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Working Paper

Voluntary bankruptcy as preemptive persuasion

IHS Economics Series, No. 334

Provided in Cooperation with:

Institute for Advanced Studies (IHS), Vienna

Suggested Citation: Dinev, Nikolay (2017) : Voluntary bankruptcy as preemptive persuasion, IHS Economics Series, No. 334, Institute for Advanced Studies (IHS), Vienna

This Version is available at:

<https://hdl.handle.net/10419/183477>

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IHS Economics Series
Working Paper 334
December 2017

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INSTITUT FÜR HÖHERE STUDIEN
INSTITUTE FOR ADVANCED STUDIES
Vienna

Impressum

Author(s):

Nikolay Dinev

Title:

Voluntary Bankruptcy as Preemptive Persuasion

ISSN: 1605-7996

2017 Institut für Höhere Studien - Institute for Advanced Studies (IHS)

Josefstädter Straße 39, A-1080 Wien

E-Mail: office@ihs.ac.at

Web: www.ihs.ac.at

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Voluntary Bankruptcy as Preemptive Persuasion

Job Market Paper

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December 21, 2017

Abstract

This paper examines the phenomenon of management-initiated, court-supervised reorganization of companies in U.S. bankruptcy court. The proposed in-court persuasion mechanism reconciles excessive reorganizations of non-viable companies (and subsequent repeat failures) with management-initiated filings and a judge who aims to always take appropriate action. In the model, management makes a preemptive voluntary filing to retain control of the process, and thereby engage in a game of Bayesian Persuasion with asymmetric information vis-à-vis the judge. This mechanism endogenously results in the reorganization of some non-viable companies, and exclusively management-initiated (i.e., voluntary) bankruptcy filings. This paper, therefore, explains why non-viable companies could be permitted to reorganize and why there are repeat offender firms that enter bankruptcy multiple times.

Keywords: Bayesian Persuasion, Bankruptcy, Chapter 11, Asymmetric Information

JEL Classification: C72, D21, D72, D82, D83, G33, K20, K40

*I gratefully acknowledge financial support from the Austrian Science Fund (FWF project number I1242-G16) as well as helpful comments from Connie Bagley, Jonathan Berk, Larry Blume, Patrick Bolton, David Brown, Thomas Gehrig, Christian Laux, Alexander Mürmann, Justinas Pelenis, Christoph Reschenhofer, Julia Reynolds, Klaus Ritzberger, Ben Sand, Jamsheed Shorish, Leopold Sögner, Anton van Boxtel, Josef Zechner, and seminar participants at Royal Holloway, University of London. The usual disclaimer applies.

1 Introduction

The process by which businesses exit the market is an important aspect of capitalist economies.¹ While some obsolete businesses simply get wound down, often a distressed company does not quietly ride off into the sunset. Instead, financially distressed companies frequently undergo a last-ditch saving effort: undergoing a bankruptcy procedure with the hope that debt reorganization will keep them afloat. These procedures are designed to filter viable from non-viable businesses, as much as they are designed to satisfy the claims of the creditors.² Djankov, Hart, McLiesh, and Shleifer (2008) document, in a study of various procedures and outcomes across the world, that different jurisdictions have adopted a wide range of pro-creditor and pro-debtor policies. For the purposes of the current study, however, the U.S. is of particular interest; not only because of its sheer size but also because of the recent trend towards other jurisdictions introducing procedures similar to Chapter 11 reorganizations into their bankruptcy codes.³

Approximately 99% of corporate bankruptcy cases in the U.S.⁴ result from *voluntary* filings; that is, management-initiated rather than creditor-initiated, legal action. Hotchkiss (1995) documents that, of the companies that eventually emerge reorganized from bankruptcy, 30-40%⁵ find themselves in financial dire straits again within 3 years of emergence. Why does a court that has an explicit mandate to liquidate non-viable businesses seem to have such a high error rate? The law, economics, and finance literature on the issue has considered bankruptcy court as an arena for structured *bargaining* (as discussed in the survey paper by White (2005)). The theoretical model I present in

¹Indeed, it is the latter half of Schumpeter's famous "creative destruction."

²See White (1989) for a discussion of filtering and filtering failure in bankruptcy court.

³Germany passed the *Gesetz zur weiteren Erleichterung der Sanierung von Unternehmen* (Law for further simplification of the rehabilitation of companies) in late 2011. It gives German bankruptcy law a Chapter 11-like procedure. In recent years, other European jurisdictions have also adjusted their bankruptcy codes in this direction.

⁴U.S. Court data available at http://www.uscourts.gov/sites/default/files/statistics_import_dir/Table702_6.pdf and http://www.uscourts.gov/sites/default/files/data_tables/Table7.03.pdf.

⁵In her sample, 32% of the reorganized companies file for bankruptcy again and a further 8% experience significant out-of-court restructuring.

this paper looks at bankruptcy through a novel lens—that of *persuasion*. I argue that the court’s reliance on management’s business judgment and commissioned reports can result in the observed pattern of voluntary filings and high recidivism rates.

Under Title 11 of the U.S. Bankruptcy Code,⁶ there are two types of bankruptcy outcomes—liquidation and reorganization. The former generally takes place under Chapter 7 and the latter under Chapter 11.⁷ The filing party retains control of the company throughout the bankruptcy process (via a trustee if the creditors have filed), and chooses the venue and the chapter under which the filing takes place. That said, the judge is the one who has authority on the final outcome (liquidation or reorganization), by, among others, converting proceedings under one chapter into proceedings under the other. Much of the focus in the bankruptcy literature has been on the strategic use of default as a precursor to bankruptcy, and the negotiation dynamics once a company is undergoing bankruptcy. Some models are silent on who the filing party is (e.g., [Ellul and Pagano \(2016\)](#)) while others imply that the creditors are the ones initiating the legal action if one is to take the equilibrium literally (e.g., [Giammarino \(1989\)](#)). Note that, for the issues which these papers explain, the identity of the filer is unimportant. In my model identity matters—not only for the purposes of negotiation leverage but also for the purposes of influencing the actions of the judge.

Negotiation is only part of what takes place in bankruptcy court. If management has filed for bankruptcy, then the judge relies on the business judgment of the incumbent CEO and documentation that management produces. In equilibrium, management files for bankruptcy exactly in order to engage in a persuasion game with the judge and preempt the creditors from doing so. The purpose of this preemptive filing is control of the process of producing and discovering information in court. This information is ultimately used by the bankruptcy judge, who has significant sway on the process and

⁶ Available at <https://www.gpo.gov/fdsys/pkg/USCODE-2016-title11/pdf/USCODE-2016-title11.pdf>.

⁷ This is a slight and immaterial simplification of reality. For example, it is possible, albeit uncommon, for liquidation to take place in Chapter 11.

outcome of the case (LoPucki and Whitford, 1993). In many cases, the judge is able to “cram down” and mandate a decision over the objections of many of the creditors.⁸ Given this court dynamic, Bayesian Persuasion with asymmetric information is an appropriate modeling choice: management, if it initiates bankruptcy, is given the power to set up the information production and discovery mechanism that could eventually sway the judge’s actions and thereby affect the payoffs of all parties.

The persuasion mechanism is simple and intuitive. When the management of a company in financial distress senses that a trip to bankruptcy court is imminent, they face the choice of filing or waiting for creditors to file. While the latter might prolong the pre-bankruptcy period, the control repercussions of a creditor-initiated filing motivate management to be the first one to file instead. Despite being better informed about the true state of the company than outsiders, management is unable to change its strategy based on that information advantage. At the end of the day, management makes an optimal pooled choice of the auditing and reporting structure. This choice leads to excessive reorganization as management has a clear preference for reorganization over liquidation, despite management’s commitment to truthfully report the findings in an audit and the judge’s best efforts to take the correct action.

1.1 Literature review

Several sources provide particularly useful summaries of the corporate bankruptcy scholarship, namely the survey papers by Hotchkiss, John, Mooradian, and Thorburn (2008) and White (2005) and the anthology of papers edited by Bhandari and Weiss (1996). One key tension described by the literature is between filtering out the viable companies and satisfying creditor preferences. The former plays a role in economic efficiency arguments about the procedure of bankruptcy—how does one differentiate companies that have temporary problems from ones that have permanent ones? The latter looks how

⁸See section 1126 of the U.S. Bankruptcy Code. “Cramdown” is the technical legal term for the judge’s forcing a decision over the objection of some creditors.

ex post deviations from absolute priority when distributing claims and proceeds affects *a priori* financing.

White (1994) analyzes filtering in U.S. Bankruptcy Court and identifies the Type I and Type II errors committed in the process—the former being the reorganization of non-viable entities and the latter the liquidation of viable ones. Some authors (e.g., Baird (1987) and Bris, Schwartz, and Welch (2005)) have particularly attributed Type I errors to the actions of biased judges and have even gone so far as to argue that a world without bankruptcy (i.e., with liquidation auctions only) is a better world. Schoar and Chang (2017) document that some judges may have a bias to liquidating or reorganizing across their judicial history. Others have identified asymmetric information as the source of the filtering failure (e.g., Giammarino (1989), Hotchkiss, John, Mooradian, and Thorburn (2008), and White (1994)). While the model I present here does feature asymmetric information, it is not the cause of the filtering failure. Rather, management’s ability to control a public experiment that produces a signal with respect to the true state of viability of the company causes the filtering failure.

Several papers (e.g., Baird (1987), Jackson (1982), Baird and Jackson (1988), Baird and Picker (1991)) focus on negotiation and bargaining leverage in bankruptcy. In particular, Adler, Capkun, and Weiss (2013) focused on the timing implications thereof. Different procedures in an international context have been studied by Franks and Lorrain (2014), Frieden and Wielenberg (2017) and White and Posner (1996). While illuminating, these alternative procedures are not a focus of this paper. Povel (1999) studied optimal “soft” and “hard” bankruptcy procedures to explain why in some jurisdictions liquidation is more prevalent than in others. Gilson (1991) looks at the choice between private workouts and Chapter 11 thereby focusing on the outside option of management and the creditors if they decide to settle their differences out of court.

The recent literature on Bayesian Persuasion which forms the basic building block of this mechanism began with the seminal work of Kamenica and Gentzkow (2011),

although the tools for this type of analysis have been available at least since [Aumann and Maschler \(1995\)](#). The key insight of this strand of the literature is best understood in juxtaposition to traditional signaling and screening models such as [Crawford and Sobel \(1982\)](#). Unlike those models, which feature unraveling and “cheap talk,” Bayesian Persuasion provides a means through which the sender of information could, under certain conditions, influence the actions of the receiver. To this end, the sender commits to a public experiment with an observable signal structure.

The literature has branched out to incorporate costly signaling ([Gentzkow and Kamenica, 2014](#)) and heterogeneous priors ([Alonso and Câmara, 2016](#)), but very few papers have examined informational asymmetry ([Hedlund \(2017\)](#) and [Perez-Richet \(2014\)](#)). In the context of bankruptcy filings, however, it is sensible to assume that management is better, albeit not perfectly, informed than the other players. Unlike both of these papers, the information structure in the model I examine is simpler, as it only allows for a binary signal. Such a signal is natural in a bankruptcy court, where the reports argue one side or the other rather than providing a probabilistic outlook. As a consequence of this information structure, no refinements beyond Perfect Bayesian Equilibrium are necessary for the model presented here. As in [Perez-Richet \(2014\)](#) but not in [Hedlund \(2017\)](#), in my setting, there is no separating equilibrium despite the extra information that the manager possesses.

In finance, the Bayesian Persuasion framework has been used to analyze voluntary disclosure in bilateral transactions ([Glode, Opp, and Zhang, 2017](#)) and the market for conflicted financial advice ([Szydlowski and Chang, 2017](#)).

The next section introduces the model and discusses Bayesian Persuasion and the solution concept. Section 3 presents the solution of the model and Section 4 concludes.

2 The Model

The model I describe here is a stylization and formalization of the relevant aspects of the U.S. Bankruptcy Code. The framework is more general, however, and can, with some adjustments, be used to describe other jurisdictions. I will henceforth refer to the game described below as the **Bankruptcy Persuasion Game** or **BPG**. The Bankruptcy Persuasion Game focuses on three pertinent players: the manager (M), the bankruptcy judge (J), and the creditor(s) (C),⁹ but abstracts from the presence of equityholders, rank-and-file employees, customers, etc. Potential conflict among the creditors of multi-creditor companies and between management and equityholders, while interesting and relevant in their own right, are not the subject of this model.

The players play a game with respect to a distressed company, which is run by the manager, financed by the creditors, and whose reorganization or liquidation may be decided by the judge upon a bankruptcy filing. Despite experiencing distress, the company may either be intrinsically economically viable or non-viable. Which of these true states obtains is unknown to the players. If either the manager or the creditors decide to file for bankruptcy, the matter is referred to the judge while the company is controlled by the filing party (for the creditors via a creditor-appointed trustee) during the bankruptcy process. The controlling party then appoints outside advisors (consultants, auditors, investment bankers, etc.) who produce a public signal about the viability of the company. For brevity, I will refer to that public signal as an “audit” and define it more formally in the next section. The court’s explicit objective is to ascertain as well as possible if the company is worth saving (if viable) or not (if non-viable), while making strides towards satisfying the creditors with the liquidation proceeds. The management’s objective is to persuade the court to reorganize the company to preserve their lucrative occupation. The creditors’ objective is to maximize financial returns.

⁹To make the exposition easier to follow, I will use the masculine form for the managers, the feminine for the judge, and the plural for the creditor(s).

More formally, the timeline and extensive form of the game are represented in Figures 1 and 2 respectively. The timeline is a simplified representation of the extensive form of the game, which is further described in more detail.

The company is in distress to begin with; it is unclear, however, whether this is because of financial difficulties only (i.e., it is nevertheless viable) or because the company has an obsolete economic model (non-viable).

The game begins with a chance move, in which nature draws a true state of viability $\omega \in \Omega = \{V, N\}$ (viable or non-viable respectively) according to a joint unconditional prior shared by all players $\Pr(V) = \mu \in (0, 1)$.¹⁰ The boundaries of the interval are excluded to eliminate degenerate strategies—a boundary $\mu \in \{0, 1\}$ is the same as all the players *knowing* the true state.

Once ω has been drawn, nature draws a noisy but (weakly) informative signal that can be high or low, $i \in \{H, L\}$, which is only observed by the manager and cannot be credibly communicated to the other players. Informativeness of the signal means that $\Pr(H|V) \geq \Pr(H|N)$. Noisiness means that neither signal results in certainty (probability of 1 or 0). Formally, $1 > \Pr(H|V) \geq \Pr(H|N) > 0$.

Hence, the manager receives a type characterized by the observed signal and updates his prior in accordance with Bayes' Rule to $\mu_H = \Pr(V|H) = (\Pr(H|V)\Pr(V))/\Pr(H)$ if the observed signal is high or to $\mu_L = \Pr(V|L) = (\Pr(L|V)\Pr(V))/\Pr(L)$ if it is low. Now,

$$1 = \Pr(H|V) + \Pr(L|V) \Rightarrow 1 = \frac{\Pr(V|H)\Pr(H)}{\Pr(V)} + \frac{\Pr(V|L)\Pr(L)}{\Pr(V)}$$

$$\Rightarrow \mu = \Pr(V) = \Pr(V|H)\Pr(H) + \Pr(V|L)\Pr(L) = \mu_H\Pr(H) + \mu_L(1 - \Pr(H))$$

Furthermore, notice that $\Pr(H|V) \geq \Pr(H|N)$ implies $\mu_H \geq \mu_L$ under the above

¹⁰Throughout, the notation $\Pr(X)$ denotes the probability of the event X obtaining. One can think of the joint prior μ as the players' best estimate of the *a priori* probability that the company is a viable going concern.

assumptions.¹¹ The former is easier to manipulate while working with the model below while the latter is a more apt and consistent assumption.

The intuitive way to understand the updated values is that the manager is privy to some inside information that tells him whether the company is more or less likely to be viable than implied by the publicly observed prior, edging his best estimate of the viability probability up to μ_H or down to μ_L .

Once this updating has occurred, the manager has the move. The order of moves proceeds as follows:

- i. The manager can voluntarily file for bankruptcy ($a_m = 1$) or pass the move to the creditors ($a_m = 0$). Formally, $a_m \in A_m := \{1, 0\}$.
- ii. The creditors, if the manager passes the move to them, can file for involuntary bankruptcy ($a_c = 1$) or refrain from action ($a_c = 0$) and await a resolution of the state of nature. Formally, $a_c \in A_c := \{1, 0\}$.
- iii. If a filing occurs, i.e., $a_m = 1$ or $a_c = 1$, a court procedure begins. The party filing the bankruptcy petition has the right to design an audit (or First Plan of Reorganization) to obtain a public signal about the viability of the company. An audit, more formally defined in Section 3, is modeled as a random mechanism which produces a signal about the state of the company. The filing party can select such a random mechanism, but both the mechanism and its outcome will be publicly observable. The signal outcome can be either that the company is viable or not, $p \in \{v, n\}$, and the filing party chooses the sensitivity of the audit mechanism, i.e., $\Pr(v|V)$ and $\Pr(n|N)$.
- iv. If a filing has occurred, the judge gets to move. She can liquidate (l) or reorganize (r) the company and, in doing so, can either take into account the result of the audit or ignore it. Formally, $a_j \in A_j := \{l, r\}$. The type of strategic communication

¹¹See Appendix [A](#) for a proof.

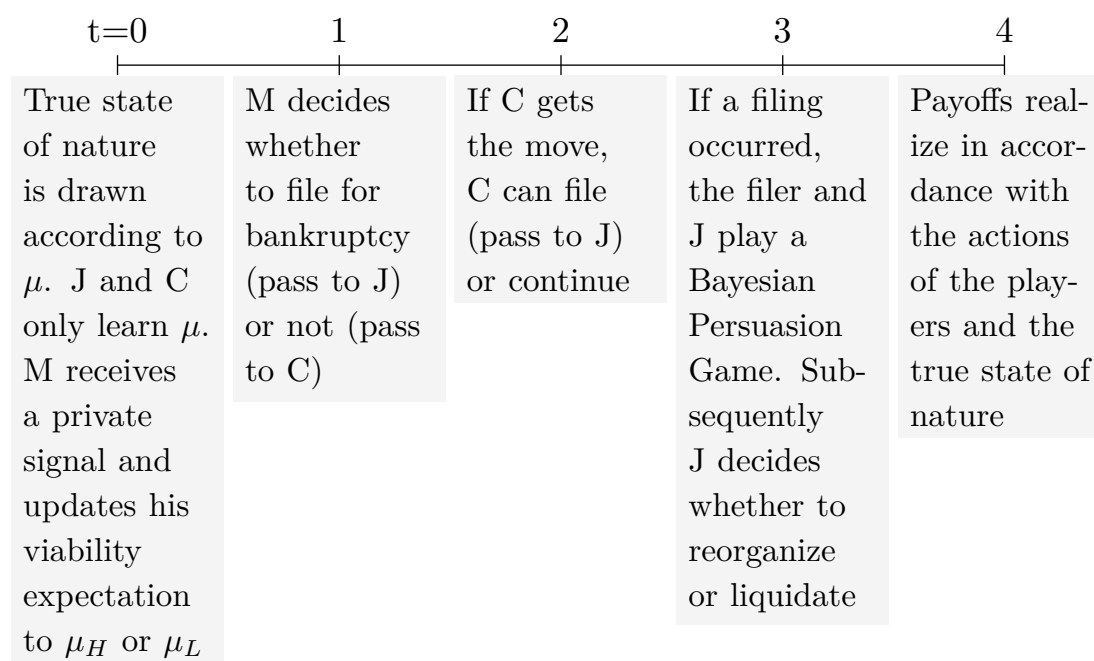


Figure 1: **Model timeline:** Order of the stages of the Bankruptcy Persuasion Game.

game between a filing party and the judge is called a Bayesian Persuasion Game (Kamenica and Gentzkow, 2011)—see below for a simple example of Bayesian Persuasion.

- v. Finally, nature reveals the state and payoffs realize in accordance with that state and the actions of the players.

Next, in an example, I consider the behavior of players on what would eventually be the unreached support of the equilibrium path. The purpose of the example is to shed light on the dynamics of the court action. Note that while strictly speaking the choice of μ is at odds with an implication of Assumptions 1 and 2, this choice is made deliberately to elucidate player behavior in the unreached parts of the game tree.

Example 2.1. Take the Bankruptcy Persuasion Game and let the common prior about the viability of the company be $\mu = 0.7$. Also let $\Pr(H|V) = \Pr(H|N)$, thereby suspending the asymmetry of information that will be discussed in the next section. This is just

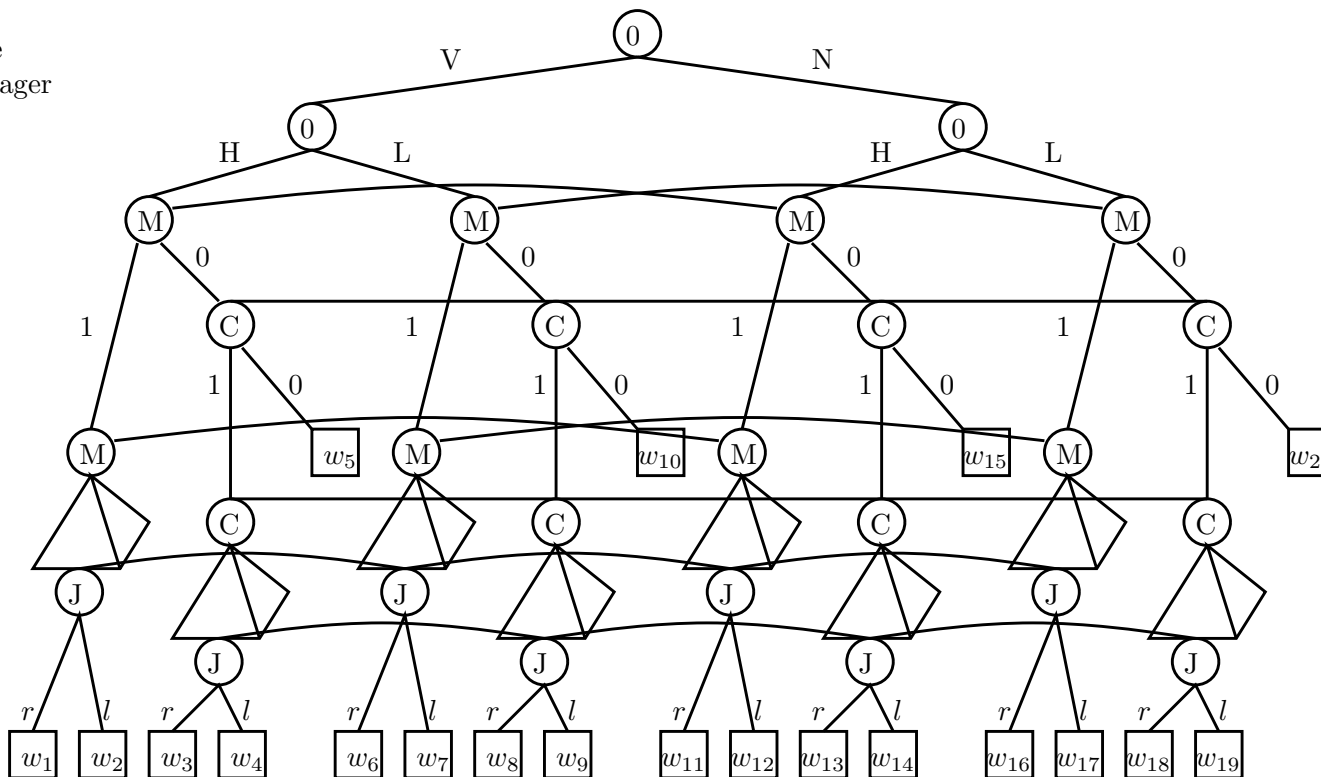
1. Nature draws the true state and private signal for the manager

2. The manager decides whether to file for bankruptcy

3. The creditors decide whether to file for bankruptcy if called upon to move

4. The filing party picks $\Pr(v|V)$ and $\Pr(n|N)$

5. The judge decides on liquidation or reorganization



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Figure 2: **The Bankruptcy Persuasion Game with Asymmetric Information** The game begins by nature selecting a true state in accordance with μ and a private signal for the manager $\in \{H, L\}$. This is followed by the manager's decision whether to file or not. If the manager does not file, then the creditors have the option to file or not. If neither the manager nor the creditors file, then the company continues out of court. If either party files, then that party enters a Bayesian Persuasion Game with the judge. The filing party designs an audit, or a public experiment, parametrized by $\Pr(v|V)$ and $\Pr(n|N)$. Then, potentially taking that signal structure and its outcome into account, the judge decides on liquidation or reorganization for the company. Finally, payoffs realize.

so that for the sake of the example no implication about the manager type can be made from his decision to pass to the creditors. The payoffs of the creditors are $U_c(\omega, 1, 0, r) = U_c(\omega, 0, 1, r) = U_c(\omega, 0, 0, r) = U_c(\omega, 0, 0, l) = 0$ and $U_c(\omega, 1, 0, l) = U_c(\omega, 0, 1, l) = 1$. Recall that v and n are the outcomes of the public audit regarding the viability of the company. Since liquidation is desired by the creditors, they will file for bankruptcy and engage in a persuasion game with the judge by designing an audit (a public experiment) comprised of two conditional probabilities $\Pr(v|V)$ and $\Pr(n|N)$.

What signaling structure is optimal from the point of view of the creditors in order for them to influence the judge to liquidate the company with as high a likelihood as possible?

Consider the following naïve audit mechanism. The creditors may do nothing (or engage in an uninformative audit), which would leave the conditional probabilities of viability unchanged from the prior, i.e., $\mu = \Pr(v|V) = \Pr(v|N)$. Since $\mu = 0.7$, it would be optimal for the judge to always reorganize, resulting in expected payoffs of $U_j = 0.7$ and $U_c = 0$ (the alternative, always liquidating, delivers $U_j = 0.3$ and mixed strategies fall in between).

A perfectly informative signal, $\Pr(v|V) = 1$ and $\Pr(n|N) = 1$, would result in the judge's always following the signal recommendation, resulting in expected payoffs of $U_j = 1$ and $U_c = 0.3$. This is an improvement for the creditors from the naïve doing nothing strategy, but can they do better?

A signaling structure of $\Pr(v|V) = 4/7$ and $\Pr(n|N) = 1$ is optimal for the creditors in this case. Furthermore, in equilibrium, the judge will conform to the signal recommendation and reorganize companies for which there is a viable signal and liquidate the ones for which there is a non-viable signal. I will first calculate the payoffs and then verify the optimality of the strategies for both players.

For the creditors:

$$U_c = (\Pr(v|V)\Pr(V) + \Pr(v|N)\Pr(V))U_c(r) \\ + (\Pr(n|V)\Pr(V) + \Pr(n|N)\Pr(V))U_c(l) = 0.6$$

For the judge:

$$U_j = \Pr(v|V)\Pr(V)U_j(V, r) + \Pr(v|N)\Pr(V)U_j(N, r) \\ + \Pr(n|V)\Pr(V)U_j(V, l) + \Pr(n|N)\Pr(V)U_j(N, l) = 0.7$$

Note that by following the signal the judge is not worse off than having had no information beyond μ . The creditors have improved significantly, however, going from 0 (without an informative public experiment), to 0.3 (with a perfectly informative one), to 0.6 (with the above signaling structure). One way to interpret this is to see the error rate of the judge as the scarce resource that the creditors are using. With the signaling structure above the creditors have managed to “flip” all the errors that the judge would make *against* them, in the absence of a public signal, into errors that go in their preferred direction.

It now remains to show that this is indeed the optimal signaling structure in this example. Can the creditors take this noisiness of the signal even further by making $\Pr(n|N) = 1$ and $\Pr(v|V) < 4/7$? If that were to happen, the judge would be better off ignoring the signal altogether and always reorganizing regardless of what signal obtains. This is easy to verify calculating payoffs just like above—following the signal would deliver less than 0.7 to the judge, whereas always reorganizing delivers 0.7.

This last feature is what gives Bayesian Persuasion its name—a signal needs to be Bayes Plausible¹² to be followed. That is, the sender of the signal can only push it so much before the posterior distribution becomes inconsistent with the prior and it

¹²Bayes Plausibility means nothing more than the judge being willing to update her beliefs in accordance with Bayes’ Rule and not acting in a conditionally dominated manner.

is optimal for the receiver to ignore the result of the audit (and other management-commissioned reports and analyses).

Now briefly consider creditors who would prefer reorganization to liquidation if called upon to move. If the rest of the parameters of the example stay the same, their best course of action will be one of a large number of payoff-equivalent audits that result in no new information for the judge. This, in turn, will lead to an optimal strategy for the judge of always reorganizing. One of these strategies is $\Pr(n|N) = 0$ and $\Pr(v|V) = 1$. Thus, notice that the creditor-optimal $\Pr(v|V)$ can take on different values in the unit interval, depending on the preference specification for the creditors. This concludes the example.

The judge's objective is to take the appropriate action for the type of company she is faced with. Let the judge's payoff be given by a function $U_j : \Omega \times A_j \rightarrow \mathbb{R}$. In particular:

Assumption 1 (Judge Preferences). $U_j(V, r) > U_j(V, l)$, $U_j(N, l) > U_j(N, r)$, and $U_j(V, r) - U_j(V, l) = U_j(N, l) - U_j(N, r)$.

The first two conditions formalize the directive for bankruptcy judges to reorganize viable going concerns and liquidate non-viable ones. The third one ensures symmetry in the payoff of the judge (errors cost the same regardless of direction) and makes the problem more tractable.

Furthermore, it is more interesting to hone in on situations, in which management cannot rely on the trivial strategy of filing and then commissioning an uninformative audit. Management might do that if the default action of the judge, with no extra information beyond the shared μ , is reorganization. If that were the case for the judge, there are, in fact, a continuum of such strategies for the manager. To avoid that, one must hence make liquidation the default action of the judge. This intuition is formalized in the next assumption.

Assumption 2 (Judge Default Action). $\mu U_j(V, r) + (1 - \mu)U_j(N, r) < \mu U_j(V, l) + (1 -$

$\mu)U_j(N, l)$.

The creditors aim to maximize financial payoff which is given by a function $U_c : \Omega \times A_m \times A_c \times A_j \rightarrow \mathbb{R}$. That is, the creditors' payoff depends on whether or not the company is viable, $\omega \in \Omega = \{V, N\}$, whether or not one of the parties files for bankruptcy, $a_m \in A_m = \{0, 1\}$ or $a_c \in A_c = \{0, 1\}$, and on what the judge decides, $a_j \in A_j = \{l, r\}$. This formalizes creditors who are focused on financial returns and are not involved in the operative business of the company. To make the problem interesting (i.e., provide a reason for the parties to disagree), let the creditors have a conflict with management over the preferred action of the judge, namely let the creditors prefer liquidation to reorganization in the event of non-viability.

Note that it is a corollary of combining the first two assumptions that $\mu < 0.5$. This allows us to focus on the interesting case, in which the troubled company is of sufficiently bad quality. In that case, a voluntary filing followed by no production of information would result in a liquidation for sure, thereby forcing the manager to produce some information via the audit.

Assumption 3 (Creditor Preferences). $U_c(N, 0, 1, l) > U_c(N, 0, 1, r)$, $U_c(N, 0, 0, l) = U_c(N, 0, 0, r)$ and $U_c(V, 0, 0, l) = U_c(V, 0, 0, r)$.

The latter two conditions simply reflect the idea that if the judge does not get to move, she does not affect the payoff of the creditors.

Now consider the actions of the creditors in case they file. Let them pick some optimal $\Pr(v|V) = y_c$.

Assumption 4 (Creditor Default Action). $\mu U_c(V, 0, 0, a_j) + (1 - \mu)U_c(N, 0, 0, a_j) < \max_{y_c} \{\mu y_c U_c(V, 0, 1, r) + \mu(1 - y_c)U_c(V, 0, 1, l)\} + (1 - \mu)U_c(N, 0, 1, l)$.

That is, the parameter constellation is such that if the manager passes the move to the creditors, they would file for bankruptcy. If they would not, then there would be no

conflict of interest between the manager and the creditors and the issue never ends up in court.

The manager is better off not going through the uncertainty of bankruptcy. If he feels that a filing by the creditors is imminent, however, he might as well file himself as this gives him control over the process, which would turn out to be a valuable lever.

The manager’s objective is the continued existence of the company—this feature naturally represents continued employment and the value of any equity compensation¹³. Let the payoff of management be given by a function $U_m : \Omega \times A_m \times A_c \times A_j \rightarrow \mathbb{R}$ satisfying the following:

Assumption 5 (Manager Preferences).

$$\begin{aligned} U_m(V, 0, 0, r) = U_m(V, 0, 0, l) &> U_m(V, 1, 0, r) \geq U_m(V, 0, 1, r) \\ &> U_m(V, 1, 0, l) \geq U_m(V, 0, 1, l) \end{aligned}$$

$$\begin{aligned} U_m(N, 0, 0, r) = U_m(N, 0, 0, l) &> U_m(N, 1, 0, r) \geq U_m(N, 0, 1, r) \\ &> U_m(N, 1, 0, l) \geq U_m(N, 0, 1, l) \end{aligned}$$

The intuition is natural here—in either state of nature, the manager prefers to continue out of court. This models management that is able to control the company without having to persuade a judge to make a determination. It prolongs the manager’s tenure and allows him to “gamble for resurrection” in case the company is not viable. If the case lands in court, the manager prefers a reorganization to a liquidation. Again, this models a manager who wants to keep his job. Outcomes in which management initiates the filing are weakly preferred to ones in which the creditors initiate the filing. This makes sense as creditor-initiated (involuntary) filings result in the immediate termination of management whereas management-initiated ones do not. Without a conflict of interest

¹³Eckbo, Thorburn, and Wang (2016) document that 15% of managers keep their jobs and do not experience a compensation decrease.

between the manager and the creditors, the problem would be much less interesting and the last three assumptions guarantee that.

What differentiates the model of Bayesian Persuasion in this paper from most of the literature is the information asymmetry. Here management, as the insider, has extra information which cannot, however, be credibly communicated. The study of the Bankruptcy Persuasion Game with asymmetric information, as described above, represents a twofold contribution: on the one hand, it is an application of Bayesian Persuasion to the bankruptcy setting—it is both a natural setting and once that helps resolve an economic puzzle. On the other hand, the paper adds to the literature that studies Bayesian Persuasion with asymmetric information. Management, who has received a private signal, has a natural informational advantage over the remaining players in the form of a more precise estimate of the state of nature. When $\Pr(H|V) = \Pr(H|N)$, the two types collapse into one and the informational asymmetry disappears, nesting the typical Bayesian Persuasion game model.

2.1 Solution Concept

The solution concept used in this paper is Perfect Bayesian Equilibrium (PBE) with ties broken by the preference of the party filing for bankruptcy. It turns out that only requiring Nash in the model introduced above delivers a multiplicity of equilibria. This section gives a brief overview of PBE. For a more general treatment, the reader is referred to Ritzberger (2002).

The goal of this refinement is to deliver for games of imperfect information a solution concept that is consistent with backward induction. Every player in the (extensive form) game is a Bayesian, in the sense that he or she has a “belief,” a probability distribution, at each (non-singleton) information set as to which node within the information set he or she is at. PBE does not go as far as possible in delivering on this goal because there are no constraints on the beliefs of different players and inconsistencies can still cause non-

credible threats. PBE ensures, however, that the behavior of players is not “conditionally irrational”—every player must have a behavior strategy at every information set of the game form that is (weakly) optimal given the set of beliefs the player holds, whether or not that information set can be reached.

In this model, PBE has bite insofar as the strategy of the judge is an object of interest. She may condition her actions on the signal that is produced in the audit commissioned by the manager (or the creditors). Furthermore, her default action, absent an informative signal, is not in the interest of the manager. Thus, the chosen audit of management has to be Bayes Plausible and (weakly) induce the judge to act on the audit outcome. The alternative would lead to a potential breakdown of the persuasion mechanism by a judge who chooses to follow a strategy involving the non-credible threat to punish all strategies that do not deliver her bliss point with an action that results in a low utility for the filing party.

3 Solution of the Model

The approach to solving the model is to constrain the strategy space of the players under PBE to those that are not conditionally dominated. Once several restrictions are made, I will show the uniqueness of the PBE of the BPG.

Recall from the example that the two probabilities $\Pr(v|V)$ and $\Pr(n|N)$, taken together, constitute the **audit** that is commissioned. All players observe these probabilities.

Lemma 3.1. *A manager who rationally files for bankruptcy picks $\Pr(v|V) = 1$ in any PBE.*

Proof. Suppose there were a PBE, in which a manager filed and picked $\Pr(v|V) < 1$.

The judge has 4 available pure strategies in this game for every observed choice of $\Pr(v|V)$ and $\Pr(n|N)$:

- i. always liquidate, regardless of the signal,
- ii. always reorganize, regardless of the signal,
- iii. follow the signal, i.e., reorganize if the observed signal is viable and liquidate if the observed signal is non-viable, and
- iv. go against the signal, i.e., reorganize if the observed signal is non-viable and liquidate if the observed signal is viable.

The fourth strategy occurs when the signal is informative in reverse.¹⁴ This is equivalent to the third strategy up to a relabeling of signal names, so henceforth only the first three strategies will be addressed.

In the first case, the judge always liquidates. The filing manager is getting his lowest payoff (see Assumption 1) for sure. Simply deviating to $\Pr(v|V) = \Pr(n|N) = 1$, which the judge will accept, as this gives her best payoff, would be profitable because $U_m(V, 1, 0, r) > U_m(V, 1, 0, l)$. Hence this candidate cannot be an equilibrium.

In the second case, the judge always reorganizes. Now either the creditors pass or they file for bankruptcy. In the former case the filing manager type has an incentive to deviate and in the latter the passing one does.

In the third case, the judge follows the signal. If this were the case, increasing $\Pr(v|V)$ to 1 improves both the filer's and the judge's payoff. If the judge followed the signal with the lower $\Pr(v|V)$, then she would still do that with $\Pr(v|V) = 1$. This strategy was available to the non-filing type previously as well, but he did not pick it (instead choosing to pass) so he will still pass now that the filing type has deviated to $\Pr(v|V) = 1$. Thus, this candidate is also not an equilibrium. This covers all possible cases and the proof is now complete.

□

¹⁴Similar to circumstances in which it is helpful to listen to advice from someone who is *always* wrong if only to then turn around and do the opposite of their advice.

One important point in the proof above that should be stressed is that given that the judge's default action is adverse to the manager, a rational manager would never commission an audit that specifies a mechanism which is outright ignored by the judge. Such a strategy would be quite obviously dominated by, among others, a perfectly informative audit.

The notion of the lemma overall is also quite intuitive. A filing manager aims to “flip” the errors of the judge, which are the scarce resource. Whereas without any additional information these errors would be contrary to the manager's interests, with the signal information, it would be optimal for the manager if the errors went to further his interests. Hence, it would be ideal, from the point of view of the manager, if *all* of the judge's mistakes further the interests of the manager.

Now that we have pruned the strategy space of the manager types given a true viable state, we are ready to pin down their strategy even further. To be able to refer to their strategy concisely, let the creditors, if called upon, pick $\Pr(v|V) = y_c \in [0, 1]$. Furthermore, let the high and the low type manager choose x_H and x_L respectively for the value of $\Pr(n|N)$.

Proposition 3.2. *The BPG has no separating PBE.*

Proof. A separating equilibrium between the two types of managers can obtain in one of two ways:

- i. both types of manager file for bankruptcy but pick $x_H \neq x_L$,
- ii. one type of manager files for voluntary bankruptcy, while the other one passes the move to the creditors.

Recall from the proof of Lemma 3.1. that a filing manager would never rationally pick a signal structure in bankruptcy that the judge would ignore.

As for case i., suppose there were a separating equilibrium, in which both types of managers file for bankruptcy. Then it must be that $x_H \neq x_L$ since the sensitivity of

the experiment contingent on the non-viable state of nature is the only means through which the types can separate. Also, neither type would choose an x_i that would result in liquidation for sure as that is the least desirable outcome for either manager and can be preempted by a perfectly informative signal.

But in equilibrium neither type would have an incentive to deviate from their chosen x_i and imitate the other type. Hence, given the payoffs above, we have:

$$\begin{aligned} & \mu_H U_m(V, 1, 0, r) + (1 - \mu_H)(1 - x_H)U_m(N, 1, 0, r) + (1 - \mu_H)x_H U_m(N, 1, 0, l) \\ & \geq \mu_H U_m(V, 1, 0, r) + (1 - \mu_H)(1 - x_L)U_m(N, 1, 0, r) + (1 - \mu_H)x_L U_m(N, 1, 0, l) \end{aligned} \quad (1)$$

$$\begin{aligned} & \mu_L U_m(V, 1, 0, r) + (1 - \mu_L)(1 - x_L)U_m(N, 1, 0, r) + (1 - \mu_L)x_L U_m(N, 1, 0, l) \\ & \geq \mu_L U_m(V, 1, 0, r) + (1 - \mu_L)(1 - x_H)U_m(N, 1, 0, r) + (1 - \mu_L)x_H U_m(N, 1, 0, l) \end{aligned} \quad (2)$$

Canceling out, and since $U_m(N, 1, 0, r) - U_m(N, 1, 0, l) > 0$ by Assumption 1, dividing through by it, it follows that:

$$x_H \leq x_L$$

$$x_L \leq x_H$$

.

The only possible solution of this system of inequalities is $x_H = x_L$, which contradicts the premise of this candidate being a separating equilibrium in the first place.

In the case ii., if one type of manager files and the other one does not, from Assumption 4, we have $U_c(N, 0, 1, l) > U_c(N, 0, 1, r)$. Hence if the creditors file, $\Pr(n|N) = 1$. Recall that the creditors, if called upon, pick $\Pr(v|V) = y_c \in [0, 1]$. This, combined with Assumption 1 gives us

$$x_i U_m(N, 0, 1, r) + (1 - x_i)U_m(N, 0, 1, l) > U_m(N, 0, 1, l)$$

for any $x_i \in (0, 1]$ and hence

$$\begin{aligned} & \bar{\mu}U_m(N, 0, 1, r) + (1 - \bar{\mu})x_iU_m(N, 0, 1, r) + (1 - \bar{\mu})(1 - x_i)U_m(N, 0, 1, l) \\ & > \bar{\mu}y_cU_m(N, 0, 1, r) + \bar{\mu}(1 - y_c)U_m(N, 0, 1, l) + U_m(N, 0, 1, l) \end{aligned}$$

for any $\bar{\mu} \in (0, 1)$. In particular, the updated prior of the non-filing type is in that interval. The inequality, however, shows that this manager has a profitable deviation by changing his strategy from not filing to filing, which contradicts the premise of the case. \square

This result tells us that better private information, while beneficial for the manager's payoff, does not really allow him to take any different actions to further profit from the information (and potentially share those profits with the judge or the creditors). Compared to a situation where types would be verifiable, the high type loses out and the low type gets a higher payoff.

I next examine the strategy of the judge. The input information she has at her disposal is comprised of the identity of the filing party (M or C), the mechanism selected by that party (the numerical values for $\Pr(v|V)$ and $\Pr(n|N)$), and the resulting public signal (v or n). The judge can either choose to ignore the latter signal or, without loss of generality, follow its recommendation.¹⁵ If the judge chooses to ignore the signal, she can choose any mixed strategy of liquidating or reorganizing. Since $\mu < 0.5$, however, liquidating dominates reorganizing and a rational judge would not choose the latter. Thus, the strategy of a rational judge is reduced to a mixed strategy of following the signal and liquidating. I will parametrize this strategy by the weight on following the signal, q , with the weight on liquidating being $(1 - q)$.

Recall that if the manager files, $\Pr(v|V) = 1$ regardless of type (similarly, if the creditors file $\Pr(n|N) = 1$). Thus the actual input variable of interest (if, without loss

¹⁵While it is possible for the judge to always go against the recommendation of the signal this is tantamount to a relabeling of the signals and results in analogous analysis. See the discussion in the proof of Lemma 3.1.

of generality, the manager files) is $\Pr(n|N) = x$.

Example 3.1. Consider a numerical example of a Bankruptcy Persuasion Game, in which $\mu = 0.3$, $\Pr(H|V) = \Pr(H|N)$. The payoffs of the manager are $U_m(\omega, 1, 0, r) = U_m(\omega, 0, 1, r) = U_m(\omega, 0, 0, r) = U_m(\omega, 0, 0, l) = 1$ and $U_m(\omega, 1, 0, l) = U_m(\omega, 0, 1, l) = 0$, $\forall \omega \in \Omega$. The payoffs of the judge are $U_j(V, r) = U_j(N, l) = 1$ and $U_j(V, l) = U_j(N, r) = 0$. For the creditors $1 = U_c(V, 0, 1, l) > U_c(V, 0, 1, r) = 0$ and $1 = U_c(N, 0, 1, l) > U_c(N, 0, 1, r) = 0$, and $1 > \mu_H > \mu_L > 0$. Now consider the following strategy combination:

- i. the creditors always file for involuntary bankruptcy and push for liquidation,
- ii. the manager picks an audit parametrized by $\Pr(n|N) = 0.7$, and
- iii. the judge's strategy is as follows: for $\Pr(n|N) \in [0, 0.7) \cup [0.8, 0.9)$, liquidate and for $\Pr(n|N) \in [0.7, 0.8) \cup [0.9, 1]$, follow the signal realization.

This strategy combination is a Nash equilibrium. To quickly verify, no player has incentive to unilaterally deviate:

- i. the creditors never get to move, but their strategy makes the manager file for bankruptcy,
- ii. the manager, upon filing for bankruptcy, would be worse off if he were to decrease $\Pr(n|N)$, because he would face certain liquidation. He'd also be worse off by increasing $\Pr(n|N)$ because $\mu_i U_m(V, 1, 0, r) + (1 - \mu_i)(0.7)U_m(N, 1, 0, r) + (1 - \mu_i)(0.3)U_m(N, 1, 0, l) > \mu_i U_m(V, 1, 0, r) + (1 - \mu_i)(0.7 + \delta)U_m(N, 1, 0, r) + (1 - \mu_i)(0.3 - \delta)U_m(N, 1, 0, l)$ for $\delta > 0$ because $U_m(N, 1, 0, r) > U_m(N, 1, 0, l)$, and
- iii. given the above strategies, the judge is better off following the signal than always liquidating at the point $\Pr(n|N) = 0.7$, so there is no profitable deviation for her either.

There is an issue with the equilibrium in Example 3.1, in particular with the off-equilibrium part of the judge's strategy, which is not a monotonic function of x_i . Consider a strategy for the judge given by liquidating for $\Pr(n|N) \in [0, 0.7)$ and following the signal for $\Pr(n|N) \in [0.7, 1]$. Notice that this strategy delivers the same payoffs as the one in the example above but does require the judge to take conditionally suboptimal actions for the off-equilibrium values of $\Pr(n|N) \in [0.8, 0.9)$. Intuitively speaking, strategies that "jump up and down" can be equilibrium strategies but there is an equilibrium strategy that delivers the same outcome with at most one jump and it is that one which will survive the refinement of the solution concept. The conditionally suboptimal off-equilibrium behavior is eliminated by using Perfect Bayesian Equilibrium instead of Nash and takes us to the following lemma.

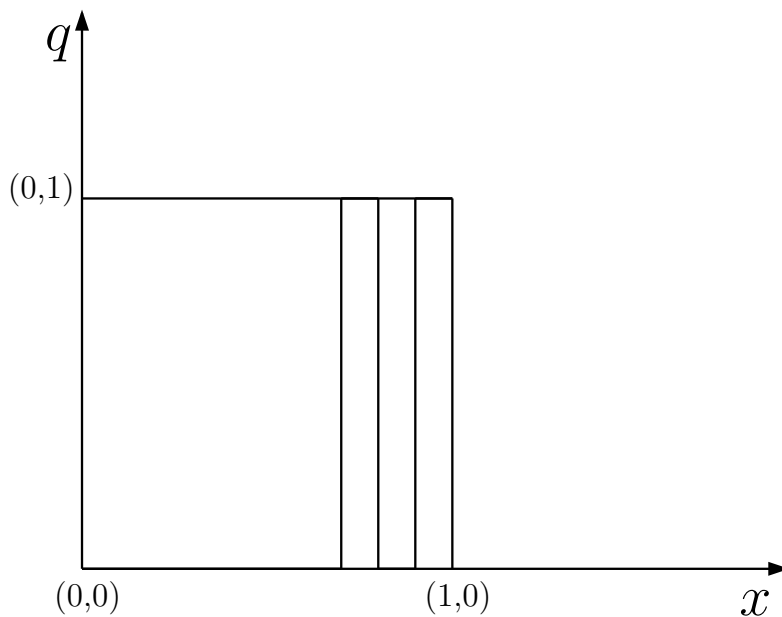


Figure 3: **Example 3.1.** One strategy for the judge (the function represented by the thick line in the graph above) which could be consistent with a Nash equilibrium but is not consistent with a PBE. This equilibrium seems unreasonable in the sense that it uses strategies that employ conditionally dominated strategies off the equilibrium path. E.g., for a judge might threaten liquidation for $\Pr = 0.85$ but a rational judge who finds herself in that information set would instead be better off following the signal.

Lemma 3.3. *In any PBE, the judge's probability weight on following the signal of the (manager-commissioned) audit, q , is a non-decreasing function of $\Pr(n|N)$.*

Proof. Notice that the manager is best off picking the lowest value of $\Pr(n|N)$ for which the company does not get liquidated for sure (because $U_m(N, 1, 0, r) > U_m(N, 1, 0, l)$). Also notice that for $\Pr(n|N) = 0$ the judge should always liquidate and for $\Pr(n|N) = 1$ she should follow the signal. In fact, there is an infimum of $\Pr(n|N)$ in the judge's strategy for which the judge switches to following the signal rather than always liquidating. A strategy for the judge that follows the signal for all values of $\Pr(n|N)$ above that infimum delivers the same equilibrium payoff as the original strategy. Wherever the two strategies disagree off the equilibrium path, it is the original strategy that is conditionally dominated. \square

Before the next proposition, one should note that the model as described has a PBE for some parameter constellations that results in neither the manager nor the creditors filing for bankruptcy. This PBE, however, results from parameter constellations that violate Assumption 4. In the real world, those are troubled companies in which neither stakeholder files, but an out-of-court agreement is reached. These workouts are not present in the stylized facts that this model aims to explain.

Lemma 3.4 (Voluntary Bankruptcy Condition). *In any PBE under Assumptions 1 through 5 above, the manager files for voluntary bankruptcy if and only if the creditors, if called upon to move, file for bankruptcy.*

Proof. “Only if” Recall the definition of y_c . They pick some $\Pr(v|V) = y_c \in \operatorname{argmax}\{\mu y_c U_c(V, 0, 1, r) + \mu(1 - y_c)U_c(V, 0, 1, l) + (1 - \mu)U_c(V, 0, 1, l)\}$. That is, y_c is an optimal choice for the creditors. Now, the creditors not filing for bankruptcy, if called upon, means that $\mu U_c(V, 0, 0, a_j) + (1 - \mu)U_c(N, 0, 0, a_j) > \mu y_c U_c(V, 0, 0, r) + \mu(1 - y_c)U_c(V, 0, 0, l) + (1 - \mu)U_c(V, 0, 0, l)$. Since we have $U_m(\omega, 0, 0, r) = U_m(\omega, 0, 0, l) > U_m(\omega, 1, 0, r)$, $\forall \omega \in \Omega$, then the manager, if he expects the creditors to pass, would also

find it optimal to pass rather than to file for bankruptcy.

“If” Now let the creditors have a y_c such that they find it optimal to file for bankruptcy. That is $\mu U_c(V, 0, 0, a_j) + (1 - \mu)U_c(N, 0, 0, a_j) < \mu y_c U_c(V, 0, 0, r) + \mu(1 - y_c)U_c(V, 0, 0, l) + (1 - \mu)U_c(V, 0, 0, l)$. Their filing would leave the manager worse off than if he files himself because $\mu_i y_c U_m(V, 0, 1, r) + \mu_i(1 - y_c)U_m(V, 0, 1, l) + (1 - \mu_i)U_m(N, 0, 1, l) < \mu_i U_m(V, 1, 0, r) + (1 - \mu_i)(1 - x)U_m(N, 1, 0, r) + (1 - \mu_i)xU_m(N, 1, 0, l)$. \square

This lemma delivers a central intuition of this paper. Whenever the manager files for bankruptcy, he does so in order to remain in the driver’s seat of the bankruptcy process and not let a creditor with divergent interests take over the process to management’s detriment. This is one explanation of why the vast majority of bankruptcy filings in the U.S. are voluntary (i.e., management, rather than the creditors, initiated the filing).

Now, adding Assumption 5 to the above would ensure that the creditors, if given the move, would file. Expecting this, a rational manager would preemptively file, thus delivering the unique PBE of the BPG that is described in the next proposition.

Proposition 3.5. *Any Bankruptcy Persuasion Game that satisfies Assumptions 1 through 5 has a unique Perfect Bayesian Equilibrium. It is either an equilibrium in which the manager and the creditors pick $a_m = a_c = 0$ or one in which the manager picks $a_m = 1$. In the latter case both manager types pick $Pr(v|V) = 1$ and $Pr(n|N) = (1 - 2\mu)/(1 - \mu)$, the judge follows the signal and the creditors maximize their payoffs contingent on getting the move. The expected payoffs of the players are:*

- i. for the manager: $\mu_i + (1 - x_i)(1 - \mu_i)$, where $i \in \{H, L\}$,*
- ii. for the creditors: $\mu U_c(V, 1, 0, r) + \mu U_c(N, 1, 0, r) + (1 - 2\mu)U_c(N, 0, 1, l)$, and*
- iii. for the judge: $(1 - \mu)$.*

Proof. As observed above, if the creditors would file (Assumption 5), the manager would file first. So far we have pruned the candidate equilibria substantially. By Lemma

3.4. and Assumption 5, we can only have equilibria in which both the creditors (if given the move) and the manager file for bankruptcy. By Lemma 3.3. the judge's strategy is a non-decreasing function of $\Pr(n|N)$ when the manager files. Furthermore, the two manager types file and choose the same audit mechanism by Proposition 3.2. I will now propose a strategy combination and verify that it is a PBE. Then I will demonstrate that every alternative candidate includes strategies that are conditionally dominated for the judge, thereby completing the proof.

I will argue that the following strategy combination is a PBE:

- i. both manager types go into voluntary bankruptcy and pick $\Pr(v|V) = 1$ and $\Pr(n|N) = (1 - 2\mu)/(1 - \mu)$,
- ii. the judge, indifferent between conforming to the signal or always liquidating, follows the recommendation of the signal, and
- iii. the creditors never get to move on the equilibrium path, but off the equilibrium path, they file for bankruptcy themselves.

I will first demonstrate that the strategy given above is an equilibrium. Then I will proceed to prove its uniqueness.

I will first specify the set of off-equilibrium beliefs of the judge. Let her believe that any manager who specifies a mechanism with $\Pr(n|N) < (1 - 2\mu)/(1 - \mu)$ is running a non-viable company with a probability greater than half and hence she would mandate the liquidation of such companies.

Recall that, it is a strictly dominant strategy for either type of manager to set $\Pr(v|V) = 1$ if he files (Lemma 3.1.).

Neither type of manager has an incentive to deviate from $\Pr(n|N) = (1 - 2\mu)/(1 - \mu)$, because a deviation would either result in immediate liquidation (if the deviation is to a lower value given the judge's beliefs) or would be a dominated strategy (decreasing $\Pr(n|N)$ to $(1 - 2\mu)/(1 - \mu)$ would result in a higher payoff for the manager). The

creditors do not get to move on the equilibrium path. The equilibrium is supported off the equilibrium path by a bankruptcy filing by the creditors, should they get the move, which is rational by Assumption 5. This, in turn, ensures that the manager will file (by Lemma 3.4.). The judge is weakly better off following the signal produced by the audit than ignoring it. Thus, this strategy combination is a PBE. The payoffs are:

- i. for the manager: $U_m = \mu_i + (1 - \frac{1-2\mu}{1-\mu})(1 - \mu_i) = \frac{\mu}{1-\mu} + \mu_i \frac{1-2\mu}{1-\mu}$,
- ii. for the judge: $U_j = (1 - \mu)$, which is no worse (in fact exactly equal) to the judge's alternative course of action, always liquidating, and
- iii. for the creditors, who never get to move, $U_c = \mu U_c(V, 1, 0, r) + \mu U_c(N, 1, 0, r) + (1 - 2\mu)U_c(N, 1, 0, l)$.

Having established existence, I next turn to uniqueness. Notice that the equilibrium above is not the only Nash Equilibrium of the BPG. In particular for some real $\Delta > 0$ any $\Pr(n|N) = (1 - 2\mu)/(1 - \mu) + \Delta > (1 - 2\mu)/(1 - \mu)$ would also be a Nash equilibrium if the judge were to enforce it with the same type of extreme beliefs described above. Namely, if the judge threatens that she would liquidate for any $\Pr(n|N) \neq (1 - 2\mu)/(1 - \mu) + \Delta$ and that threat is taken at face value by the other players. Such a strategy on behalf of the judge would, however, be “conditionally irrational.” This conditionally dominated strategy at an unreached information set of the judge is excluded by the PBE solution concept.

To see this, let management pick $\Pr(v|V) = 1$ and, crucially, $\Pr(n|N) = (1 - 2\mu)/(1 - \mu) + \Delta/2$. Contingent upon obtaining the move from management, the judge has an incentive to deviate from her stated strategy. Liquidating would deliver her a payoff of $(1 - \mu)$ while following the signal would deliver $\mu + ((1 - 2\mu)/(1 - \mu) + \Delta/2)(1 - \mu) > \mu + (1 - 2\mu)(1 - \mu)/(1 - \mu) = 1 - \mu$. Thus, a rational judge who does not employ non-credible threats would follow the signal rather than the strategy which enforces a higher precision in the non-viable state of nature.

This argument leads to $\Pr(n|N) = (1 - 2\mu)/(1 - \mu)$ as the highest $\Pr(n|N)$ that the judge can credibly enforce. \square

This result establishes the unique PBE of the game and thus enables us to derive testable predictions. While viable companies are reorganized more often than non-viable ones, judges are unable to tell the companies apart and there is no incentive for managers of better companies to differentiate themselves through their actions. This result is novel and demonstrates that in a Bayesian Persuasion Game a pooling equilibrium obtains despite asymmetric information.

Furthermore, it is interesting that since the private information bears no consequence on management's strategy and the original μ is correct in an expected value sense, the expected payoff of management is changed by the realization of the signal but not by whether there is a private signal stage or not. Thus, a rational manager would not be willing to pay extra for information about the status of the company as this information provides no strategic advantage.

4 Conclusion

This paper makes three distinct contributions. Firstly, it proposes a potential explanation for the observed pattern of voluntary bankruptcy filings and the high proportion of companies that have been reorganized by U.S. courts that arguably should not have been. Persuasion is the mechanism of the economic interaction, as contrasted with the negotiation lens that the bankruptcy literature has taken thus far. This mechanism has implications for the behavior of the management of companies in distress. Managers will undertake voluntary filings. The behavior of high- and low-type managers would be indistinguishable.

Secondly, the paper presents a very natural application of the methodology of Bayesian Persuasion. While in some other applications the commitment of management might

be an unrealistic assumption, in this case, it conforms to the institutional detail of outside certification of viability through auditors, investment bankers, and other external advisors.

Finally, the paper adds to the literature on Bayesian Persuasion with asymmetric information, whereby it is differentiated by a binary signal. This, in turn, implies that Perfect Bayesian Equilibrium delivers a unique equilibrium in the game and thereby delivers testable predictions. In addition to exclusively observing voluntary chapter 11 filings, in which management is pushing to increase the likelihood of a reorganization, one would expect no investment by management in finding out the true state of nature. Neither would one expect the manager's actions to betray his type. Lastly, the judge should be expected to follow the recommendations of management-commissioned reports and audits.

Further work left for future research includes an empirical analysis of the predictions of this paper, the conducting of a welfare analysis, the introduction of side bets (for the manager) on the state of nature, and an extension of the model to accommodate a continuous state space. It would be interesting to be able to compare the U.S. mechanism to other mechanisms known from international practices, e.g., bankruptcy auctions.

References

- ACHARYA, V. V., AND K. V. SUBRAMANIAN (2009): “Bankruptcy Codes and Innovation,” *The Review of Financial Studies*, 22(12), 4949–4988.
- ADLER, B. E., V. CAPKUN, AND L. A. WEISS (2013): “Value Destruction in the New Era of Chapter 11,” *The Journal of Law, Economics, and Organization*, 29(2), 461–483.
- AGHION, P., O. HART, AND J. MOORE (1992): “The Economics of Bankruptcy Reform,” Working Paper 4097, National Bureau of Economic Research.
- AIVAZIAN, V., AND J. CALLEN (1983): “Reorganization in bankruptcy and the issue of strategic risk,” 7, 119–133.
- AIVAZIAN, V., AND S. ZHOU (2012): “Is Chapter 11 Efficient?,” *Financial Management*, 41(1), 229–253.
- ALONSO, R., AND O. CÂMARA (2016): “Bayesian persuasion with heterogeneous priors,” *Journal of Economic Theory*, 165(Supplement C), 672 – 706.
- (2017): “On the value of persuasion by experts,” *Working paper*.
- AUMANN, R. J., AND M. MASCHLER (1995): *Repeated Games with Incomplete Information*. The MIT Press.
- AYOTTE, K., AND H. YUN (2009): “Matching Bankruptcy Laws to Legal Environments,” *The Journal of Law, Economics, and Organization*, 25(1), 2–30.
- BAIRD, D. G. (1986): “The Uneasy Case for Corporate Reorganizations,” *Journal of Legal Studies*, 127(51).
- (1987): “A world without bankruptcy,” *Law and Contemporary Problems*, 50, 173–193.

- BAIRD, D. G., A. BRIS, AND N. ZHU (2007): “The Dynamics of Large and Small Chapter 11 Cases: An Empirical Study,” *Working Paper*.
- BAIRD, D. G., AND T. H. JACKSON (1988): “Bargaining after the Fall and the Contours of the Absolute Priority Rule,” *University of Chicago Law Review*, (55).
- BAIRD, D. G., AND R. C. PICKER (1991): “A Simple Noncooperative Bargaining Model of Corporate Reorganizations,” *The Journal of Legal Studies*, 20(2), 311–349.
- BEBCHUK, L., AND J. FRIED (1997): “The Uneasy Case for the Priority of Secured Claims in Bankruptcy: Further Thoughts and a Reply to Critics,” *Cornell Law Review*, 82, 1279–1348.
- BERKOVITCH, E., AND R. ISRAEL (1999): “Optimal Bankruptcy Laws Across Different Economic Systems,” *The Review of Financial Studies*, 12(2), 347–377.
- BERKOVITCH, E., R. ISRAEL, AND J. ZENDER (1997): “Optimal bankruptcy law and firm-specific investments,” *European Economic Review*, 41, 487–497.
- BERKOVITCH, E., R. ISRAEL, AND J. F. ZENDER (1998): “The Design of Bankruptcy Law: A Case for Management Bias in Bankruptcy Reorganizations,” *The Journal of Financial and Quantitative Analysis*, 33(4), 441–464.
- BETKER, B. L. (1995): “Management’s Incentives, Equity’s Bargaining Power, and Deviations from Absolute Priority in Chapter 11 Bankruptcies,” *The Journal of Business*, 68(2), 161–183.
- BHANDARI, J. S., AND L. A. WEISS(EDS.) (1996): “Corporate bankruptcy: economic and legal perspectives,” .
- BOLTON, P., AND D. SCHARFSTEIN (1996): “Optimal Debt Structure and the Number of Creditors,” *Journal of Political Economy*, 104(1), 1–25.

- BRIS, A., A. SCHWARTZ, AND I. WELCH (2005): “Who Should Pay for Bankruptcy Costs?,” *Journal of Legal Studies*, 295(34).
- BROWN, D. T. (1989): “Claimholder Incentive Conflicts in Reorganization: The Role of Bankruptcy Law,” *The Review of Financial Studies*, 2(1), 109–123.
- CHO, I.-K., AND D. M. KREPS (1987): “Signaling Games and Stable Equilibria,” *The Quarterly Journal of Economics*, 102(2), 179–221.
- CORNELLI, F., AND L. FELLI (1997): “Ex-ante efficiency of bankruptcy procedures,” *European Economic Review*, 41(3-5), 475–485.
- CRAWFORD, V. P., AND J. SOBEL (1982): “Strategic Information Transmission,” *Econometrica*, 50(6), 1431–1451.
- DJANKOV, S., O. HART, C. MCLIESH, AND A. SHLEIFER (2008): “Debt Enforcement around the World,” *Journal of Political Economy*, 116(6), 1105–1149.
- ECKBO, B., K. THORBURN, AND W. WANG (2016): “How costly is corporate bankruptcy for the CEO?,” *Journal of Financial Economics*, 121(1), 210–229.
- ELLUL, A., AND M. PAGANO (2016): “Corporate Leverage and Employees’ Rights in Bankruptcy,” *Working Paper*.
- FRANKS, J., AND G. LORANTH (2014): “A Study of Bankruptcy Costs and the Allocation of Control*,” *Review of Finance*, 18(3), 961–997.
- FRANKS, J., AND O. SUSSMAN (2005): “Financial Distress and Bank Restructuring of Small to Medium Size UK Companies,” *Review of Finance*, 9(1), 65–96.
- FRANKS, J. R., K. G. NYBORG, AND W. N. TOROUS (1996): “A Comparison of US, UK, and German Insolvency Codes,” *Financial Management*, 25(3), 86–101.

- FRANKS, J. R., AND W. N. TOROUS (1989): “An Empirical Investigation of U.S. Firms in Reorganization,” *The Journal of Finance*, 44(3), 747–769.
- (1994): “A comparison of financial restructuring in distressed exchanges and chapter 11 reorganizations,” *Journal of Financial Economics*, 35(3), 349–370.
- FRIEDEN, M., AND S. WIELENBERG (2017): “Insolvency administrator’s incentives and the tradeoff between creditor satisfaction and efficiency in bankruptcy procedures,” *Business Research*, 10(2), 159–187.
- GENTZKOW, M., AND E. KAMENICA (2014): “Costly Persuasion,” *The American Economic Review*, 104(5), 457–462.
- GERTNER, R., AND D. SCHARFSTEIN (1991): “A Theory of Workouts and the Effects of Reorganization Law,” *The Journal of Finance*, 46(4), 1189–1222.
- GIAMMARINO, R. M. (1989): “The Resolution of Financial Distress,” *The Review of Financial Studies*, 2(1), 25–47.
- GILSON, S. C. (1990): “Bankruptcy, boards, banks, and blockholders: Evidence on changes in corporate ownership and control when firms default,” *Journal of Financial Economics*, 27(2), 355–387.
- (1991): “Managing Default: Some Evidence on How Firms Choose between Workouts and Chapter 11,” *Journal of Applied Corporate Finance*, 4(2), 62–70.
- GLODE, V., C. C. OPP, AND X. ZHANG (2017): “Voluntary Disclosure in Bilateral Transactions,” *Working Paper*.
- HEDLUND, J. (2017): “Bayesian persuasion by a privately informed sender,” *Journal of Economic Theory*, 167(C), 229–268.
- HENNESSY, C. A., AND D. LIVDAN (2009): “Debt, bargaining, and credibility in firm-supplier relationships,” *Journal of Financial Economics*, 93(3), 382–399.

- HOTCHKISS, E. (1995): “Postbankruptcy Performance and Management Turnover,” *The Journal of Finance*, 50, 3–21.
- HOTCHKISS, E. S., K. JOHN, R. M. MOORADIAN, AND K. S. THORBURN (2008): “Bankruptcy and the Resolution of Financial Distress,” *Handbook of Empirical Corporate Finance*, Volume 2.
- JACKSON, T. H. (1982): “Bankruptcy, Non-Bankruptcy Entitlements, and the Creditors’ Bargain,” *The Yale Law Journal*, 91(5).
- KAMENICA, E., AND M. GENTZKOW (2011): “Bayesian Persuasion,” *American Economic Review*, 101(6), 2590–2615.
- LOPUCKI, L. M. (1983): “The Debtor in Full Control—Systems Failure under Chapter 11 of the Bankruptcy Code,” *American Bankruptcy Law Journal*, 57, 99.
- LOPUCKI, L. M., AND W. C. WHITFORD (1993): “Corporate Governance in the Bankruptcy Reorganization of Large, Publicly Held Companies,” *University of Pennsylvania Law Review*, 141(3).
- PEREZ-RICHET, E. (2014): “Interim Bayesian Persuasion: First Steps,” *The American Economic Review*, 104(5), 469–474.
- POVEL, P. (1999): “Optimal ‘soft’ or ‘tough’ bankruptcy procedures,” *The Journal of Law, Economics, and Organization*, 15(3), 659–684.
- RITZBERGER, K. (2002): *Foundations of Non-Cooperative Game Theory*, no. 9780199247868 in OUP Catalogue. Oxford University Press.
- ROE, M. J. (1983): “Bankruptcy and Debt: A New Model for Corporate Reorganization,” *Columbia Law Review*, 83(3), 527–602.
- SCHOAR, A., AND T. CHANG (2017): “Judge Specific Differences in Chapter 11 and Firm Outcomes,” *Working Paper*.

- SCHWARTZ, A. (2005): “Normative Theory of Business Bankruptcy,” *Virginia Law Review*, 91(5), 1200–1265.
- STIGLITZ, J. (1972): “Some Aspects of the Pure Theory of Corporate Finance: Bankruptcies and Take-Overs,” *Bell Journal of Economics*, 3(2), 458–482.
- SZYDLOWSKI, M., AND B. CHANG (2017): “The Market for Conflicted Advice,” 2017 Meeting Papers 133, Society for Economic Dynamics.
- TASHJIAN, E., R. C. LEASE, AND J. J. MCCONNELL (1996): “An empirical analysis of prepackaged bankruptcies,” *Journal of Financial Economics*, 40(1), 135–162.
- THORBURN, K. S. (2000): “Bankruptcy auctions: costs, debt recovery, and firm survival,” *Journal of Financial Economics*, 58(3), 337 – 368.
- TRIANDIS, G. G. (1993): “The Effects of Insolvency and Bankruptcy on Contract Performance and Adjustment,” *The University of Toronto Law Journal*, 43(3), 679–710.
- WEISS, L. A., AND K. H. WRUCK (1998): “Information problems, conflicts of interest, and asset stripping: Chapter 11’s failure in the case of Eastern Airlines,” *Journal of Financial Economics*, 48(1), 55–97.
- WHITE, M. J. (1980): “Public Policy toward Bankruptcy: Me-First and Other Priority Rules,” *The Bell Journal of Economics*, 11(2), 550–564.
- (1989): “The Corporate Bankruptcy Decision,” *Journal of Economic Perspectives*, 3(2), 129–51.
- (1994): “Corporate Bankruptcy as a Filtering Device: Chapter 11 Reorganizations and Out-of-Court Debt Restructurings,” *The Journal of Law, Economics, and Organization*, 10(2), 268–295.
- (2005): “Corporate and Personal Bankruptcy Law,” Working Paper 17237, National Bureau of Economic Research.

WHITE, M. J., AND R. A. POSNER (1996): *The costs of corporate bankruptcy: A U.S.-European comparison*. 467–500. Cambridge University Press.

ZAME, W. (1993): “Efficiency and the Role of Default When Security Markets Are Incomplete,” *American Economic Review*, 83(5), 1142–64.

A Proof of $\Pr(H|V) \geq \Pr(H|N) \Rightarrow \mu_H \geq \mu_L$

Recall that there are two possible true states, $\{V, N\}$, and two possible signals, $\{H, L\}$ and all four event combinations in the Cartesian product of these sets have nonzero probabilities. Beginning with $\Pr(H|V) \geq \Pr(H|N)$ and restating in terms of the constituent events yields:

$$\frac{\Pr(H \cap V)}{\Pr(H \cap V) + \Pr(L \cap V)} \geq \frac{\Pr(H \cap N)}{\Pr(H \cap N) + \Pr(L \cap N)}$$

Taking reciprocals and reversing the direction of the inequality yields:

$$\begin{aligned} \frac{\Pr(H \cap V) + \Pr(L \cap V)}{\Pr(H \cap V)} &\leq \frac{\Pr(H \cap N) + \Pr(L \cap N)}{\Pr(H \cap N)} \\ \Leftrightarrow 1 + \frac{\Pr(L \cap V)}{\Pr(H \cap V)} &\leq 1 + \frac{\Pr(L \cap N)}{\Pr(H \cap N)} \Leftrightarrow \frac{\Pr(L \cap V)}{\Pr(H \cap V)} \leq \frac{\Pr(L \cap N)}{\Pr(H \cap N)} \end{aligned}$$

Multiplying through by $\Pr(H \cap N)/\Pr(L \cap V)$ results in:

$$\begin{aligned} \frac{\Pr(H \cap N)}{\Pr(H \cap V)} \leq \frac{\Pr(L \cap N)}{\Pr(L \cap V)} &\Leftrightarrow \frac{\Pr(H \cap N)}{\Pr(H \cap V)} + 1 \leq \frac{\Pr(L \cap N)}{\Pr(L \cap V)} + 1 \\ \Leftrightarrow \frac{\Pr(H \cap V) + \Pr(H \cap N)}{\Pr(H \cap V)} &\leq \frac{\Pr(L \cap V) + \Pr(L \cap N)}{\Pr(L \cap V)} \end{aligned}$$

Again taking reciprocals yields:

$$\frac{\Pr(H \cap V)}{\Pr(H \cap V) + \Pr(H \cap N)} \geq \frac{\Pr(L \cap V)}{\Pr(L \cap V) + \Pr(L \cap N)}$$

Finally, restating again in terms of conditional probabilities yields:

$$\mu_H = \Pr(V|H) \geq \Pr(V|L) = \mu_L$$

□