Judicial expertise and effort decisions

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December 11, 2013

Abstract

We analyze the behavior of court-appointed experts in a situation where they may be guided both by reputation and error minimization motives. Experts choose their effort level, higher effort leading to a higher probability of finding evidence. Judges may choose to monitor experts before making a final decision. We determine the equilibrium that arises in terms of the judge’s and expert’s respective effort decisions, depending upon the value of several parameters, regarding notably the efforts efficiency and the preferences of each party. Moreover, in terms of judicial quality, we show that devoting more resources to the judge in order to allow him monitoring the expert more efficiently is not always desirable, since it may lead the expert to make a lower effort to discover the real state of Nature.

Keywords: Expert, Judicial Expertise, Reputation, Monitoring.

JEL codes: K40, K41, K49.

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1 Introduction

In the fields of finance, software and pharmaceutical patents, science is advancing rapidly. This quick evolution naturally leads to advances in other fields, such as law: for instance, the development of DNA tests helped solving and judging a lot of criminal cases. But meanwhile, the appeal to science and scientific methods makes harder for the judges to interpret the proofs and results of scientific, medical and technological investigations. In this context, Posner (2012) argues that judges should be more open to appoint neutral experts in courts, in order to fill the gap between the evidence and their ability to evaluate it.

Indeed, in most legal systems, whether adversarial or inquisitorial, law allows and sometimes recommends the appointment of court-appointed experts. In the United States, Rule 706 of the Federal Rules of Evidence about court-appointed expert witnesses specifies that “the court may appoint any expert that the parties agree on and any of its own choosing”. In France, the article 145 of the Code de procédure civile provides that the judge may order judicial expertise before or during any procedure.

The role of experts in a broad sense (i.e. judicial experts and technical advisors) is to gather evidence, make findings and provide testimony in order to help the judge making an accurate decision. Note that such role, as important as it may be, remains a role of advisor: the judge keeps all his discretionary power over the decision-making process. As a “simple” advisor, the expert is expected to perform his duty as reliably as possible. But of course, nothing guarantees that the expert fulfills his task perfectly well. First, the highest efforts may lead to errors, i.e. advices which are not consistent with what really happened, either because the expert is not talented or because the case is especially complex. Second, like any agent performing for a principal (the judge), the expert may be tempted to free-ride by providing low effort, leading with a higher probability to wrong advice to the judge, thereby potentially misleading him. Of course, mistaken advice from the expert may be detected by the judge if the latter monitors the evidence provided by the expert by appealing to his own judicial staff or to a counter-expertise, or by

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1Speech at the 7th Circuit Bar Association, May 2012, reported by Chicago Tribune in “Federal Judge Richard Posner takes on science and law”.

2This risk of error is partly dependent upon the expertise field, this risk being obviously lower for instance in a DNA analysis than in an expertise over medical malpractice.
using a cross-examination procedure.

The question we ask is about the incentives of experts to perform their task and of judges to monitor them. We assume that the judge is guided by error minimization, which we define as the fact of returning a verdict consistent with truth. We consider the judge as a deputy of the judicial system, intended to make a decision in order to improve judicial quality. Thus, we do not take into account possible careerist motives of judges, in order to remain as general as possible and because we adopt a static framework with a single court. We assume that experts are guided by two types of motives, i.e. error minimization and reputation. Most papers about expertise highlight the importance of the expert’s reputational concern. In our model, the expert’s reputation increases as the recommendations of his report are not in contradiction with the information coming from the judge’s monitoring effort. Indeed, the judge infers from such situation that the expert was not mistaken. But some sociology articles also highlight that experts would be mainly guided by their interest in justice and the prospect to improve their competences; this leads to consider that the expert, as the judge, is guided by the aim of error minimization.

We consider a judicial case in which an expert chooses an effort level in order to acquire information about the state of Nature and then conveys his information to a judge. The judge decides whether to monitor the expert’s advice. Such monitoring effort may consist for instance in using judicial staff in order to gather evidence or asking a second opinion through counter-expertise and then to compare the results of these investigations to those displayed by the expert. On the one hand, if no evidence is found in contradiction with the expert’s advice, then the judge makes a decision consistent with this advice. The same applies if no monitoring is made, i.e. if no evidence is found in contradiction with the expert’s advice. On the other hand,

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3Indeed, the question of the “utility function” of judges has been much analyzed and debated. Posner (1993) considers that judges would be guided by the same incentives as any individual and would try to maximize notably popularity and prestige and to avoid reversal. For a more precise analysis about judges’ reputational concerns, see e.g. Levy (2005).

4Some reputation motives of judges, which make sense in a system of elected as well as of appointed judges, is interesting to examine in a hierarchical system, such as an inferior court and an appeal court. See, for instance, Shavell (2006) and Cameron et Kornhauser (2005b,a).

5See Pélisse et al. (2012).

6Thereafter, for more clarity, we denote the expert as “he” and the judge as “she”.

7The efficiency of such monitoring depends on the judicial means available to the judge: the more resources are available to monitor the expert, the more efficient is the monitoring.

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if some contradictory evidence is found, then the judge makes a decision different from the expert’s advice.

**Literature.** The literature on expertise has been widely developed, especially in recent years. But most papers analyze the incentives of experts in a general framework, *i.e.* they do not focus on judicial expertise. This paper is one of the first attempts, to our knowledge, to analyze the behavior and incentives of court-appointed experts. Crawford et Sobel (1982) build a model in which an agent receives private information and sends a signal to a receiver who makes a decision which determines the welfare of both parties. Sobel (1985) and Morris (2001) introduce reputational concerns in the agent’s utility and show that reputational motives may lead to a desired behavior from experts, but such result may depend on whether the decision-maker trusts the expert and on the bias he attributes to the latter. In the same vein, Krishna et Morgan (2001) question whether the consultation by the judge of a second expert may modify the behavior of a biased expert if this expert has an incentive in withholding substantial information. The answer is conditional to the bias direction of each expert, *i.e.* to the fact that experts are biased in the same or in opposite direction(s). More recently, Bourjade et Jullien (2011) consider experts as being guided not only by a bias or reputation concerns, but also by altruism: in this context, the expert will decide whether to reveal his information, both on the basis of his motives (bias, reputation and altruism) and of his bias.

Few papers focus on judicial expertise. Tomlin et Cooper (2008) provide a framework for assessing the appropriate use of court-appointed experts. They show that the possibility to appoint neutral experts helps to lead to appropriate judicial outcomes. Moreover, they provide guidance on the circumstances in which judges should appoint experts and on the frequency with which such appointments should occur, depending on the level of information of the judge. Yee (2008) analyzes the role of the judicial expert in an adversarial context by building a dueling expert game: experts strategically produce good or bad evidence to support their partisan testimony, and the two experts always provide conflicting evidence. His main result is that the characteristics of experts, *i.e.* their ability to persuade judges using available good evidence, and the quality of judges, *i.e.* their ability to distinguish good from bad evidence, determine the accuracy of verdicts.

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8See Oytana (2012) for analyses of judicial experts in the context of an appeal trial.
Our paper stands out from the previous papers on several points. First, most papers consider a biased expert. More precisely, the expert has some information and may decide not to convey it completely to the decision maker if his bias commands him not to. As we consider a court-appointed expert, and in order to focus on other aspects, we do not take into account a potential bias, which makes more sense in an adversarial procedure where each party may appeal to an expert. The aspect about which we focus is the degree of effort of the expert in a context of moral hazard. The expert’s motives drive his effort and may push him to choose a too high or too low effort level. Second, like Bourjade et Jullien (2011), we do not consider only reputational motives but rather adopt the view that the expert is also interested in error minimization (truth, in other words). He thus derives utility from the fact that a right decision is made by the judge. But in contrast with Bourjade et Jullien (2011), this “fair decision” motive will impact on his effort level, not on his incentive to reveal information, which is consistent with our “no bias” assumption. Finally, we take into account efforts from both the judge and the expert: the expert chooses his effort level and the judge chooses her monitoring effort, whereas the mentioned articles take only the expert’s effort into account. On this point, our model joins Burkart et al. (1997) but applies to a different context.

The paper is organized as follows. Section 2 displays the formal structure of the model. Section 3 determines the equilibrium judge’s effort whereas Section 4 determines the expert’s one. Section 5 leads a comparative statics analysis taking into account the interdependence of the judge’s and expert’s efforts. Section 6 compares the effort levels to the optimal levels and derives recommendations in terms of public policy. Finally, Section 7 concludes.

2 The Model

We consider a situation where a court must make a decision in a trial. The decision made by the judge is given by $y$. This decision is right if and only if it consistent with the state of Nature $\theta$, i.e. if $y = \theta$. If $y \neq \theta$, the decision is wrong. As the state of Nature cannot be directly observed by the judge, she hires a judicial expert. The timing of the game is as follows. At date $t = 0$, Nature chooses $\theta$. At date $t = 1$, the expert makes an effort to find evidence and obtains a signal $s_e$ over the state of
Nature, which he returns to the judge. At date $t = 2$, the judge observes the signal and chooses her monitoring effort. At date $t = 3$, the judge makes a decision.

**The expert.** The effort level of the expert, unobservable by the judge, is given by $e_e \in [0, 1]$. The cost function $c_e(e_e)$ is increasing, strictly convex and satisfies the Inada endpoint conditions. The probability that the expert obtains a right signal ($s_e = \theta$) is $\mu p(e_e)$, with $p(e_e) = e_e$ for simplicity, $\mu$ standing for the efficiency of the investigation effort. With probability $1 - \mu e_e$, the expert gets a signal which is inconsistent with the state of Nature ($s_e \neq \theta$), i.e. produces bad evidence. The signal $s_e$ is observable by the judge: it may be viewed as the evidence produced in the expertise report.

The expert is concerned both by error minimization, with weight $\lambda \in [0, 1]$, and reputation, with weight $1 - \lambda$. The gain in error minimization is given by the probability that the judge’s verdict is right ($y = \theta$), weighted by $\lambda$. The gain in reputation is given by the probability that his signal $s_e$ is consistent with the judge’s decision ($y = s_e$), weighted by $1 - \lambda$. In the case where $y = s_e$, the judge has not found any information in contradiction with the expert’s signal through her monitoring, so that the judge considers the expert as talented and makes a decision consistent with this signal. The expert’s utility is equal to the sum of his error minimization gain and his reputation gain net of his investigation cost.

**The judge.** The monitoring effort of the judge, unobservable by the expert, is given by $e_j$.

The cost function $c_j(e_j)$ is increasing, strictly convex and satisfies the Inada endpoint conditions. With probability $q(e_j) = e_j$, the monitoring effort allows the judge to obtain new evidence over the state of Nature. We assume in this case

9 Again, we do not take into account any information manipulation possibility by the expert: we assume he conveys all evidence he obtains to the judge.

10 Such efficiency may depend for instance on the intrinsic quality of the expert, on the available resources and on the time allowed to him.

11 This monitoring effort, which is also an investigation effort, may consist in a counter-expertise, a follow-up of the expert by the judge’s staff or by the judge herself or a deeper investigation from the judge.

12 We thus assume that the judge cannot infer the quality of expertise from the simple reading of the expert’s report. Indeed, the quality of a report over a psychiatric diagnosis or a DNA analysis may be hard to assess to the judge, precisely because she does not have the necessary competences. A new or parallel investigation or a new expert’s report are examples of elements which help her
the judge always makes a decision consistent with that evidence, even if it is different from the expert’s signal. More precisely, with probability $\eta e_j$, the evidence obtained by the judge is consistent with the state of Nature, $\eta$ standing for the efficiency of the monitoring effort\footnote{The efficiency depends on (human and financial) resources available to the judge.}. The decision is given by $y = \theta$. With probability $(1 - \eta)e_j$, the new evidence obtained by the judge is bad, independently from the expert’s evidence. If both the judge and expert obtain bad evidence (different from $\theta$), we assume that the judge’s evidence is different from the expert’s evidence, which implies that $y \neq \theta$ and $y \neq s_e$. With some probability $1 - e_j$, the monitoring effort does not produce evidence; in this case, she makes a decision consistent with the expert’s signal: $y = s_e$. The judge derives utility from error minimization: her gain is given by the probability that her decision is right, weighted by $G_j \in [0, 1]$. $G_j$ stands for the judge’s involvement in the quality of the decision. The judge’s utility is equal to her error minimization gain net of her monitoring cost.

3 The judge’s monitoring effort

We determine the equilibrium judge’s effort for a given expert’s effort and lead a comparative statics analysis\footnote{The equilibrium judge’s effort taking into account the equilibrium expert’s effort is displayed in Section 5.}.

The judge’s effort leads to a right decision in two cases: either her effort leads to a signal consistent with Nature, either she obtains no signal and relies upon the expert’s signal in case the latter is right. Thus, the probability of a right decision is equal to the sum of the probability that the judge’s effort leads to good evidence ($e_j \eta$) and of the probability (given by $(1 - e_j)e_e \mu$) that she obtains no evidence and the expert’s signal is right ($s_e = \theta$). This probability is:

$$\Pr (y = \theta| e_e) = e_j \eta + (1 - e_j)e_e \mu$$

(1)

The judge chooses $e_j$ so as to maximize her utility given by:

$$U_j = G_j \Pr (y = \theta| e_e) - c_j (e_j)$$

(2)
The F.O.C. is:

\[ U'_j = G_j (\eta - e_e \mu) - c'_j (e^*_j) = 0 \]  

(3)

We focus on an interior monitoring effort, which implies that this condition is always satisfied:

\[ \eta > e_e \mu \]  

(4)

Such condition implies that the marginal gain from an effort is strictly positive with \( G_j (\eta - e_e \mu) > 0 \), so that the judge always chooses a positive effort at equilibrium. Note that it can be showed that this condition also allows ensuring that if the evidence found by the judge is different from that of the expert, then it is optimal for the judge to make a decision consistent with this new evidence, rather that with the expert’s signal.

We now turn to a comparative statics analysis on the judge’s effort, by taking the expert’s effort as given. This will allow to distinguish then the direct effects of our parameters on the judge’s effort from indirect effects due to interactions with the expert’s effort. We first investigate the impact of the implication of the judge in the decision-making (\( G_j \)) on her equilibrium monitoring effort (\( e^*_j \)). By differentiating (3) with respect to \( e^*_j \) and \( G_j \) respectively, we obtain:

\[ \frac{\partial U'_j}{\partial e_e} = -\mu G_j < 0 \]  

(5)

Using the implicit function theorem, the sign of \( \left( \frac{de^*_j}{de_e} \right) \) is identical to the sign of \( \left( \frac{\partial U'_j}{\partial e_e} \right) \), which implies that the judge’s equilibrium level of effort is increasing in \( G_j \). This result is intuitive: the more the judge feels concerned in the decision-making, the higher monitoring effort she chooses.

Following the same reasoning, we find that the equilibrium monitoring effort (\( e^*_j \)) increases with respect to the judge’s effort efficiency (\( \eta \)). This result shows a self-enforcing effect of the monitoring effort quality on its equilibrium level: the more resources available to the judge, the higher monitoring effort he chooses. A contrario, there is no compensation effect, i.e. the judge does not compensate the lack of available resources by making a higher effort. \( \eta \) has a double effect on the probability of a right decision. First, an increase in \( \eta \) improves the probability that new evidence
from the judge is consistent with the state of Nature (for a given judge’s effort level) and second, improves the equilibrium monitoring effort.

Then, the equilibrium monitoring effort $e^*_j$ is decreasing with respect to the efficiency of the expert’s effort $\mu$. Thus, the more efficient is the expert’s effort, the lower is the judge’s monitoring effort. In other terms, the judge compensates a low expert’s effort quality by raising her monitoring effort. The overall impact of an increase of $\mu$ on the probability of a right decision is ambiguous: on one side, an increase (resp. a decrease) in $\mu$ increases (decreases) the probability that the signal $s_e$ is right. On the other side, an increase (a decrease) in $\mu$ reduces (increases) the judge’s monitoring effort, so that the overall effect is not clear.

Finally, the equilibrium monitoring effort $e^*_j$ is decreasing with respect to the expert’s investigation effort $e_e$. Thus, the higher the expert’s investigation effort, the lower the judge’s monitoring effort.

**Lemma 1.** For a given expert’s investigation level ($e_e$), the judge’s monitoring effort $e^*_j$ is increasing in the judge’s concern in the decision-making ($G_j$) and in the monitoring effort’s efficiency ($\eta$), and decreasing in the investigation effort’s efficiency ($\mu$) and in the expert’s investigation effort ($e_e$).

However, note that this comparative statics analysis is not sufficient to analyze the global effect of a variation of parameters on the equilibrium judge’s effort level, since a variation of $\mu$, $\eta$, $G_j$ and $\lambda$ have an impact on $e_e$, which is not taken into account in this analysis.

4 The expert’s investigation effort

We determine the equilibrium expert’s effort for a given judge’s effort and lead a comparative statics analysis.$^{15}$

As mentioned above, the expert derives utility from error minimization to some extent $\lambda$ and from reputation to some extent $1 - \lambda$. The expert’s benefit in error minimization depends on the probability that a right decision is made. This probability is equal to:

$^{15}$The equilibrium expert’s effort taking into account the interaction with the equilibrium judge’s effort is displayed in Section 5.
Pr \( (y = \theta | e_j) = e_j\eta + (1 - e_j) e_e\mu \) (6)

The expert’s benefit in reputation depends on the probability that the judge’s decision \( y \) fits with the expert’s signal \( s_e \). This probability is given by the probability that the expert’s signal is right and that the judge receives information that confirms this signal \((e_j\eta e_e\mu)\), plus the probability that the judge obtains no information at all so that she makes a decision consistent with the expert’s signal \((1 - e_j)\). It is equal to:

\[
Pr (y = s_e | e_j) = e_j e_e \mu + (1 - e_j) e_e
\] (7)

Overall, the utility of the expert is given by:

\[
U_e = \lambda Pr (y = \theta | e_j) + (1 - \lambda) Pr (y = s_e | e_j) - c_e (e_e)
\] (8)

The expert chooses \( e_e \) so as to maximize his utility. The FOC is:

\[
U_e' = \lambda (\mu (1 - e_j)) + (1 - \lambda) (\mu e_j \eta) - c_e' (e_e) = 0
\] (9)

Note first that \( e_j \) has opposite effects on the error minimization marginal benefit and on the reputation marginal benefit. Indeed, an increase in \( e_j \) reduces the marginal benefit in error minimization and increases the marginal benefit in reputation. Moreover, the efficiency of the judge’s effort \( \eta \) has a direct effect on the expert’s effort level through the reputation benefit, whereas it has no impact on the marginal benefit in error minimization. This comes from the fact that the expert’s effort has an impact on the probability of a right decision (and then, on his error minimization benefit) only if the judge obtains no new information from her monitoring effort. Yet, when the judge gets no new information from her monitoring effort, the efficiency of this effort plays no role, which explains that the effort efficiency does not exist in the expert’s benefit in error minimization.

We lead now a comparative statics analysis on the expert’s effort, by assuming the judge’s effort as exogenous. The reasoning is the same as the one used in the determination of the judge’s effort. By analyzing first how the expert’s effort \( e_e^* \) varies depending upon his preferences (error minimization versus reputation), we
obtain ambiguous results. Indeed, differentiating (9) respectively with regard to $e^*$ and $\lambda$ leads to the following result.

If $e_j < \frac{1}{1+\eta}$, then an increase in $\lambda$ has a strictly positive impact on the expert’s level of effort. Indeed, this condition implies that $e_j$ and/or $\eta$ are low. Yet, when $e_j$ is low, the expert does not take the risk that his reputation is damaged if he is wrong, since the probability that the judge makes a decision fitting with his signal $s_e$ is high, even if $s_e \neq \theta$. Moreover, if $\eta$ is low, then even if the expert obtains a right signal $s_e$, the probability that the judge makes a decision in contradiction with the expert’s signal is high. Consequently, if $e_j$ and/or $\eta$ are low enough, the expert has few power on his benefit in terms of reputation and is then not incited to make a high effort when mainly guided by his reputation ($\lambda$ low). Conversely, the more the expert derives utility from error minimization ($\lambda$ high), the more he is incited to make a high level of effort in order to obtain a signal consistent with the state of nature if $e_j < \frac{1}{1+\eta}$: the expert knows that the probability with which the judge makes a right decision thanks to her monitoring effort is low, since $e_j$ and/or $\eta$ are low. In particular, the low level of monitoring effort allows the expert to have a higher impact on the probability of a right decision: when $e_j$ is low, the judge follows more often the expert’s signal by making a decision $y = s_e$. Consequently, the marginal increase in the probability of a right decision from the expert’s effort (and then the marginal benefit in error minimization) is higher when the judge’s monitoring effort level is lower; this in turn incites the altruistic expert to increase his effort level.

Conversely, if $e_j > \frac{1}{1+\eta}$, the intuitions are in exact opposition to the previous case. When mainly guided by reputation motives, the expert makes a high effort in order to increase the chances that his signal is consistent with the decision made by the judge. When guided mainly by error minimization, then he chooses a low effort level, since the probability that the judge’s decision is right is high.

We now turn to the impact of the effort’s efficiency ($\eta$ and $\mu$) on the equilibrium expert’s effort $e^*_e$. By differentiating the FOC (9) respectively with regard to $e^*_e$ and $\eta$, and then with regard to $e^*_e$ and $\mu$, we find that the sign of $\left(\frac{de^*_e}{d\eta}\right)$ and of $\left(\frac{de^*_e}{d\mu}\right)$ is positive. The expert’s effort increases with his effort efficiency ($\mu$), since $\mu$ has a positive impact both on his marginal benefit in reputation and in error minimization. His effort also increases with the judge’s effort efficiency, since $\eta$ has a positive
impact on the marginal benefit in reputation. Note that an increase in the efficiency of the judge’s and of the expert’s effort has a double impact on the probability of a right decision, through the increase in $\mu$ and $\eta$ and also through the increase of the equilibrium expert’s effort.\[^{16}\]

Finally, the monitoring effort of the judge $e_j$ has an ambiguous impact on the equilibrium expert’s effort $e_e^\ast$. Indeed, by differentiating the FOC (9) respectively with regard to $e_e^\ast$ and $e_j$, we find that the impact of $e_j$ on $e_e^\ast$ depends on the value of $\lambda$ and $\eta$. If $\lambda < \frac{\eta}{1+\eta}$, then $(\eta - (1+\eta) \lambda) \mu > 0$, which means that the expert’s equilibrium level of effort increases with the judge’s monitoring effort. In others terms, when mainly guided by his reputation ($\lambda$ low), then a high monitoring effort by the judge leads to a high effort from the expert. Conversely, if $\lambda > \frac{\eta}{1+\eta}$, then $(\eta - (1+\eta) \lambda) \mu < 0$, which implies that the expert’s effort decreases with regard to the judge’s effort. Thus, if the expert is mainly guided by error minimization ($\lambda$ high), then a high monitoring effort from the judge leads to a low effort from the expert. This result is interesting in the sense that an increase in the judge’s monitoring effort may have opposite consequences in the experts’ population, by raising the effort level of reputation-guided experts and by decreasing the effort level of error minimization-guided experts.\[^{17}\]

The comparative statics results may be summarized in the following lemma.

**Lemma 2.** For a given judge’s monitoring effort $e_j$, the expert’s equilibrium effort $e_e^\ast$ is increasing (respectively decreasing) with the value the expert attaches to error minimization $\lambda$ if $e_j < \frac{1}{1+\eta}$ (resp. if $e_j > \frac{1}{1+\eta}$) and is increasing (resp. decreasing) with the judge’s monitoring effort if $\lambda < \frac{\eta}{1+\eta}$ (resp. $\lambda > \frac{\eta}{1+\eta}$). Moreover, the expert’s effort is increasing with regard to the judge’s effort efficiency $\eta$ and to his own effort efficiency $\mu$.

The previous results about the expert’s equilibrium effort are valid for a given level of the judge’s effort and do not take into account the indirect impact of a variation

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\[^{16}\]These effects on the probability of a right decision are nevertheless different from those identified in the comparative statics analysis on the monitoring effort of the judge for a given expert’s effort. We will expose the interactions between the consequences of an increase in $\mu$ and $\eta$ on the equilibrium efforts in the next section.

\[^{17}\]This illustrates a hold-up problem raised notably in Burkart et al. (1997), where the monitoring effort of an important shareholder (in our case, the judge) leads to a decrease of the manager’s effort (in our case, the expert).
of parameters $\mu$, $\eta$, $G_j$ and $\lambda$ on the expert’s level of effort via their effects on the judge’s level of effort.

5 Interactions between the judge’s and the expert’s efforts

A comparative statics analysis taking into account the interactions between the levels of effort of the expert and the judge allows to characterize the determinants of these efforts. We highlight that indirect effects coming from the interaction between efforts come to reinforce or to counter the direct effects highlighted in the previous section.

5.1 The judge’s monitoring effort efficiency

The equilibrium of the model is defined by the combination of the FOC over the judge’s and the expert’s equilibrium efforts\[18\]:

\[
\begin{cases}
G_j (\eta - e^*_e \mu) - c'_j (e^*_j) = 0 \\
\lambda (\mu (1 - e^*_j)) + (1 - \lambda) (\mu e^*_j \eta) - c'_e (e^*_e) = 0
\end{cases}
\] (10)

By differentiating the FOC with regard to $\eta$\[19\], we obtain the following system of equations:

\[
\begin{pmatrix}
c''_j (e^*_j) \\
\mu ((1 + \eta) \lambda - \eta)
\end{pmatrix}
\begin{pmatrix}
G_j \\
\frac{\partial c'_j}{\partial \eta}
\end{pmatrix} =
\begin{pmatrix}
G_j \\
e^*_j (1 - \lambda) \mu
\end{pmatrix}
\] (11)

The comparative statics analysis is lead by using the Cramer rule. We assume that the following hypothesis is verified:

Hypothesis 1.

\[E_1 > |E_2|\] (12)

\[18\] We apply here the Nash equilibrium concept. Indeed, as we assume that the judge is not able to determine the quality of expertise by reading the report, then her decision whether to monitor is not dependent upon the expertise result. On the contrary, this means that the monitoring (if any) occurs through some parallel investigation. In this respect, the Nash equilibrium seems more relevant than others, such as for instance the Von Stackelberg equilibrium.

\[19\] See the appendix for more details.
where $E_1 = c_j^* (e_j^* e_e^*)$ and $E_2 = G_j \mu^2 (\eta - (1 + \eta) \lambda)$.

This hypothesis allows ensuring that the determinant of the left matrix is positive, and that the indirect effect on $e_j^*$ via the impact on $e_e^*$, measured by $|G_j \mu^2 (\eta - (1 + \eta) \lambda)|$, is lower than the initial increase of the monitoring effort, measured by $c_j^* (e_j^*) c_e^* (e_e^*)$.

The reasoning is the same for the expert. This hypothesis also allows avoiding the case where the determinant is zero.\footnote{If this hypothesis is not valid, i.e. if $E_1 < |E_2|$, then two cases may arise. First, if $E_1 + E_2 > 0$, then the determinant is still strictly positive so that our results will remain true. Second, if $E_1 + E_2 < 0$, then the determinant is strictly negative and the comparative statics results would be exactly converse to those exposed thereafter.}

The impact of an increase in the judge’s monitoring effort efficiency $\eta$ on her own effort level $e_j^*$ is given by:

$$
\frac{\partial e_j^*}{\partial \eta} = \frac{1}{A} \left( \frac{c_j'' (e_j^*)}{\text{Indirect effect of } \eta \text{ on } e_j^*} \times \frac{G_j}{\text{Direct effect of } \eta \text{ on } e_j^*} - \frac{G_j \mu}{\text{Indirect effect of } \eta \text{ on } e_j^* \text{ via } e_e^*} \times \frac{e_j^* (1 - \lambda) \mu}{\text{Direct effect of } \eta \text{ on } e_e^*} \right) (13)
$$

As highlighted in our previous comparative statics results (see Lemmas 1 and 2), the direct effect of an increase of the judge’s effort efficiency $\eta$ is an increase in the efforts of both parties. However, the results are more ambiguous once the interactions between them are taken into account. An increase in $\eta$ increases the expert’s effort, but thereby decreases the judge’s monitoring effort. This indirect effect contradict the direct effect of an increase of $\eta$ on the judge’s effort. Overall, an increase in $\eta$ has an ambiguous impact on the judge’s effort, due to interactions between the judge’s and the expert’s efforts.

Now, the impact of the judge’s effort efficiency $\eta$ on the expert’s effort level $e_e^*$ is given by:
\[
\frac{\partial e^*_e}{\partial \eta} = \frac{1}{A} \left( -\mu \left( (1 + \eta) \lambda - \eta \right) G_j + \frac{e''_j(e_j^*)}{\mu} \times e_j^*(1 - \lambda) \right) \tag{14}
\]

The impact of \( \eta \) on the expert’s effort depends on his preferences.

Consider first the case where the expert is guided mainly by reputation concerns, \( \text{i.e. } \lambda < \frac{\eta}{1 + \eta} \). This situation illustrates the case where the expert’s effort increases with regard to the judge’s effort (lemme 2). From the expert’s viewpoint, two effects coexist. First, an increase in \( \eta \) has a direct positive effect on \( e^*_e \). Second, an increase in \( \eta \) has a direct positive effect on the judge’s effort, and thereby indirectly increases the expert’s effort. These two effects are both positive, so that when mainly guided by his reputation, the expert’s effort increases with the judge’s effort efficiency.

Consider now the case where the expert is mainly guided by error minimization, \( \text{i.e. } \lambda > \frac{\eta}{1 + \eta} \). The impact of \( \eta \) on the expert’s effort is then ambiguous, since two effects act in opposite directions. First, the direct effect of an increase in \( \eta \) is an increase in the expert’s effort. Second, an increase in \( \eta \) increases the judge’s effort, and thereby indirectly decreases the expert’s effort. Overall, the impact of an increase in \( \eta \) is unclear when the expert is mainly guided by error minimization motives.

These results are summarized in the following proposition.

**Proposition 1.** At equilibrium, the impact of an increase (or decrease) of the judge’s effort efficiency \( \eta \) on her own effort and on the expert’s effort when guided mainly by error minimization \( (\lambda > \frac{\eta}{1 + \eta}) \) is ambiguous. An increase in \( \eta \) increases the expert’s effort if he is mainly guided by his reputation \( (\lambda < \frac{\eta}{1 + \eta}) \).

**Proof.** The proof is exposed in appendix (section 8.1). 

\[\text{21Note however that in this case, it is unclear whether the comparative statics of section 4 under-estimates or over-estimates the increases of the expert’s effort with regard to the judge’s effort efficiency.}\]
5.2 The expert’s effort efficiency

We now determine the impact of the expert’s effort efficiency $\mu$ on the judge’s and expert’s effort level at equilibrium. By differentiating the FOC (10) with regard to $\mu$, we obtain the following system of equations:

$$\left( \begin{array}{c} c''_j (e^*_j) \\ \mu ((1 + \eta) \lambda - \eta) \end{array} \right) \left( \begin{array}{c} \frac{\partial \epsilon_j^*}{\partial \mu} \\ \frac{\partial \epsilon^*_e}{\partial \mu} \end{array} \right) = \left( \begin{array}{c} - \epsilon^*_e G_j \\ \lambda + \epsilon^*_j (\eta - (1 + \eta) \lambda) \end{array} \right)$$

(15)

Under Hypothesis 1, the determinant of the left matrix is positive. Using the Cramer rule, we find that the impact of the expert’s effort efficiency $\mu$ on the judge’s effort at equilibrium ($e^*_j$) is given by:

$$\frac{\partial e_j^*}{\partial \mu} = \frac{1}{A} \left( \begin{array}{c} c''_e (e^*_e) \times (-\epsilon^*_e G_j) \\ \mu ((1 + \eta) \lambda - \eta) \end{array} \right) \times \left( \begin{array}{c} \frac{\partial \epsilon_j^*}{\partial \mu} \\ \frac{\partial \epsilon^*_e}{\partial \mu} \end{array} \right)$$

(16)

As highlighted in lemmas 1 and 2, the direct effect of an increase in $\mu$ is a decrease in the judge’s effort and an increase in the expert’s effort. The decrease in the judge’s effort due to an increase in the expert’s effort efficiency is reinforced once indirect effects due to interactions between the two efforts are taken into account. Indeed, an increase in $\mu$ directly increases the expert’s effort and thereby, indirectly reduces the judge’s effort.

The impact of the expert’s effort efficiency $\mu$ on his own effort level is given by:

---

22 Refer to the appendix for more details.

23 Note that if the expert is mainly guided by error minimization concern, then the sign of the indirect effects is the same as the direct ones highlighted in the previous section: the comparative statics lead in section 4 under-estimates the decrease in the judge’s effort with regard to $\mu$. On the contrary, if the expert is mainly guided by reputation concerns, the indirect effects have opposite signs and the comparative statics highlighted in section 4 under- or over-estimates the reduction of the judge’s effort with regard to $\mu$. 

\[
\frac{\partial e^*_e}{\partial \mu} = \frac{1}{A} \left( \frac{\mu((1 + \eta) \lambda - \eta)}{\lambda} \times (-e^*_e G_j) \right) \times \left( \lambda + e^*_j \left( \eta - (1 + \eta) \lambda \right) \right) \quad (17)
\]

The impact of an increase of \( \mu \) on the expert’s effort level depends on his preferences.

Consider first the case where the expert is mainly guided by reputation concerns, with \( \lambda < \frac{\eta}{1+\eta} \). The impact of an increase of \( \mu \) on the expert’s effort is then ambiguous. First, an increase in \( \mu \) increases directly the expert’s effort. Second, an increase in \( \mu \) reduces the judge’s effort, thereby reducing indirectly the expert’s effort.

Consider now the case where the expert is mainly guided by error minimization concerns, with \( \lambda > \frac{\eta}{1+\eta} \). In this case, an increase in \( \mu \) reinforces the direct effect highlighted in lemma \( \text{[2]} \). Two similar effects indeed arise. First, the direct effect of an increase in \( \mu \) is an increase in the expert’s effort. Second, an increase in \( \mu \) reduces the judge’s effort, thereby increasing again the expert’s effort.

These comparative statics results lead to the following proposition.

**Proposition 2.** At equilibrium, an increase (resp. decrease) in the expert’s effort efficiency \( \mu \) reduces (resp. increases) the judge’s monitoring effort and increases (resp. decreases) the expert’s effort if the latter is mainly guided by error minimization (\( \lambda > \frac{\eta}{1+\eta} \)). On the contrary, an increase (or a decrease) of \( \mu \) has an ambiguous impact on the expert’s effort if he is mainly guided by reputation (\( \lambda < \frac{\eta}{1+\eta} \)).

**Proof.** The proof is exposed in section \( \text{[8.2]} \) in the appendix. \( \Box \)

We now turn to the consequences of the judge’s concern in the decision-making.
5.3 The judge’s concern in the decision-making

We aim here at determining the impact of the judge’s concern in the quality of the decision-making \( G_j \) on the judge’s and the expert’s effort levels at equilibrium. By differentiating FOC given by (10) with regard to \( G_j \), we obtain the following system of equations:

\[
\begin{pmatrix}
c''_j(e^*_j) & G_j \mu \\
\mu ((1 + \eta) \lambda - \eta) & c''_e(e^*_e)
\end{pmatrix}
\begin{pmatrix}
\frac{\partial e^*_j}{\partial G_j} \\
\frac{\partial e^*_e}{\partial G_j}
\end{pmatrix}
= \begin{pmatrix}
\eta - e^*_e \mu \\
0
\end{pmatrix}
\]

(18)

As \( \eta > e^*_e \mu \) (see condition 4), the Cramer rule allows highlighting that in equilibrium, the judge’s effort level \( e^*_j \) increases with regard to her concern in the decision-making \( G_j \):

\[
\frac{\partial e^*_j}{\partial G_j} = \frac{1}{A} \begin{pmatrix}
c''_j(e^*_j) & \times \\
\mu ((1 + \eta) \lambda - \eta) & (\eta - e^*_e \mu)
\end{pmatrix} > 0
\]

(19)

Moreover, we find that the impact of an increase in the judge’s concern in the decision-making \( G_j \) on the expert’s effort depends on his incentives. Indeed:

\[
\frac{\partial e^*_e}{\partial G_j} = \frac{1}{A} \begin{pmatrix}
-\mu ((1 + \eta) \lambda - \eta) & \times \\
\mu ((1 + \eta) \lambda - \eta) & (\eta - e^*_e \mu)
\end{pmatrix}
\]

(20)

If the expert is mainly guided by his reputation \( (\lambda < \frac{\eta}{1+\eta}) \) then the expert’s effort increases with \( G_j \) \( \left( \frac{\partial e^*_e}{\partial G_j} > 0 \right) \). Conversely, if the expert is mainly guided by error minimization \( (\lambda > \frac{\eta}{1+\eta}) \), then the expert’s effort decreases with regard to the judge’s concern in the decision-making \( \left( \frac{\partial e^*_e}{\partial G_j} < 0 \right) \).

These results lead to the following proposition.

**Proposition 3.** At equilibrium, an increase in the judge’s concern for the decision-making \( G_j \) leads to an increase in the judge’s monitoring effort and in the expert’s effort if he is mainly guided by reputation concerns, and to a decrease in his effort if he is mainly guided by error minimization concerns.

\[24\text{For more details, see the appendix, section 8.3.}\]
Proof. The proof is exposed in appendix, section 8.3.

The intuition of this proposition is as follows. The direct effect of a higher judge’s concern in the decision-making is an increase in her monitoring effort. Hypothesis 1 implies that, for a given increase of her effort, the indirect effect is lower than the initial effect on $e_j$. Thus, the direct effect from an increase in $G_j$ strictly prevails over the indirect effect, leading to an increase of the judge’s effort with regard to $G_j$. Moreover, as the expert’s effort increases (resp. decreases) with the judge’s effort to the condition that he is highly concerned (resp. few concerned) by his reputation, then the expert’s effort increases with regard to $G_j$ when he is mainly guided by reputation concerns, and decreases with $G_j$ when he is mainly guided by error minimization concerns.

5.4 The experts’ motives

Now we determine the impact of the expert’s concerns ($\lambda$) on the effort levels. By differentiating the FOC given by (10) with regard to $\lambda$, we obtain the following system of equations:

$$
\begin{pmatrix}
c''_j(e_j^*) & G_j\mu \\
\mu ((1 + \eta) \lambda - \eta) & c'_e(e_e^*)
\end{pmatrix}
\begin{pmatrix}
\frac{\partial e^*_j}{\partial \lambda} \\
\frac{\partial e^*_e}{\partial \lambda}
\end{pmatrix}
= \begin{pmatrix}
0 \\
(1 - e^*_j (1 + \eta)) \mu
\end{pmatrix}
$$

(21)

According to the Cramer rule, the impact of $\lambda$ on the judge’s effort $e^*_j$ is ambiguous and depends on the sign of $(1 - e^*_j (1 + \eta)) \mu$:

$$
\frac{\partial e^*_j}{\partial \lambda} = \left( -G_j\mu \frac{1}{\text{Indirect effect of } \lambda \text{ on } e^*_j \text{ via } e^*_e} \times \left(1 - e^*_j (1 + \eta)\right) \mu \right) \frac{1}{A}
$$

(22)

The impact of $\lambda$ on the expert’s effort is also ambiguous and depends on the sign of $(1 - e^*_j (1 + \eta)) \mu$:

$$
\frac{\partial e^*_e}{\partial \lambda} = \left( \frac{c''_j(e_j^*)}{\text{Indirect effect of } \lambda \text{ on } e^*_e} \times \left(1 - e^*_j (1 + \eta)\right) \mu \right) \frac{1}{A}
$$

(23)

The expression $(1 - e^*_j (1 + \eta)) \mu$ is positive only if $e^*_j < \frac{1}{1 + \eta}$, and negative otherwise.

\footnote{For more details, see the appendix, section 8.4}
Proposition 4. At equilibrium, if \( e_j^* < \frac{1}{1 + \eta} \), then a higher expert’s concern for error minimization (higher \( \lambda \)) leads to a decrease in the judge’s effort and to an increase in the expert’s effort. Conversely, if \( e_j^* > \frac{1}{1 + \eta} \), then a higher expert’s concern for error minimization leads to an increase in the judge’s effort and to a decrease in the expert’s effort.

Proof. The proof is exposèd in the appendix, section 8.4.

Indeed, when \( e_j^* < \frac{1}{1 + \eta} \), we showed that a higher \( \lambda \) has a strictly positive impact on the expert’s effort. According to hypothesis 1, this increase prevails over the indirect effect coming from the interdependence of the judge’s and expert’s efforts (note that this effect may be positive or negative). Thus, the direct effect prevailing, the expert’s effort increases with regard to \( \lambda \). Conversely, when \( e_j^* > \frac{1}{1 + \eta} \), we have highlighted that an increase in \( \lambda \) has a direct strictly negative impact on the expert’s effort. Again, according to hypothesis 1, this effect prevails over the indirect effect due to the efforts interdependence.

6 Judicial quality

We define the judicial quality as the probability that a right decision is made minus the cost of the judge’s and expert’s efforts. The judicial quality is thus given by:

\[
Q = e_j \eta + (1 - e_j) e_e \mu - c_j (e_j) - c_e (e_e)
\]

Thus, the effort choice of the judge, whose aim is to maximize the judicial quality\(^{26}\), denoted hereafter socially optimal effort level of the judge \( e_o^j \), is given by the FOC:

\[
\frac{\partial Q}{\partial e_j} = \eta - e_e \mu - c_j' (e_o^j) = 0
\]

\(^{26}\)The maximization of \( Q \) is equivalent to the minimization of the sum of the costs (cost of efforts and cost of a judicial error), as proposed notably by Shavell (1995) and Cameron et Kornhauser (2005b).
The SOC is given by $\frac{\partial^2 Q}{\partial e_j^2} = -c''_j (e_j) < 0$. At equilibrium, when the judge makes a socially optimal level of effort $e^o_j$ (which is anticipated by the expert), the equilibrium is defined as:

$$
\begin{align*}
\eta - e^*_j \mu - c'_j (e^o_j) & = 0, \\
\lambda \left( \mu (1 - e^o_j) \right) + (1 - \lambda) \left( \mu e^o_j \eta \right) - c'_e (e^*_e) & = 0
\end{align*}
$$

By comparing systems (10) and (26), it is obvious that the judge’s equilibrium effort is consistent with her socially optimal effort if her error minimization concern is maximal, i.e. if $G_j = 1$. Alternatively, if $G_j < 1$, then the judge’s equilibrium effort defined in (10) is sub-optimal, since the social marginal benefit of the judge $(\eta - e^*_e \mu)$ is higher than her private marginal benefit $(G_j (\eta - e^*_e \mu))$.

**Proposition 5.** If the judge’s error minimization benefit $(G_j)$ equals 1, then her monitoring effort chosen at equilibrium is socially optimal. If her error minimization benefit is strictly lower than 1, then her equilibrium monitoring effort is sub-optimal.

**Proof.** For $G_j = 1$, the judge’s marginal benefit is given by $\eta - e^*_e \mu$, at the equilibrium defined in (10) as at the optimum defined in (26). The marginal benefits being equal, the FOC imply that $c'_j (e^*_j) = c'_j (e^o_j)$, so that $e^*_j = e^0_j$.

For $G_j < 1$, the equilibrium judge’s marginal benefit defined in (10) is lower than her optimal marginal benefit defined in (26). Indeed:

$$
G_j (\eta - e^*_e \mu) < \eta - e^*_e \mu
$$

This condition is always satisfied if $G_j < 1$. In this case, $c'_j (e^*_j) < c'_j (e^o_j)$ and $e^*_j < e^o_j$.

Thus, in order to reach the optimum, the judicial system shall try to increase the judge’s incentives when her effort is not maximal. The question which arises is then to know how to reach this goal in our framework. Several solutions are envisaged, but do not show the same advantages.

A first solution in order to increase the judge’s monitoring effort is to act on the efficiency of this effort. However, the result of such measure is not certain since the impact of an increase in the monitoring effort efficiency on the judge and on the
error minimization - guided expert is unclear (see proposition 1).

A second solution to increase this effort with certainty is to reduce the expert’s effort efficiency $\mu$. The judicial authority might for instance reduce the means available to the expert or shorten the time assigned to the expert to fulfill his task in order to accelerate the procedure. The judge would take it into account by increasing her equilibrium monitoring effort (see proposition 2). Note however that by reducing $\mu$, the judge’s equilibrium effort increases at the same rate as her socially optimal effort.

A third solution in order to increase the judge’s effort is to try to increase $G_j$ directly, i.e. to make the judge more concerned by a right decision-making. To influence the personal motives of the judges may appear to be difficult, but one can think of ways of reaching such aim. For instance, conditioning the career of judges on their previous decisions may be seen as equivalent to increasing $G_j$. Of course, this implies that the judicial authority recognizes when the judge makes a right/wrong decision, which raises practical problems. The rate of decisions confirmed by a higher court (as the appeal court) might be used as a proxy, even if that measure is imperfect: the career of judges would then depend upon the rate of their decisions confirmed in appeal. Shavell (1995) argues that the appeal court is a means of error correction, which comes from the fact that the latter would be more efficient than inferior courts. According to that reasoning, the proxy which we propose might fulfill ex ante this role of incitement of judges.

A fourth solution allowing to raise the judge’s effort is to increase the expert’s concern for reputation $(1 - \lambda)$ compared to that for error minimization ($\lambda$) if the judge’s equilibrium effort is low and conversely if her equilibrium effort is high (see proposition 4). However, we will expose thereafter that increasing the expert’s concern for reputation leads to a perverse effect, which is to take away the expert from his socially optimal effort level.

27 Note that the reduction in the expert’s effort efficiency may appear as counterproductive but it is not necessarily the case since the expert makes an effort which can be too high compared to his optimal effort level, as we will show.

28 In both cases, whatever the judge’s equilibrium effort (low or high), it remains lower than the optimal level if $G_j \neq 1$. 

22
Regarding now the expert’s optimal effort from the quality of justice viewpoint, the socially optimal level of effort of the expert maximizes the quality of justice as defined in (24). This effort, denoted $e^o_e$, is defined by the following FOC:

$$
\frac{\partial Q}{\partial e_c} = \mu (1 - e_j) \text{unexpected''inmath} - c'_e (e^o_e) \text{unexpected''inmath} = 0 \quad (28)
$$

The SOC is given by $\frac{\partial^2 Q}{\partial e_c^2} = -c''_j (e_e) < 0$. At equilibrium, when the expert chooses the socially optimal effort level (anticipated by the judge), the equilibrium is defined by:

$$
\begin{cases}
G_j (\eta - e^*_o \mu) - c'_j (e^*_j) = 0 \\
\mu (1 - e^*_j) - c'_e (e^*_e) = 0
\end{cases}
$$

(29)

The comparison of systems (10) and (29) leads to the next proposition.

**Proposition 6.** If the expert is only guided by error minimization concerns ($\lambda = 1$), then the equilibrium effort level of the expert $e^*_e$ is socially optimal. If the expert is at least partly guided by reputation concerns ($\lambda < 1$), then the expert’s effort is sub-optimal if $e^*_j < \frac{1}{1+\eta}$ (i.e. the judge’s effort is low or rather inefficient) and is higher than the optimal level if $e^*_j > \frac{1}{1+\eta}$ (i.e. the judge’s effort is high or rather efficient).

**Proof.** For $\lambda = 1$, the marginal benefit of the expert is given by $\mu (1 - e^*_j)$, at the equilibrium defined in (10) as at the optimum defined in (29). The marginal benefit being the same, the first order conditions over the expert’s effort imply that $c_e (e^*_e) = c_e (e^o_e)$ and then $e^*_e = e^o_e$. The equilibrium effort level defined in (10) is consistent with the socially optimal effort level defined in (29).

For $\lambda < 1$, the marginal benefit of the expert defined in (10) is lower than his marginal benefit defined in (29) if:

$$
\lambda (\mu (1 - e^*_j)) + (1 + \lambda) (\mu e^*_j \eta) < \mu (1 - e^*_j)
$$

(30)

This condition is satisfied if and only if $e^*_j < \frac{1}{1+\eta}$. Under this condition, the equilibrium effort level of the expert is sub-optimal since condition (30) implies that $c'_j (e^*_e) < c'_j (e^o_e)$, so that $e^*_e < e^o_e$. Similarly, the equilibrium effort level of the expert is higher than the socially desired effort level ($e^*_e > e^o_e$) if $e^*_j > \frac{1}{1+\eta}$. 

□
Assume that $\lambda < 1$. The condition under which the expert’s equilibrium effort level is sub-optimal is given by $e_j^* < \frac{1}{1+\eta}$. The condition is the same as the one necessary for the reputation-guided expert to make a lower effort than an error minimization-guided expert. Indeed, under the condition that $e_j^* < \frac{1}{1+\eta}$, then the more the expert is error minimization-guided, the higher effort he will choose and the more he is reputation-guided, the lower effort he makes. Meanwhile, this condition also implies that the expert’s effort will be sub-optimal anyway. Under such circumstances, the judicial authority may choose between several solutions to increase the expert’s effort.

The first solution consists of increasing the means available to the expert, or those available to the judge. Indeed, an increase in one of the efforts’ efficiency ($\eta$ or $\mu$) has a direct positive impact on the expert’s level of effort. However, once the interactions between the efforts are taken into account, the results of such measure are more ambiguous (see propositions [1] and [2]). Overall, the effects on an increase in the efficiency of the effort of the judge or the expert on the expert’s effort depend upon the expert’s incentives. These effects are clear only if the expert is mainly guided by reputation concerns and the means are put on the judge’s efficiency, or if the expert is mainly guided by error minimization and the means are put on the expert’s efficiency.

Another possibility to increase the expert’s effort is to increase the judge’s concern in the decision-making ($G_j$). However, such measure has contradictory effects depending on the expert’s preferences. This increases the efforts of the reputation-guided expert, and decreases the efforts of the error minimization-guided expert (see proposition [3]). Even if the expert’s preferences determine the effects of such measures, these effects are more easily predictable than those proposed in the previous solution. Thus, such measure is particularly interesting if the expert is mainly guided by reputation: the increase in $G_j$ brings the judge’s and expert’s equilibrium effort levels closer to the socially optimal ones. The global effect in terms of quality of justice is positive. The effect is more ambiguous if the expert is mainly guided by error minimization, since his effort level moves away from the socially desired level.

A last possibility to increase the expert’s equilibrium effort when it is sub-optimal is to bring the expert to be more concerned by error minimization and less by his reputation, since the expert’s equilibrium effort is consistent with the socially optimal
one when $\lambda = 1$. To that end, the judicial authority might for instance restrict the ties between the expert’s career and his reputation. Indeed, the more reputed the expert, the more chances he has to be chosen for an expertise, and this is positive in terms of career. In order to avoid such pattern, one might imagine a situation where experts would be picked randomly among an experts list for every expertise. In this case, the expert would be probably less guided by reputation and more, in relative terms, by error minimization. However, the expert’s reputation may be important not only in the judicial sphere. Most experts also have a professional activity outside the judiciary. In order to minimize the expert’s reputation concern outside the judiciary, a possibility is to make the identity of experts private information, and to forbid them to take advantage from their expert position in an aim of promotion in their external professional activity. Such measures are certainly hard to implement and may have perverse effects: they can discourage the experts from appearing among the list of court-appointed experts. Finally, note that our model states that increasing the error minimization concern of experts when they make a sub-optimal effort ($e^*_j < \frac{1}{1+\eta}$) leads to the reduction of the judge’s monitoring effort (see proposition 4), which is already sub-optimal (except in the particular case where $G_j = 1$).

Conversely, and according to a similar reasoning, if $e^*_j > \frac{1}{1+\eta}$ (the judge’s effort is high or efficient), the expert’s effort at equilibrium is too high compared to the optimal level ($e^*_j > e^*_o$), and this effort is higher the higher is the reputation concern. In this case, the expert should be incited to reduce his effort. Here again, the expert should be less reputation-guided. Thus result is interesting since it implies that, whatever the configuration, i.e. that the expert’s effort is too high or too low compared to the optimum, the judicial authority always shall reduce the reputation concerns of experts in order to come close to the optimal level. Moreover, when $e^*_j > \frac{1}{1+\eta}$, the fact that experts have more concern for error minimization and less to reputation presents the advantage in doing so to increase the judge’s monitoring effort (which is sub-optimal) and to reduce the experts’ effort.

Another way of reaching the socially optimal effort level is to reduce the means available to the expert or to the judge, which has a negative impact on the expert’s effort if direct effects highlighted in lemmas 1 and 2 prevail. In the opposite case, the effects are ambiguous, making such measure hard to use.
Finally, the last possibility is to modify the judge’s concern in the decision-making. However, if the expert is mainly guided by his reputation, such measure will have a negative impact on his effort only if the judicial authority reduces the judge’s concern in the decision-making, which leads to a decrease in the judge’s equilibrium effort level, which is already sub-optimal.

7 Conclusion

This article contributes to the analysis of the relationship between the judge and the court-appointed expert. Our aim is to highlight the determinants of the effort level of these two parties and the interdependence relationships between them, in a context where the judge has no information on the real effort level of the expert, and conversely. In our model, the expert first chooses his level of effort intended to find evidence, whose result depends on the means available to him; then the judge chooses her monitoring effort level over the information provided by the expert, the result of which is also depending on the means available to her. We determine the parameters which influence the equilibrium effort levels of each one and compare them to the socially optimal effort levels in terms of judicial quality.

We show that when the means available to the judge increase, the impact on her monitoring effort is ambiguous, because of two effects. An increase in the judge’s effort efficiency has a direct positive effect by increasing the judge’s marginal benefit and an indirect negative effect via an increase in the expert’s effort (the efforts of parties being substitutes). The impact of the expert’s effort efficiency leads to a clear effect on the judge’s equilibrium effort: the more efficient the expert’s effort, the lower the judge’s effort. Regarding the expert’s effort, we highlight that the impact of the efforts’ efficiency is ambiguous. On one side, the direct effect is positive: higher efficiency of one of the two efforts increases the expert’s equilibrium effort. On the other side, indirect effects depend mostly on the preferences of the expert, i.e. whether he is mainly guided by reputation or error minimization concerns. Finally, we show that the impact of his preferences (reputation versus error minimization) on his effort level depends on the judge’s characteristics: with an efficient judge who makes high effort, then the expert’s effort is increasing with regard to his reputation, whereas with a less efficient judge who makes low effort, then the expert’s effort is
increasing with regard to his error minimization concerns.

In terms of judicial quality, we highlight that the monitoring effort chosen by the judge is always sub-optimal. In order for the judge to have more incentives to effort, we discuss several solutions. One of them is to make the judge’s career depending on the rate of decisions confirmed by the superior court. Moreover, we find that the expert’s effort may be too low or to high with regard to the optimal level of effort. Indeed, if the judge makes high effort and/or if this effort is sufficiently efficient, then the expert makes a too high effort level compared the optimal level, so that his incentives to effort should be reduced. Conversely, if the judge makes low effort and/or this effort is rather low, then the expert’s equilibrium effort will be too low compared to the optimal level, so that he should be more incited. In both cases, we show that a way of reaching the optimal effort level is to increase his error minimization concern and to reduce his reputation concern. A way would be to choose the experts randomly and to make their report anonymous, in order to avoid the possibility for them to take advantage from their reputation in terms of career.

Our model might be extended on two points. A first extension would be to consider a dynamic model. Indeed, we take into account a reputation gain in a static context, but reputational concerns are generally better taken into account in a dynamic model, as in Sobel (1985) and Morris (2001). Thus, in our framework, it might be interesting to consider that the expert’s reputation depends on the judge’s belief about the expert’s preferences, such belief being formed by observing both the information collected by the expert and by the judge in the previous periods. A second possible extension would consist of taking into account the cost of improving the means available to the expert’s effort and to the judge’s monitoring. Such costs are absent from our model, but their existence might partly modify our conclusions.
8 Appendix

Remind that the determinant, denoted $A$, is given by:

$$A = \begin{vmatrix} c''(e^*_j) & G_j \mu \\ \mu ((1 + \eta) \lambda - \eta) & c''(e^*_e) \end{vmatrix}$$

(31)

By computing this determinant and rearranging, we find that it is strictly positive if the following condition is verified:

$$c''(e^*_j) c''(e^*_e) > |G_j \mu^2 (\eta - (1 + \eta) \lambda)|$$

(32)

This condition is equivalent to that exposed in hypothesis 1.

8.1 Proof of proposition[1]: comparative statics on the judge’s monitoring effort efficiency ($\eta$) at equilibrium

Differentiating the first order conditions of the judge and the expert given by (10) with regard to the judge’s effort efficiency ($\eta$), we obtain:

$$\begin{cases} \frac{\partial e^*_j}{\partial \eta} c''(e^*_j) + \frac{\partial e^*_j}{\partial \eta} G_j \mu = G_j \\ \frac{\partial e^*_j}{\partial \eta} \mu ((1 + \eta) \lambda - \eta) + \frac{\partial e^*_j}{\partial \eta} c''(e^*_e) = e^*_j (1 - \lambda) \mu \end{cases}$$

(33)

The Cramer rule allows finding that a variation of the judge’s effort efficiency on the judge’s equilibrium effort $e^*_j$ is given by:

$$\frac{\partial e^*_j}{\partial \eta} = \frac{G_j}{A} \begin{vmatrix} G_j & G_j \mu \\ e^*_j (1 - \lambda) \mu & c''(e^*_e) \end{vmatrix}$$

(34)

Moreover, the Cramer rule allows showing that a variation in the judge’s effort efficiency $\eta$ on the expert’s equilibrium effort $e^*_e$ is given by:

$$\frac{\partial e^*_e}{\partial \eta} = \frac{G_j}{A} \begin{vmatrix} c''(e^*_j) & G_j \\ \mu ((1 + \eta) \lambda - \eta) & e^*_j (1 - \lambda) \mu \end{vmatrix}$$

(35)
The computation of expressions (34) and (35) shows that their sign is ambiguous. Thus, the effect of a variation of the judge’s effort efficiency has an ambiguous effect on the effort levels. However, we can show that (35) is positive if $\lambda < \frac{\eta}{1+\eta}$: the expert’s effort increases with regard to $\eta$ if he is mainly guided by his reputation.

8.2 Proof of proposition 2: comparative statics on the expert’s effort efficiency $\mu$ at equilibrium

Differentiating the first order conditions of the judge and the expert given in (10) with regard to the expert’s effort efficiency $\mu$, we have:

$$\begin{cases} \frac{\partial e_j^*}{\partial \mu} c_j''(e_j^*) + \frac{\partial e_j^*}{\partial \mu} G_j \mu & = -e_j^* G_j \\ \frac{\partial e_j^*}{\partial \mu} \left(\left(1 + \eta\right) \lambda - \eta\right) + \frac{\partial e_j^*}{\partial \mu} c_j''(e_j^*) & = \lambda + e_j^* \left(\eta - \left(1 + \eta\right) \lambda\right) \end{cases}$$

(36)

The Cramer rule allows finding that the impact of a variation of $\mu$ on the judge’s equilibrium effort $e_j^*$ is given by:

$$\frac{\partial e_j^*}{\partial \mu} = \frac{-e_j^* G_j}{A} \begin{vmatrix} G_j \mu & e_j^* c_j''(e_j^*) \\ \lambda + e_j^* \left(\eta - \left(1 + \eta\right) \lambda\right) & c_j''(e_j^*) \end{vmatrix}$$

(37)

Moreover, the Cramer rule allows finding that the impact of a variation of $\mu$ on the expert’s equilibrium effort $e_e^*$ is given by:

$$\frac{\partial e_e^*}{\partial \mu} = \frac{c_j''(e_j^*)}{A} \begin{vmatrix} e_e^* G_j & -e_e^* G_j \\ \mu \left(\left(1 + \eta\right) \lambda - \eta\right) & \lambda + e_e^* \left(\eta - \left(1 + \eta\right) \lambda\right) \end{vmatrix}$$

(38)

Computing expressions (37) and (38), we find that the sign of (37) is negative and the sign of (38) is ambiguous. Thus, the impact of an increase (resp. a decrease) in the expert’s effort efficiency $\mu$ has a negative (resp. positive) effect on the judge’s equilibrium effort, and an ambiguous effect on the expert’s equilibrium effort. However, the expression (38) is always positive if $\lambda > \frac{\eta}{1+\eta}$: the expert’s effort increases with regard to $\mu$ if he is mainly guided by error minimization.
8.3 Proof of proposition 3: comparative statics over the judge’s concern in the decision-making $G_j$ at equilibrium

Differentiating the first order conditions of the judge and the expert given in (10) with regard to the judge’s concern in the decision-making $G_j$, we obtain:

$$\begin{cases} 
\frac{\partial c_j^*}{\partial G_j} c_j^* (e_j^*) + \frac{\partial c_j^*}{\partial G_j} G_j \mu = \eta - e_{e}^* \mu \\
\frac{\partial e_j^*}{\partial G_j} \mu ((1 + \eta) \lambda - \eta) + \frac{\partial c_j^*}{\partial G_j} c_j^* (e_j^*) = 0
\end{cases}\quad(39)$$

The Cramer rule allows finding that the impact of a variation of $G_j$ on the judge’s equilibrium effort $e_j^*$ is given by:

$$\frac{\partial e_j^*}{\partial G_j} = \frac{\begin{vmatrix} \eta - e_{e}^* \mu & G_j \mu \\
0 & c_j^* (e_j^*) \end{vmatrix}}{A} \quad(40)$$

Moreover, the Cramer rule allows finding that the impact of a variation of $G_j$ on the expert’s equilibrium effort $e_{e}^*$ is given by:

$$\frac{\partial e_{e}^*}{\partial G_j} = \frac{\begin{vmatrix} c_j^* (e_j^*) & \eta - e_{e}^* \mu \\
\mu ((1 + \eta) \lambda - \eta) & 0 \end{vmatrix}}{A} \quad(41)$$

Computing expressions (40) and (41), we find that the sign of (41) is positive if \( \lambda < \frac{\eta}{1+\eta} \). Thus, the impact of an increase (resp. a decrease) in the judge’s concern in the decision-making $G_j$ has a positive (resp. negative) effect on the judge’s equilibrium effort and on the expert’s equilibrium effort if the latter is mainly guided by his reputation, and a negative (resp. positive) effect on the expert’s equilibrium effort if the latter is mainly guided by error minimization.

8.4 Proof of proposition 4: comparative statics on the expert’s relative concern for error minimization ($\lambda$) at equilibrium

Differentiating the first order conditions of the judge and the expert given in (10) with regard to the expert’s concern for error minimization ($\lambda$), we obtain:
\[
\begin{align*}
\frac{\partial e^*_j}{\partial \lambda} e''_j(e^*_j) + \frac{\partial e^*_e}{\partial \lambda} G_j \mu &= 0 \\
\frac{\partial e^*_j}{\partial \lambda} \mu ((1 + \eta) \lambda - \eta) + \frac{\partial e^*_e}{\partial \lambda} e''_e(e^*_e) &= (1 - e^*_j(1 + \eta)) \mu
\end{align*}
\] (42)

The Cramer rule allows to find that the impact of a variation of \( \lambda \) on the judge’s equilibrium effort \( e^*_j \) is given by:

\[
\frac{\partial e^*_j}{\partial \lambda} = \frac{0 \quad G_j \mu}{(1 - e^*_j(1 + \eta)) \mu \quad c''_e(e^*_e)} A
\] (43)

Moreover, the Cramer rule allows to find that the impact of a variation of \( \lambda \) on the expert’s equilibrium effort \( e^*_e \) is given by:

\[
\frac{\partial e^*_e}{\partial \lambda} = \frac{c''_j(e^*_j) \quad 0}{\mu ((1 + \eta) \lambda - \eta) (1 - e^*_j(1 + \eta)) \mu A}
\] (44)

Computing expressions (43) and (44), we find that if \( e^*_j < \frac{1}{1+\eta} \), then the sign of (43) is negative and the sign of (44) is positive. Thus, an increase (resp. a decrease) in the expert’s concern for error minimization \( \lambda \) decreases (resp. increases) the judge’s monitoring effort and increases (resp. decreases) the expert’s effort. Conversely, if \( e^*_j > \frac{1}{1+\eta} \), then an increase (resp. a decrease) in the expert’s concern for error minimization \( \lambda \) increases (resp. decreases) the judge’s monitoring effort and decreases (resp. increases) the expert’s effort.
References


