she would receive from her outside opportunity.[23]

This subsection considers the agent's optimal certification cutoff when the principal always finds the agent's preferred allocation rule agreeable because the agent's expected baseline quality is sufficiently larger than β_P that the following assumption is met:

Assumption 1: $\int_{\underline{\beta}}^{\overline{\beta}}\left[\left(\beta+e(\beta)-\psi\big(e(\beta)\big)\right)f(\beta)d\beta\right] \geq \beta_P + e_P^* - \psi(e_P^*)$.

Assumption 1 guarantees that the principal receives a larger expected net payout from a certified agent than she would receive from her outside option even when the cutoff is maximally optimistic with $\tilde{\beta}_S = \underline{\beta}$. Assumption 1 considers the expected net payout instead of the expected virtual payout because we assume that the principal, who has minimal influence over the allocation rules in this subsection, lacks the commitment power to deny the agent funding when $\left(\beta_P + e_P^* - \psi(e_P^*)\right) \in \left[\int_{\underline{\beta}}^{\overline{\beta}}\left(\beta+e(\beta)-\psi\big(e(\beta)\big)-\frac{1-F(\beta)}{F(\beta)}\psi'\big(e(\beta)\big)\right)f(\beta)d\beta\,, \int_{\underline{\beta}}^{\overline{\beta}}\left(\beta+e(\beta)-\right.\right.$

[23] If $\tilde{\beta}_S$ is the certification cutoff replicating the agent's optimal allocation rule, the principal's certification participation constraint will be represented by $(CPC_P)\ \frac{1}{1-F(\tilde{\beta}_S)} * \int_{\tilde{\beta}_S}^{\overline{\beta}}\left[\left(\beta+e(\beta)-\psi\big(e(\beta)\big)\right)f(\beta)d\beta\right] \geq \left(\beta_P + e^* - \psi(e^*)\right)$. This constraint captures the fact that buyers cannot be forced to purchase certified assets when their outside options have higher expected returns.

$\psi\left(e(\beta)\right)\Big) f(\beta) d\beta\Big]$.[24] If Assumption 1 holds, the principal will consent to purchasing certified assets even when all assets become certified. The next subsection relaxes Assumption 1 to consider the case in which the principal's certification participation constraint may prevent the agent from implementing his preferred allocation rule.

The timing of the setup is modified as follows:

1. The principal desires the agent to (potentially) produce an asset with gross payout $V = \beta + e$.
2. Before learning his type, the agent chooses allocation rule $\alpha(\hat{\beta})$.[25]
3. The agent is privately informed of the potential asset's baseline quality $\beta \in [\underline{\beta}, \overline{\beta}]$.
4. The principal and agent meet. The principal writes a menu of contracts stipulating transfers $t(\hat{\beta})$ and asset payouts $V(\hat{\beta})$ for every possible announcement $\hat{\beta} \in [\underline{\beta}, \overline{\beta}]$ by the agent.
5. The agent accepts or rejects the terms of the menu of contracts.
6. Contract execution: the agent announces $\hat{\beta}$ and the principal's outside opportunity materializes with probability ν and offers baseline quality β_P. Conditional on materializing, the agent receives I with probability $\alpha(\hat{\beta})$ and the principal receives I with probability $\left(1 - \alpha(\hat{\beta})\right)$. With probability $1 - \nu$, the principal's opportunity fails to materialize and the agent receives I with certainty.
    a. Upon receiving I, the agent produces the asset by investing I and exerting the necessary effort e' at cost $\psi(e')$. The principal receives the asset's payout while the agent receives $t(\hat{\beta})$.
    b. Upon receiving I, the principal conducts her own lending at cost I and exerts the full-information first-best level of effort e_P^* with $\psi'(e_P^*) = 1$. She receives the corresponding payout $V_P(e_P^*) = \beta_P + e_P^*$.

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[24] Restricting the principal's consideration to expected net payouts allows for easier comparisons between $\tilde{\beta}_S$ and $\tilde{\beta}^*$. If instead the principal's considerations in Assumption 1 involved the expected virtual payout $\int_{\underline{\beta}}^{\overline{\beta}} \left(\beta + e(\beta) - \psi\left(e(\beta)\right) - \frac{1-F(\beta)}{F(\beta)} \psi'\left(e(\beta)\right)\right) f(\beta) d\beta$, Proposition 4 would only be able to compare $\tilde{\beta}_S$ and $\tilde{\beta}_B$.

[25] As the agent's allocation rule would not change were the agent to know his type, the exact sequence of steps 2 and 3 does not impact the results.

When choosing his allocation rule, the agent's incentives strongly differ from both the principal's and the efficiency-maximizing certifier's. As he does not yet know β, the agent will choose $\alpha(\beta)$ to maximize his expected rent. From Equation $(A10)$ in Appendix A, his expected rent is given by

$$E\left[(1-\nu\big(1-\alpha(\beta)\big)U(\beta)\right]=\int_{\underline{\beta}}^{\overline{\beta}}\Big(1-\nu\big(1-\alpha(\beta)\big)\Big)\big(1-F(\beta)\big)\,\psi'(e(\beta))d\beta.$$

From the Independence Lemma, differentiating pointwise with respect to α yields:

$$\nu\big(1-F(\beta)\big)\psi'\big(e(\beta)\big)>0. \qquad (5.7)$$

Expression (5.7) is striking, because it suggests that, were it possible, the agent would prefer the allocation rule $\alpha(\beta)=1$ for all β. Such an allocation rule maximizes the agent's rent by guaranteeing the agent funding, and this allocation rule could be replicated by choosing a certification test with cutoff $\tilde{\beta}_S=\underline{\beta}$, causing all agents to pass and have allocation probability $\alpha=1$. These findings are summarized in the following Proposition:

Proposition 3. If Assumption 1 holds, the agent's optimal allocation rule is maximally optimistic and is replicated by the certification cutoff $\tilde{\beta}_S=\underline{\beta}$.

Proposition 3 establishes two important findings. First, Proposition 3 establishes that seller certification is excessively optimistic relative to the efficiency-maximizing certifier's optimal cutoff, resulting in type I errors. This finding is consistent with White's (2010) claim that greater seller influence over SF certification allowed low-quality SF securities to receive AAA ratings. Second, Proposition 3 establishes that seller certification may become so optimistic that it is meaningless, and this finding seems to capture the sheer frequency with which formerly-rated AAA SF products were downgraded below investment grade during the Great Recession.

C. *The Constrained Seller Certification Cutoff*

This subsection considers how the optimal certification cutoff replicating the agent's preferred allocation rule would need to be modified when the principal's funding following certification is not guaranteed. In particular, we consider the possibility that the principal refuses to fund a certified agent because Assumption 1 does not hold. If Assumption 1 does not hold, certified agents will only be able to guarantee funding from the principal by choosing some $\tilde{\beta}>\underline{\beta}$ such that the principal's expected net payouts from certified agents exceed $\Pi_P(e_P^*)=$

$\beta_P + e_P^* - \psi(e_P^*) - I$. The principal will participate in the certification scheme as long as this certification participation constraint is met:

$$\frac{\int_{\tilde{\beta}_S}^{\overline{\beta}} \Big(\beta + e(\beta) - \psi\big(e(\beta)\big)\Big) f(\beta) d\beta}{1 - F\big(\tilde{\beta}_S\big)} \geq \beta_P + e_P^* - \psi(e_P^*). \quad (CPC_P)$$

Having already established that the agent's preferred allocation rule is consistent with a certification cutoff, the timing below considers the certification cutoff chosen by the agent when the principal's participation in the certification scheme is in doubt. The timing of the setup is therefore modified as follows:

1. The principal desires that the agent to (potentially) produce an asset with gross payout $V = \beta + e$.
2. Before learning his type, the agent chooses certification cutoff $\tilde{\beta}_S$.
3. The agent is privately informed of the potential asset's baseline quality $\beta \in \left[\underline{\beta}, \overline{\beta}\right]$.
4. The principal and agent meet. The principal writes a menu of contracts stipulating transfers $t\big(\hat{\beta}\big)$ and asset payouts $V\big(\hat{\beta}\big)$ for every possible announcement $\hat{\beta} \in \left[\underline{\beta}, \overline{\beta}\right]$ by the agent.
5. The agent accepts or rejects the terms of the menu of contracts.
6. Contract execution: the agent chooses to certify $\hat{C}$ or not $\widehat{N}$. The principal's outside opportunity materializes with probability ν and offers baseline return β_P. If the outside opportunity materializes and (CPC_P) is met, certified agents receive I but non-certified agents do not. If the outside opportunity materializes and (CPC_P) is not met, the principal keeps I for her own lending. With probability $1 - \nu$, the opportunity fails to materialize and all agents are allocated I with certainty.
    a. Upon receiving I, the agent produces the asset by investing I and exerting the necessary effort e' at cost $\psi(e')$. The principal receives the asset's payout while the agent receives $t(\hat{\beta})$.
    b. Upon receiving I, the principal conducts her own lending at cost I and exerts the full-information first-best level of effort e_P^* with $\psi'(e_P^*) = 1$. She receives the corresponding payout $V_P(e_P^*) = \beta_P + e_P^*$.

The agent's problem is to choose $\tilde{\beta}_S$ to maximize his expected rent:

$$\max_{\tilde{\beta}_S} \int_{\tilde{\beta}_S}^{\overline{\beta}} \left(1 - F(\beta)\right) * \psi'\left(e(\beta)\right) d\beta + \int_{\underline{\beta}}^{\tilde{\beta}_S} (1 - \nu) * \left(1 - F(\beta)\right) \psi'\left(e(\beta)\right) d\beta, \quad (A)$$

subject to

$$\frac{\int_{\tilde{\beta}_S}^{\overline{\beta}} \left(\beta + e(\beta) - \psi\left(e(\beta)\right)\right) f(\beta) d\beta}{1 - F\left(\tilde{\beta}_S\right)} \geq \beta_P + e_P^* - \psi(e_P^*). \quad (CPC_P)$$

Because the agent's preferred certification cutoff $\underline{\beta}$ violates (CPC_P) when Assumption 1 does not hold and because satisfying (CPC_P) jeopardizes rent, the agent will choose $\tilde{\beta}_S$ so that (CPC_P) exactly binds:

$$\frac{\int_{\tilde{\beta}_S}^{\overline{\beta}} \left[\left(\beta + e(\beta) - \psi\left(e(\beta)\right)\right) f(\beta) d\beta\right]}{1 - F\left(\tilde{\beta}_S\right)} = \beta_P + e_P^* - \psi(e_P^*). \quad (5.8)$$

Note that $\tilde{\beta}_S$ in Equation (5.8) equates the principal's own net payout $\Pi_P(e_P^*) = (\beta_P + e^* - \psi(e^*) - I)$ with the net payout of the *average* certifying agent instead of the *marginal* certifying agent. As a result, $\tilde{\beta}_S$ is looser and relatively more optimistic than the certification cutoff $\tilde{\beta}^*$ replicating the efficiency-maximizing certifier's optimal allocation rule in Proposition 1. This leads to Proposition 4:

Proposition 4. If Assumption 1 does not hold, the agent's optimal certification cutoff given by Equation (5.8) is excessively optimistic and distorted below the certification cutoff $\tilde{\beta}^*$ preferred by the efficiency-maximizing certifier.

Qualitatively, the agent's optimal constrained cutoff in Proposition 4 is similar to the agent's optimal unconstrained cutoff in Proposition 3, but with one important difference. The cutoff $\tilde{\beta}_S$ in Proposition 4 is similar because the seller's certification cutoff is still distorted below the efficiency-maximizing certifier's cutoff, resulting in type I errors. This constrained cutoff is different, however, because it is less optimistic with $\tilde{\beta}_S > \underline{\beta}$. Although this more restrictive cutoff lowers the agent's welfare, this more restrictive cutoff increases the total joint surplus of the principal and agent because it is closer to the efficiency-maximizing certifier's cutoff $\tilde{\beta}^*$.

D. Correcting Seller-Biased Certification

This subsection considers how policymakers may alter the risk weights assigned to different types of lending in order to prevent excessively optimistic certification. This concern of overly optimistic certification is motivated by White's (2010) conjecture that too many financial products were being certified just prior to the Great Recession because sellers had excessive influence over the certification process. In order to understand how policymakers can use risk weights to combat such excessively loose certification cutoffs, this subsection models different risk weights with a non-negative tax. We would represent a more generous risk weight with a smaller tax and a less generous risk weight with a larger tax. Using taxes to model different risk weights, this section then considers how an excessively optimistic cutoff might be improved. We show that even if the certification process is biased and optimistic, $\tilde{\beta}^*$ can be induced with the appropriate tax.

To extend the previous analysis, this section models risk weights as a tax the agent pays when producing his own asset. Let τ represent the tax the agent pays when allocated funding I. In order to incentivize the agent to sign a contract, the principal will have to fully compensate the agents for the tax, causing the incidence of the tax to fall on the principal. Of course, such compensation lowers the expected net payout associated with a randomly selected certified agent relative to the her outside option. If the certifier chooses the allocation rule $\alpha(\beta)$ to maximize an objective function with positive weights on both the agent's welfare and the principal's welfare, then a higher tax will incentivize an allocation rule less biased towards the agent.

To study seller-biased certification, we modify the certifier's objective function from Section 3 and consider a certifier who is no longer efficiency maximizing and impartial. Instead, the certifier will be biased towards the seller with an objective function that places greater weight on the agent's welfare. If $\theta \in \left(\frac{1}{2}, 1\right)$ denotes the weight the certifier assigns to the agent's welfare, then the certifier's objective function will be given by:

$$\max_{\alpha(\beta)} E[S] = \theta E\left[(1 - \nu\left(1 - \alpha(\beta)\right)U(\beta)\right] + (1 - \theta)E[\Pi]$$

$$= (2\theta - 1) * \int_{\underline{\beta}}^{\overline{\beta}} \left(1 - \nu\left(1 - \alpha(\beta)\right)\right) \frac{\left(1 - F(\beta)\right)}{f(\beta)} \psi'\left(e(\beta)\right) f(\beta) d\beta + (1 - \theta)$$
$$* \int_{\underline{\beta}}^{\overline{\beta}} \left[\left(1 - \nu\left(1 - \alpha(\beta)\right)\right) * \left(\beta + e(\beta) - \psi\left(e(\beta)\right) - \tau\right) + \nu\left(1 - \alpha(\beta)\right)\right.$$
$$\left. * \left(\beta_P + e_P^* - \psi(e_P^*)\right) - I\right] * f(\beta) d\beta.$$

Point-wise optimization with respect to $\alpha(\beta)$ yields:

$$\nu(1-\theta)\left[\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\beta)\right)}{f(\beta)}\,\psi'\big(e(\beta)\big)+\beta+e(\beta)-\psi\big(e(\beta)\big)-\tau \right.$$
$$\left. -\left(\beta_P+e_P^*-\psi(e_P^*)\right)\right]. \tag{5.9}$$

If $\theta=\frac{1}{2}$ and $\tau=0$, Expression (5.9) is essentially identical to Expression (4.5), and we conclude that the certifier's optimal allocation rule can be replicated by the certification cutoff $\tilde{\beta}^*$. If $\theta>\frac{1}{2}$ but θ is small enough so that $\left(\beta+e(\beta)-\psi\big(e(\beta)\big)+\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\beta)\right)}{f(\beta)}\psi'\big(e(\beta)\big)\right)$ is still increasing in β, however, then Equation (5.9) will only permit an interior solution for $\alpha(\beta)$ at the single $\tilde{\beta}_C$ such that $\tilde{\beta}_C+e(\tilde{\beta}_C)-\psi\left(e(\tilde{\beta}_C)\right)-\tau+\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\tilde{\beta}_C)\right)}{f(\tilde{\beta}_C)}\psi'\left(e(\tilde{\beta}_C)\right)=\beta_P+e_P^*-\psi(e_P^*)$.[26] If $\beta>\tilde{\beta}_C$, the certifier's objective function is increasing in α and $\alpha=1$ is optimal. If $\beta<\tilde{\beta}_C$, the certifier's objective function is decreasing in α and $\alpha=0$ is optimal. Thus, the certifier's optimal allocation rule can be replicated by creating a test with certification cutoff $\tilde{\beta}_C$.

We denote the optimal tax as the one that maximizes allocative efficiency. The efficiency-maximizing tax τ^* will be set to implement the efficiency-maximizing certification cutoff $\tilde{\beta}^*$. Observe that $\tilde{\beta}^*$ will be implemented when τ^* is set so that

$$\tau^*=\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\tilde{\beta}^*)\right)}{f(\tilde{\beta}^*)}\,\psi'\left(e(\tilde{\beta}^*)\right). \tag{5.10}$$

Moreover, Expression (5.10) shows that the optimal certification tax is increasing in the seller's influence θ:

$$\frac{d\tau^*}{d\theta}=\frac{1}{(1-\theta)^2}\frac{\left(1-F(\tilde{\beta}^*)\right)}{f(\tilde{\beta}^*)}\psi'\left(e(\tilde{\beta}^*)\right)>0. \tag{5.11}$$

These findings are summarized by Proposition 5:

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[26] If θ is too large, then Expression (5.9) may equal zero for multiple β. For tractability, we restrict θ to be close enough to $1/2$ so that $\left(\beta+e(\beta)-\psi\big(e(\beta)\big)+\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\beta)\right)}{f(\beta)}\psi'\big(e(\beta)\big)\right)$ is still increasing in β. It is trivial to show that $\left(1-\frac{\theta}{1-\theta}\right)\psi'\big(e(\beta)\big)\frac{d}{d\beta}\left[\frac{\left(1-F(\beta)\right)}{f(\beta)}\right]<1$ for all β is sufficient for $\left(\beta+e(\beta)-\psi\big(e(\beta)\big)+\frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\beta)\right)}{f(\beta)}\psi'\big(e(\beta)\big)\right)$ to be increasing in β.

Proposition 5. To implement the efficiency-maximizing certification cutoff $\tilde{\beta}^*$ when $\left(1-\frac{\theta}{1-\theta}\right)\psi'(\beta)\frac{d}{d\beta}\left[\frac{(1-F(\beta))}{f(\beta)}\right] < 1$, the tax τ^* should be set such that $\tau^* = \frac{(2\theta-1)}{1-\theta}\frac{\left(1-F(\tilde{\beta}^*)\right)}{f(\tilde{\beta}^*)}\psi'\left(e\left(\tilde{\beta}^*\right)\right)$. This certification tax is increasing in the seller's influence as captured by θ.

Proposition 5 is significant because it shows that stricter risk weights (as modeled by positive taxes on the purchases of the agent's assets) are efficiency-improving when sellers have excessive influence over the certification cutoff. Moreover, the size of the efficiency-maximizing tax τ^* is increasing in the magnitude of the seller's influence as captured by θ. To the extent that greater concentration of issuance affords issuers in SF markets greater influence than issuers in CF markets, this finding suggests that policymakers should apply strictly larger risk weights to purchases of all SF assets, not just those rated below the AAA cutoff.

6. Concluding Remarks

This paper is motivated by the observation that just prior to the Great Recession overly optimistic credit ratings appeared excessively pronounced in SF credit markets but not CF credit markets. Following the conjectures of Pagano and Volpin (2010) and White (2010) that this excessive optimism was caused by excessive seller influence because of the seller-pays ratings model, this paper assesses whether excessive seller influence leads to overly optimistic ratings. The findings suggest that excessive seller influence leads to biased certification cutoffs, and that extreme levels of seller influence may render cutoffs so optimistic that certification becomes meaningless.

To correct the problem of overly optimistic certification, this paper considers two policy options. First, we consider how the cutoff would be set if buyers could choose the certification cutoff directly. We show that buyer certification successfully corrects the problem of overly optimistic credit ratings but causes credit ratings to become excessively pessimistic. Second, we consider how stricter risk weights (modeled by taxes on purchases of the agent's assets) can influence the certification cutoff when certification is biased by seller influence. Our analysis suggests that the certification cutoff can be set at the efficiency-maximizing level when risk weights are set appropriately. Given these two results, we believe that policymakers would be able to better target overly optimistic SF credit ratings by employing stricter risk weights for SF asset purchases rather than trying to give buyers greater influence over the certification process by changing the credit-rating business model to a buyer-pays model.

We believe there are two aspects of the model that could be extended in future research. First, buyer and seller influence is exogenous in the model instead of being endogenously determined by market share. Although this modeling choice keeps the model tractable, we believe that further policy tools could be evaluated were the influence of buyers and sellers endogenous to the model. Second, future work could consider new policy insights when greater strategic interaction is introduced by the presence of multiple buyers and sellers. Although the model's consideration of a single buyer, a single seller, and a single non-strategic certifier demonstrated that the flaws in the credit-rating process were more intractable than commonly modeled in the literature, we believe that richer strategic interaction might better capture the interaction of factors contributing to the biases in the certification for SF assets.

Appendix A: Deriving the Truth-Telling Constraints

In this appendix, we present the derivations of the truth-telling constraints used in Sections 3, 4, and 5. We first start with the benchmark model of Section 3. To ensure that the direct revelation mechanisms of Section 3 are truthful, we require that the following condition holds for any pair $(\beta, \beta') \in \left[\underline{\beta}, \overline{\beta}\right]$:

$$U(\beta) = t(\beta) - \psi\big(e(\beta)\big) \geq t(\beta') - \psi(e(\beta') + \beta' - \beta). \qquad (A1)$$

Following Laffont and Martimort (2002), Equation $(A1)$ can be converted into local first- and second-order sufficient conditions for incentive compatibility. Truth-telling will require that:

$$\dot{t}(\beta) - \psi'\big(e(\beta)\big) * \big(1 + \dot{e}(\beta)\big) = 0, \qquad (A2)$$

$$\psi''\big(e(\beta)\big) * \big(1 + \dot{e}(\beta)\big) \geq 0. \qquad (A3)$$

Equation $(A3)$ can be rewritten as the following local incentive constraint

$$\dot{e}(\beta) \geq -1, \qquad (A4)$$

and from the Envelope Condition, Equation $(A2)$ will imply that:

$$\dot{U}(\beta) = \psi'\big(e(\beta)\big). \qquad (A5)$$

From Equation $(A5)$, the rent accruing to an agent with baseline quality β is given by:

$$U(\beta) = U\left(\underline{\beta}\right) + \int_{\underline{\beta}}^{\beta} \psi'\big(e(x)\big)\, dx. \qquad (A6)$$

Equations (A4) and (A6) represent sufficient conditions for truth-telling in the direct revelation mechanisms considered by the principal.

The introduction of the allocation rule $\alpha(\hat{\beta})$ in Sections 4 and 5 slightly alters the sufficient truth-telling constraints. For the menu of contracts to incentivize truth-telling, we require that for any pair $(\beta, \beta') \in [\underline{\beta}, \bar{\beta}]$:

$$[1-\nu(1-\alpha(\beta))] * [t(\beta)-\psi(e(\beta))]$$
$$\geq [1-\nu(1-\alpha(\beta'))][t(\beta')-\psi(e(\beta')+\beta'-\beta)]. \qquad (A7)$$

Converting $(A7)$ to localized first- and second-order conditions yields:

$$\nu\dot{\alpha}(\beta)\left(t(\beta)-\psi(e(\beta))\right)+\left(1-\nu(1-\alpha(\beta))\right) * \left(\dot{t}(\beta)-\psi'(e(\beta))(1+\dot{e}(\beta))\right)=0, \quad (A8)$$

$$\psi''(e(\beta)) * (1+\dot{e}(\beta))\left(1-\nu(1-\alpha(\beta))\right)+\nu\dot{\alpha}(\beta)\psi'(e(\beta)) \geq 0. \qquad (A9)$$

Clearly, if $\dot{e}(\beta) \geq -1$ and $\dot{\alpha}(\beta) \geq 0$, then the localized second-order condition $(A9)$ will be satisfied.

We now solve for the agent's expected rent conditional on β. Let $U(\beta)=t(\beta)-\psi(e(\beta))$. From the Envelope Condition and Equation $(A8)$:

$$\left(1-\nu(1-\alpha(\beta))\right)U(\beta)-\left(1-\nu\left(1-\alpha\left(\underline{\beta}\right)\right)\right)U\left(\underline{\beta}\right)$$
$$=\int_{\underline{\beta}}^{\beta}\left(1-\nu(1-\alpha(x))\right) * \psi'(e(x))dx.$$

The agent's unconditional expected rent can be solved using integration by parts:

$$\int_{\underline{\beta}}^{\overline{\beta}}\left(1-\nu(1-\alpha(\beta))\right)U(\beta)f(\beta)d\beta$$
$$=\int_{\underline{\beta}}^{\overline{\beta}}\left(1-\nu(1-\alpha(\beta))\right)(1-F(\beta))\,\psi'(e(\beta))d\beta\,, (A10)$$

when $U\left(\underline{\beta}\right)=0$.

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