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Abstract. We develop a double-sided moral hazard model in which the production of justice depends on two tasks (jurisdictional and administrative). The jurisdictional task can be provided only by a judge (the agent) while the administrative task can be provided either by the government (the principal) and/or by the judge. However, the judge performs the administrative task at a higher unit cost. First, we show that the first-best situation is such that the judge exerts no effort to provide the administrative task. Second, we show that two forms of (second-best) optimal contract can emerge when neither the government's effort nor the judge's effort is contractible: either the incentives are shared between the government and the judge and the judge exerts no effort to provide the administrative task, or the judge faces high-powered incentives which induce her to exert effort to provide both tasks. Our model proposes a rationale for judges work overload observed in many countries.

JEL classification: double-sided moral hazard, task misallocation, judicial organization, production of judicial services.
Keywords: D20, D86, K40.

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1 Introduction

"*In an ideal world, a trial would never be unreasonably delayed or cut short. Judges would never need to juggle multiple difficult trials or drown in administrative tasks that distract from the fair adjudication of cases*" Tomi Mendel (2015, *Vanderbilt Law Review*)

In reality, judges are frequently diverted from their judicial function (Buscaglia and Ulen, 1997; Smith and Feldman, 2001; French, 2009). They are often required to spend time performing administrative tasks in addition to their jurisdictional tasks. Consequently, they may become overburdened (Sheldon, 1981).[1] Since this causes backlogs and delays, the judges' administrative workloads can raise the cost of access to the judiciary, and reduce faith in the legal system (Dakolias, 1999).[2] In turn, these inefficiencies in the judiciary are likely to have negative impacts on investments, financial markets and economic growth (North, 1990; La Porta et al., 1997, 1998; Djankov et al., 2003).

One of the reasons why such a situation has arisen is lack of public resources and court administrative staff to carry out non-judicial duties. Smith and Feldman (2001) report that state supreme courts in the U.S. lack equivalent administrative assistance to that provided to the federal judiciary, and are thus more likely to bear the administrative burden. Furthermore, the Strategic Plan for the Federal Judiciary of the United States[3] refers to the importance of securing sufficient resources to attract, recruit and retain the necessary staff to support judges and handle the workload. Similarly, a report from the French Senate[4] interprets the small numbers of law clerks per judge as resulting in lack of logistic support, and points to the potentially disastrous consequences for judges' workloads and the functioning of the whole justice system.

There is evidence of a negative relationship between judges' administrative workload and judiciary performance. Buscaglia and Dakolias (1999) show that clearance rates and procedural times improve if judges spend less time on administrative tasks and focus more on their adjudicative duties. Flanders (1977) shows that the number of completed cases per judge decreases with the number of published decisions and concludes that "many judges may wish to consider reducing the number of opinions they prepare, in the interest of conserving their time to meet the demands of other cases on their dockets". Gomes and Akutsu (2016) argue that an increase in the number of assistants increases the time that judges can devote to judicial activities, and for the case of Brazil show a positive link between the number of assistants per judge and courts' productivity.

This situation raises a number of questions. First, why are judges ultimately diverted from their judicial function? Second, given that judges' opportunity cost of performing administrative tasks is clearly high, why do governments not provide more support staff to carry out these administrative duties? Finally, why do judges agree to take on these duties in addition to their judicial work? In the present paper, we provide a rationale for this puzzle.

We develop a double-sided moral hazard model in which the production of justice depends on two tasks. One of these tasks, the jurisdictional one, can be provided only by a judge (the agent).

[1] Buscaglia and Ulen (1997) report that in some Latin American countries such as Argentina, Brazil and Peru, judges spend more than 60% of their working time on non-adjudicative tasks.

[2] In the long run, the burden imposed on judges is also likely to decrease the incentives for legal professionals to work in the public legal system, and consequently, to lower the quality of human resources in the judiciary.

[3] http://www.uscourts.gov/statistics-reports/strategic-plan-federal-judiciary

[4] http://www.senat.fr/rap/a10-116-4/a10-116-412.html

The other task, the administrative one, can be provided by the government (the principal) and/or by the judge but at a higher unit cost. First, we show that the first-best situation is that the judge does not exert any efforts to provide the administrative task.

Thereafter, we show that two forms of optimal contract can emerge when the effort levels of the government and of the judge are not contractible: either the judge faces a high incentive (i.e. the judge is completely responsible for the judicial output) which induces her to exert effort to provide the two tasks, or the incentives are shared between the judge and the government (i.e. they share responsibility for the judicial output) and the judge exerts no efforts to provide the administrative task.

We show that these two types of contract are inefficient for two different reasons. The former is inefficient because there is a misallocation of tasks compared to the first-best situation where the judge does not perform any administrative tasks. The latter is inefficient because - although the allocation of tasks is the same as in the first-best situation - neither the government nor the judge receives full return for their effort. Consequently, neither party provides the first-best level of effort. When choosing the optimal contract, the government faces a trade-off between these two inefficiencies. We show that the optimal contract (i.e. the contract preferred by the government among these two types of contract) depends on the difference between the government's and the judge's unit cost for performing the administrative task. If the differential is large, the optimal contract is the one in which the incentives are shared and the judge does not perform any administrative tasks. If the differential is small, the optimal contract is the one in which the judge faces high-powered incentives and performs both the jurisdictional and administrative tasks.

Using a Cobb-Douglas specification for the judicial production, we provide some additional results to show the link between the form of the optimal contract and the fundamentals of the model, i.e. the output elasticities of the jurisdictional and administrative tasks, and the unit cost parameters. This specification allows us to provide some insights into the relationship between the level of the incentives faced by the judge, the degree of inefficiency associated with each type of optimal contract, and the fundamentals of the model. Specifically, we find that the inefficiency due to the misallocation of administrative tasks increases when the cost of the administrative tasks for the judge is relatively high compared to the cost of the administrative tasks for the government, and that the degree of inefficiency due to the (double) moral hazard problem is larger when the judicial output elasticities of the administrative and jurisdictional effort are high.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Our contracting model of judicial production is described in Section 3. Section 4 presents our main results, and Section 6 discusses possible remedies for the problem at hand, and proposes several testable implications of our analysis. Section 5 proposes two extensions of our model and Section 7 concludes.

2 Related literature

Our paper contributes to several strands of the law and economics literature and also to the literature on organization theory.

It adds to work that focuses on the role of the organization of courts and its impact on the efficiency of the judicial sector. This literature explores the link between various performance measures of judicial output and aspects of judicial organization such as the appointment process (Beenstock and Haitovsky, 2004), career incentives (Schneider, 2005), case-management (Buscaglia and Ulen, 1997), mode of disposition (Dimitrova-Grajzl et al., 2014), court size (Peyrache and Zago, 2016; Dimitrova-Grajzl et al., 2012; Grajzl and Silwal, 2016), and resources allocated to courts (Deffains and Roussey, 2011; Roussey and Deffains, 2012). We contribute to this literature by studying how incentives and the resulting allocation of administrative tasks between a representative judge and the government affect judicial efficiency in a setting with moral hazard on both sides.

It is noteworthy that the judicial output should be considered in our model as a composite variable including the different aspects of justice. Research studying the measurement of judicial output refers to the need to consider its different aspects (Dakolias, 1999; Roussey, 2016). Basically, three types of judicial output index can be distinguished. First, judicial output can be considered in terms of dispute resolution which can be measured by the average time needed to resolve a case (Mitsopoulos and Pelagidis, 2007), or the number of cases a judge completes in a given period (Beenstock and Haitovsky, 2004; Rosales-López, 2008; Dimitrova-Grajzl et al., 2012). Second, judicial output can be measured by the quality of decisions. This can be captured by the percentage of cases confirmed on appeal (Schneider, 2005), or the occurrence of legal errors (Chopard et al., 2018). Third, judicial output can be measured in terms of lawmaking (Landes and Posner, 1979). Even in civil-law countries, it is now widely acknowledged that judges participate in the creation of law by interpreting statute law, and by publishing new judicial opinions. This output can be measured by the number of decisions published by a judge or the number of citations to a decision (Choi et al., 2010).

Our approach is also in line with the literature on how incentives influence a judge's activity and behavior (Dewatripont and Tirole, 1999; Shapiro and Levy, 1995). This literature strand highlights the role of financial rewards (Cooter, 1983) but also prestige, individual and collective reputation (Garoupa and Ginsburg, 2010), popularity (Posner, 1993) and career opportunities (Taha, 2004; Schneider, 2005) as motivational factors. To the extent that judges' statuses differ across legal systems, rules likely to motivate judges differ between common law and civil law countries. In Spain, where the civil-law judiciary employs tenured judges on fixed pay, Bagues and Esteve-Volart (2010) show that between 2004 and 2007 financial bonuses awarded to judges achieving good quantitative targets increased average judicial production. Posner (1993) suggests that since in common law countries reputation and prestige can be effective motivations for elected judges, greater transparency in the conduct of their decision-making could provide very strong incentives. Relying on evidence from the New York State Committee to Review Audio-Visual Coverage of Court Proceedings (1997) that allowing trials to be broadcasted is linked positively to better judicial performance, Burki and Perry (1998) argue that judges exposed to press and public scrutiny have an incentive to do a better job in conducting trial and proceedings. They argue also that disclosing how individual judges vote if decisions are made by a panel of judges could incentivize judges to consider and decide cases more carefully. Schneider (2005) describes the link between the promotion system within the German labor judiciary and appraisals of judges' quantitative performance. In particular, the odds of promotion for judges acting in the Labor Courts of Appeals are based on individual quantitative productivity data such as number of cases processed, backlogs and settlement rates. Taha (2004) presents empirical evidence from U.S.

federal district courts that judges' performance is influenced by their chances of promotion to a U.S. courts of appeals. The present paper builds on this literature and considers that government can choose the incentives offered to judges. We show that, depending on the relative cost of administrative tasks for the government, the cost of jurisdictional tasks, and the form of the judicial production function, the optimal incentives the judge should face are either high-powered or low-powered. In particular, if the judge cost of performing administrative tasks is sufficiently low (but still higher than the cost of government performing administrative tasks), then the incentives should be high. Otherwise, the incentives should be low.

Finally, this paper contributes to the double-sided moral hazard literature which considers situations where both a principal and an agent provide efforts in order to produce an output but their effort levels are not verifiable. This setting differs from the standard principal-agent model in which only the agent provides an effort. So far, double-sided moral hazard models have helped to explain the prevalence of sharecropping in agriculture (Stiglitz, 1974; Eswaran and Kotwal, 1985), the emergence of franchise contracts (Mathewson and Winter, 1985; Lal, 1990; Bhattacharyya and Lafontaine, 1995) and the (in)efficiency of teams and partnerships (Holmstrom, 1982; Legros and Matsushima, 1991; Legros and Matthews, 1993). In the present paper, we develop a double-sided moral hazard model to study the organization of the judiciary. Our model departs from the usual double-sided moral hazard model because we assume that both the principal and the agent can perform one of the tasks. This leads to the novel conclusion that, either the principal chooses to implement high-powered incentives to induce the agent to perform both tasks, or chooses to share the incentives in order to induce the agent to perform the task that the principal is not capable of doing, while the principal performs the other task. If the principal chooses to induce the agent to perform both tasks, the optimal contract is inefficient, as in the usual double-sided moral hazard problem. However, in this case, unlike in the double-sided moral hazard problem, the inefficiency is due to task misallocation.

3 The Model

Judicial services are provided by the judiciary by combining two kinds of tasks, administrative tasks and jurisdictional tasks, which are performed thanks to efforts A and e, respectively. These variables can include both quantity effort and quality effort. The two types of task require different types of competencies. Jurisdictional tasks e can be performed only by a skilled representative judge (J) and consist of preparing case files, hearing parties, and rendering and writing judgments. Administrative tasks can be performed either by the judge or by administrative staff such as clerks, judicial assistants and secretaries responsible for the preparation, registration or filing of cases. We assume that the government (G) can choose the number of administrative tasks performed by the administrative staff (on the basis that each administrative agent performs a fixed number of administrative tasks and that G chooses the number of administrative agents).[5] The number of administrative tasks performed by J is denoted by $a \geq 0$ and the number of administrative tasks performed by G is denoted by $r + \underline{r} \geq 0$ where $\underline{r} \geq 0$ represents an exogenous minimum level of administrative effort that G is obliged to perform. It can represent the level of administrative effort that the government pays ex-ante (before setting the contract), or the level of administrative

[5]We abstract from the principal-agent relationship between the government and the administrative staff.

effort that the government commits to before the judge's incentive scheme is chosen. In Section 6 we assume that this level is exogenous and discuss how it could be endogenously chosen. We assume that the administrative efforts provided by J and G are perfect substitutes:

$$A = a + r + \underline{r}. \tag{1}$$

We model the need for both jurisdictional and administrative efforts to provide judicial services using a production function $f(A, e)$ which increases when the total administrative effort increases and when the jurisdictional effort increases, $f_A, f_e > 0$ (with subscripts denoting partial derivatives). We assume that f is strictly concave with respect to (A, e). We assume also that $f_e(A, 0) > c'(0)$ for all $A \geq 0$ in order to focus on solutions such that $e > 0$. Notice that for most of our results, we do not impose any more structure on the production function. In particular, we make no assumption regarding the sign of f_{Ae}.

The benefit from the judicial production is

$$\pi(A, e) = f(A, e) + \tilde{\epsilon}, \tag{2}$$

where $\tilde{\epsilon}$ is a random term with mean zero.

Note that f can be interpreted as a measure of judicial output in terms of productivity, quality and/or judicial lawmaking (see Section 2 for some related literature).

The expected benefit from the production of justice then is

$$E[\pi] = f(A, e). \tag{3}$$

We suppose that $\tilde{\epsilon}$ cannot be observed by G or J. Moreover, the effort level exerted by one co-provider is not verifiable. Because the effort levels and the random term are non-verifiable, observing the output f does not allow one to infer the effort level exerted by G and J hence the incentive problem. Moreover, as a consequence, the incentive contract must be based on f and not on efforts a, e or r.

We assume that J can allocate her time between the two tasks (administrative and jurisdictional). We assume also that J faces no time constraint. In Section 5.1 we will show that including a time constraint would not modify our qualitative results.

The unit cost for J to perform an administrative task is denoted $\delta_a > 0$, and the cost of performing a jurisdictional task is denoted $c(e)$, with $c' > 0$ and $c'' \geq 0$. The unit cost for G to perform an administrative task is $\delta_r > 0$. Since performing non-judicial duties such as administrative tasks is not the main function of judges, their opportunity cost is quite large. Thus, we assume that the unit cost for J to perform administrative tasks is always larger than the unit cost for G to perform administrative tasks, i.e. $\delta_r < \delta_a$.

J receives a fixed salary F, which may be supplemented by a variable remuneration βf depending on the output of the judiciary. The variable remuneration can be financial or in the form of psychological satisfaction, reputation enhancement or promotion chances, depending on the performance of the judiciary (see Section 2 for a review of the literature on this point). The rate β of the flexible remuneration is decided by G (who also pays F), and together with F defines the incentive linear contract.[6] G values the judicial output $f(A, e)$, pays a remuneration to J,

[6]This assumption does not imply loss of generality. We build on Bhattacharyya and Lafontaine (1995) who

$\beta f(A,e)+F$ and carries the cost of its administrative effort, $\delta_r r$. The value $(1-\beta)f$ represents the benefit that G can expect from the judicial output. It can be regarded as the merit – or accountability – that citizens attribute to G for the performance of the judiciary. This ultimately might result in a certain degree of popularity of G, or improve the likelihood of re-election.

The timing of the game is as follows. First G decides on the incentive contract. Then, J decides whether or not to accept the contract. Finally, if the contract is accepted by J, both providers G and J choose their preferred effort levels given the agreed contract: J chooses e and a and G chooses r. Then, the value of the judicial output is observed and G and J receive their respective payoffs.

When it designs the contract, G anticipates this move. Thus, we can write G's problem as:[7]

$$\underset{\beta,F,r\geq 0,a\geq 0,e\geq 0}{Max} \; Eu^G = (1-\beta)f(A,e) - \delta_r r - F, \tag{P}$$

subject to:

$$Eu^J = F + \beta f(A,e) - \delta_a a - c(e) \geq 0, \tag{PC}$$

$$a\frac{\partial Eu^J}{\partial a} = 0 = e\frac{\partial Eu^J}{\partial e}, \tag{IC_J}$$

and,

$$r\frac{\partial Eu^G}{\partial r} = 0, \tag{IC_G}$$

Condition (PC) is J's participation constraint. It states that J will only accept a contract that provides her with a positive expected utility. (IC_J) is J's incentive constraint which determines her effort. Condition (IC_G) is G's incentive constraint. The incentive constraints also include three conditions that we do not include in the program, namely $\frac{\partial Eu^J}{\partial a} \leq 0$, $\frac{\partial Eu^J}{\partial e} \leq 0$, and $\frac{\partial Eu^G}{\partial r} \leq 0$. These conditions have to be checked when the corresponding effort levels are null.

It can be seen that necessarily, at the optimum, the participation constraint is binding, i.e. (PC) becomes

$$Eu^J = F + \beta f(A,e) - \delta_a a - c(e) = 0. \tag{4}$$

As a consequence, G's optimization program is equivalent to maximizing the joint surplus, $S \equiv Eu^G + Eu^J$ with respect to (β, r, a, e), subject to the incentive constraints (IC_J) and (IC_G). Condition (4) characterizes the lump-sum transfer F.

The Lagrangian of this simplified problem is given by:

$$L = f(A,e) - \delta_a a - c(e) - \delta_r r + \lambda_a a\frac{\partial Eu^J}{\partial a} + \lambda_e e\frac{\partial Eu^J}{\partial e} + \lambda_r r\frac{\partial Eu^G}{\partial r} + \mu_r r + \mu_a a + \mu_e e, \tag{5}$$

where λ_a and λ_e are the Lagrange multipliers associated to J's incentive constraint (IC_J), λ_r is the Lagrange multiplier associated to G's incentive constraint (IC_G), and μ_r,μ_a, and μ_e are the Lagrange multipliers associated to the positivity constraints respectively $r \geq 0$, $a \geq 0$ and $e \geq 0$,.

The necessary conditions include the following.

show that in double-sided moral hazard contracting problems there is always an optimal contract that is linear.

[7]We drop the arguments of f when there is no possible confusion.

With respect to J's administrative effort a:

$$\frac{\partial L}{\partial a} = f_A - \delta_a + \lambda_a \left(\beta f_A - \delta_a + a\beta f_{AA}\right) + \lambda_e e\beta f_{Ae} + \lambda_r r(1-\beta) f_{AA} + \mu_a = 0. \qquad (NC_a)$$

With respect to J's jurisdictional effort e:

$$\frac{\partial L}{\partial e} = f_e - c' + \lambda_a a\beta f_{Ae} + \lambda_e \left(\beta f_e - c' + \beta e f_{ee} - e c''\right) + \lambda_r r(1-\beta) f_{Ae} + \mu_e = 0. \qquad (NC_e)$$

With respect to G's administrative effort r:

$$\frac{\partial L}{\partial r} = f_A - \delta_r + \lambda_a a\beta f_{AA} + \lambda_e e\beta f_{Ae} + \lambda_r \left[(1-\beta) f_A - \delta_r + r(1-\beta) f_{AA}\right] + \mu_r = 0. \qquad (NC_r)$$

With respect to β:

$$\frac{\partial L}{\partial \beta} = \lambda_a a f_A + \lambda_e e f_e - \lambda_r r f_A = 0. \qquad (NC_\beta)$$

The necessary conditions associated with the positivity constraints are $\mu_a a = 0$, $\mu_e e = 0$, $\mu_r r = 0$ and $\mu_a, \mu_e, \mu_r, a, e, r \geq 0$.

The solution to G's optimization problem is not straightforward because the Lagrangian is not necessarily concave. Therefore, as we show in Section 4, the optimal contract can induce J either to specialize in jurisdictional tasks or to perform both kinds of tasks.

4 Results

In this section, we proceed with the analysis. We focus first on the first-best situation where the efforts of G and J are verifiable, then we investigate the situation where the efforts of G and J are not contractible.

4.1 First Best

We consider the first-best situation in which effort levels are verifiable, and thus can be included in the contract. Let a^{FB}, e^{FB} and r^{FB} denote the first-best levels of effort. They maximize G's and J's joint surplus:

$$\underset{r\geq 0, a\geq 0, e\geq 0}{Max} \; S = f(A,e) - \delta_a a - c(e) - \delta_r r, \qquad (FB)$$

where $A = a + r + \underline{r}$.

We obtain the following preliminary result:

Proposition 1 [First best]: *The first-best solution is unique and such that the judge does not perform any administrative tasks, $a^{FB} = 0$.*

Proof: Since the administrative efforts of G and the judge are perfect substitutes ($A = a + r + \underline{r}$), and the marginal costs are constant with $\delta_a > \delta_r$, we must have $a^{FB} = 0$.

This sharp result holds because the administrative efforts of G and J are perfect substitutes, and the cost of performing administrative tasks is linear and strictly smaller for G. We relax these assumptions in Section 5.

In order to focus on the most interesting situation, we make the following assumption:

Assumption 1: The minimum level of administrative effort provided by the government, $\underline{r}$, is such that, $f_A(\underline{r}, e) > \delta_a$ for all $e \geq 0$.

Assumption 1 states that, when the administrative total effort is minimal ($A = \underline{r}$), the marginal judicial benefit of an increase in the administrative effort is always larger than the unit cost for J performing administrative tasks. This implies that the optimal total administrative effort is always interior, i.e. $A^* > \underline{r}$.[8]

The first-best effort levels are characterized by the following conditions:

$$a^{FB} = 0, \ f_A(r^{FB} + \underline{r}, e^{FB}) = \delta_r \text{ and } f_e(r^{FB} + \underline{r}, e^{FB}) = c'(e^{FB}). \quad (6)$$

In the first-best situation, J performs only jurisdictional tasks and the levels of the administrative and jurisdictional efforts are such that the marginal judicial benefit of an increase in each kind of effort equals its marginal cost.

We next analyze the optimal contract when the three effort levels, a, r and e, are not contractible. Notice that none of our main results requires either the production function f or the jurisdictional effort cost function c to be specified.

4.2 Optimal contract: a trade-off between two inefficiencies

Here we focus on the situation where the efforts of G and of J are not contractible. Using the necessary conditions provided in Section 3, we obtain the following result:

Proposition 2 [Allocation of tasks]: *The optimal contract can lead to two different task allocations: the judge either performs both administrative and jurisdictional tasks, or only jurisdictional tasks. Specifically, the optimal contract is such that either (C1) the judge performs the two tasks and government's administrative effort is minimal ($a^* > 0$ $e^* > 0$ and $r^* = 0$) and the judge is a full-residual claimant ($\beta^* = 1$), or (C2) the judge performs only jurisdictional tasks ($a^* = 0$ $e^* > 0$ and $r^* > 0$) and the incentives are shared ($0 < \beta^* < 1$).*

Proposition 2 states that two types of contract can be optimal. The first type of contract (C1) is such that J faces high-powered incentives ($\beta^* = 1$) and then is motivated to perform both jurisdictional and administrative tasks. The optimal effort levels are such that

$$r^* = 0, \ f_A(a^* + \underline{r}, e^*) = \delta_a \text{ and } f_e(a^* + \underline{r}, e^*) = c'(e^*). \quad (7)$$

These conditions state that G performs the minimum administrative tasks ($\underline{r}$), and J performs administrative tasks ($a^* > 0$) and jurisdictional tasks. The levels of administrative and jurisdictional efforts are such that the marginal judicial benefit of an increase in each kind of effort equals its marginal cost. These differ from the first-best conditions (6) because the marginal cost of the administrative effort is δ_a instead of δ_r. So, J faces high-powered incentives and then performs the administrative tasks but G performs only the minimum administrative tasks $\underline{r}$.

[8] This assumption also implies that $\underline{r} < A^{FB}$. In Section 6, we discuss the case where $\underline{r} = A^{FB}$.

The second type of contract (C2) is such that incentives are shared between J and G ($0 < \beta^* < 1$) and the optimal effort levels are characterized by:

$$a^* = 0,\ (1-\beta)(f_A(r^* + \underline{r}, e^*) = \delta_r \text{ and } \beta f_e(r^* + \underline{r}, e^*) = c'(e^*). \tag{8}$$

These conditions state that J does not perform any administrative tasks, G performs a higher level of administrative tasks than the minimum ($r^* > 0$), and J performs jurisdictional tasks. The levels of the administrative and jurisdictional efforts are such that the weighted marginal judicial benefit of an increase in each kind of effort equals its marginal cost. They differ from the first-best conditions (6) because the marginal benefits are distorted due to the shared incentives.

Notice that Proposition 2 also implies that above the minimum administrative effort, $\underline{r}$ the remaining administrative effort cannot be shared between J and G. This result is due to the combination of perfect substitutability between J's and G's administrative efforts and the linearity of the administrative effort costs. We relax these assumptions in Section 5.

We focus now on the difference between the optimal effort levels and the first-best effort levels. We obtain the following result:

Corollary 1 [Optimal efforts]: *If $f_{eA} \geq 0$, then both the optimal administrative effort and the optimal jurisdictional effort are lower than the corresponding first-best levels of effort, i.e. $A^* < A^{FB}$ and $e^* \leq e^{FB}$. We have $e^* = e^{FB}$ only if $f_{eA} = 0$ under contract (C1).*

This result states that the optimal efforts are lower than the first-best levels when the judicial production function is such that a marginal increase in the administrative effort level does not decrease the productivity of jurisdictional effort, and vice versa ($f_{eA} \geq 0$). The intuition is as follows.

First, consider the case of contract (C1). In this situation, J exerts effort on both tasks. Since the unit cost for J to perform administrative tasks is larger than the unit cost for G to perform these tasks, J exerts a lower administrative effort level than the effort level that G provides in the first-best situation. This does not influence the choice of the jurisdictional effort level as long as $f_{eA} = 0$. However, if $f_{eA} > 0$, the decrease in the administrative effort decreases the marginal benefit of jurisdictional efforts, and then J chooses a jurisdictional effort level below the first-best level.

Second, consider the case of contract (C2). In this situation, J specializes in jurisdictional tasks while G performs administrative tasks. Thus, the allocation of tasks corresponds to the first best situation but J and G receive only a fraction of the return from their efforts, and then they exert lower levels of effort than in the first best situation. If $f_{eA} > 0$, the decrease in the levels of each type of effort decreases the marginal benefit of an increase in the level of the other type of effort, which then magnifies the decrease in the administrative and jurisdictional efforts.

In the case (not considered here) where the judicial production function is such that a marginal increase in the administrative effort level decreases the productivity of the jurisdictional efforts and vice versa (i.e. $f_{eA} < 0$), we cannot exclude the possibility that either the optimal administrative effort level or the optimal jurisdictional effort level will be larger than the corresponding first-best level of effort. The reason for this is that, in this situation, a decrease in the administrative effort level provides incentives to increase the jurisdictional level and vice versa.

We know from Proposition 2 that either type of contract (C1 or C2) could emerge as the optimal contract. The following result shows that the optimal contract is generically unique and that the type of contract that emerges as optimal depends on a specific threshold:

Proposition 3 [Optimal contract]: *There exists a threshold $\widehat{\theta} > \delta_r$ such that the optimal contract is the non-specialization contract (C1) if $\delta_a < \widehat{\theta}$ and the optimal contract is the specialization contract (C2) if $\delta_a > \widehat{\theta}$. If $\widehat{\theta} = \delta_a$, the government is indifferent between contract (C1) and contract (C2).*

Proposition 3 states that the non-specialization contract with high-powered incentives for J ($\beta^* = 1$) is chosen by G if the unit cost of the administrative effort for J is sufficiently low (but still above the unit cost of the administrative effort for G).

This arises because G *faces a trade-off between the inefficiency due to misallocation of tasks, and the inefficiency due to moral hazard.* If the unit cost of the judge's administrative effort is sufficiently low (but still above the unit cost of G's administrative effort), then the loss of surplus due to the misallocation of tasks is lower than the loss of surplus due to the (double-sided) moral hazard problem, and as a consequence, G chooses the non-specialization contract (C1). If the unit cost of the judge's administrative effort is sufficiently large, then the loss of surplus due to task misallocation is larger than the loss of surplus due to the (double-sided) moral hazard problem, and therefore, G chooses the specialization contract (C2).

The threshold $\widehat{\theta}$ is the level of J's unit cost of administrative effort such that the joint surplus is the same under either contract (C1) or contract (C2), or:

$$S\left(A_1^*\left(\widehat{\theta}\right), e_1^*\left(\widehat{\theta}\right)\right) = S\left(A_2^*, e_2^*\right), \tag{9}$$

where $A_1^* = a_1^* + \underline{r}$ and $A_2^* = r_2^* + \underline{r}$. (A_1^*, e_1^*) is characterized by $f_A(A_1^*, e_1^*) = \widehat{\theta}$ and $f_e(A_1^*, e_1^*) = c'(e_1^*)$. (A_2^*, e_2^*) is characterized by $(1-\beta^*)f_A(A_2^*, e_2^*) = \delta_r$ and $\beta^* f_e(A_2^*, e_2^*) = c'(e_2^*)$, with the optimal level of incentives associated with contract (C2), β^*, characterized as follows. If $(f_A)^2 f_{ee} - (f_e)^2 f_{AA} = 0$ then:

$$\beta^* = \frac{-(f_e)^2 f_{AA}}{(f_A)^2 c'' - 2(f_e)^2 f_{AA}}, \tag{10}$$

with $(A, e) = (A_2^*, e_2^*)$.

Otherwise, we have:

$$\beta^* = \frac{(f_A)^2 c'' - 2(f_e)^2 f_{AA} - f_A\sqrt{(f_A)^2 (c'')^2 - 4(f_e)^2 f_{AA}(c'' - f_{ee})}}{2\left[(f_A)^2 f_{ee} - (f_e)^2 f_{AA}\right]}, \tag{11}$$

with $(A, e) = (A_2^*, e_2^*)$.

Thus, the threshold $\widehat{\theta}$ depends in a non-trivial way, on all the fundamentals of the model: the judicial production function, the administrative effort unit cost parameter δ_r and the jurisdictional effort cost function $c(.)$.

While the above analysis provides some general insights, it fails to provide the intuition behind all the factors determining the optimal contract without further structure on the judicial production function and the jurisdictional effort cost function. The general formulation given above does not provide closed-form expressions for the levels of the optimal efforts, the optimal incentives level, the threshold that characterizes the optimal contract or the total surplus. To obtain further intuition, we analyze the solution to our problem using specific functional forms.

4.3 Cobb-Douglas judicial output function and linear cost of jurisdictional effort

In this section, we use a Cobb-Douglas specification of the production function f and a linear specification of the jurisdictional effort cost function $c(.)$ in order to illustrate our general results and to provide some comparative statics.

Let us assume that the production function is such that $f(A, e) = A^\alpha e^\gamma$ with $\alpha + \gamma < 1$ and $c(e) = \delta_e e$ with $\delta_e > 0$. Using this example, we find that the first-best levels of effort are given by:

$$r^{FB} = \left((\gamma/\delta_e)^\gamma(\alpha/\delta_r)^{1-\gamma}\right)^{\frac{1}{1-(\alpha+\gamma)}} - \underline{r} \text{ and } e^{FB} = \left((\alpha/\delta_r)^\alpha(\gamma/\delta_e)^{1-\alpha}\right)^{\frac{1}{1-(\alpha+\gamma)}}. \tag{12}$$

Notice that here, Assumption 1 implies that $\underline{r} < \left((\gamma/\delta_e)^\gamma(\alpha/\delta_a)^{1-\gamma}\right)^{\frac{1}{1-(\alpha+\gamma)}}$. Moreover, in the first best case, the total surplus is given by:

$$S^{FB} = [1 - (\alpha + \gamma)]\left[\left(\frac{\gamma}{\delta_e}\right)^\gamma\left(\frac{\alpha}{\delta_r}\right)^\alpha\right]^{\frac{1}{1-(\alpha+\gamma)}}. \tag{13}$$

We find that the optimal effort levels under contract (C1) are given by:

$$a_1^* = \left((\gamma/\delta_e)^\gamma(\alpha/\delta_a)^{1-\gamma}\right)^{\frac{1}{1-(\alpha+\gamma)}} - \underline{r} \text{ and } e_1^* = \left((\alpha/\delta_a)^\alpha(\gamma/\delta_e)^{1-\alpha}\right)^{\frac{1}{1-(\alpha+\gamma)}}. \tag{14}$$

These expressions are close to the expressions of the first-best level of G's administrative effort (r^{FB}) and the first best-level of J's jurisdictional effort (e^{FB}), respectively. However, the unit cost of administrative effort differs. Indeed, J performs administrative task and her unit cost of administrative effort is larger than G's ($\delta_a > \delta_r$). As a consequence, the level of administrative effort is lower than the corresponding first-best level. Since $f_{eA} > 0$ when f takes the Cobb-Douglas form, the level of jurisdictional effort is also lower than the corresponding first best level. This illustrates the task misallocation problem that arises under contract (C1).

Now, let us consider contract (C2). In this case, we find that the optimal levels of effort are given by:

$$r_2^* = \left((1-\beta_2^*)(\gamma/\delta_e)^\gamma(\alpha/\delta_r)^{1-\gamma}\right)^{\frac{1}{1-(\alpha+\gamma)}} - \underline{r} \text{ and } e_2^* = \left(\beta_2^*(\alpha/\delta_r)^\alpha(\gamma/\delta_e)^{1-\alpha}\right)^{\frac{1}{1-(\alpha+\gamma)}}. \tag{15}$$

where $0 < \beta_2^* < 1$. Notice that both levels of effort are lower compared to the first-best levels only because the incentives are shared between J and G. This illustrates the (double-sided) moral hazard inefficiency that arises in contract (C2).

We find that the optimal level of incentives β_2^* is given by:

$$\beta_2^* = 1/\left(1 + \sqrt{\frac{\alpha}{\gamma}\frac{1-\gamma}{1-\alpha}}\right). \tag{16}$$

Notice that, if $\alpha = \gamma$, incentives are shared equally between J and G, $\beta_2^* = 1/2$. Moreover, J's incentives level, β_2^*, decreases with the output elasticity of the administrative effort, α, and increases with the output elasticity of jurisdictional effort, γ. Consequently, G's incentives level,

$(1-\beta_2^*)$, increases with the output elasticity of administrative effort, α, and decreases with the output elasticity of jurisdictional effort, γ. This result is quite intuitive: the incentive sharing rule should favor the (best) provider of the task with the largest output elasticity of effort.

Now let us consider the total surplus in each case. In the case of contract (C1), the total surplus is given by:

$$S_1^* = [1-(\alpha+\gamma)]\left[\left(\frac{\gamma}{\delta_e}\right)^{\gamma}\left(\frac{\alpha}{\delta_a}\right)^{\alpha}\right]^{\frac{1}{1-(\alpha+\gamma)}}, \tag{17}$$

and, in the case of contract (C2), the total surplus is:

$$S_2^* = \left[\left[(1-\beta_2^*)^{\alpha}(\beta_2^*)^{\gamma}\right]^{\frac{1}{1-(\alpha+\gamma)}} - \alpha\,(1-\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}} - \gamma\,(\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}}\right]\left[\left(\frac{\gamma}{\delta_e}\right)^{\gamma}\left(\frac{\alpha}{\delta_r}\right)^{\alpha}\right]^{\frac{1}{1-(\alpha+\gamma)}}. \tag{18}$$

Having computed the closed-form expressions of the efforts and total surpluses in both the first-best case and for the two possible optimal contracts, we can provide further intuition about how the threshold level $\widehat{\theta}$ depends on the parameters of the model and about the extent of the two types of inefficiency.

The threshold $\widehat{\theta}$ is a non-monotonic function of α and γ: In order to provide additional insights in relation to the result of Proposition 3, we compute the closed form expression of the threshold $\widehat{\theta}$ and analyze its dependence on the fundamentals of the model.

Contract (C1) is chosen if and only if $S_1^* \geq S_2^*$, or $\delta_a \leq \widehat{\theta}$ with:

$$\widehat{\theta} = \delta_r\left[\frac{1-(\alpha+\gamma)}{\left[(1-\beta_2^*)^{\alpha}(\beta_2^*)^{\gamma}\right]^{\frac{1}{1-(\alpha+\gamma)}} - \alpha\,(1-\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}} - \gamma\,(\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}}}\right]^{\frac{1-(\alpha+\gamma)}{\alpha}}, \tag{19}$$

if $S_2^* > 0$. Otherwise, $\widehat{\theta} = +\infty$.

Condition (19) illustrates Proposition 3. When the cost of administrative tasks for J is lower than the threshold, the optimal contract is such that J performs the two tasks (contract (C1)) and, when the cost of administrative tasks for J is larger than this threshold, the optimal contract is such that J does not provide any administrative effort (contract (C2)).

The threshold, characterized by the right-hand side in condition (19), does not depend on the cost functions because the judicial production function has a Cobb-Douglas form. It depends only on the administrative tasks (α) and jurisdictional tasks (γ) output elasticities.

The relationship between the threshold and the two elasticities is not straightforward. In order to obtain further insights, Table 1 provides numerical computations of the threshold as a function of the two elasticities. The first row in Table 1 presents the value of the judicial output elasticity of jurisdictional effort γ (we let the value of this parameter vary between 0.1 and 0.9). The first row indicates the value of the judicial output elasticity of administrative effort α (we make the value of this parameter vary between 0.01 and 0.9).

This numerical example deserves at least three comments. First, we observe that the threshold increases when γ increases. In other words, when the output elasticity of the jurisdictional effort increases, the likelihood that the optimal contract is such that the judge performs both kinds of tasks (contract (C1)) increases. Second, and somewhat surprisingly, we observe that the threshold can decrease and then increase when α increases: for instance, if $\gamma = 0.7$, then $\widehat{\theta}/\delta_r = 2082.10$

α \ γ	0.1	0.3	0.5	0.7	0.9
0.01	3.12	9.09	50.23	4485.20	$+\infty$
0.02	2.41	5.91	25.97	2082.10	$+\infty$
0.03	2.11	4.67	18.00	1689.10	$+\infty$
0.05	1.82	3.56	11.67	3181.60	$+\infty$
0.1	1.56	2.60	6.90	$+\infty$	$-$
0.3	1.37	1.90	3.76	$-$	$-$
0.4	1.39	1.91	3.52	$-$	$-$
0.5	1.47	2.21	$-$	$-$	$-$
0.7	$+\infty$	$-$	$-$	$-$	$-$
0.9	$-$	$-$	$-$	$-$	$-$

Table 1: Threshold $\widehat{\theta}/\delta_r$ as a function of α and γ

when $\alpha = 0.02$, $\widehat{\theta}/\delta_r = 1689.10$ when $\alpha = 0.03$ and $\widehat{\theta}/\delta_r = 3181.60$ when $\alpha = 0.05$. In other words, when the output elasticity of administrative effort increases, the likelihood that the optimal contract is such that J performs both tasks (contract (C1)) may first decrease and then increase. Third, when γ is sufficiently large, the threshold goes to infinity. In other words, when the output elasticity of jurisdictional task is sufficiently large, the optimal contract is such that J exerts effort on the two tasks (contract (C1)).

How big is the distortion of the optimal efforts? We now can evaluate how much the effort levels differ between the first-best situation, and under the two contracts (C1) and (C2).
Let us compute the rate of decrease in the jurisdictional effort and the total administrative effort when switching from the first-best situation to contract (C1). These rates are given by:

$$\frac{e^{FB} - e_1^*}{e^{FB}} = 1 - \left(\frac{\delta_r}{\delta_a}\right)^{\frac{\alpha}{1-(\alpha+\gamma)}} \text{ and } \frac{A^{FB} - A_1^*}{A^{FB}} = 1 - \left(\frac{\delta_r}{\delta_a}\right)^{\frac{1-\gamma}{1-(\alpha+\gamma)}}. \tag{20}$$

The two rates increase when the ratio of the cost of administrative effort δ_r/δ_a (which is smaller than 1) decreases, when α increases and when γ increases. In other words, in the case of contract (C1), both the jurisdictional effort and the administrative effort move away from the first-best levels when J's cost of performing administrative tasks increases relatively to G's cost of performing administrative tasks and when the judicial output becomes more elastic with respect to administrative or jurisdictional efforts. Note that the fact that the degree of inefficiency in the effort level depends positively on the ratio of the unit costs of administrative tasks is intuitive. Indeed, the inefficiency of contract (C1) is due to the fact that, unlike in the first-best situation, J provides administrative efforts, and then, the higher the cost of performing these tasks for J compared to G, the higher the degree of inefficiency of contract (C1).

We now do the same kind of analysis for contract (C2) which is such that J does not perform any administrative tasks. When switching from the first-best situation to contract (C2), the rates of decrease of the jurisdictional effort and of the total administrative effort are given by:

$$\frac{e^{FB} - e_2^*}{e^{FB}} = 1 - (\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}} \text{ and } \frac{A^{FB} - A_2^*}{A^{FB}} = 1 - (1-\beta_2^*)^{\frac{1-\gamma}{1-(\alpha+\gamma)}}, \tag{21}$$

where β_2^* is characterized by condition (16).

Notice that, when the judicial output function has a Cobb-Douglas form, these rates do not depend on the cost parameters but only on the output elasticities of the administrative and jurisdictional efforts, α and γ. In particular, the rate of decrease of the jurisdictional effort increases unambiguously as α increases, and the rate of decrease of the administrative effort increases unambiguously as γ increases. However, the effect of an increase in γ on the rate of decrease of the jurisdictional effort, and the effect of an increase in α on the rate of decrease of the administrative effort are ambiguous because β_2^* increases when γ increases and decreases when α increases, and the weight $\frac{1}{1-(\alpha+\gamma)}$ increases when γ or α increase. Overall, in the case of contract (C2), we can only conclude that the jurisdictional effort moves away from the first-best level if the judicial output is more sensitive to administrative efforts, while the administrative effort moves away from the first best level if the judicial output is more sensitive to jurisdictional efforts.

How large is the loss of total surplus? In order to evaluate the extent of the loss in total surplus induced by the two contracts (C1) and (C2), we compute the rate of decrease of the total surplus. When switching from the first best situation to contract (C1), we have:

$$\frac{S^{FB} - S_1^*}{S^{FB}} = 1 - \left(\frac{\delta_r}{\delta_a}\right)^{\frac{\alpha}{1-(\alpha+\gamma)}}. \tag{22}$$

The degree of inefficiency, measured by the rate of decrease of the total surplus, is higher if J's cost of administrative effort increases compared to G's, and if the judicial production function becomes more elastic with respect to administrative efforts or jurisdictional efforts.
When switching from the first-best situation to contract (C2), we have:

$$\frac{S^{FB} - S_2^*}{S^{FB}} = 1 - \frac{\left[(1-\beta_2^*)^{\alpha}(\beta_2^*)^{\gamma}\right]^{\frac{1}{1-(\alpha+\gamma)}} - \alpha(1-\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}} - \gamma(\beta_2^*)^{\frac{1}{1-(\alpha+\gamma)}}}{1-(\alpha+\gamma)}. \tag{23}$$

The relationship between this rate of decrease and the two elasticities is not straightforward. In order to obtain some insights into this relationship, we provide numerical computations of this decrease rate as a function of the two elasticities in Table 2.

α \ γ	0.1	0.3	0.5	0.7	0.9
0.01	1	3	8	25	247
0.02	2	5	13	42	387
0.03	3	7	17	56	471
0.05	3	9	24	80	475
0.1	5	15	38	124	–
0.3	15	38	86	–	–
0.5	38	86	–	–	–
0.7	124	–	–	–	–
0.9	–	–	–	–	–

Table 2: Rate of decrease of the total surplus (%) as a function of α and γ (contract (C2)).

In Table 2, we observe that the rate of decrease of the total surplus increases when the output elasticities of administrative and jurisdictional tasks increase.

5 Extensions

In this section, we relax several of our model assumptions and study whether this leads to the conclusion that beyond the minimal level of administrative tasks $\underline{r}$, both the government and the judge provide additional administrative efforts. First, we introduce a time constraint for the judge and then consider that the judge's and the government's administrative efforts are imperfect substitutes.

5.1 Judge's time constraint

Assume that J faces a time constraint $a + e \leq T$. Would this lead J and G to invest effort in administrative tasks? To answer this question, let us denote $\mu_T \geq 0$ the Lagrangian multiplier associated with the time constraint $a + e \leq T$. The necessary conditions for J and G to choose respectively $a > 0$ and $r > 0$ can be written as follows:

$$f_A - \delta_a + \lambda_a (a\beta f_{AA}) + \lambda_e e\beta f_{Ae} + \lambda_r r(1-\beta) f_{AA} - \mu_T = 0. \tag{24}$$

and,

$$f_A - \delta_r + \lambda_a a\beta f_{AA} + \lambda_e e\beta f_{Ae} + \lambda_r r(1-\beta) f_{AA} = 0 \tag{25}$$

Combining these two conditions, we obtain $\mu_T = \delta_r - \delta_a < 0$, which is a contradiction.

Hence, if G chooses a contract in which J provides administrative tasks ($a > 0$), then G will not perform more administrative tasks than the minimum level ($r = 0$). If G chooses a contract in which G performs more administrative tasks than the minimum level ($r > 0$) then J will not perform any administrative tasks ($a = 0$).

5.2 Administrative task: imperfect substitutability and convex costs

We now assume that the efforts of G and J on administrative tasks are imperfectly substitutable. Let us assume that $A = a + h(r)$ with $h' > 0$ and $h'' \leq 0$. Note that h' represents the marginal productivity of G's effort on administrative tasks whereas the marginal productivity of J's effort on administrative tasks is 1. The following two necessary conditions have to hold for both a and r to be strictly positive:

$$f_A - \delta_a + \lambda_a a\beta f_{AA} + \lambda_e e\beta f_{Ae} + \lambda_r r(1-\beta) f_{AA} = 0. \tag{26}$$

and,

$$h' f_A - \delta_r + \lambda_a a\beta f_{AA} + \lambda_e e\beta f_{Ae} + \lambda_r r(1-\beta) f_{AA} = 0 \tag{27}$$

These conditions hold only if $(1 - h') f_A = \delta_a - \delta_r$ with $\delta_a - \delta_r > 0$. Hence, it is necessary to have $h' < 1$. In this case, it is possible that G and J share administrative tasks, and G exerts an effort larger than the minimum, i.e. $a > 0$ and $r > 0$. However, it is necessary that *J's effort in the administrative task is more productive than G's effort ($1 > h'$)*, which is a debatable assumption.

Notice that the assumption of imperfect substitutability with $A = a + h(r)$ is equivalent to assuming that G's administrative effort cost is convex. Let $R = h(r)$ denote the effective administrative effort of G. Then the cost of exerting an effective effort level R is $\delta_r r = \delta_r h^{-1}(R)$, where h^{-1} is the inverse function of h. Since h is concave, then h^{-1} is convex. In other words, the cost of exerting an effective effort R is convex.

6 Discussions

In this section, we discuss possible solutions to the problem at hand and several testable implications of our analysis.

6.1 Remedies

We discuss two possible solutions and the extent to which they are implementable. First, we discuss how the problem could be resolved if the government were able to commit to providing a specific level of administrative effort, and why it may prefer not to do this. We then discuss the implication of a policy that would ban judges from carrying out administrative tasks.

6.1.1 The government's commitment issue

Our model is based on the assumption that the government does not commit to providing a sufficiently high pre-specified level of administrative tasks, $\underline{r}$, prior to setting the incentive scheme. In this sense, the contract we have analyzed is an *incomplete contract*. Obviously, if the government could commit to setting the first-best level of administrative tasks – i.e. $\underline{r} = r^{FB}$ – then it could implement the first-best while choosing to provide high-powered incentives to the judge ($\beta = 1$). There are at least two reasons why we believe that it is reasonable to assume that the government cannot commit to setting the first-best level of administrative tasks. First, governments generally lack commitment power; second, governments may lack the information necessary to estimate the first-best level (at least ex-ante). We discuss these reasons in detail below.

Governments are comprised of elected politicians and members who are elected or appointed for relatively short periods of time. Therefore, the composition of governments changes frequently, and the promises and decisions made by one government are not necessarily honored by the government or by the succeeding ones. One way for the government to commit to providing the first-best level of administrative effort (assuming that this level can be known), is by being constrained to obey a rule that does not allow it to violate past decisions (North and Weingast, 1989; Acemoglu et al., 2010). In reality, such institutional bounds are rarely observed, and also are not always beneficial. Indeed, in some situations, it has been shown that incomplete contracts can outperform complete contracts (Bernheim and Whinston, 1998; Battaglini and Harstad, 2016; Crocker and Masten, 1991; Crocker and Reynolds, 1993). For instance, Crocker and Masten (1991) argue that in the context of an uncertain and complex environment, it can be more efficient if parties do not commit ex ante to specific decisions because it allows them ex post to adapt to changing economic circumstances. In our context, we assume that the government can commit to providing a minimal level of administrative effort, i.e. it can choose $\underline{r}$ before choosing the incentive scheme. At the time that government chooses this minimal level, there will likely be some uncertainty about the *future* marginal opportunity cost of judicial funds, i.e. there is likely to be some uncertainty about parameter δ_r. Indeed, the opportunity cost of judicial funds is likely to vary depending on budgetary pressures and financial necessity. Hence, in our setting, the government may prefer not to commit ex ante to providing a specific level of administrative tasks in order to benefit from flexibility to choose the level of its administrative effort after the uncertainty is resolved.

6.1.2 Banning the judge from performing administrative tasks

It might be thought that one solution to the problem would be (when feasible) to ban the judge from performing administrative tasks. However, in our setting, this policy would not increase the total surplus. Indeed, banning the judge from carrying out administrative tasks implies that the government has to consider an additional constraint, $a = 0$. As a consequence, the total surplus (which the government maximizes) cannot increase. Indeed, with a ban, when it would be optimal to implement the non-specialization contract with high-powered incentives, i.e. when the unit cost of administrative task of the judge is sufficiently low (see Proposition 3), the government would be forced to choose the specialization contract (C2), and then would receive a lower surplus than in the case of the non-specialization contract (C1). More generally, a mandatory restriction on the judge's administrative effort cannot lead to an increase in the total surplus.

6.2 Predictions and testable implications

In this section, we provide several implications of our model. First, we discuss some implications related to the assessment of the effectiveness of the judiciary. Then we deliver a testable implication of our model in relation to skill-biased technical change in courts. We also provide a testable implication regarding the link between economic shocks, judge incentive schemes and the induced allocation of tasks.

6.2.1 Assessment and errors

We have assumed that the government, at the time it chooses the optimal contract, perfectly knows the fundamentals of the model. However, note that a minimal error in assessing the cost of the administrative tasks for instance, could have a large negative impact. Indeed, since the nature of the optimal contract (C1 or C2) depends on whether the ratio of the unit cost of the government's administrative effort compared to the judge's, is below or above a specific threshold, then *a small error* could lead government to choose contract (C1) while (C2) is optimal, or to choose contract (C1) while contract (C2) is optimal. For instance, if the cost of the administrative effort of the government is overestimated, then the government might choose contract (C1) while contract (C2) is the optimal one, resulting in the judge performing administrative tasks when it would be optimal for the judge not to do so. In contrast, if the cost of the government's administrative effort is underestimated, then the government could choose contract (C2) while contract (C1) would be optimal and the judge then would not carry out any administrative tasks when it would be optimal for her to do so.

The analysis in the main part of the paper and the above remarks have an important implication for the measurement of the effectiveness of the judiciary. They highlight that judiciaries where judges do not perform administrative tasks are not necessarily efficient since this kind of arrangement could correspond to a second-best situation (when judges are able to perform administrative tasks at low cost), or even to a third-best situation (e.g. when the cost of judges performing administrative tasks has been overestimated).

6.2.2 Skill-biased technical change

Our model predicts that if the relative cost of judges performing administrative tasks becomes sufficiently low, the government should provide strong incentives for them to perform both jurisdictional and administrative tasks instead of just jurisdictional tasks. The relative cost of administrative tasks performed by judges compared to administrative staff may be affected by new technologies. Moreover, new technologies such as computers are likely to be biased in favor of the most skilled (Autor et al., 1998), the judge in our case.

Therefore, our analysis provides predictions about the link between skill-biased technical change, the distribution of earnings in the organization, and the resulting allocation of tasks. For instance, assuming that computerization of courts enables judges to perform some administrative tasks at a lower cost compared to their being conducted by administrative staff, our model implies that computerization of courts increases the likelihood that judges perform administrative tasks and face higher incentives.

6.2.3 Economic shocks

Any shock that affects the government's use of scarce public resources can lead to a change in the (opportunity) cost of the administrative tasks for the government. For instance, in the context of economic and budgetary crises, allocating public resources implies difficult trade-offs.

Assume, for example, that the initial optimal contract is such that the incentives are shared and judges perform jurisdictional tasks while the government carries out administrative tasks. A negative economic shock could lead to a large increase in the opportunity cost of administrative tasks being performed by government, and the optimal contract may switch from a situation with shared incentives to a situation with high-powered incentives.

Assuming that the government is able to adapt judges' incentive schemes sufficiently rapidly, our model delivers clear predictions about how judges' incentives should vary following an economic shock, and how this would affect the allocation of tasks: judges are likely to face higher incentives and to perform more administrative tasks following a negative economic shock but to face lower incentives and perform fewer administrative tasks following a positive economic shock.

7 Conclusion

In this paper, we provide a double-sided moral hazard model of the production of justice. The judicial output depends on jurisdictional tasks that can only be provided by a judge, and on administrative tasks that can be provided by either the government and/or by the judge. However, the judge performs the administrative task at a higher unit cost. In this setting, the first-best situation is that the judge specializes in jurisdictional tasks.

When the efforts of the government and the judge are not contractible, there is a double-sided moral hazard problem. We find that the optimal contract is either such that the judge faces very high-powered incentives and provides jurisdictional and administrative tasks, or the incentives are shared between the judge and the government with the result that the judge specializes in jurisdictional tasks and the government provides administrative tasks.

When deciding between these two forms of contract, the government faces a trade-off between two different sources of inefficiency. In the former case, there is a misallocation of the administrative tasks, while in the latter case the government and the judge do not reap the full returns from their efforts and their effort levels are distorted compared to the first-best situation. We show that the form of the optimal contract depends on the difference between the government's and the judge's unit cost of performing the administrative task. When the differential is large, the second-best optimal contract is the one where incentives are shared and the judge does not perform any administrative tasks. When the differential is small, the second-best optimal contract is the one where the judge faces high-powered incentives and performs both jurisdictional and administrative tasks.

Our analysis highlights that judicial systems in which judges do not perform administrative tasks are not necessarily (more) efficient. Indeed, if the (double) moral hazard inefficiency is less severe than the misallocation inefficiency, the second-best optimal situation is such that judges face low-powered incentives and specialize in jurisdictional tasks. This is the case especially if judges are able to perform administrative tasks at relatively low cost.

Our analysis also provides a range of testable implications. For instance, our results suggest that skill-biased technical change or negative economic shocks increase the likelihood that judges face very high-powered incentives and perform administrative tasks.

Lack of commitment power on the part of the government is central to our analysis. Increasing this power would have benefits where the government is able to assess the relevant level of administrative tasks ex ante. However, if there is uncertainty about this relevant level, it would be better for the government not to commit and to benefit from some flexibility.

We believe that there is no straightforward solution to eliminating these two inefficiencies. Our analysis suggests that simple solutions such as banning judges from doing administrative tasks (assuming this is feasible), are likely to have a negative impact. Banning judges from doing administrative tasks would constrain the government from choosing the contract where incentives are shared even when this is not optimal. In other words, it would force the government to choose the (double) moral hazard inefficiency even when the misallocation inefficiency is less severe.

Appendix: Additional Proofs

Proof of Proposition 2: We consider different situations.

Case I: $a > 0$ and $r > 0$:
We must have $\mu_a = \mu_r = 0$ and then (NC_a) and (NC_r) imply that $\delta_a = \delta_r$, which is a contradiction.

Case II: $a > 0$, $e > 0$ and $r = 0$:
We must have $\mu_a = \mu_e = 0$ and $\beta f_A = \delta_a$, $\beta f_e = c'$ and $(1-\beta)f_A - \delta_r \leq 0$. Plugging these conditions into (NC_a), (NC_e), (NC_r) and (NC_β) we find:

$$(1-\beta)f_A + \beta\lambda_a a(f_{AA} - \frac{f_A}{f_e} f_{Ae}) = 0 \tag{28}$$

$$(1-\beta)f_e + \lambda_a a \left[\beta(f_{Ae} - \frac{f_A}{f_e} f_{ee}) + \frac{f_A}{f_e} c''\right] = 0 \tag{29}$$

$$f_A - \delta_r + \lambda_a a \beta f_{AA} + \lambda_e e \beta f_{Ae} + \lambda_r \left[(1-\beta)f_A - \delta_r\right] + \mu_r = 0 \tag{30}$$

$$\lambda_e e = -\lambda_a a f_A / f_e \tag{31}$$

If $f_A f_{Ae} - f_e f_{AA} = 0$, then condition (28) implies that $\beta = 1$. If $f_A f_{Ae} - f_e f_{AA} \neq 0$, conditions (28) and (29) imply that $\beta > 0$ and:

$$\lambda_a a = \frac{1-\beta}{\beta} \frac{f_A f_e}{f_A f_{Ae} - f_e f_{AA}}, \tag{32}$$

$$(1-\beta)(f_e)^2 + \frac{1-\beta}{\beta} \frac{f_A f_e}{f_A f_{Ae} - f_e f_{AA}} \left[\beta(f_e f_{Ae} - f_A f_{ee}) + f_A c''\right] = 0 \tag{33}$$

$$\tag{34}$$

One can easily check that condition (33) implies that $\beta = 1$ and then $\lambda_a = 0$, $f_A = \delta_a$, and $f_e = c'$. Notice that $(1-\beta)f_A - \delta_r = -\delta_r \leq 0$.

Case III: $a = 0$, $e > 0$ and $r > 0$:
We must have $\mu_e = \mu_r = 0$, $\beta f_e = c'$, $(1-\beta)f_A = \delta_r$ and $\beta f_A - \delta_a \leq 0$. One can easily check that one must have $0 < \beta < 1$. Moreover, plugging these conditions into (NC_a), (NC_e), (NC_r) and (NC_β) we find:

$$f_A - \delta_a + \lambda_a (\beta f_A - \delta_a) + \lambda_e e \beta f_{Ae} + \lambda_r r (1-\beta) f_{AA} + \mu_a = 0, \tag{35}$$

$$\lambda_r r \left(f_{Ae} - \frac{f_A}{f_e} c'' + \beta \left(\frac{f_A}{f_e} f_{ee} - f_{Ae} \right) \right) = -(1-\beta) f_e, \tag{36}$$

$$\lambda_r r \left(f_{AA} + \beta \left(\frac{f_A}{f_e} f_{Ae} - f_{AA} \right) \right) = -\beta f_A, \tag{37}$$

$$\lambda_e e f_e = \lambda_r r f_A \tag{38}$$

We then must have $\lambda_r \neq 0$ and $f_{AA} + \beta\left(\frac{f_A}{f_e} f_{Ae} - f_{AA}\right) \neq 0$. We can then easily show that

$\lambda_r = -\frac{f_A-\delta_r}{f_{AA}+\beta\left(\frac{f_A}{f_e}f_{Ae}-f_{AA}\right)}$ and:

$$\left[(f_A)^2 f_{ee} - (f_e)^2 f_{AA}\right]\beta^2 + \left[2(f_e)^2 f_{AA} - (f_A)^2 c''\right]\beta - (f_e)^2 f_{AA} = 0 \tag{39}$$

If $(f_A)^2 f_{ee} - (f_e)^2 f_{AA} = 0$ then $\beta = \frac{-(f_e)^2 f_{AA}}{(f_A)^2 c'' - 2(f_e)^2 f_{AA}}$. Otherwise,

$$\beta = \frac{(f_A)^2 c'' - 2(f_e)^2 f_{AA} - \sqrt{D}}{2\left[(f_A)^2 f_{ee} - (f_e)^2 f_{AA}\right]}, \tag{40}$$

where

$$D = \left[2(f_e)^2 f_{AA} - (f_A)^2 c''\right]^2 + 4(f_e)^2 f_{AA}\left[(f_A)^2 f_{ee} - (f_e)^2 f_{AA}\right] \tag{41}$$

$$= (f_A)^2\left[(f_A)^2(c'')^2 - 4(f_e)^2 f_{AA}(c'' - f_{ee})\right] > 0. \tag{42}$$

Notice that the second root of (39) cannot be a solution since $\frac{(f_A)^2 c'' - 2(f_e)^2 f_{AA} + \sqrt{D}}{2[(f_A)^2 f_{ee} - (f_e)^2 f_{AA}]} > 1$. Also notice that the right-hand side in (40) belongs to $(0, 1)$.

Case IV: $a = 0$, $e > 0$ and $r = 0$:
We must have $\mu_e = 0$, $\beta f_e = c'$, $(1-\beta)f_A - \delta_r \leq 0$ and $\beta f_A - \delta_a \leq 0$. Plugging these conditions into (NC_a), (NC_e), (NC_r) and (NC_β) we find:

$$f_A - \delta_a + \lambda_a(\beta f_A - \delta_a) + \mu_a = 0 \tag{43}$$

$$f_e - c' = 0. \tag{44}$$

$$f_A - \delta_r + \lambda_r\left[(1-\beta)f_A - \delta_r\right] + \mu_r = 0. \tag{45}$$

$$\lambda_e = 0. \tag{46}$$

We then must have $\beta = 1$. It remains to check that $\psi(\underline{r}) \equiv f_A(\underline{r}, e) - \delta_a \leq 0$, which holds because of Assumption 1.

Proof of Corollary 1: In the case of contract (C1), we have $f_A = \delta_a$ and $f_e = c'$. Differentiating with respect to δ_a, we find $\frac{\partial e^*}{\partial \delta_a} = \frac{f_{eA}}{c'' - f_{ee}}\frac{\partial A^*}{\partial \delta_a}$ and $\frac{\partial A^*}{\partial \delta_a} = 1/\left(c'' f_{AA} - f_{AA} f_{ee} + (f_{eA})^2\right) < 0$. Since $\delta_a > \delta_r$, we have $e^* < e^{FB}$ and $A^* < A^{FB}$.

Now let us define two parameters, $\theta_1 > 1$ and $\theta_2 > 1$ such that $\theta_1 f_A = \delta_a$ and $\theta_2 f_e = c'$. The effort levels in case (C2) are characterized by these two conditions when $\theta_2 = \beta$ and $\theta_1 = 1 - \beta$. The first-best effort levels are characterized by the two conditions when $\theta_2 = 1$ and $\theta_1 = 1$.

Differentiating the two conditions with respect to θ_1 and θ_2, we find:

$$\frac{\partial A}{\partial \theta_1} = -\frac{(c'' - \theta_2 f_{ee})f_A}{\theta_1 c'' f_{AA} - \theta_1\theta_2(f_{AA}f_{ee} - (f_{Ae})^2)} > 0, \tag{47}$$

$$\frac{\partial e}{\partial \theta_1} = -\frac{\theta_2 f_A f_{eA}}{\theta_1 c'' f_{AA} - \theta_1\theta_2(f_{AA}f_{ee} - (f_{Ae})^2)} \geq 0, \tag{48}$$

$$\frac{\partial A}{\partial \theta_2} = \frac{f_{Ae} f_e}{\theta_2(f_{AA}f_{ee} - (f_{Ae})^2)} \geq 0, \tag{49}$$

$$\frac{\partial e}{\partial \theta_2} = -\frac{f_{AA} f_e}{\theta_2(f_{AA}f_{ee} - (f_{Ae})^2)} > 0. \tag{50}$$

This is sufficient to complete the proof.

Proof of Proposition 3: Let a_1^*, e_1^* denote the optimal levels of effort for contract (C1) and r_2^*, e_2^* denote the optimal levels of effort for contract (C2). Contract (C1) is preferred to contract (C2) if and only if:

$$\Delta = f(A_1^*, e_1^*) - \delta_a a_1^* - c(e_1^*) - [f(A_2^*, e_2^*) - \delta_r r_2^* - c(e_2^*)] \geq 0, \tag{51}$$

where $A_1^* = a_1^* + \underline{r}$ and $A_2^* = r_2^* + \underline{r}$. (A_1^*, e_1^*) is characterized by $f_A(A_1^*, e_1^*) = \delta_a$ and $f_e(A_1^*, e_1^*) = c'(e_1^*)$ and (A_2^*, e_2^*) is characterized by $(1 - \beta^*) f_A(A_2^*, e_2^*) = \delta_r$, $\beta^* f_e(A_2^*, e_2^*) = c'(e_2^*)$ and β^* is characterized as in condition (40). We have $\frac{\partial \Delta}{\partial \delta_a} = -a_1^* < 0$. Moreover, $lim_{\delta_a \to \delta_r} \Delta = f(A^{FB}, e^{FB}) - \delta_r A^{FB} - c(e^{FB}) - [f(A_2^*, e_2^*) - \delta_r r_2^* - c(e_2^*)] > 0$.

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