The Economics of the Right to be Forgotten*

Byung-Cheol Kim† Jin Yeub Kim‡

March 16, 2015

Abstract

We examine the underlying economics behind the emerging issue of the so-called "right to be forgotten," which subsumes the right for individuals to ask for 'inadequate, irrelevant or no longer relevant, or excessive' information about them to be dropped from Internet searches. At stake is the conflict between the privacy right and other fundamental rights such as the freedom of speech, expression, and access to information. First, we analyze a legal dispute game between a petitioner, claiming the right to be forgotten, and an Internet search engine. In particular, we characterize conditions under which litigation arises as an equilibrium outcome. Then we provide comparative static results on the probability of lawsuits and the likelihood of broken-links, in connection to the social value of information. Our model offers a useful framework in understanding the effects of Europe's expansion of the right to be forgotten to non-European websites: If the European ruling applies to all global search engine domains, then the expected amount of broken-links would fall.

Keywords: Right to be forgotten, privacy, litigation, internet services.

JEL Classification: C72, D82, K20, K41, L86.

*First version: December 2014. This is a preliminary version. Any comment will be appreciated. We thank Jay Pil Choi and Lars Stole for helpful feedback.

†Department of Economics, Georgia Institute of Technology. E-mail: byung-cheol.kim@econ.gatech.edu, Webpage: https://sites.google.com/site/byungcheolkim76

‡Department of Economics, University of Nebraska-Lincoln. E-mail: shiningjin@gmail.com, Webpage: https://sites.google.com/site/jinyeubkim

1 Introduction

In 2009, Mario Costeja González, a Spaniard lawyer, requested Google Spain the removal of a link to a digitized 1998 article in *La Vanguardia* newspaper about the forced sale of properties arising from social security debts – one of which belonged to Costeja. His grounds were that the forced sale had been concluded years before, a debt had been paid in full, and information regarding his home-foreclosure notices was no longer relevant but defamatory. When the request was unsuccessful, Costeja sued Google, the dominant search engine that covers more than 90 percent of all online searches in Europe. The case was eventually elevated to the European Court of Justice (ECJ). In May 2014, the court found for Costeja that both Google Inc. and its subsidiary Google Spain were required to remove the list of pertinent links from Google search results on Costeja's name. More generally, the court ruled that the operator of a search engine is obliged to remove, when requested by an individual, links to web pages that contain 'inadequate, irrelevant or no longer relevant, or excessive' information relating to that person in the results page following a search on the data subject's name, where the interests in those results appearing are outweighed by the person's privacy rights.[1]

Upon the ruling Google launched the online request process, and has complied with roughly 41 percent of more than 231,000 link-removal requests that it has received over the last ten months from individuals in EU and EFTA countries. Table 1 shows data on total number of requests Google has received, total number of URLs that Google has reviewed for removal, and the percentages of URLs removed for the top five countries as of March 15, 2015 since the launch of Google's official request process on May 29, 2014. Table 2 lists the ten domains where Google removed the most URLs from search results. Not surprisingly, *Facebook.com* tops among the most impacted domains, a majority of which offer search or social networking services.

The European ruling on the Costeja case and the subsequent compliance of Google set a major precedent over what is so-called the "right to be forgotten," the notion of which is derived from numerous preexisting European ideals on private information about individuals. The right to be forgotten essentially allows individuals to have information about themselves

[1] Case C-131/12 *Google Spain SL, Google Inc. v Agencia Española de Protección de Datos, Mario Costeja González* [2014] ECLI:EU:C:2014:317.

Table 1: European privacy requests for search removals on Google

Country	Total requests	Total URLs evaluated	% URLs removed
All EU and EFTA	**231,358**	**836,142**	**40.6**
France	47,154	157,560	47.8
Germany	38,801	147,144	49.0
U.K.	29,409	114,875	35.5
Spain	21,436	69,555	35.7
Italy	17,369	59,551	26.5

Source: https://www.google.com/transparencyreport/removals/europeprivacy/
(updated as of Mar. 15, 2015, 6 pm)

Table 2: Most impacted sites by Google's removal of links

Web domain	Total URLs requested for removal	Type
facebook.com	5,522	social networking service
profileengine.com	5,221	social network search
groups.google.com	3,702	discussion groups
youtube.com	3,384	video-sharing
badoo.com	3,307	dating-focused social networking
yasni.de	2,298	search engine
whereevent.com	2,267	event search tool
192.com	2,151	online directory
plus.google.com	2,150	social networking service
yasni.fr	1,900	search engine

Source: The same with Table 1; type is added by authors. (updated as of Feb. 15, 2015)

deleted so that they cannot be found by search engines.[2] The application scope of such right remains a controversial topic and the consensus is not yet made. The key source of controversy stems from different views on the right to be forgotten and related fundamental rights between European and American legal frameworks.[3] Nonetheless, as the European ruling legally solidified the right to be forgotten as a fundamental human right, the already-issued EU guidelines surrounding data protection calls on Google to apply the European ruling to all of its global search engine domains and not only to its European local domains. This precipitated a spark debate on the global extension of the scope of the European ruling

[2]In fact, the right to be forgotten is more broadly applicable to any Internet service provider not only limited to search engines. However because the most notable and majority of cases regard Google's search results, we will focus on "Google" as a representative player in subsequent discussions of this paper.

[3]We offer a brief literature review on opposed approaches to the right to be forgotten between Europe and U.S. in Subsection 1.1.

and the establishment of the right to be forgotten to the status of an internationally accepted human right.

At the heart of the debate lie several conflicting interests. The individuals can rightly desire to avoid any harm incurred by the search result links that are defamatory, embarrassing, or misleading. Therefore, the individuals' rights to de-list the prominence of such information in search engine results are indispensable on the basis of privacy rights. But what about the rights of the individuals seeking information or of the search engines providing information? Network users are deprived of the links that help them easily find contents, and search engines may experience profit loss from broken links. In essence, the removal of links under the pretext of protecting privacy rights can encroach other fundamental rights, such as the freedom of speech, expression, and access to information, and generate various layers of social costs.

Then what is the proper balance between clashing values of privacy and free speech, or the right to be forgotten versus the right to remember? Various attempts have been made to discuss these issues, much of which take legal or philosophical perspectives. However, to the best of our knowledge, any formal analysis on the underlying economics has hardly been conducted. How would the value of the right to be forgotten relative to the right to remember influence individuals' behavior and search engines' response? Does the number of requests for removal that are processed exceed the socially optimum amount? Are there too many or too few links taken down from a social welfare perspective? In an attempt to answer these questions, we build a game-theoretical model to provide the *economics* of the right to be forgotten. Our goal in this paper is to offer not only theoretical insights but also practical implications on the related issues.

In Section 2, we present a model of the right to be forgotten as an extensive-form legal dispute game between a petitioner and a web search engine (Google). The petitioner, who suffers harm from the links, can claim the removal of related links; the claiming is a costly process. The search engine can either accept the claim or reject it depending on its profit loss, which is positively related with network users' loss that arises when the links are broken. If the claim is rejected, then the petitioner can proceed to court against the search engine, where litigation is costly for both parties. The petitioner's uncertainty about the search engine's loss from the broken links plays a key role in our model because the search engine, with private information, can make a better assessment of the trial's expected outcome.

In Section 3, we characterize conditions under which litigation may arise as an equilibrium outcome. Given the associated primitives, we obtain a unique sequential equilibrium in the legal dispute game. In particular, as long as the claim fee is sufficiently small, the petitioner will act aggressively and always claim his right to be forgotten, in hopes of his claim being accepted and, despite rejection, of winning in a trial. Upon rejection, litigation always ensues if the petitioner's harm is fairly large; otherwise litigation still takes place with positive probability. Therefore, regardless of the size of the petitioner's harm, there is always the possibility of lawsuits as the equilibrium outcome, which leads to broken links.

We give the comparative static results regarding the probability of lawsuits and the likelihood of broken-links in Section 4. As a standard intuition might suggest, if network users' loss from broken links (S) is higher, then more types of Google reject the petitioner's claim and the petitioner correctly expects to win a trial less often. Surprisingly, the petitioner can still commit to litigate with probability one when rejected (for up to a sufficiently large size of S), and thus more number of cases are brought to court. Even so, less types of Google accepting the claim primarily affects the likelihood of broken-links as a resulting equilibrium outcome to fall unambiguously. The intuition is as follows: The probability of Google's rejection increases as S increases, raising the probability of lawsuits; however the petitioner has no certainty of winning in court,[4] and thus the effect of the increased probability of Google's rejection is second order.

Our equilibrium and comparative static results provide two interesting implications as is discussed in Section 5. First, informational asymmetry influences the petitioner's assessment of the trial's expected outcome; and thus our model predicts that the expected number of broken links exceeds the socially optimum amount if the petitioner overestimates his winning probability, and the converse is true if the petitioner underestimates. Second, even if the individual's harm from the links is relatively small compared to total social welfare lost by the broken links,[5] the petitioner's lower expected probability of winning in court does not

[4] In fact, the petitioner's expected probability of winning in court declines as S increases.

[5] In Section 5, we define the value of the right to be forgotten to be the (ex-post) social welfare loss from the links, measured by the petitioner's harm; and the value of the right to remember to be the (ex-post) social welfare loss from the broken links, measured by network uses' and search engine's loss. For our purpose, the

deter him from acting aggressively. Hence, an excessive amount of claims are brought to court and resolved by costly court-imposed judgments. Thus we confirm as an equilibrium phenomenon one conspicuous concern in the debate of the right to be forgotten: Too many requests for the removal of links are processed from a social welfare perspective.

In Section 6, we relate our equilibrium results to the current situation regarding the European ruling and the debate on its expansion. In particular, we give a numerical example to explain the economics behind the European ruling and Google's compliance; and discuss how our results offer a reasonable prediction of individuals behavior of claiming the RTBF and Google's response in removing the links if the European ruling expands to all of Google's global search engine domains. Interestingly, if Google applies the European ruling to non-European websites as well, then the amount of broken-links would decrease because Google will then decline the removal requests much more often. Therefore, our key finding may invalidate the ground for concerns about the threatening impact of the expansion on the right to freedom of speech.

Several possible extensions arise in our model that require some discussion; we mention a few in Section 7. First, as a complement to Section 4, we give comparative static results with respect to changes in litigation costs. Second, the modeling framework we developed here could be equally applicable under the British rule on litigation fees. Also suitable versions of the results continue to hold when uncertainty is two-sided. We could also relax or impose correlation between the players' losses, but the logic of our analysis suggests that the main insights of the results in this paper would also apply to this extension but with some added nuances. Lastly, we address how the right to be forgotten affects behavior of professionals who have reputational concerns. All proofs for the results in the main text can be found in Appendix A.

1.1 Literature Review

Before closing the introduction, we offer a brief review on the burgeoning literature on the right to be forgotten. Many legal scholars focus on describing institutional and conceptual differences in how Europeans and Americans have approached to the problem (e.g., Ambrose

definition of the right to remember subsumes both the right of free speech and access to information and the search engine's right to do business.

and Ausloos (2013); Bennett (2012); Bernal (2014); McNealy (2012); Rosen (2012a,b); and Walker (2012)). For example, Rosen (2012b) addresses the differences between European and American conceptions of the balance between privacy and free speech and how the right to be forgotten represents a threat to free speech. He notes that in Europe the right to be forgotten finds its intellectual root in the right to be oblivion, *le droit à l'oubli* in French law: a convicted criminal has a right to oppose the publication of his or her criminal history upon serving time; whereas in America such right would make a direct conflict to the First Amendment to the United States Constitution, which protects the freedom of speech.[6] McNealy (2012) indicates that while some plaintiffs in the U.S. have attempted to assert a right to be forgotten through the privacy law of the U.S., the U.S. court has seldom allowed for removing certain information from the press. Instead the court recognized the "right to be alone," which grants a recovery to an injured party from the public disclosure of private information under the tort of "invasion of privacy."[7]

Another strand of literature elaborate on web technological solutions in implementing a right to be forgotten. This is important because any practical enforcement and implementation of the right to be forgotten must be assisted and bounded by technological solutions. According to Rosen (2012a), there is a blob machine-like solution such as X-Pire and TigerText, which allows individual users to put expiration dates on text messages or photos that are copied and reposted by others. O'Hara (2012) discusses technological solutions available to data controllers, like Facebook or Google. Under the current European regulation, the right to be forgotten applies to the takedown of the reposted content without delay. For example, Facebook is forced to delete the reposted pictures when the original owner demands the erasure; but it takes proper tech-solutions to trace, identify, and delete all relevant data. The blob machine-like solution may provide the initial owners with an immediate technological solution. While we abstract away from technological aspects in the enforcement of the

[6] This stark contrast stands out in the following case in point. Two Germans murdered a famous German actor Walter Sedlmayr and they served their time. Released from prison, they attempted to delete their names from the German Wikipedia article of the late Mr. Sedlmayr, which successfully led to the deletion. They further moved to scrub their names from the English-language version of the Wikipedia article by filing a suit against the Wikimedia Foundation, the non-profit American organization (located in San Francisco) that runs Wikipedia. However, the Foundation did not comply with the request obviously relying on the First Amendment; their names are still posted. See John Schwartz, *Two German Killers Demanding Anonymity Sue Wikipedia's Parent*, N.Y. TIMES, Nov. 12.2009.

[7] See Purtz v. Srinvisan, No. 10CESC02211 (Fresno Co. Small Cl. Ct. Jan. 11, 2011) in McNealy (2012).

right to be forgotten, our model does not rule out the interpretation that the court's decision rule (for a practical enforcement) might be bounded by available technologies.

The contribution of our paper is that we offer a first formal model of the economics behind the right to be forgotten. We conclude the introduction by noting that the methodological approaches in the literature on the economic analysis of litigation is somewhat similar to that in the current paper. For example, in his seminal paper, Bebchuk (1984) models an extensive form game of two parties' litigation and settlement decisions, in which the defendant has private information about his liability. The key difference is that Bebchuk (1984) shows how informational asymmetry influences the optimal settlement amount in pretrial negotiation; whereas we focus on the relative values of various social welfare loss and their effects on the probability of lawsuits and broken-links as equilibrium outcomes.

2 The Model

Two risk-neutral parties are involved in a potential legal conflict regarding the right to be forgotten – the *RTBF game*. A petitioner, denoted as P, alleges that he suffers harm of size $h > 0$ from the links provided on a web search engine, say Google, denoted as G.[8] Google loses $L \geq 0$ if the links are removed. At the heart of the debates on the right to be forgotten lies one important issue that cannot be overlooked: the effect of the broken links not only on Google but also on the general public – in particular, network users. For example, some users may need to exert more effort (or may even fail) to find the right content without the links offered by the search engine. To capture such externality, we denote by $S \geq 0$ any welfare, generally construed, that is lost if the links are broken. This parameter can be interpreted as the value of searched information to network users, or more broadly as the *social value of the freedom of speech*.

We assume that Google internalizes users' welfare loss as her own profit loss, and thus impose a direct relationship between L and S.[9] In particular, let $L = \gamma S$, where $\gamma \in [0, \bar{\gamma}]$

[8] For exposition, we use male pronouns for the petitioner and female pronouns for Google.

[9] This assumption substantially simplifies the exposition while conveying all the key insights of our model. Suitable versions of the results continue to hold when this assumption is relaxed as long as L is private information to Google. But it seems natural to impose a linear relationship between L and S; for example, the broken links can lower advertising profits from users' search. In contrast, we do not impose any deterministic relationship between h and S (nor h and L). We discuss correlation between losses in Subsection 7.4.

measures the fraction of users' welfare loss for which Google will internalize, possibly greater than one. The petitioner's harm and users' welfare loss are common and public knowledge, whereas only Google knows her true γ.[10] The petitioner believes that γ is drawn from a non-degenerate distribution $F(\cdot)$ over the interval $[0, \bar{\gamma}]$.

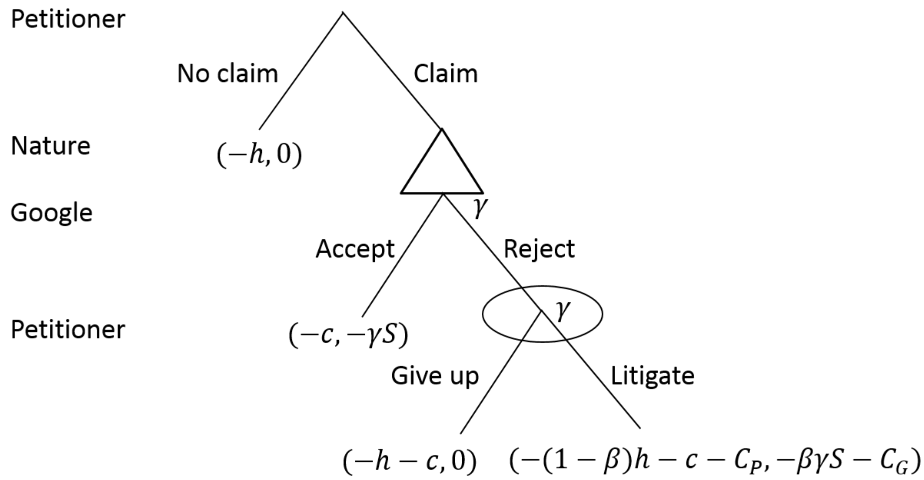


Figure 1: The game tree

The game tree illustrated in Figure 1 describes the sequence of events. The petitioner first chooses either to "claim" (i.e., requests Google to remove the links) at a fee of $c > 0$, or to make "no claim." This decision is made without knowing Google's γ.[11] Once a claim is filed, Google then decides whether to accept or reject the claim. If Google accepts and takes down the links, she loses γS and the petitioner receives payoff of $-c$. If Google rejects, then the petitioner will have to choose whether to "litigate" or "give up" (i.e., drop the case), still not knowing Google's γ. By giving up, the petitioner's payoff is $-h - c$ and Google's payoff is zero. If the petitioner litigates and a trial takes place, then the litigation costs of the petitioner and Google will be C_P and C_G, respectively. Let β be the likelihood of the petitioner's prevailing in a trial. Under the American rule on litigation fees, the expected payoffs from litigation then are $-(1-\beta)h - c - C_P$ for the petitioner and $-\beta\gamma S - C_G$ for

[10] We can extend our model with two-sided incomplete information, which will be briefly discussed in Subsection 7.3.

[11] If γ is known to the petitioner, then the petitioner knows exactly when Google will accept or reject his claim. If Google is expected to reject the claim, then the claim itself incurs a mere cost with no additional expected benefit. Therefore, there is no reason for the petitioner to claim at a certain fee prior to litigation when he is sure of rejection under complete information.

Google.[12]

The expected outcome of a trial depends on the factual issues relevant to the links in question; and so the expected ruling of a trial can be estimated by h, γ, and S. Thus it will be assumed that $\beta = g(h, \gamma, S)$, where g is a twice-differentiable function, $0 \leq g(h, \gamma, S) \leq 1$, and its partial derivatives satisfy $g_h \geq 0$, $g_\gamma \leq 0$, and $g_S \leq 0$ for all (h, γ, S). The conditions on the first derivatives assume that the probability that the court rules in favor of the petitioner increases if the net social welfare saved by taking down the links (h) increases, and decreases if the net social welfare saved by not taking down the links ($\gamma S + S$) increases (by either a higher γ or S).[13] Note that Google possesses some private information that is relevant to estimating the trial's expected outcome. Google's private information allows her to make a better assessment of the likelihood of the petitioner's prevailing in a trial (to be $g(h, \gamma, S)$); while the petitioner does not know γ, and correspondingly $g(h, \gamma, S)$, but would form a posterior expectation of the winning probability $g(h, \gamma, S)$ given $F(\cdot)$. We further assume that $g_{\gamma\gamma}\gamma + 2g_\gamma < 0$ and $g + g_\gamma \gamma < 1$, $\forall \gamma \in [0, \bar{\gamma}]$. The first condition imposes upward concavity on Google's expected payoff from litigation, ensuring that G's best responses are well defined; the second condition requires that G's marginal loss from rejecting relative to accepting with respect to γ is less than 1, which is essentially the same thing as imposing strict monotonicity of G's best responses.[14]

3 Equilibrium Results

In this section, we characterize conditions under which court-imposed settlements (or lawsuits) may arise as an equilibrium outcome, and analyze equilibria of this game. Our model does not convey any substantial insight if all types of Google always accept the claim or if the petitioner always gives up upon rejection. For our model to capture many situations in which

[12] We briefly examine our model under the British rule of litigation fees and discuss relevant results in Subsection 7.2.

[13] Note that if the petitioner wins the trial, then the links are removed and the ex-post social welfare loss is $\gamma S + S$; whereas if Google wins, then the links remain and the ex-post social welfare loss is h. As an example, we can assume $g(h, \gamma, S) = \frac{h}{h+\gamma S+S}$. Although such functional form may seem ad-hoc, it summarizes the essential component of the court's decision rule that depends on the relative balance between social welfare and loss that arise when one party wins.

[14] The second assumption is essential for keeping the analysis tractable, but might also be viewed as ensuring that the marginal value of switching from accepting to rejecting is monotone increasing in G's type γ, or requiring a strictly increasing differences property on G's expected payoffs.

the court judgment plays a role in the issue of RTBF and to yield a rich set of theoretical implications, we rule out such cases with Assumptions 1 and 2 given in the text.

Let the petitioner's strategy be represented by (p_1, p_2), where p_1 denote the probability that the petitioner would claim and p_2 denote the conditional probability that he litigates if Google rejected. Let us first consider the outcome after the path of play reached the decision node controlled by Google, i.e., $p_1 = 1$. In this continuation subgame, Google with type γ compares her payoff from accepting, $-\gamma S$, with her expected payoff from rejecting, $(1-p_2)\cdot 0 + p_2\,[-g(h,\gamma,S)\gamma S - C_G]$, when she anticipated that the petitioner would behave according to p_2. Google with type γ is just indifferent between accepting and rejecting the claim if she believes that the probability of P's litigation is p_2 if and only if:

$$\gamma S = p_2\,[g(h,\gamma,S)\gamma S + C_G]\,. \tag{3.1}$$

Lemma 1. *There exists a unique $\gamma > 0$ that satisfies (3.1) given $p_2 > 0$.*

Define γ_G be such unique value of γ that satisfies (3.1). We assume that $\frac{dg(h,\gamma_G,S)}{dh} > 0$ and $\frac{dg(h,\gamma_G,S)}{dS} < 0$.[15] Note that given $p_2 > 0$, it will not be the case that Google will always reject no matter what her type is.

Because G's expected payoffs satisfy the strictly increasing differences property, i.e., the difference between her expected payoff from rejecting and her payoff from accepting is a strictly increasing function of her type γ, no matter what P's action may be, G's higher types find rejection relatively more attractive than lower types do. Thus Google will always want to use a cutoff strategy.

Lemma 2. *Google's best response against any strategy of the petitioner, p_2, is using a cutoff strategy with the cutoff γ_G that satisfies (3.1), characterized as:*

(i) all types with $\gamma \geq \gamma_G$ will reject the claim; and

(ii) all types with $\gamma < \gamma_G$ will accept the claim.

Now at the petitioner's node after the claim has been rejected, P compares his payoff

[15] Note that $\frac{\partial \gamma_G}{\partial p_2} > 0$, $\frac{\partial \gamma_G}{\partial h} > 0$, $\frac{\partial \gamma_G}{\partial S} < 0$, and $\frac{\partial \gamma_G}{\partial C_G} > 0$.

from giving up, $-h-c$, with his expected payoff from litigation,

$$-\left(1-g(h,\tilde{\gamma}(\gamma_G),S)S+S\right)h-c-C_P, \tag{3.2}$$

where $\tilde{\gamma}(\gamma_G) \equiv \mathbb{E}[\gamma|\gamma \geq \gamma_G]$ is P's posterior expectation of γ if the claim is rejected, given by

$$\mathbb{E}\left[\gamma|\gamma \geq \gamma_G\right] = \int_{\gamma_G}^{\bar{\gamma}} \frac{xf(x)}{1-F(\gamma_G)}dx. \tag{3.3}$$

If $F(\cdot)$ is a Uniform distribution over the interval $[0,\bar{\gamma}]$, then (3.3) becomes $\frac{\gamma_G+\bar{\gamma}}{2}$. It is easy to see that this is a monotonically increasing function of γ_G. In fact it is true for any generic distribution F as long as it is non-atomic over the interval $[0,\bar{\gamma}]$, where $\bar{\gamma}$ need not equal one.[16] Therefore as more types accept (i.e., γ_G increases), their expected γ increases, in turn lowering the petitioner's expected probability of winning in court, and so the term (3.2) monotonically falls with γ_G.

Suppose now that all types of G reject the claim. Then $\gamma_G = 0$, and the posterior expectation of γ equals the priors. If P's expected payoff from litigation were already less than his payoff from giving up under the priors, then as more types accept, litigation would become even less profitable; in such cases, the petitioner will always give up upon rejection regardless of his posterior expectations. The following assumption rules this out by requiring that the petitioner's case has merit – P's expected payoff from litigation is greater than his payoff from giving up given the prior distribution of Google's types,[17] i.e., $-\left(1-g(h,\mathbb{E}(\gamma),S)\right)h - c - C_P > -h-c$.

Assumption 1. *$g(h,\mathbb{E}(\gamma),S)h > C_P$.*

Assumption 1 requires that the petitioner's harm should not be too small, nor its litigation cost should be too large; or the social value of the freedom of speech, captured by S, should not be too large in order for litigation to be ex-ante profitable to the petitioner. Now under

[16] This is intuitive because when more types reject, the interval of types who reject increases (i.e., γ_G falls), and their expected γ decreases.

[17] Bebchuk (1984) assumes that litigation has a positive expected value for the plaintiff even if the defendant is of the lowest type. Translating into our model, this assumption is equivalent as to assume that litigation is profitable against Google of the highest type $\bar{\gamma}$. In other words, there is some minimal probability of P winning in litigation and that litigation is profitable even with this minimal probability. In this sense, Assumption 1 is a weaker version of Bebchuk (1984)'s assumption.

Assumption 1, even if all types of Google reject the claim, litigation would be profitable to the petitioner compared to giving up.

In addition, it is of no interest if all types of Google were to always accept the claim. This happens when $\gamma_G \geq \bar{\gamma}$. The sufficient condition in Lemma 3 ensures that $\gamma_G < \bar{\gamma}$.

Lemma 3. *If $(1-g(h,0,S))\bar{\gamma}S > C_G$, then there is a positive probability that G would reject.*

Throughout this paper, we make the following assumption to rule out the possibility that Google would always accept the claim no matter what her type is.

Assumption 2. $(1-g(h,0,S))\bar{\gamma}S > C_G$.

Assumption 2 implies that there is some lower bound on S. This is intuitive because if S is too small, then rejecting (and subsequent litigation by P) will cause Google to win litigation with a very small probability but with an additional litigation cost; therefore, any type of G may as well accept the claim. Similarly, G's litigation cost must not be too large. In addition, the above assumption implies that the petitioner's harm should not be too large, because otherwise, if h is too large compared to S then even the highest type of Google may not find it in her interest to reject the claim.

Under Assumption 2, some types of Google will always reject, and so, the total prior probability of the path of play facing Google of type γ in the rejection state is strictly positive, i.e., $(1-F(\gamma_G)) > 0$. Therefore, Bayes' formula completely characterizes P's belief probabilities upon rejection.[18] Upon rejection, the petitioner forms his posterior expectation of γ given the posterior beliefs concentrated on $[\gamma_G, \bar{\gamma}]$, and decides whether to litigate or to give up. In doing so, the petitioner's strategy p_2 must be optimal given Google's optimal cut-off strategy γ_G. The petitioner will be indifferent between litigating and giving up upon rejection if and only if:

$$g(h, \tilde{\gamma}(\gamma_G), S)h - C_P = 0. \tag{3.4}$$

Let γ^* be the unique value of γ_G that solves (3.4).[19] It trivially follows that $\gamma^* > 0$; otherwise, Assumption 1 is violated.

[18] Because of Assumption 2, Bayes' consistency implies full consistency of beliefs (i.e., the conditional probabilities that P faces Google of type γ given rejection). So upon rejection P determines his posterior beliefs using Bayes' formula.

[19] Note that $\frac{\partial \gamma^*}{\partial h} > 0$, $\frac{\partial \gamma^*}{\partial S} < 0$, and $\frac{\partial \gamma^*}{\partial C_P} < 0$.

Lemma 4. *The petitioner's best response upon rejection is characterized as:*

(i) $p_2 = 1$ *if* $\gamma_G < \gamma^*$*;*

(ii) $p_2 \in [0,1]$ *if* $\gamma_G = \gamma^*$*; and*

(iii) $p_2 = 0$ *if* $\gamma_G > \gamma^*$*.*

Let γ_G^* be the cutoff value γ_G for $p_2 = 1$, i.e., γ_G^* satisfies:

$$\gamma_G^* S = g(h, \gamma_G^*, S)\gamma_G^* S + C_G. \tag{3.5}$$

We can now characterize a unique equilibrium to the continuation subgame following the petitioner's claim.

Proposition 1. *Under Assumptions 1 and 2, there is a unique Nash equilibrium in the subgame when the claim is made, in which the equilibrium strategies are characterized as follows:*

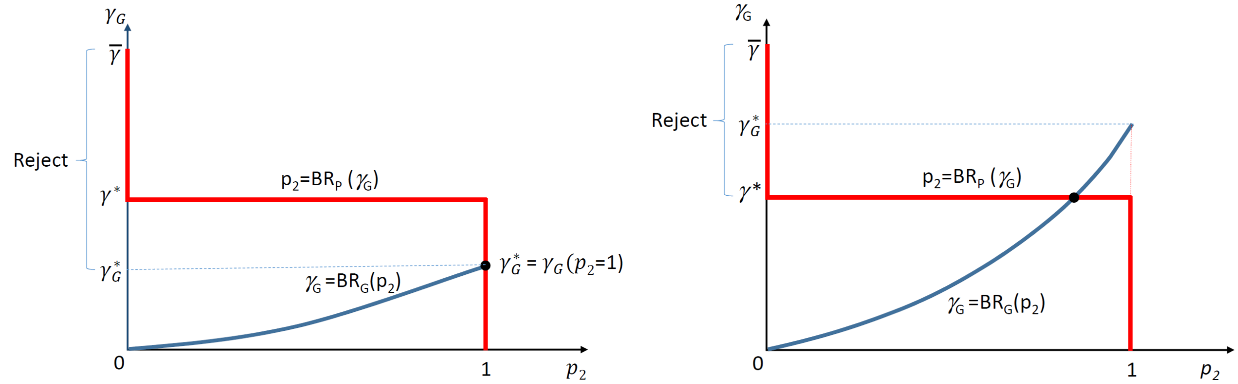
(1) if $\gamma_G^* < \gamma^*$*, then G of type* $\gamma \geq \gamma_G^*$ *reject the claim, G of type* $\gamma < \gamma_G^*$ *accept the claim, and P always choose to litigate,* $p_2 = 1$*; and*

(2) if $\gamma_G^* \geq \gamma^*$*, then G of type* $\gamma \geq \gamma^*$ *reject the claim, G of type* $\gamma < \gamma^*$ *accept the claim, and P randomizes, choosing litigation with probability* $p_2 = \frac{\gamma^* S}{g(h,\gamma^*,S)\gamma^* S + C_G}$*.*

In addition, the posterior beliefs of P satisfy Bayes theorem upon rejection given the priors, i.e., $\frac{f(\gamma)}{1-F(\gamma_G)}$*, where* γ_G *is the cutoff value of G's strategy, and thus the posterior expectation of* γ *upon rejection is* $\mathbb{E}(\gamma | \gamma \geq \gamma_G)$*.*

Proposition 1 describes the unique equilibrium in the subgame following $p_1 = 1$. The equilibrium strategies described above form the unique equilibrium in behavioral strategies. Under Assumption 2, the rejection state occurs with positive probability under the unique equilibrium, and thus the equilibrium strategies are always sequentially rational for P upon rejection with the beliefs specified above.[20] Figure 2 illustrates the best responses of Google and the petitioner (Lemmas 2 and 4) in each of the two cases in Proposition 1.

[20] The beliefs are weakly consistent with the equilibrium in behavioral strategies. Because $(1 - F(\gamma_G)) > 0$, rejection is never a zero-probability event and so weak sequential equilibrium implies full sequential equilibrium.



Case *(1)*: $\gamma_G^* < \gamma^*$ Case *(2)*: $\gamma_G^* \geq \gamma^*$

Figure 2: Best responses and Nash equilibrium

Consider now the petitioner's initial node in which he has to decide whether to claim or not. Because of Proposition 1, the petitioner compares his payoff from "no claim," $-h$, with his expected payoff from "claim" under the prior distribution of Google's types given the equilibrium strategies γ_G and p_2 in the unique equilibrium of the subgame,

$$\begin{aligned} &F(\gamma_G)(-c)+ \\ &(1-F(\gamma_G))\left[(1-p_2)(-h-c)+p_2\left(-\left(1-g(h,\tilde{\gamma}(\gamma_G),S)\right)h-c-C_p\right)\right]. \end{aligned} \tag{3.6}$$

Then the petitioner's optimal strategy at his initial node would be to claim if (3.6)$\geq -h$. This condition reduces to:

$$c \leq F(\gamma_G)h + (1-F(\gamma_G))p_2\left[g(h,\tilde{\gamma}(\gamma_G),S)h - C_P\right]. \tag{3.7}$$

As is evident from (3.7), if the primitives of our model were such that $\gamma_G^* \geq \gamma^*$, then given the subgame equilibrium strategies specified in Proposition 1, (3.7) becomes:

$$c \leq F(\gamma^*)h, \tag{3.8}$$

whereas if the primitives were such that $\gamma_G^* < \gamma^*$, then given the subgame equilibrium, (3.7) becomes:

$$c \leq F(\gamma_G^*)h + (1-F(\gamma_G^*))\left[g(h,\tilde{\gamma}(\gamma_G^*),S)h - C_P\right]. \tag{3.9}$$

The intuition is straightforward: the claim fee has to be small enough for "claim" to be profitable to the petitioner assuming that all moves after the claim would be determined according the strategies specified in Proposition 1.

Proposition 2. *Under Assumptions 1 and 2, for any given c, h, S, C_P, and C_G, P's strategy p_1 such that $p_1 = 1$ if (3.7) holds and $p_1 = 0$ if otherwise, together with the strategies and beliefs described in Proposition 1, constitute a unique sequential equilibrium of the RTBF game.*

The intuition simply follows: When a petitioner supposedly suffered harm from the links that are on a web search engine, then as long as the claim fee is small enough, the petitioner (regardless of the size of his harm) will act aggressively and claim his right to be forgotten, in hopes of his claim being accepted and, despite rejection, of winning in court, both of which will lead to broken links.

4 Higher Users' Welfare Loss

In this section, we examine the effect of a change in users' welfare loss S (when links are removed) on the *probability of lawsuits*, the likelihood that the case will be settled in court once the claim has been made. This allows us to calculate the *likelihood of "broken links"* as a final outcome in equilibrium.[21]

4.1 The Effect on the Probability of Lawsuits

One might naively reason that if there is a higher welfare loss to users from broken links relative to the petitioner's harm, then the petitioner should expect to lose the trial with a higher probability and litigation becomes less likely. However this is almost surely not the case because the petitioner can commit to litigate with probability one up to a sufficiently large S.

Formally, the probability of lawsuits in the unique equilibrium of the subgame following

[21] Another important factors that shape the probability of lawsuits and the likelihood of broken-links are the magnitude of the parties' litigation costs. The comparative static results regarding the effects of higher C_G or C_P can be found in Subsection 7.1.

the petitioner's claim can be calculated as follows:

$$
\begin{aligned}
Pr(\text{“lawsuits”}) &\equiv (1 - F(\gamma_G))p_2 \\
&= \begin{cases} (1 - F(\gamma_G^*)) & \text{if } \gamma_G^* < \gamma^*, \\ (1 - F(\gamma^*)) \left(\dfrac{\gamma^* S}{g(h, \gamma^*, S)\gamma^* S + C_G} \right) & \text{if } \gamma_G^* \geq \gamma^*. \end{cases}
\end{aligned} \tag{4.1}
$$

Note that the total prior probability that G will reject the claim is $1 - F(\gamma_G)$, where G's optimal cutoff value γ_G (either γ_G^* or γ^*) decreases in S. Therefore according to G's optimal cutoff strategy, $(1 - F(\gamma_G))$ increases in S with a kink at $\gamma_G^* = \gamma^*$. Also notice that in equilibrium the probability that P litigates is $p_2 = 1$ when $\gamma_G^* < \gamma^*$, whereas p_2 decreases with S when $\gamma_G^* \geq \gamma^*$. Otherwise in the latter case, if P were to commit to litigation, then G with types $\gamma \geq \gamma_G^*$ will reject, in which case P's litigation becomes unprofitable and so his commitment to litigation is not credible. That is, rejection by less of high types provides more information that P's case is weak. Therefore P must lower his probability of choosing "litigate" so as to make more types of G reject. In particular, he would litigate with a lower probability just enough to make G of type $\gamma = \gamma^* \leq \gamma_G^*$ indifferent.[22] His now-lower probability of litigating implies a greater chance of being rejected; but after rejection he was correct to litigate according to such probability, which confirms P's indifference between litigation and give-up.

Define S^* to be the value of S such that $\gamma_G^* = \gamma^*$ given other primitives. The following proposition shows the effect of an increase in S on the probability of lawsuits in the unique subgame equilibrium following P's claim.

Proposition 3. *For given h, C_P, and C_G, the probability of lawsuits increases with a small increase in S if $S < \tilde{S}$ for some $\tilde{S} \in [S^*, \bar{S})$; and the probability of lawsuits decreases with a small increase in S if $S \geq \tilde{S}$.*

Proposition 3 implies that the probability of lawsuits achieves its maximum at a unique $\tilde{S} \in [S^*, \bar{S})$. This is illustrated in Figure 3.

[22] This can be easily observed in Figure 2 Case *(2)*: As γ^* falls by an increase in S (the red horizontal line shifts down), then p_2 in Nash equilibrium, which is the fixed point of the best responses, decreases. Note that as S approaches $\bar{S}$, $\gamma^* \to 0$ and so $p_2 \to 0$.

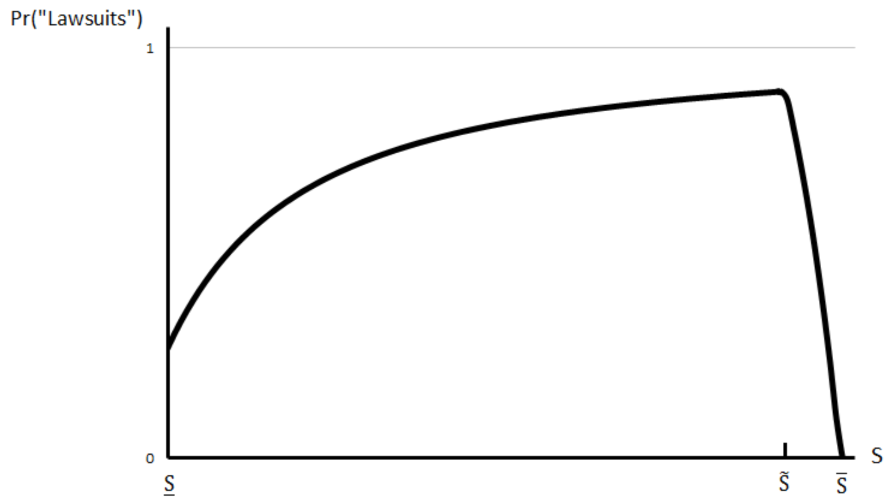


Figure 3: The effect of S on the probability of lawsuits in equilibrium

The intuition is as follows. Generally when S increases, the probability of G's rejection increases, and so P's posterior assessed probability of winning in a trial decreases, in turn lowering P's expected payoff of the trial with his posterior concentrated on $[\gamma_G, \bar{\gamma}]$. When $S < S^*$, even though P's expected payoff from litigation falls by an increase in S, the increased S is not large enough to make litigation unprofitable compared to giving up and thus P can still maintain to act aggressively – litigate with probability one. Therefore a higher S in this case has a correspondingly higher chance of being rejected by Google, and the petitioner always proceeds to court. On the other hand, if S increases when $S \geq S^*$, the increased probability of G's rejection makes P's litigation unprofitable compared to giving up. This implies that P would no longer be able to litigate with probability one; thus upon rejection, P would have to litigate less often to compensate for his loss from litigation. Such fall in P's probability of litigation more than offsets the increased probability of rejection by G when $S \geq \tilde{S}$. Therefore, the overall probability of lawsuits fall.[23]

4.2 The Effect on the Likelihood of Broken Links

We now assess the likelihood of broken-links as a resulting equilibrium outcome. Consider again the equilibrium path after the petitioner has made the claim. The links are removed

[23]Under a certain condition on the right derivative of the probability of lawsuits evaluated at $S = S^*$, the maximum occurs at the kink $\gamma_G^* = \gamma^*$, i.e., $\tilde{S} = S^*$. The condition is given in the proof of Proposition 3.

in either of the following cases: (i) Google accepts the claim; or (ii) Google rejects, the petitioner litigates and wins. Therefore, we can compute the expected likelihood of broken-links as follows:

$$\begin{aligned} &Pr(\text{“broken links”}) \equiv F(\gamma_G) + (1 - F(\gamma_G))p_2 g(h, \tilde{\gamma}(\gamma_G), S) \\ &= \begin{cases} F(\gamma_G^*) + (1 - F(\gamma_G^*))g(h, \tilde{\gamma}(\gamma_G^*), S) & \text{if } \gamma_G^* < \gamma^*, \\ F(\gamma^*) + (1 - F(\gamma^*))\left(\dfrac{\gamma^* S}{g(h, \gamma^*, S)\gamma^* S + C_G}\right) g(h, \tilde{\gamma}(\gamma^*), S) & \text{if } \gamma_G^* \geq \gamma^*. \end{cases} \end{aligned} \tag{4.2}$$

The following proposition shows how a change in S affects the likelihood of broken-links.

Proposition 4. *The likelihood of broken-links unambiguously decreases with an increase in S, for given h, C_P, and C_G.*

The result is straightforward. When more welfare is lost from broken links, the outcome of broken links becomes less likely. However to understand the intuition behind the course of such effect better, we need to consider two channels through which an increase in S separately affects the likelihood of broken-links, decomposed as follows:

$$\underbrace{F(\gamma_G^*)}_{(1)} + \underbrace{(1 - F(\gamma_G^*))g(h, \tilde{\gamma}(\gamma_G^*), S)}_{(2)} \quad \text{if } \gamma_G^* < \gamma^*.$$

(1) As S increases, less types of Google accept, i.e., $F(\gamma_G^*)$ decreases, contributing to less chance of broken links;

(2) At the same time, more types of Google reject and the expected probability of the petitioner winning in court falls, so whether Term (2) rises or falls is ambiguous.

Regardless, the first effect is stronger than the second effect because P's expected winning probability is less than one, so that a decrease in Term (1) more than offsets any increase in Term (2). Similarly for the second case:

$$F(\gamma^*) + \underbrace{(1 - F(\gamma^*))\left(\frac{\gamma^* S}{g(h, \gamma^*, S)\gamma^* S + C_G}\right)}_{=Pr(\text{“lawsuits”})} \underbrace{g(h, \tilde{\gamma}(\gamma^*), S)}_{(*)} \quad \text{if } \gamma_G^* \geq \gamma^*.$$

As is evident from the previous discussion, the first term $F(\gamma^*)$ decreases with S while $(1 - F(\gamma^*))$ increases. Even if Pr("lawsuits") may increase for $S \in [S^*, \tilde{S})$, the marginal increase is less than the marginal decrease in the first term. Moreover, the expected probability of P winning (Term (*)) is constant (and less than one) for any S. The reason is that when $\gamma_G^* \geq \gamma^*$, P is just indifferent between litigation and give-up after rejection by the types $\gamma \geq \gamma^*$, implying that his (posterior-assessed) probability of winning must remain the same regardless of a change in S.[24]

In either case, an increase in S unambiguously lowers the likelihood of broken-links with a kink at $S = S^*$. Figure 4 illustrates this comparative static result.

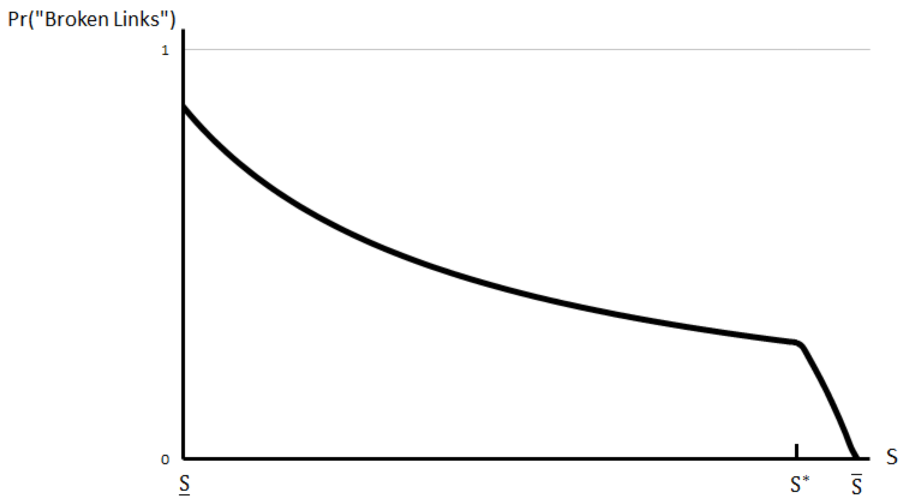


Figure 4: The effect of S on the likelihood of broken-links in equilibrium

An obvious implication is that if higher welfare is lost from broken links, the petitioner "correctly" expects to win the case less often, but he can still credibly "threat" to litigate with probability one even for a considerably large amount of users' welfare loss; and as a result, an excessively more number of claims are rejected and brought to court. Nonetheless, the court is more likely rule in favor of Google, which together with less Google's immediate acceptance of the claim primarily contribute to lower chance of broken-links. This effect is exacerbated when users' welfare loss is so high such that the petitioner starts to give up more often.

[24]Given G's optimal cutoff strategy with the cutoff value γ^*, P's posterior expectation of γ on the interval $[\gamma^*, \bar{\gamma}]$ decreases as more types reject by an increase in S.

5 Social Welfare and Efficiency

Our equilibrium and comparative static results provide an interesting observable implication that answers the following questions: Are there too many or too few links delisted at equilibrium in terms of social efficiency? Does the number of requests for removal that are submitted exceed the socially optimal amount?

5.1 Optimal Probability of Broken Links

Suppose now that a social planner considers the (ex-post) social welfare maximization problem,[25] where ex-post social welfare is given by the total payoffs of all associated individuals (the petitioner with harm level h, Google of type γ, and network users) less fixed costs. When the links are taken down, the ex-post social welfare loss is $\gamma S + S$, whereas when the links remain, the ex-post social welfare loss is h. Thus the social planner's decision would depend on whether or not h (welfare saved by taking down the links) is higher than $\gamma S + S$ (welfare saved by retaining the links). In this sense, we can then interpret h as the social value of the right to be forgotten (or, the right of privacy) and $\gamma S + S$ as the social value of the right to remember (or, the right of free speech and access to information plus Google's right to do business).

For any given h, γ, and S, if $h > \gamma S + S$, the *social efficiency* calls for the links to be delisted – "favoring" the right of privacy over the right of free speech, expression, and access to information; if otherwise, the links to be retained. This implies that there exists a socially optimal cutoff value of γ such that if Google's type is below such cutoff, then the social planner would require removal; otherwise retention is required. We define this value as the social planner's *efficiency cutoff*, denoted by γ^e, such that:

$$\gamma^e = \begin{cases} \bar{\gamma} & \text{if } h \geq \bar{\gamma} S + S, \\ \frac{h-S}{S} & \text{if } S < h < \bar{\gamma} S + S, \\ 0 & \text{if } h \leq S. \end{cases} \tag{5.1}$$

[25] A social planner is represented by the omniscient benevolent dictator. By *ex-post*, we mean that claim fee and litigation costs are not included in the social planner's problem. This restriction does not derive the result, but is in line with the litigation literature.

Therefore, for given h and S, γ^e can be interpreted as the highest possible type of Google against whom the social planner would dictate removal. Accordingly, the socially efficient probability of broken-links is given by $Pr^e(\text{“broken links”}) \equiv F(\gamma^e)$.

Let $Pr^*(\text{“broken links”})$ denote the expected probability of broken-links evaluated at equilibrium, given in (4.2). Then in terms of social efficiency, if $Pr^*(\text{“broken links”}) < Pr^e(\text{“broken links”})$, then too few links are expected to be broken in the equilibrium; if $Pr^*(\text{“broken links”}) > Pr^e(\text{“broken links”})$, then too many links. In order to describe whether there are too many or too few links taken down in the equilibrium of our RTBF game, we shall adopt the following definitions. We will refer to an equilibrium in which the petitioner claims, i.e., c is such that (3.7) is satisfied, as a *claim* equilibrium. An equilibrium is a *no-claim* equilibrium if otherwise. In the claim equilibrium, the social planner's "assessment" of the petitioner's winning probability upon rejection by types $\gamma \geq \gamma_G$ can be defined as follows:

$$g^e(\gamma^e; \gamma_G) \equiv \begin{cases} \frac{F(\gamma^e) - F(\gamma_G)}{1 - F(\gamma_G)} & \text{if } \gamma_G \leq \gamma^e, \\ 0 & \text{if } \gamma_G > \gamma^e. \end{cases} \tag{5.2}$$

We arrive at the following results.

Proposition 5. *For given h and S:*

(i) In the claim equilibrium,

$$Pr^e(\text{“broken links”}) > Pr^*(\text{“broken links”}) \quad \text{if } g(h, \tilde{\gamma}(\gamma_G), S) < g^e(\gamma^e; \gamma_G);$$
$$Pr^e(\text{“broken links”}) < Pr^*(\text{“broken links”}) \quad \text{if } g(h, \tilde{\gamma}(\gamma_G), S) > g^e(\gamma^e; \gamma_G).$$

(ii) In the no-claim equilibrium,

$$Pr^e(\text{“broken links”}) > Pr^*(\text{“broken links”}) = 0 \quad \text{if } h > S;$$
$$Pr^e(\text{“broken links”}) = Pr^*(\text{“broken links”}) = 0 \quad \text{if } h < S.$$

Proposition 5*(i)* implies that too few (many) broken links are expected to arise in the claim equilibrium if the petitioner underestimates (overestimates) the his winning probability in court.[26] When $g(h, \tilde{\gamma}(\gamma_G), S) = g^e(\gamma^e; \gamma_G)$, the expected probability of broken-links in equilibrium exactly coincides with the socially efficient probability of broken-links because the petitioner "correctly" updates his belief on the types of Google who would reject, against whom the social planner would dictate removal. In such case, the amount of broken links in the claim equilibrium achieves social efficiency.

For the no-claim equilibrium, it is somewhat more obvious: If the petitioner's harm is greater than network users' welfare loss, then (5.1) implies that the social planner would find at least some (lower) types of Google who should be dictated to remove the links but against whom the petitioner had not filed the claim in the first place; On the other hand, if otherwise, then the social planner would prefer retention of the links even against the type of Google who loses nothing, and so the no-claim equilibrium coincides with what social efficiency would dictate.

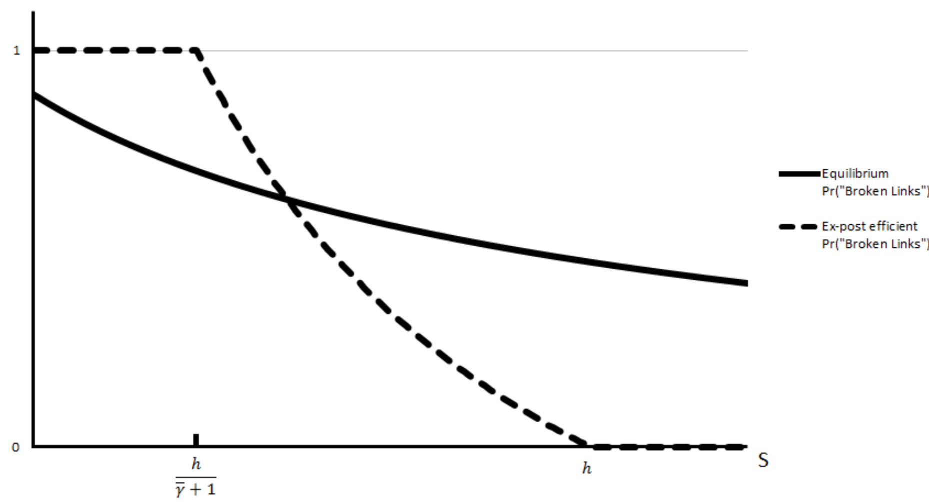


Figure 5: Equilibrium vs. optimal probability of broken-links

Figure 5 illustrates Proposition 5*(i)* for given h in terms of S. Our model shows that in equilibrium there may be too many or too few broken links compared to the socially optimal amount of broken links that maximizes the ex-post social welfare. The case of too few broken links occurs when S is relatively small; the opposite happens for a relatively larger S.

[26]In other words, too few (many) broken links arise in the claim equilibrium if the petitioner's posterior expectation of γ upon rejection is less (greater) than the highest possible type against whom the social planner would dictate removal.

Beyond the theoretical underpinning, Proposition 5 suggests a testable empirical study with the real world data. Let us assume an ideal situation in which one could collect all factual information on the true values of h, γ, and S. Based on these information, the ex-post efficient rule can be established, which would depend on the relative values of h and $(\gamma + 1)S$. Then we can compare the actual rulings in the RTBF cases with what the ex-post efficiency would rule. The outcomes of the actual rulings would essentially be either of the following two cases: (i) the links remain uncut when they should have been removed from a social efficiency perspective; or (ii) the links are taken down when they should have been retained. If we find that the first cases occur far more than the second, then it may imply that the right to be forgotten is under-protected relative to the efficient level. On the other hand, if the second cases prevail, the right to be forgotten is threatening the right to remember beyond the properly balanced level. Therefore we might be able to evaluate the rulings in the current RTBF cases in terms of social efficiency.

5.2 Excessive Number of Claims

Continuing from the previous analysis, we can also consider efficiency with regard to the number of claims. As implied by Propositions 1 and 2, the petitioner tends to act aggressively and file the request for removal as long as his claim fee is small. Therefore we might reasonably expect that the number of requests submitted to Google exceeds the socially optimal amount for some range of values, which is exactly what happens in the RTBF game as discussed in this subsection. We start by the following proposition.

Proposition 6. *For given h and S, if $\gamma^e < \bar{\gamma}$, then the claim equilibrium renders an excessive number of claims that are brought to a trial. Moreover if $\gamma^e < \gamma_G$, then the claim equilibrium renders an excessive number of claims that are accepted by Google, as well as those that are brought to a trial.*

The proof is obvious. The first threshold condition in Proposition 6 implies that $\gamma S + S > h$ for all $\gamma \in (\gamma^e, \bar{\gamma}]$. So if the social planner, who finds out that Google is of such type in the RTBF game, would dictate to the petitioner with harm h not to request the removal in the first place so that the links are not removed. In this sense, too many requests for the removal of links are brought to court and resolved by costly court-imposed judgments. The second threshold condition implies that there exists $\gamma \in (\gamma^e, \gamma_G)$ such that $\gamma S + S > h$. So if the petitioner's claim is submitted to such type, social efficiency calls for the claim not to be accepted immediately. In fact, the claims that are made to and accepted by Google of types $\gamma \in (\gamma^e, \gamma_G)$ and the ones that are rejected by Google of types $\gamma \in [\gamma_G, \bar{\gamma}]$ should not have been in place.

On the other hand, if $\gamma^e = \bar{\gamma}$, i.e., the efficiency cutoff is exactly the highest type of Google, then $h \geq \gamma S + S$ for any $\gamma \in [0, \bar{\gamma}]$. In such case, the petitioner was correct to file a claim in the sense that the social planner would prefer the petitioner to claim versus no-claim against any type of Google.

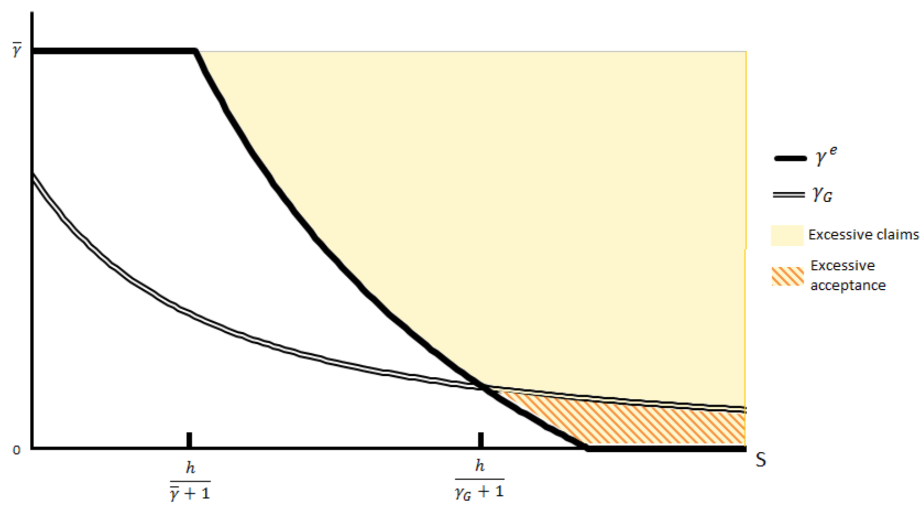


Figure 6: Excessive amount of claims

Proposition 6 is illustrated in Figure 6, which plots the social planner's efficiency cutoff and Google's optimal cutoff value of her equilibrium strategy in relation to S. The shaded area above the efficiency cutoff indicates the types of Google against whom social efficiency would require the links to be retained for given h and S. Therefore the social planner, who finds out that Google is of type $\gamma > \gamma^e$, would dictate the petitioner with harm h not to file a claim in the first place (or more generally retention of the links). We can see that too many claims are filed and eventually brought to costly litigation when $S > \frac{h}{\bar{\gamma}+1}$; and too many claims are accepted by Google when $S > \frac{h}{\gamma_G+1}$, in terms of efficiency, the observations of which confirm our claims in Proposition 6.

6 The European Ruling and the Debate on Expansion

In this section, we discuss the following questions: (1) How do our model and equilibrium results connect to explaining the initial European ruling on Costeja case and the subsequent launch of Google's online request process within Europe? (2) Could our results provide a reasonable prediction of individuals' behavior of removal request and Google's response in delisting the links when the European ruling is applied to all of Google's global search engine domains?

In answering these questions, we simplify our model by assuming that γ is drawn from a Uniform distribution $F(\cdot)$ over the interval $[0,1]$. We further assume $g(h,\gamma,S) = \frac{h}{h+\gamma S+S}$ for analytical tractability.[27] Accordingly, we give a numerical example that maps our model into the economics behind the current situation since the European ruling; in doing so, we first justify the case that initially led to the European ruling and set a major precedent over the issue of the right to be forgotten in terms of our model. Finally, under our model, we describe the effect of the expansion of the right to be forgotten to non-European websites.

For the first question, let us assume that Costeja (petitioner) suffers harm of size $h = 150$ from the defamatory links remained on Google's search results. So Costeja first requested Google Spain that the links to be removed; Google Spain then forwarded the request to Google Inc. When that was unsuccessful, Costeja eventually brought the case to court. The court considered the scope of removal to be *all* Google domains on a global basis. To capture this situation, suppose that if the links for queries that include Costeja's name are delisted from all Google domains, then network users' welfare loss is $S^W = 100$; and Google internalizes users' loss as her own profit loss by γS^W, where the profit-loss rate γ is private information. Costeja believes that Google's profit-loss rate is uniformly distributed on $[0,1]$ Finally suppose that litigation costs for both parties are $C_P = C_G = 10$.[28] Then our model yields the following equilibrium strategies of Costeja and Google:

- Costeja claims if $c \leq 81.84$, and always litigates;
- Google would reject the claim if $\gamma \geq 0.22$, otherwise accept.

[27] We give a clear exposition of Propositions 1 and 2 under these simplifying assumptions in Online Appendix B.

[28] We can think of all the parameter values in terms of monetary unit.

Therefore if we assume that Costeja's initial claim fee was reasonably less than 81.84 and Google's profit-loss rate were greater than 22 percent, the above equilibrium submits the actual sequence of events in the Costeja case: Costeja first requested, Google rejected, Costeja then sued Google, and so the case resorted to the court-imposed judgment. For illustration, let Google's true profit-loss rate to be fixed at 30 percent from any delisted information. Once the case was actually proceeded to a trial, the ECJ gathered all the relevant information and the process of discovery revealed Google's true loss; in fact the ECJ "efficiently" ruled in favor of the petitioner because the ex-post social welfare loss from the broken links ($(\gamma+1)S = 130$) was less than the ex-post social welfare loss from the links ($h = 150$).

Now in order comply with the European ruling, Google launched the online request process. When an individual makes a request for search removals through a web-form, Google evaluates whether the results include outdated or inaccurate information about the person and weighs whether there is a public interest in the information remaining in search results; Google may decline to remove certain information, and if so an individual may request a data protection authority to review Google's decision. Since its first day of compliance, Google received more than 219,000 claims and has accepted about 40 percent of the total URLs requested for removal, delisting more than 795,000 URLs.

A notable aspect in Google's compliance is its interpretation of the ECJ ruling that it is an application of European law that applies to services offered to Europeans and not to global in reach. Based on this interpretation, Google in fact restricted its compliance to the local subsidiary for which the requester is associated with. In particular, the requesting individual will need some connection to one of EU and EFTA countries, and Google would remove the links from search results only in European versions of Google search services. Therefore when Google evaluates whether to remove the links or not, it will assess network users' welfare loss pertaining only to the *local* domain.

Taking this into account, we assume that if users' welfare loss from the broken links of searched results on a certain name in all Google domains on a global basis were $S^W = 100$ (as in the Costeja case), then the broken links only in a local Google domain would result in a lower welfare loss, say $S^L = 70$. Then our model predicts the following strategies of a petitioner and Google:

- The petitioner with harm $h = 150$ claims if $c \leq 101.88$, and always litigates;
- Google would reject the claim if $\gamma \geq 0.37$, otherwise accept.

The above example illustrates several interesting observations when network users' social welfare loss is $S^W = 100$ in comparison to when $S^L = 70$, given any petitioner with a fixed harm level of $h = 150$. We list these in terms of our results in Sections 4 and 5 as follows:

1. The petitioner would expect Google to accept his request with a higher probability of 0.37 when $S^L = 70$ than the probability of 0.22 when $S^W = 100$. In both examples, the petitioner litigates with probability one upon rejection. Thus the equilibrium probability of lawsuits is 0.63 when $S^L = 70$, which is less than 0.78 when $S^W = 100$.

2. The petitioner's expected probability of winning in court[29] is

$$g(150, \tilde{\gamma}(0.37), 70) = 0.56 > 0.48 = g(150, \tilde{\gamma}(0.22), 100).$$

   Then the ex-ante likelihood of broken links is 0.72 $(= 0.37 + 0.63 \cdot 1 \cdot 0.56)$ when $S^L = 70$, which is greater than 0.60 $(= 0.22 + 0.78 \cdot 1 \cdot 0.48)$ when $S^W = 100$.

3. Social efficiency implies that the claim should be made against any type of Google when $S^L = 70$, but only against Google of types $\gamma < 0.5$ when $S^W = 100$.[30] This implies that in the latter case, the petitioner's claim may have been excessive in the sense that it could be inefficiently be brought to court and resolved by costly court-imposed judgments.

4. The socially optimal probability of broken-links is one when $S^L = 70$, while it is 0.5 when $S^W = 100$. Together with (2), this implies that too few broken links are expected to arise in equilibrium when $S^L = 70$, while too many links are expected to be broken in equilibrium when $S^W = 100$.

[29] Those types of Google who accept ($\gamma < 0.37$) estimates the petitioner's winning probability to be $g(150, \gamma, 70) \in (0.61, 0.68]$ and those types who reject ($\gamma \geq 0.37$) estimates $g(150, \gamma, 70) \in [0.52, 0.61]$, when $S^L = 70$; whereas when $S^W = 100$, those types who accept ($\gamma < 0.22$) assesses $g(150, \gamma, 100) \in (0.55, 0.60]$ and those types who reject ($\gamma \geq 0.22$) assesses $g(150, \gamma, 100) \in [0.43, 0.55]$.

[30] Social efficiency calls for the links to be broken if $h > \gamma S + S$. This implies that the petitioner should not have filed the claim in the first place against Google with type $\gamma \geq \frac{h-S}{S}$. Note that when $S^L = 70$, $(\gamma + 1)70 < 150$ for all $\gamma \in [0, 1]$.

5. If Google's true profit-loss rate is $\gamma \in [0.22, 0.37)$ for any delisted information, then Google accepts the claim when $S^L = 70$ when she would have rejected it if $S^W = 100$.

How could our model explain Google's immediate acceptance without being brought to legal authorities or to court over the past few months? The above example provides a numerical equilibrium prediction regarding Google's removal request process: The likelihood of Google's acceptance of a claim is about 37% for given $h = 150$ and $S^L = 70$. We note some caveats in this observation. First, the question of whether the remaining 63% of rejection has been proceeded to a data protection authority or court and how those were resolved are unanswered. Nonetheless, we can expect a priori about 72% of the links would be delisted if every requester appeals against Google's rejection decision; if the court correctly and efficiently rules in favor of the requester, then every claim will result in broken links.

Second, we described the equilibrium consequences in a game between Google and a petitioner with a fixed level of harm; however Google's removal request process is used by petitioners with different sizes of harm from the links that give various levels of welfare to network users.[31] Therefore a complete description of the current situation should involve an analysis of the probability of acceptance given some distributions of h and S. Such analysis is, in principle, technically feasible; however simplicity of our model makes the fundamental issues in the RTBF game easier to see than the more complicated analysis, and thus our "simple" model can give a reasonable description of petitioners' and Google's behaviors without ignoring vital aspects of the real games.

The intuition behind this second point may be described as follows. Assumption 1 implies a lower bound on h such that litigation is profitable to the petitioner given the prior distribution of Google's types. If this assumption is relaxed, then there is still a unique equilibrium to the RTBF game such that the petitioner always chooses not to claim if $h \leq \underline{h}$. Of note is that $\underline{h}$ increases with S, which implies that those petitioners with $h \leq \underline{h}^W$ who did not claim at all when $S^W = 100$ would now be able to make a claim when $S^L = 70$ as long as $h > \underline{h}^L$ and the claim fee is small enough, and Google would accept the claim with positive probability. Also Assumption 2 gives a sufficient condition on an upper bound of h for which there is a positive probability that Google would reject. If this assumption is relaxed, then

[31] A petitioner's harm and network user's welfare loss are not necessarily correlated. We will briefly comment on this in Subsection 7.4.

when the petitioner with a sufficiently large h claims, Google would always accept the claim no matter what her type is. Such upper bound $\bar{h}$ also increases with S, which implies that those petitioners with some high levels of harm whose claims were rejected with positive probability when $S^W = 100$ would now be able to make a claim that is always accepted when $S^L = 70$. These considerations imply that for a smaller network users' social welfare loss, (i) more claims would be made by petitioners with small harm and would be accepted with positive probability, and (ii) more claims by petitioners with large harm would be accepted with probability one; both of which contribute to greater acceptance by Google and thus more broken links.

Third, note that Google has actually processed 40.4% of removal requests according to its recent transparency report. One explanation involves chilling effects due to one of the features in the Principles of European Tort Law (PETL): the European ruling essentially puts the burden of proof on data controllers under the provision of PETL. That is, the data controllers must prove that the retention of the links is necessary for exercising the right of free speech and falls under the category specified as an exemption from the duty to remove. What this means is that a data controller, upon receiving requests, must take every possible means to evaluate each case; and if the requester confronts a rejection decision, then the data controller is fined a considerable amount of penalty if it did not comply with the rules in the RTBF standards. Thus data controllers may more often opt for removal of the links than otherwise would have.[32] Although the equilibrium strategy of Google when $S^L = 70$ demands only the types $\gamma < 0.33$ should accept, some higher types might as well immediately accept the request in fear of monetary sanctions rather than fighting for the retention of potentially ambiguous contents.

Notwithstanding these issues, we can explain how the equilibrium consequences are influenced by Google's compliance restricted to local domains in terms a change in network users' welfare loss from delinked information. By reverse-engineering, we can equally examine how the global expansion might affect the expected chance of broken links. The emerging debate regarding the right to be forgotten is on whether the European ruling should apply far more

[32] Rosen (2012b) mentions that "the prospect of ruinous monetary sanctions for any data controller that "does not comply with the right to be forgotten or to erasure" – a find up to 1,000,000 euros or up to two percent of Facebook's annual worldwide income – could lead data controllers to opt for deletion in ambiguous cases, producing a serious chilling effect" (pp.90-91).

broadly than originally understood. Should Google impose the right to be forgotten decision on all of its global search results? The central issue at hand is a clash between European and American conceptions of privacy rules. Privacy watchdogs in the European Union have already issued guidelines in September 2014 calling on Google to apply the European ruling to its entire search engine. However the guidelines are not binding, and Google's independent advisory council is expected to recommend that Europe's privacy standards should only apply within Europe.

In the midst of the battle over whether people have the right to be forgotten online, our model may provide an interesting prediction of what would happen if Google expands the scope of link removals to all of its domains. As noted earlier, our key presumption is that if the European ruling is imposed also on sites that operate outside Europe, then network users' welfare loss from globally delisted links would become larger. This implies that Google would reject more removal requests while it already rejects about 60%. If the requester disagrees with Google's initial decision and resort to national data regulators, then more number of cases would proceed to costly litigation. At the same time, because the relative value of the right to be forgotten would lessen, the court would be more likely to find for Google. Thus our model predicts that the expansion of the European ruling would actually contribute to less number of links delisted.

Furthermore, our discussion of efficiency in Section 5 renders a rather surprising policy implication on how to deal with the expansion of the right to be forgotten. Applying an empirical test briefly discussed, if the current ruling is not strong enough to protect the right to be forgotten and thus too many defamatory links remain uncut, the expansion will be hardly justified as an effort to strengthen the protection of the right to be forgotten as argued by some European data regulators. By contrast, if too many links are taken down under the current legal standard, the expansion may help to get close to the efficient outcome.

The advocates for freedom of speech and access to information stress that the European legal decision unjustly limits what can be published online. The expansion of European privacy rights may certainly allow increasingly more individuals to take Google and other search engines to court to force them to remove links from global search results; However the concern that the right to be forgotten is a threat to free speech on the internet is superfluous.

Our analysis of the underlying economics implies that the expansion might actually strike an optimal balance between privacy and free speech: empowering individuals to manage and control their personal data while protecting freedom of speech, expression, and access to information by optimally retaining disclosure of information that is of public interest. In fact, individuals can simply use a non-European web address whatsoever if only the links on European sites are removed, while the expansion allows less of the overall links delisted in the first place.

7 Discussions

7.1 Higher Litigation Costs, Lawsuits, and Broken Links

Because our RTBF game is featured as a legal dispute, the probability of G's rejection and the probability of P's litigate are shaped by various factors – one of them being the magnitude of the parties' litigation costs. Here we discuss the effect of changes in litigation costs on the probability of lawsuits and the likelihood of broken-links in equilibrium. In fact, the results are closely in line with Bebchuk (1984)'s comparative statics with a subtle difference.

Note that Assumptions 1 and 2 imply upper bounds for C_P and C_G, respectively. Denote $\bar{C}_P$ and $\bar{C}_G$ to be the corresponding upper bounds, for given values of h and S; and let C_P^* and C_G^* denote the values of C_P and C_G such that $\gamma_G^* = \gamma^*$. Because $C_P \in (0, \bar{C}_P)$ and $C_G \in (0, \bar{C}_G)$, the subsequent results will hold for marginal changes in the parameters within the relevant range.

Proposition 7. *(a) The probability of lawsuits decreases in C_G for any $C_G \in (0, \bar{C}_G)$; The likelihood of broken-links increases in C_G if $C_G \in (0, C_G^*)$, but decreases in C_G if $C_G \in [C_G^*, \bar{C}_G)$. (b) Both the probability of lawsuits and the likelihood of broken-links are not affected by a change in C_P if $C_P \in (0, C_P^*)$; both decrease in C_P if $C \in [C_P^*, \bar{C}_P)$.*

The traditional comparative static results continue to hold for the effect of changing Google's litigation costs on the probability of lawsuits: The probability of lawsuits unambiguously falls when Google's litigation cost increases.[33] This is straightforward because, for

[33] Bebchuk (1984) shows that "an increase in the litigation costs of *either* party will increase the likelihood of a settlement" (409). The counterpart of the likelihood of a settlement translated into our setting is $1 - Pr(\text{"lawsuits"})$.

any type, Google's expected payoff from litigation becomes smaller with a higher litigation cost. A rather interesting observation is that an increase in Google's litigation cost (up to a certain point) causes Google more likely to accept the petitioner's claim, creating more chance of broken links despite a relatively low petitioner's winning probability.[34] Only when Google's cost is sufficiently high so that the petitioner chooses to litigate less often results in less chance of broken links. In this case, an increase in Google's litigation cost leads the petitioner to choose litigation with a lower probability that induces exactly the same interval of Google's types who would reject; in turn maintaining the same expected winning probability for the petitioner. But now that the petitioner chooses litigation with less probability, which leads to less chance of broken links.

One might expect that when the petitioner's litigation costs increase, he would proceed to court less often and so the probability of lawsuits also falls, which would lead to less broken links. However, this is not always the case. A change in the petitioner's litigation costs has no effect on Google's cutoff type, and so on the probabilities of acceptance and rejection, up to a large amount of C_P.[35] Hence, the expected number of cases that proceed to court and the chance of broken links remain constant. The intuition is that the types of Google who reject are large enough ($\gamma_G^* < \gamma^*$) – enough to compensate for the petitioner's higher cost – so that the petitioner believes that he still has a fair chance of winning in court and litigates with probability one. However, when the petitioner's litigation cost is high enough, if the petitioner still maintains to litigate with probability one, then the cutoff type of Google is high such that litigation becomes unprofitable; and so the petitioner must proceed to court less often to induce more types of Google to reject. Then as the petitioner's litigation cost increases, less types of Google accept and those types who reject are faced with much less probability of the petitioner's litigation, both of which lead to a decrease in the likelihood of broken-links.

7.2 Different Legal Rules on Litigation Costs

In all preceding analyses, we assumed the *American rule* of litigation costs – each party bears his or her own litigation costs regardless of the trial's outcome. Our model can be equally

[34] An increased acceptance by Google makes the petitioner's inference about the case less favorable to him upon rejection, however the former direct effect dominates the latter indirect one.

[35] Note that when $\gamma_G^* < \gamma^*$ (or $C_P < C_P^*$), Google's best response is independent of C_P.

used under the *British rule*, which governs that the losing party bears all the litigation costs. Hence, we can examine how the probability of lawsuits and the likelihood of broken-links are affected by different legal rules. Bebchuk (1984) similarly examines the effects of various legal rules of litigation costs on the likelihood of settlement (i.e., the probability of acceptance), but in a different setting in which the parties can settle out of court by choosing the optimal settlement amount in a pre-trial negotiation environment.[36]

If the British rule is adopted in our model, the expected payoffs from litigation become $-(1-\beta)(h+C_P+C_G)-c$ for the petitioner and $-\beta(\gamma S+C_G+C_P)$ for Google, where $\beta = g(h,\gamma,S)$; all other specifications of the model are maintained. Then we obtain the following result.

Proposition 8. *A change from the American rule to the British rule might increase, decrease, or has no effect on the probability of lawsuits and the likelihood of broken-links.*

Proposition 8 implies that the effects of different legal rules governing the allocation of litigation costs on the probability of lawsuits and broken links are ambiguous. We find some interesting underlying economics behind this result. First, a change to the British rule unambiguously lowers the petitioner's optimal cut-off type of Google, γ^*, that makes him indifferent between litigating and giving up upon rejection by types greater than such cut-off. This is because the amount that depends on the trial's outcome is larger under the British rule than under the American rule; hence, the marginal benefit to the plaintiff from litigating against a low type than against a high type is greater under the British rule. Therefore, the petitioner would want more (lower) types of Google to reject under the British rule in order to limit Google's ability to signal the weakness of the petitioner's case.

However, whether Google's cutoff value γ_G of her equilibrium strategy rises or falls is ambiguous. To understand this, we need to note that Google's expected payoff from litigation also depends on C_P under the British rule because the petitioner's litigation cost becomes Google's burden when she loses the trial. Under the British rule, Google will suffer a loss of $\gamma S+C_G+C_P$ if she loses and will bear no loss if she wins, whereas under the American rule

[36] Bebchuk (1984) focuses on how an informational asymmetry might influence parties' litigation and settlement decisions and how it might lead to a failure of settlement. Among the results is that the likelihood that a case will end up in litigation is lowest under the American rule and greatest under the British rule.

she will suffer a loss of $\gamma S + C_G$ if she loses and will pay C_G if she wins. We give the intuition by comparing these arrangements for the cutoff type, γ_G^A, that is indifferent between accepting and rejecting under the American rule.[37] If C_P is sufficiently high, then considerably larger stake depends on the trial's outcome under the British rule compared to the American rule; and so the cutoff type γ_G^A would prefer to accept, which implies that more types of Google accept under the British rule. On the other hand, if C_P is negligibly small, then when the cutoff type γ_G^A loses under the British rule suffers a loss that is just about what she would have lost under the American rule, but pays nothing when she wins under the British rule while she pays her litigation cost when she wins under the American rule. So the cutoff type γ_A would prefer to reject, implying Google will reject more often under the British rule.

Thus the probability of lawsuits (and correspondingly the likelihood of broken links) under the British rule may be greater or smaller than that under the American rule greatly depending on the primitives of the model. This implies that examining whether the expected number of cases that are brought to court would increase or decrease in equilibrium by a different legal rule only complicates some details of the analysis without adding commensurate insight. More importantly, regardless of legal rules, Propositions 1 and 2 still hold, which implies that all the main insights of our analyses in Sections 4 and 5 carry over.

7.3 Two-sided Private Information

Our model assumes that h is known to all, but γ remains the search engine's private information. What if h is also private information the petitioner? For sake of discussion, suppose that there are the two types of petitioners: $\overline{h}$ and $\underline{h}$. Google believes that the petitioner is of type $\overline{h}$ with probability λ and $\underline{h}$ with probability $1 - \lambda$. Then, our analysis for each type of h can be considered two distinct cases with the single-type petitioner for each $\lambda = 0, 1$. In general, for an intermediate $\lambda \in (0, 1)$, the petitioner's decision to litigate or not should be a function of λ. Assuming that the full information case of $\lambda = 1$ ensures the litigation upon rejection (i.e., $p_2 = 1$), the petitioner will follow litigation upon rejection for a sufficiently large λ by the continuity argument, whereby the equilibrium will be described as Proposition 1-1. As λ continues to fall, Google will adjust her strategy by rejecting the claim more often. One interesting issue that may arise in this two-sided asymmetric information setting

[37] See the proof of Proposition 8 in Appendix A for details.

is the petitioners' signaling incentives, as is well documented by Daughety and Reinganum (2014). For example, since Google's decision must be based on the *average* type, some type of petitioners, who did not claim if Google had known the exact type, may opt for claiming because Google may accept the request in the two-sided asymmetric information. Obviously, the analysis shall become considerably involved. Admitting this is an interesting theoretical subject, we think that eventually the equilibrium will be characterized by a variant of Propositions 1 and 2. We leave this analysis for further research for now.

7.4 Correlation between Losses

For our base model, we assume that network users' loss from the broken links S is not correlated with the petitioner's harm h. Justification comes from the fact that the petitioner's harm mostly depends on his own individual characteristics. For example, Costeja might have relatively large harm than others in similar situations because as a lawyer he might lose some potential clients due to search results on his blemished reputation in the past. However, it is plausible to think of a positive correlation between the two: If a petitioner's harm comes from users' search and the value of the right to remember increases with the search intensity, we should expect that h is an increasing function of S. Then we can write $h = \delta S$, and the likelihood of the petitioner's prevailing in a trial would become $\beta = g(\delta, \gamma, S)$. This change would not qualitatively affect our analysis.

Another plausible scenario is to consider a positive relationship between h and γS. That is, a petitioner a higher harm level may expect larger Google's loss from the broken links. However as long as γ is Google's private information, the petitioner must still form some belief about Google's type upon rejection and our analysis should still apply. Thus we assert that our assumptions on h, γ, and S substantially simplifies the exposition while conveying all the key insights of our model.

7.5 Threats to Reputation Capital

The right to be forgotten laws can be seen as offering a "reset" over an individual's damaging reputation. While a second chance for an individual's mistake should be regarded as a respectable social value, it makes inevitable conflicts with the right of others for public information to assess the risks involved in dealing with someone.[38] Remarkably, no one could deny the significance of so-called 'reputation capital' in our information-based economy: Customers look for reviews and ratings on goods and services. Employers get opinion on potential employees. Business works hard to build strong positive reputation, for it thrives with good reputation and withers with bad one. As much as the reputation capital is a vital in decision-makings, any distortion in inference from reputation should be deeply damaging.

We briefly demonstrate how a broken link challenges the reputation system. Let us consider a client who looks for a professional such as a lawyer, a consultant, an accountant, etc. There are two types of professionals, efficient type (E) with probability θ and inefficient type (I) with $1-\theta$, where θ measures the client's prior belief of meeting the efficient. Assume that type E professionals have positive reputation with probability π_E but blemished reputation with probability $1-\pi_E$, whereas type I professionals have positive reputation with probability $\pi_I < \pi_E$. Then, using the Bayes' rule, we can easily show that the posterior belief on type E decreases as some type I professionals "reset" their reputation. This implies the efficacy of positive reputation in identifying a better professional declines with the stronger the right-to-be forgotten enforcement. Furthermore, because the return to better reputation decreases when the links to information pertinent to blemished reputation can be easily washed out, the incentives to build up or maintain clean reputation would weaken. In this aspect, the value of the right to remember can broadly include any negative effects of the broken links on the system of reputation capital.[39]

8 Concluding Comments

We are living in a world where an individual's online activity can leave behind "digital footprints" that can never be forgotten and other users can generate "data shadows" by spreading the digital footprints without permissions.[40] The Big Data is built upon digital footprints

[38] The Freeman, *The Internet Memory Hole "The right to be forgotten" — a privacy right or Orwellian incinerator?* NOV. 24, 2014 by WENDY MCELROY

[39] As a related point, people argued that the expansion of the European right to be forgotten into the globe may lead to more censorship by public officials such as autocrats who want to whitewash the past or remove links they don't like. Focusing on the economics of the right to be forgotten, we do not take such concerns into account throughout this article. For this point, we refer to the N.Y. TIMES Editorial, *Europe's Expanding 'Right to Be Forgotten'*, Feb. 5. 2015.

[40] See Koops (2011).

and data shadows, and the right to be forgotten is becoming an extremely important issue. Threats to privacy in the era of open internet are far more ubiquitous than the threats from back-then new technologies of Kodak camera and the tabloid press. In the canonical article on the right to privacy, Warren and Brandeis (1890) made the following warning: "The press is overstepping in every direction the obvious bounds of propriety and of decency. Gossip is no longer the resource of the idle and of the vicious, but has become a trade, which is pursued with industry as well as effrontery" (pp.195-96). At the heart of the current issue of the right to be forgotten, a deeper stake is found: how to protect a personal *dignity* from easier exposure and more difficult erasure.

The right to be forgotten is to protect the private dignity by making the erasure easier. However this right may well make a fundamental conflict with the right to remember – free speech and access to information. The value of dignity is a socially constructed value,[41] so much so the values of the right to remember. Consequently, it is not surprising to see wide variations in evaluating the right to be forgotten, as is highlighted in the diametrical positions between the European Union and the U.S. on the scope of privacy rights. Not only across countries but also over time, the socially constructed values may change, which implies that the debate over the right to be forgotten is expected to intensify.

In this paper, we pioneer an economic analysis of the right to be forgotten and offer a novel framework in examining the impact of the expansion of the European standards on the right to be forgotten. We contend that the expansion should be understood by analyzing an optimal balance between privacy and free speech, rather than by a power game between European data regulators and the dominant search engine, or by a clash between the European privacy rule and the American First Amendment. If we could quantify privacy protection as the number of links removed, then our analysis demonstrates that the expansion does not pose a threat to the right of free speech. In any case, it is the authors' opinion that our paper should be taken as only a first step in an attempt to build the economics behind the right to be forgotten, and we hope other works would follow and complement ours.

[41] See Rosen (2012a).

References

Ambrose, M. L., and J. Ausloos (2013): "The right to be forgotten across the pond," *Journal of Information Policy*, 3, 1–23.

Bebchuk, L. A. (1984): "Litigation and Settlement under Imperfect Information," *Rand Journal of Economics*, 15(3), 404–415.

Bennett, S. C. (2012): "Right to Be Forgotten: Reconciling EU and US Perspectives, The," *Berkeley J. Int'l L.*, 30, 161.

Bernal, P. (2014): "The EU, the US and Right to be Forgotten," in *Reloading Data Protection*, pp. 61–77. Springer.

Daughety, A. F., and J. F. Reinganum (2014): "Revelation and Suppression of Private Information in Settlement-Bargaining Models," *The University of Chicago Law Review*, pp. 83–108.

Koops, B.-J. (2011): "Forgetting footprints, shunning shadows: A critical analysis of the'right to be forgotten'in big data practice," .

McNealy, J. E. (2012): "The emerging conflict between newsworthiness and the right to be forgotten," *Northern Kentucky Law Review*, 39(2), 119–135.

O'Hara, K. (2012): "Can Semantic Web Technology Help Implement a Right to Be Forgotten?," *Computers and Law*, 22(6).

Rosen, J. (2012a): "Deciders: The Future of Privacy and Free Speech in the Age of Facebook and Google, The," *Fordham L. Rev.*, 80, 1525.

——— (2012b): "The right to be forgotten," *Stanford law review online*, 64, 88.

Walker, R. K. (2012): "Right to be Forgotten, The," *Hastings LJ*, 64, 257.

Warren, S., and L. Brandeis (1890): "The Right to Privacy," *Harvard Law Review*, 4(5).

A Appendix A: Proofs

Proof of Lemma 1. When $\gamma = 0$, the left-hand-side of (3.1) is zero; the right-hand side is $p_2 C_G > 0$. The left-hand-side is increasing in γ with the slop $S > 0$. The slope of the right-hand-side is $p_2 S(g_\gamma \gamma + g)$. Because $g_\gamma \gamma + g < 1$, the positive LHS slope is strictly greater than the RHS slope for any for any $\gamma \in [0, \bar{\gamma}]$ and for any $p_2 > 0$. Therefore by the single crossing property, there exists a unique $\gamma > 0$ that satisfies (3.1). □

Proof of Lemma 2. Follows from the proof of Lemma 1 and the previous discussion in the text. □

Proof of Lemma 3. We want $\gamma_G < \bar{\gamma}$ to have some types of Google reject. Note that γ_G is defined by (3.1), and is increasing in p_2. Therefore, it suffices to have $\gamma_G < \bar{\gamma}$ at $p_2 = 1$. Define γ_G^* such that it satisfies:

$$\gamma_G^* S = g(h, \gamma_G^*, S)\gamma_G^* S + C_G$$

Then $\gamma_G^* < \bar{\gamma}$ is equivalent to:

$$C_G < \underbrace{(1 - g(h, \gamma_G^*, S))}_{(*)} \bar{\gamma} S. \tag{A.1}$$

Note that as γ_G^* approaches $\bar{\gamma}$, the term $(*)$ increases. Suppose that for $\gamma_G^* = 0$, the condition (A.1) holds. Then for any $\gamma_G^* > 0$, this condition will hold. Therefore if $C_G < (1 - g(h, 0, S))\bar{\gamma} S$, then $\gamma_G^* < \bar{\gamma}$, which implies $\gamma_G < \bar{\gamma}$. Also note that by Lemma 1, $\gamma_G > 0$. Therefore Google will neither accept no matter what her private information is nor reject not matter what her private information is, assuming the petitioner's case has merit (Assumption 1). Rather the petitioner's claim will be accepted by Google whose type is sufficiently low and rejected by Google for whom this is not the case. □

Proof of Lemma 4. The petitioner's expected payoff from litigation (if the claim is rejected) depends on the posterior expectation of γ on the interval $[\gamma_G, \bar{\gamma}]$. If γ_G increases, then $\tilde{\gamma}(\gamma_G) = E[\gamma | \gamma \geq \gamma_G]$ increases (or the expected probability of winning in litigation, $g(h, \tilde{\gamma}(\gamma_G), S)$, decreases), and thus the expected value of litigation falls. Note that by construction, the posterior expectation of γ concentrated on $[\gamma^*, \bar{\gamma}]$ makes P just indifferent between litigation and give-up (i.e., (3.4) holds for $\gamma_G = \gamma^*$). For *(i)*: When $\gamma_G < \gamma^*$, then P's expected payoff from litigation (when a posterior expectation of γ is concentrated on $[\gamma_G, \bar{\gamma}]$) is greater than that when it is concentrated on $[\gamma^*, \bar{\gamma}]$. Therefore when $\gamma_G < \gamma^*$, the left-hand-side of (3.4) becomes strictly positive, and so P must always litigate, i.e., $p_2 = 1$. For *(iii)*: When $\gamma_G > \gamma^*$, $p_2 = 0$ by the similar logic. For *(ii)*: Lastly when $\gamma_G = \gamma^*$, P's expected payoff from litigation following rejection by the types $\gamma \geq \gamma_G = \gamma^*$ is exactly the expected value when the posterior is concentrated on $[\gamma^*, \bar{\gamma}]$. By construction of γ^*, P is indifferent between litigation and give-up after rejection by the types $\gamma \geq \gamma_G$, and so P follows a randomized strategy $p_2 \in [0, 1]$. □

Proof of Proposition 1. Consider the subgame following the claim. Under Assumption 2, the petitioner uses Bayes' theorem to compute his posteriors on G's type when the claim is rejected.

(1) γ_G is defined by (3.1). We can easily see that γ_G is increasing in p_2 and $p_2 \leq 1$, so that $\gamma_G \leq \gamma_G^*$. Therefore if $\gamma_G^* < \gamma^*$, then $\gamma_G < \gamma^*$. Given G's cutoff strategy $\gamma_G < \gamma^*$, upon rejection, P's best-response strategy must be $p_2 = 1$ by Lemma 4 (because litigation has a higher expected payoff under the posterior concentrated on $[\gamma_G, \bar{\gamma}]$ than giving up). Against P's strategy $p_2 = 1$, G's best response is to use the cutoff strategy given by γ_G which equals γ_G^* when $p_2 = 1$. Therefore G of types $\gamma \geq \gamma_G^*$ reject the claim and otherwise accept, believing that P will litigate with probability one. This in turn justifies P's optimal strategy to be $p_2 = 1$. This is the only subgame-perfect Nash equilibrium after P's claim.

(2) If $\gamma_G^* \geq \gamma^*$, then $\gamma_G \gtreqless \gamma^*$ depends on P's strategy p_2. (i) First suppose that $p_2 = 0$. Then it must be $\gamma_G = 0$; i.e., any type of Google will reject the claim because they expect P to give up for sure and thus earning zero instead of $-\gamma S$ by accepting the claim. Because $\gamma_G = 0 < \gamma^*$, it must be $p_2 = 1$ by Lemma 4, which is a contradiction. (That is, upon rejection by any type, P learns nothing additional about G's type, which implies that his posterior expectation of γ equals his priors; however by Assumption 1, P will prefer to litigate than to give up and so $p_2 = 1$.) (ii) Now suppose that $p_2 = 1$. Then $\gamma_G = \gamma_G^* \,(\geq \gamma^*)$. If $\gamma_G > \gamma^*$, then it must be $p_2 = 0$ also by Lemma 4, which is again a contradiction. (That is, if $\gamma_G > \gamma^*$ and $p_2 = 1$, upon rejection, P's expected payoff from litigation when his posterior is on $[\gamma_G, 1]$ is less than that

when his posterior is on $[\gamma^*, 1]$; therefore it must be $p_2 = 0$ contradicting $p_2 = 1$.) Therefore if $p_2 = 1$, then it must be $\gamma_G = \gamma_G^*$ and $\gamma_G^* = \gamma^*$. Note that p_2 can be computed by plugging in γ^* in (3.1): $p_2 = \frac{\gamma^* S}{g(h,\gamma^*,S)\gamma^* S + C_G} = \frac{\gamma_G^* S}{g(h,\gamma_G^*,S)\gamma_G^* S + C_G}$ (by $\gamma^* = \gamma_G^*$) $= \frac{g(h,\gamma_G^*,S)\gamma_G^* S + C_G}{g(h,\gamma_G^*,S)\gamma_G^* S + C_G}$ (by (3.5)), which confirms the petitioner's strategy to litigate with probability one. (iii) Lastly suppose that $p_2 \in (0,1)$. Then it must be $\gamma_G = \gamma^*$ by Lemma 4. Given such cutoff strategy of G, P is in fact just indifferent between litigation and give-up (See (3.4)), justifying that P uses a randomized strategy $p_2 \in (0,1)$. Now P's strategy should confirm that G uses the cutoff γ^*. Plugging γ^* in (3.1), we have:

$$\gamma^* S = p_2 \left[g(h, \gamma^*, S)\gamma^* S + C_G \right],$$

which implies that p_2 is uniquely determined by:

$$p_2 = \frac{\gamma^* S}{g(h, \gamma^*, S)\gamma^* S + C_G}. \tag{A.2}$$

Therefore, believing P randomizes between litigation and give-up with probability given in (A.2), G's best response is to use the cutoff $\gamma_G = \gamma^*$. (Note that when $\gamma^* \leq \gamma_G^*$, $p_2 < 1$ implies $\gamma^* S < g(h, \gamma^*, S)\gamma^* S + C_G \leq \gamma_G^* S \; \leftrightarrow \; \gamma^* < \gamma_G^*$.) Thus if $\gamma_G^* \geq \gamma^*$, G's cutoff strategy given by $\gamma_G = \gamma^*$ and p_2 given by (A.2), where $p_2 = 1$ iff $\gamma^* = \gamma_G^*$, is the only subgame-perfect Nash equilibrium following the claim. □

Proof of Proposition 2. Suppose that $\gamma_G^* < \gamma^*$ for given h, S, C_P, and C_G, then $\gamma_G = \gamma_G^*$ and $p_2 = 1$ form a unique equilibrium in the subgame when $p_1 = 1$, where P's posterior expectation of Google's types is given by $\mathbb{E}(\gamma | \gamma \geq \gamma_G^*)$. Using backward induction, given the unique subgame equilibrium, if c is such that

$$c \leq F(\gamma_G^*)h + (1 - F(\gamma_G^*)) \left[g(h, \tilde{\gamma}(\gamma_G^*), S)h - C_P \right],$$

then P will always prefer "claim" to "no claim." Therefore, P's strategy profile $(p_1, p_2) = (1, 1)$, G's cutoff strategy with $\gamma_G = \gamma_G^*$, and P's posteriors $\mathbb{E}(\gamma | \gamma \geq \gamma_G^*)$ upon rejection form a unique sequential equilibrium of this game. If c is larger than the right-hand-side of the above inequality, then $(p_1, p_2) = (0, 1)$, $\gamma_G = \gamma_G^*$, and P's posteriors $\mathbb{E}(\gamma | \gamma \geq \gamma_G^*)$ upon rejection form a unique sequential equilibrium. That is, the specified strategies are sequentially rational given the posterior beliefs $\frac{f(\gamma)}{1-F(\gamma_G)}$ and these beliefs are consistent with such strategies. Sequential equilibrium implies subgame perfection; so if there were multiple sequential equilibria, then there would also be multiple subgame perfect equilibria, contradicting the uniqueness of Nash equilibrium in the subgame specified in Proposition 1. A similar argument proves that there is a unique sequential equilibrium in the case of $\gamma_G^* \geq \gamma^*$ for given h, S, C_P, and C_G, except that now $p_1 = 1$ if $c \leq F(\gamma^*)h$ and $p = 0$ if otherwise. $\square$

Proof of Proposition 3. As is evident from (4.1), there is a kink in $(1 - F(\gamma_G))$ at $\gamma_G^* = \gamma^*$. Let S^* be a value of S such that $\gamma_G^* = \gamma^*$ for given values of h, C_P, and C_G. Differentiation of (4.1) yields:

$$\frac{dPr(\text{“lawsuits”})}{dS} = (1 - F(\gamma_G)) \underbrace{\left[\frac{\partial p_2}{\partial S} + \frac{\partial p_2}{\partial \gamma_G}\frac{d\gamma_G}{dS}\right]}_{=\frac{dp_2}{dS}} - f(\gamma_G)p_2 \underbrace{\frac{d\gamma_G}{dS}}_{<0}.$$

First consider the case $S < S^*$ (or when $\gamma_G^* < \gamma^*$). For given values of h, C_P, and C_G, Assumption 2 can be rewritten in terms of S such that $S > \underline{S}$ for some $\underline{S} > 0$ such that $(1 - g(h, 0, \bar{S}))\bar{\gamma}\bar{S} = C_G$. These two conditions on S are in strict inequality and so continue to hold for a small change in S. When $S < S^*$, $p_2 = 1$ and $\gamma_G = \gamma_G^*$; Then $\frac{dp_2}{dS} = 0$ and total differentiation of (3.1) shows that γ_G^* falls as S increases. So the derivative of (4.1) for $S \in (0, S^*)$ is $-f(\gamma_G^*)\frac{d\gamma_G^*}{dS} > 0$. The probability of “lawsuits” thus unambiguously increases with an increase in S when $S < S^*$. Next consider the case $S \geq S^*$. Assumption 1 can also be rewritten in terms of S of strict inequality such that $S < \bar{S}$; and so for $S \in [S^*, \bar{S})$, the conditions still hold for a small increase in S. When $S \geq S^*$, $p_2 = \frac{\gamma^* S}{g(h,\gamma^*,S)\gamma^* S + C_G}$ and $\gamma_G = \gamma^*$, and so the derivative of (4.1) for $S \in [S^*, \bar{S})$ is

$$-f(\gamma^*)\frac{d\gamma^*}{dS} + (1 - F(\gamma^*))\frac{dp_2}{dS}, \tag{A.3}$$

where $\frac{dp_2}{dS} < 0$ and $\frac{d\gamma^*}{dS} < 0$. (Differentiation of (3.4) for $\gamma_G = \gamma^*$ with respect to S shows that γ^* falls as S increases. The derivative of the left-hand-side of (3.4) with respect to S is negative holding $\gamma_G = \gamma^*$ fixed. Thus a decrease in the value of the left-hand-side of (3.4) will decrease the borderline type γ^*. Also p_2 monotonically decreases and converges to zero as $S \longrightarrow \bar{S}$ for $S \geq S^*$.) Note that the right and left derivatives of Pr("lawsuits") differ at $S = S^*$. At $S = S^*$, it is a special case where $p_2 = 1$ and $\gamma_G = \gamma^* = \gamma_G^*$; the left derivative evaluated at $S = S^*$ is then $-f(\gamma^*)\frac{d\gamma^*}{dS}$, which is greater than (A.3) at $S = S^*$. Now note that $\lim_{S \to \bar{S}}(1 - F(\gamma^*))p_2 = 0$, whereas $(1 - F(\gamma^*))p_2 > 0$ at $S = S^*$. Hence, the argmax of Pr("lawsuits") $\in [S^*, \bar{S})$. Define such argmax to be $\tilde{S}$; then (A.3)> 0 if $S < \tilde{S}$ and (A.3)< 0 if $S > \tilde{S}$,[42] which completes the proof. If we further impose the following condition, then the probability of lawsuits achieves its unique maximum at the kink $\gamma_G^* = \gamma^*$, i.e., $\tilde{S} = S^*$.

Assumption 3. $-f(\gamma^*)\frac{d\gamma^*}{dS}|_{S=S^*} + (1 - F(\gamma^*))\frac{dp_2}{dS}|_{S=S^*} < 0.$

Assumption 3 implies that the right derivative of $\frac{dPr(\text{"lawsuits"})}{dS}|_{S=S^*} < 0$, and continues to be negative for $S > S^*$. ☐

Proof of Proposition 4. Inspection of (4.2) and Proposition 3 confirms this. ☐

Proof of Propositions 5 and 6. Directly follow from the discussion in the text together with Propositions 1 and 2. (We will add the technical details later.) ☐

Proof of Proposition 7. Recall that the probability of lawsuits and the likelihood of broken-links are given by (4.1) and (4.2), respectively. We can see that the left and right derivatives differ at $\gamma_G^* = \gamma^*$. We begin by the following lemma:

Lemma 5. *An increase in the petitioner's litigation cost, C_P, has no effect on γ_G^*, whereas will decrease γ^*. On the other hand, an increase in Google's litigation cost, C_G, will increase γ_G^*, whereas has no effect on γ^*. Formally,*

$$\frac{d\gamma_G^*}{dC_P} = 0, \qquad \frac{d\gamma^*}{dC_P} < 0; \qquad \frac{d\gamma_G^*}{dC_G} > 0, \qquad \frac{d\gamma^*}{dC_G} = 0.$$

Proof of Lemma 5. γ_G^* is defined by (3.5), in which we can easily see that γ_G^* is not affected by C_P; Differentiation of (3.5) with respect to C_G shows that $\frac{d\gamma_G^*}{dC_G} > 0$ holding other variables fixed. On the other hand, γ^*, defined by (3.4) for $\gamma_G = \gamma^*$, is not affected by C_G while differentiation of (3.4) with respect to C_P shows that $\frac{d\gamma^*}{dC_P} < 0$. ☐

[42] If we assume that $\frac{f(\gamma)}{1-F(\gamma)}$ strictly increases in γ, then the second derivative of Pr("lawsuits") is negative whenever (A.3)$= 0$. This ensures uniqueness of $\tilde{S}$. With a Uniform distribution $F(\cdot)$, this assumption is not necessary. (Need to check if such condition is necessary for generic distribution.)

(a) Lemma 5 implies that $\gamma_G^* < \gamma^*$, Google's optimal cutoff value $\gamma_G = \gamma_G^*$ increases with an increase in Google's litigation cost C_G. Therefore, $Pr(\text{"lawsuits"}) = (1 - F(\gamma_G^*))$ falls with a small increase in C_G when $\gamma < \gamma^*$. On the other hand, when $\gamma \geq \gamma^*$, Google's optimal cutoff value $\gamma = \gamma^*$ is not affect by a change in C_G. Regardless, $Pr(\text{"lawsuits"}) = (1 - F(\gamma_G^*))p_2$ also falls with an increase in C_G when $\gamma_G^* \geq \gamma^*$, due to the direct negative effect of C_G on $p_2 = \frac{\gamma^* S}{g(h,\gamma^*,S)\gamma^* S + C_G}$. Thus an increase in C_G always leads to a lower probability of lawsuits with a kink at $\gamma_G^* = \gamma^*$. For the likelihood of broken-links, when $\gamma_G^* < \gamma^*$, it is given by $Pr(\text{"broken links"}) = F(\gamma_G^*) + (1 - F(\gamma_G^*))g(h, \tilde{\gamma}(\gamma_G^*), S)$. As C_G increases more types of Google accept (i.e., the first term increases); while the probability of lawsuits, $(1 - F(\gamma_G^*))$ and the expected probability of the petitioner winning in court, $g(h, \tilde{\gamma}(\gamma_G^*), S)$, both fall, and so the multiplication of these two terms falls (i.e., the second term decreases). But a decrease in the second term is dominated by an increase in the first term, because otherwise, for a small $\varepsilon > 0$, it must be:

$$\begin{aligned} F(\gamma_G^* + \varepsilon) - F(\gamma_G^*) &\leq (1 - F(\gamma_G^*))g(h, \tilde{\gamma}(\gamma_G^*), S) - (1 - F(\gamma_G^* + \varepsilon))g(h, \tilde{\gamma}(\gamma_G^* + \varepsilon), S), \\ &< g(h, \tilde{\gamma}(\gamma_G^*), S)(F(\gamma_G^* + \varepsilon) - F(\gamma_G^*)), \end{aligned}$$

where the inequality holds because $g(h, \tilde{\gamma}(\gamma_G^*), S) > g(h, \tilde{\gamma}(\gamma_G^* + \varepsilon), S)$. This gives a contradiction because $g(h, \tilde{\gamma}(\gamma_G^*, S)) < 1$. When $\gamma_G^* \geq \gamma^*$, the likelihood of broken-links is given by $Pr(\text{"broken links"}) = F(\gamma^*) + (1 - F(\gamma^*))p_2 g(h, \tilde{\gamma}(\gamma^*), S)$. An increase in C_G does not affect the interval of Google's type who accept. This implies that P's expected probability of winning remains the same; however higher C_G lowers P's probability of choosing litigation, and thus the probability of broken-links falls.

(b) Lemma 5 implies that when $\gamma_G^* < \gamma^*$, γ_G^* is not affected by C_P. We can then easily observe that $Pr(\text{"lawsuits"}) = (1 - F(\gamma_G^*))$ remains constant by any small change in C_P when $\gamma_G^* < \gamma^*$. Moreover, because γ_G^* does not change, both the probability of rejection by Google (and obviously the probability of acceptance) and P's expected winning probability stay the same. Thus $Pr(\text{"broken links"}) = F(\gamma_G^*) + (1 - F(\gamma_G^*))g(h, \tilde{\gamma}(\gamma_G^*), S)$ also remains constant. On the other hand, when $\gamma_G^* \geq \gamma^*$, γ^* decreases with an increase in C_P. So, the effect of an increase in C_P on $Pr(\text{"lawsuits"}) = (1 - F(\gamma^*))\left(\frac{\gamma^* S}{g(h,\gamma^*,S)\gamma^* S + C_G}\right)$ seems not obvious because we need to consider an indirect effect of C_P on $Pr(\text{"lawsuits"})$ through γ^*. Let C_P^* denote

the value of C_P such that $\gamma^*_G = \gamma^*$. Then for $C_P \in [C^*_P, \bar{C}_P)$ (or when $\gamma^*_G \geq \gamma^*$), we have:

$$\begin{aligned} \frac{dPr(\text{“lawsuits”})}{dC_P} &= \frac{\partial Pr(\text{“lawsuits”})}{\partial \gamma^*}\frac{d\gamma^*}{dC_P} \\ &= -f(\gamma^*)p_2\frac{d\gamma^*}{dC_P} + (1-F(\gamma^*))\frac{\partial p_2}{\partial \gamma^*}\frac{d\gamma^*}{dC_P}, \end{aligned} \tag{A.4}$$

where the first term is positive because $\frac{d\gamma^*}{dC_P} < 0$ by Lemma 5, whereas the second term is negative because $\frac{\partial p_2}{\partial \gamma^*} > 0$. Note that the left and right derivatives differ at $C_P = C^*_P$. The left derivative evaluated at $C_P = C^*_P$ is zero (because $p_2 = 1$ and $\gamma_G = \gamma^*_G = \gamma^*$ at $C_P = C^*_P$); whereas the right derivative evaluated at $C_P = C^*_P$ is $(1 - F(\gamma^*))\frac{dp_2}{dC_P}|_{C_P=C^*_P} < 0$. The derivative (A.4) remains negative for $C_P \in (C^*_P, \bar{C}_P)$ assuming $\frac{f(\gamma)}{1-F(\gamma)}$ strictly increases in γ. Therefore, $Pr(\text{“lawsuits”}) = (1-F(\gamma^*))p_2$ decreases in C_P when $\gamma^*_G \geq \gamma^*$. For the likelihood of broken-links in this case, we have $Pr(\text{“broken links”}) = F(\gamma^*)+(1-F(\gamma^*))p_2 g(h, \tilde{\gamma}(\gamma^*), S)$, where $F(\gamma^*)$ decreases and $1-F(\gamma^*)$ increases by an increase in C_P; however any increase in $(1-F(\gamma^*))$ is dominated by the decrease in the second term. So the likelihood of broken-links also decrease in C_P when $\gamma^*_G \geq \gamma^*$. □

Proof of Proposition 8. First we prove that given the primitives that satisfy Assumptions 1 and 2 under both rules, γ^* is lower under the British rule than under the American rule. Given Google's type γ, the petitioner's expected payoff from litigation under the American rule is

$$-(1-g(h,\gamma,S))h - c - C_P, \tag{A.5}$$

while under the British rule it is

$$-(1-g(h,\gamma,S))(h + C_P + C_G) - c \tag{A.6}$$

Suppose that two types of Google, γ^l and γ^h, such that $\gamma^l < \gamma^h$, are given. Let $g^l \equiv g(h, \gamma^l, S)$ and $g^h \equiv g(h, \gamma^h, S)$. Obviously, $g^l > g^h$. Then the difference between the expected outcome of litigating against the lower type γ^l and that against the higher type γ^h, under the American rule, is

$$-(1-g^l)h - c - C_P - [-(1-g^h)h - c - C_P] = h(g^l - g^h) > 0, \tag{A.7}$$

whereas under the British rule it is

$$-(1-g^l)(h+C_P+C_G)-c-[-(1-g^h)(h+C_P+C_G)-c]=(h+C_P+C_G)(g^l-g^h)>0. \tag{A.8}$$

We can see that (A.8)>(A.7). In other words, the marginal benefit to the petitioner from litigating against a lower type than against a higher type is greater under the British rule. We can also see this by noting that the amount that depends on the trial's outcome (win or lose) is greater under the British rule. (The petitioner's litigation cost C_P under the American rule can be seen as a fixed cost that incurs regardless of the trial's outcome; on the other hand under the British rule, the petitioner bears no litigation cost if he wins while pays $C_P + C_G$ if he loses.) This implies that there is more severe adverse selection problem under the British rule, and thus the petitioner's optimal cutoff type of Google, γ^*, is lower under the British rule than under the American rule. The probability of lawsuits and the likelihood of broken-links depend on γ_G^* and whether $\gamma_G^* < \gamma^*$ or $\gamma_G^* \geq \gamma^*$, given other parameters. We now show that the effect on γ_G^* of changing from the American rule to the British rule is ambiguous. First recall that γ_G^* under the American rule, denoted as γ^A satisfies

$$\gamma^A S = g(h,\gamma^A,S)\gamma^A S + C_G, \tag{A.9}$$

while γ_G^* under the British rule, denoted as γ^B satisfies

$$\gamma^B S = g(h,\gamma^B,S)(\gamma^B S + C_G + C_P). \tag{A.10}$$

If the cutoff type γ^A under the American rule were to compare her loss $\gamma^A S$ from accepting and her expected court loss $g(h,\gamma^A,S)(\gamma^A S + C_G + C_P)$ from rejecting under the British rule, then it depends on h, S, C_P, and C_G whether

$$\begin{aligned} & g(h,\gamma^A,S)\gamma^A S + C_G \lesseqgtr g(h,\gamma^A,S)(\gamma^A S + C_G + C_P), \\ \leftrightarrow\ & (1-g(h,\gamma^A,S))C_G \lesseqgtr g(h,\gamma^A,S)C_P. \end{aligned} \tag{A.11}$$

If $<$ in (A.11), then $\gamma^B > \gamma^A$; if $>$ then $\gamma^B < \gamma^A$, and if $=$, then $\gamma^B = \gamma^A$. In particular, when h, S, C_P, and C_G are such that $g(h,0,S)(C_G + C_P) \leq C_G$ (the intercepts of the RHS when $\gamma = 0$ in (A.10) and (A.9) respectively), then $\gamma^B < \gamma^A$ because $g_\gamma < 0$ and so the slope of the RHS of (A.10), $g_\gamma(\gamma S + C_G + C_P) + gS$, is strictly less than the slope of the RHS of (A.9), $g_\gamma \gamma S + gS$. On the other hand, when $g(h, 0, S)(C_G + C_P) > C_G$, then it crucially depends on (A.11). See Figure 7 for an illustration.

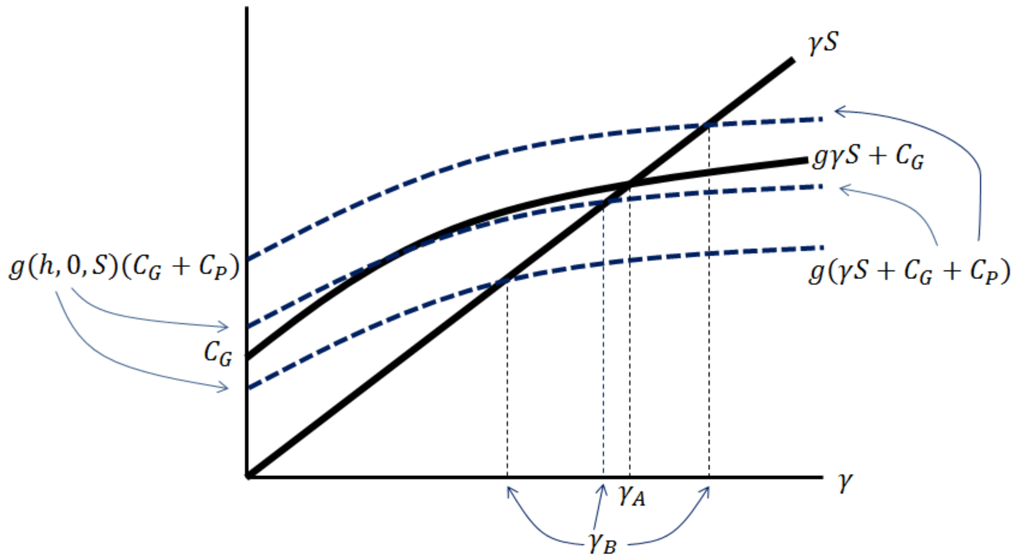


Figure 7: An illustration of $\gamma^B \gtrless \gamma^A$

Then it follows that the probability of lawsuits and the likelihood of broken-links can either rise, fall, or remain the same depending on the given parameter values, whether $\gamma^B > \gamma^A$, and whether $\gamma^B > \gamma^*$ under the British rule. $\square$