



Judges and court productivity: evidence from Spanish labour courts

Ángel Martín-Román¹ · Alfonso Moral¹ · Virginia Rosales²

Accepted: 11 June 2025
© The Author(s) 2025

Abstract

The aim of this paper is to test whether the courts' productivity, proxied by the “Resolution Rate”, is affected by the acting of other judges, beside the incumbent one, ruling in the court as substitute judges. It also seeks to study if this effect depends on whether the additional judges are professionals or not. From a methodological point of view, the treatment variable is defined as a dummy that takes the value of 1 if the court is shared with other judges. To analyse the impact of this variable on court productivity, least squares, panel data estimations and dose–response models are applied. The data was obtained from the annual judicial statistics published by the Spanish General Council of the Judiciary with information from all the Spanish Social Courts from 2005 to 2019. This database was modified in several ways to make the analysis robust and to eliminate possible sources of endogeneity. The main results show a reduction in productivity when other non-professional judges were working in the court, besides the incumbent one. However, no significant differences were detected if these additional judges were professional.

Keywords Labour Courts · Court Productivity · Judicial Policy Making · Professional Judges · Treatment Effect

JEL Classification J53 · J63 · K31 · K41 · K49

✉ Ángel Martín-Román
almartin@uva.es

¹ Department of Economic Analysis, University of Valladolid, Valladolid, Spain

² Department of Applied Economics, University of Granada, Granada, Spain

1 Introduction

The Report on the evaluation of European judicial systems elaborated by the European Commission for the Efficiency of Justice indicates that the average number of professional judges¹ per 100,000 inhabitants in Spain was 11.2 in 2020 (11 below the 22.2 of the European Union average). This report also states that the average number of lawyers per 100,000 inhabitants in Spain exceeded 300, compared to the European average of 176. These figures might partly explain the high level of litigation, possible congestion problems and the need to pay attention to the productivity of the judicial system.

Although the literature has examined many determinants of court productivity, the impact of judges' replacement has received relatively little attention. However, replacements are quite frequent, and further investigation is required to fully understand their effects. In this context, Spanish labour courts provide an appealing framework for exploring this question.

Since the early 1990s, there has been a growing number of studies in this field. Using the economic analysis, both, researchers and practitioners have analysed the effect of several variables on the courts' output. Some of them have focused on their productivity while others on their quality. For instance, in his seminal paper "Is the Ninth Circuit too large? A Statistical Study of Judicial Quality", Posner (2000) analysed the effect of an increasing number of judgeships on the quality of judicial decisions, considering the reversals made by the Supreme Court as a proxy for quality. His results show that "adding judgeships tends to reduce the quality of a court's output" (p. 711).

A similar study, but using panel data for courts in Israel, was conducted by Beenstock and Haitovsky (2004), to determine the effect of the increase in the number of judges on the judge's productivity and court output. Their results showed that when more judges were appointed, judges, on average, reduced their productivity. The authors argue that judges' productivity is endogenous, "for the same caseload, judges complete more cases under pressure and complete less when new judges are appointed." (p. 351) At the same time, judges' reallocation towards more congested courts is a source of reverse causality issues. For these reasons, endogeneity must be seriously tackled when implementing the empirical strategy.

While these arguments are plausible, recent empirical evidence points to the existence of additional factors that could have truly causal effects on judges' productivity. Thus, sometimes, the acting of other judges in the court, besides the incumbent one, is related to certain situations namely judge's leave, vacation, rotation, and so on. As any other organization, courts need the stability of their personnel, otherwise, organizational issues might arise. Then, one can expect that these circumstances will generate delays and congestion, and therefore a negative effect on judges' productivity and court output. For instance, Rosales-López (2008) and Grazl and Silwal (2020) provide empirical evidence showing that the rotation of judges has a negative effect on court productivity, while Espasa and Esteller-Moré (2015) showed that the acting

¹ Within the conceptual framework of this article, the terms career judge and professional judge are considered equivalent.

of temporary judges in Catalanian Civil Courts tends to have a negative impact on court efficiency, which potentially affects productivity.

In this context, we present our research question: Does the appointment of replacement judges or substitute judges² to cover the incumbent judge's absences reduce court productivity?³ The issue of replacement is important in three ways: 1) because of its quantitative significance. Thus, it is worth noting that the volume of rulings issued by substitute judges is substantial. The data indicate that 18% of the court rulings during the analysed period were delivered by judges replacing the incumbent. In absolute terms, this amounts to more than 450,000 rulings, warranting a more detailed examination. 2) a replacement indicates that more than one judge served in the court throughout the year. However, not concurrently, so, following the literature cited above, this could have an impact on court productivity. 3) two types of judges can be appointed to do the replacement: professional and non-professional judges. As we will explain in Sect. 4, both types of judges do not have the same background, resulting in differences in their human capital and experience. According to Schneider (2005), this could have a significant effect on court productivity.

Analyzing judicial productivity allows us to identify bottlenecks and design reforms to optimize the justice system, ensuring a more efficient administration. For instance, substitute judges can affect the flow of court work. Their intervention can cause delays due to the time they need to familiarize themselves with the cases. Moreover, assessing the influence of substitute judges' participation allows for improved allocation of human resources in the judiciary. A study of their impact can help design strategies to minimize the negative effects of their intervention and optimize the overall productivity of the court.

In addition, we test whether there are differences in the effect on productivity depending on the type of judge making the substitution. As we mentioned above, in the case of the Spanish Judicial System, we can find two general types of judges acting in the courts: professional and non-professional. While the first ones were selected in a publicly regulated selection process and attended the Judicial Academy, the second ones have a degree in Law, but they did not attend the Judicial Academy and were appointed by the General Council of the Judiciary. Moreover, they may play different roles within a court regardless of their condition as professional or non-professional. In our view, these differences which are related to the access to the category of judge and human capital can influence their productivity.⁴

Following Beenstock and Haitovsky (2004) and Espasa and Esteller-Moré (2015), our main objective in this paper is to conduct a study focusing on the effect that the number and the type of judge —professional or non-professional— may have on courts' productivity.⁵ To achieve this aim, a set of econometric models will be estimated in order to explain the differences existing in the courts productivity of

²Throughout this paper, the terms substitute judge and replacement judge are considered synonyms.

³Although, in the case of the Spanish Judicial System, other judges may also serve as reinforcements (support judges), court-year observations involving these judges have been excluded from the study to avoid endogeneity issues (see methodological section).

⁴For more details on the type of judges, see Sect. 4.

⁵The courts productivity will be proxied by the Resolution Rate. See Sect. 5 for further details.

the about 350 first-instance Spanish Social Courts existing in Spain,⁶ over the period 2005–2019.⁷ The first reason for focusing on the labour or social jurisdiction is that we are interested in analysing the effects on the labour market. In a country like Spain, which usually has one of the highest unemployment rates in the OECD and the EU, if not the highest, it is essential to investigate all the institutional factors that affect the functioning of the labour market. On the other hand, analysing civil or criminal jurisdictions poses challenges due to procedural heterogeneity, which introduces noise into the analysis. For these reasons, we focus the study to Labour Courts, where cases are more standardized and thus more comparable. (Ferro et al., 2020).

From a methodological point of view, we carry out an empirical strategy attempting to isolate the true causal effect of interest previously mentioned. A quasi-experimental design is proposed to circumvent the problems of selection bias. Thus, if judges other than the incumbent judge act during a specific year, that court will be considered to have been “treated” during that year. Otherwise, the court-year observation will be considered as belonging to the control group. In other words, the logic of a Differences-in-Differences (DiD) estimator is used. In addition, a wide set of control covariates related to judicial activity is considered to minimize the omitted variable bias. Finally, an ad-hoc data cleansing procedure is implemented to eliminate reverse causality problems. With all these empirical strategies, we tackle different sources of potential endogeneity. It is worth noting that, moreover, we check if the intensity of the treatment is relevant to account for the outcomes obtained. This is done using dose–response econometric techniques.

This article seeks to contribute to several strands of research. First, the literature on the Economics of the Legal Process and Court Performance, especially on the empirical analysis of the court’s productivity (e.g., Beenstock & Haitovsky, 2004; Espasa and Esteller-Moré, 2015). Second, it contributes to the field that studies the consequences of judge disparities. From a theoretical point of view, Posner (2005) and Gennaioli and Shleifer (2008) show that judges’ decisions can be influenced by their judicial policy preferences and their aversion to having their resolutions overturned. From an empirical point of view, some recent papers corroborate these theoretical findings in general terms (e.g., Autor et al., 2019; Bhuller et al., 2020) and also for labour judges (Semet, 2016). Finally, another strand of research related to our paper is the literature analysing labour judges’ behaviour and its effect on labour market outcomes (e.g., Ichino et al., 2003; Jimeno et al., 2020; Marinescu, 2011). This is especially important because of the effects that dismissal costs can have on the dynamic evolution of employment, as highlighted by the theory of dynamic labour demand (Cabo & Martín-Román, 2019; Hamermesh, 2017).

Overall, our results show that court productivity, proxied by the resolution rate, decreases when other judges besides the incumbent are acting in the court in a specific year. However, this outcome heavily depends on the type of judge who replaces the

⁶We only consider first-instance courts for reasons of data availability. Since we need statistical power to carry out our empirical strategy, it is advisable to have a high number of courts (observed over several years) to generate enough degrees of freedom to make the estimates reliable.

⁷Although information is available for 2020, 2021 and 2022, it has been decided to dispense with it to avoid the effects that the COVID 19 pandemic may have caused on productivity and the other variables included in the empirical section.

incumbent one. Whereas this effect is statistically significant when non-professional labour judges are considered, we cannot find significant differences as far as other professional labour judges are concerned. When implementing the dose–response econometric strategy, also appealing results are obtained. There is a less significant treatment effect when the percentage of sentences handed down by substitute judges increases. These findings have profound policy implications, and we think they are extremely valuable for policymakers in their decision making process and when devising specific measures affecting labour courts internal functioning.

The paper proceeds as follows. Section 2 briefly presents a literature review. Section 3 describes the functioning of the Social Jurisdiction in Spain and its main indicators. Section 4 offers a brief outline of the judicial career in Spain. The sample and descriptive statistics are presented in Sect. 5. The empirical strategy is offered in Sect. 6, while in Sect. 7 the results are discussed. Lastly, Sect. 8 presents the concluding remarks and useful suggestions for judicial public policy making.

2 Literature review

Most of the early studies on court productivity were conducted in the 1990s within the framework of the judicial reform developed by different countries around the world.⁸ Since then, there has been a growing interest in this field on behalf of practitioners, consultants, judicial policy designers and academics.⁹ In this context, courts can be seen as production units, whose main output can be proxied by the rate of resolutions. Empirical evidence shows that judicial output depends on variables related to the judicial staff and its incentives (Posner, 1993), the institutional and organizational constraints, the rate of litigation, and so on. In this section, we will briefly revise some of the main empirical results provided by the literature on this field, focusing on the variables related to the objective of our study.

It is remarkable that, despite there being growing research on court productivity, there are just a few studies that have addressed the issue of the effect of the type of judge or the turnover of judges on judicial productivity. In this sense, two of the first researchers on this topic were Beenstock and Haitovsky (2004) who conducted a study on the effect of the number of judges on the output of the judiciary. Their main results show that when more judges are appointed, on average they reduce their productivity.

⁸ See among others, Dakolias (1995), Buscaglia and Ulen (1997), Hammergren (1999), Zuckerman (2000), World Bank (2004).

⁹ Authors such as Kittelsen and Fordsund (1992), Pastor (1993), Pedraja-Chaparro and Salinas-Jiménez (1996), Buscaglia and Ulen (1997), Djankov et al. (2003), Pastor (2003a, 2003b), Pastor and Maspons (2004), Scheneider (2005), Rosales-López (2008), Di Vita (2010), García-Rubio and Rosales-López (2010), Mitsopoulos and Pelagidis (2010), Mora-Sanguinetti (2010), Kesan and Ball (2011), Dimitrova-Grajzl et al., (2012a, 2012b, 2014, 2016), Deyneli (2012), Finocchiaro Castro and Guccio (2014), Marciano and Khalil (2012), Palumbo et al. (2013), Bielen et al. (2015), Espasa and Esteller-Moré (2015), Melcarne and Ramello (2015), Voigt and El-Bialy (2016), El-Bialy (2016), Rosales (2017), Bielen et al. (2018), Falavigna et al. (2018), Gomes et al (2018), Grajzl and Silwal (2020), among others, have conducted empirical studies to analyze the variables that determine court production.

Also focused on the court staff, Moral et al (2021), following Posner (2000), Martín-Román et al. (2013) and Malo (2018), studied the effect of the number and the type of judges—professional and non-professional—on the quality of judicial resolutions of the Spanish Social Courts.¹⁰ Their main conclusions show that the quality of judicial decisions decreases when other judges besides the incumbent one are acting in the court, but this effect is smaller when the other judges are non-professional. Against this background, and although productivity and quality are different variables, a trade-off can occur between them. Spending more time on quality resolutions can come at a cost in terms of productivity. For this reason, variables such as court staff may influence both indicators, albeit in different ways.¹¹

Courts, like any other organization, need a certain stability of their personnel. The rotation of judges can hurt court productivity. In the case of Spain, this is an event that usually happens in small courts, which are located in rural towns or far from large cities, where one can observe a higher level of turnover or vacancy, which generates delays and congestion. In this sense, Rosales-López (2008) found that the number of resolutions is lower when there is rotation, dismissal or vacancy of judges in the Andalusian civil courts, while Espasa and Esteller-Moré (2015) showed that the acting of temporary judges in Catalanian civil courts tends to have a negative impact on their efficiency. More recently, Grazjl and Silwal (2020) found similar results in the case of Nepal. Using judge-level panel data the authors show that the rotation of judges harms judicial productivity at case resolution.

Other variables related to judges' background and characteristics have been also found significant when explaining court productivity. For instance, the human capital of judges, proxied by the educational level or accumulated experience, has a positive effect on court results. Schneider (2005) found that the higher the educational level of the judges, the greater their productivity in the court. In other order of ideas, according to Buscaglia and Dakolias (1999), the management style of judges influences the courts' productivity. Those judges who know how to delegate administrative tasks, use new technologies and carry out rational and active management of the court will achieve greater productivity. In this context, the allocation of judges' time is a key variable: the more time they dedicate to administrative tasks, the less productivity in the court. The more time they dedicate to jurisdictional tasks, the greater productivity in the court.

External variables on the side of the “demand of justice” can also be considered relevant to explain court productivity. According to authors such as Priest (1989) and

¹⁰ There are two types of judges acting in the Spanish Social Courts: professional or non-professional judges. While the first ones were selected in a public regulated selection process and attended to the Judicial Academy; the second ones have a degree in Law, but they did not attend to the Judicial Academy and were appointed by the General Council of the Judiciary (See Sect. 4).

¹¹ And that is why we decided to conduct first, a study analysing the effect of the number and type of judges on the quality of resolutions (already published in Moral et al., 2021) and second, the effect of the number and type of judges on court productivity (the main objective of this paper). And that is because within this approach usually known as “the economics of court performance” courts are seen as production units, where their main output is the resolutions (sentences, for example), and several “production factors” such as capital, work and technology, can affect the productivity and/or the quality of courts resolutions (see Rosales-López, 2008). Here we focused on the effect of one of these production factors: “work” (that includes judges) on court productivity.

Pastor (1993), among others, a high rate of litigation increases the courts' workload and can lead to problems such as delay and congestion in the system. Where it is expected that the more complex the filed cases, the lower their productivity (Buscaglia and Ullen, 1997). In this sense, addressing problems of reverse causality and endogeneity, Dimitrova-Grazjl et al. (2012a), found that "the primary driving force of output of Slovenian courts is the demand for their services." (p. 19). Similar results were found by Espasa and Esteller Moré (2015) in the case of Catalanian courts.

In comparative perspective, Elbialy and García Rubio (2011) examine civil and criminal courts in Egypt and find that civil courts tend to be relatively inefficient, possibly due to the greater complexity typically associated with civil cases. Ferrandino (2014) analysed criminal courts in the United States and concluded that only a fraction operates efficiently. Similarly, Ferro et al. (2018) studied the efficiency of criminal courts in Argentina and found that caseload is a significant environmental factor. They also report that substitute judges and temporary staff, on average, perform more efficiently than their permanent counterparts.

Summarizing, it is important to bear in mind that "adjudication is a labor-intensive activity and, although fine-tuning their organization can indeed enhance the productivity of the courts, the role of the judges still remains pivotal" (Falavigna et al., 2018, p. 31). For this reason, in line with previous studies such as Beenstock and Haitovsky (2004), Rosales-López (2008), Espasa and Esteller (2015) and Grajzl and Silwal (2020) our main objective is to determine the effect that the acting of other judges, besides the incumbent one, may have an effect on courts' productivity, but having in mind the endogeneity problems related to the court workload. See Sects. 5 and 6 and for the descriptive analysis and empirical strategy.

3 Social jurisdiction in Spain

In the Spanish case, Civil, Criminal, Administrative, Social and Military are the five jurisdictions composing the Judicial System. The Social order is the responsible jurisdiction for labour disputes and other social claims, like those related to social security, in the country. Constituted by five chambers—one for every jurisdiction—the highest judicial institution is the Supreme Court. The National Court rules over the entire country, and it is composed of four chambers. In this case, the Social Chamber oversees social and labour cases involving more than one Autonomous Community. The Superior Justice Courts (Tribunales Superiores de Justicia) are 17, one for every Spanish Autonomous Community, having authority only in its community. Each one of them is constituted by three chambers: the Third Chamber or Social Chamber is the appealing instance for decisions taken at the first instance. Lastly, the Social Courts (386 in 2022), are distributed by province and are responsible for the decisions at the first instance concerning labour and social matters in the Spanish Judicial System.¹²

¹² https://www.poderjudicial.es/cgpj/es/Temas/Estadistica-Judicial/Estadistica-por-temas/Estructura-judicial-y-recursos-humanos--en-la-administracion-de-justicia/Planta-judicial-*y-plantillas-organicas/Planta-judicial/

In 2019, 6.9% of the filed cases in the Spanish Judicial System were social cases. Compared to Civil (38%) or Criminal Jurisdictions (51.2%), the percentage of filed cases in the Social Jurisdiction is very low. As shown in Table 1, when comparing indicator trends between 2015 and 2019, it can be observed that filed cases in the Social Jurisdiction increased by 10.01%, as well as the resolved cases (2.87%) and the pending cases (1.97%). The litigation Rate also increased by 6.98%. Regarding the productivity rates, the Resolution Rate decreased by 13.33% while the Pending Rate and the Congestion Rate increased by 8% and 2.25% respectively. Finally, while the average length of the procedures at the first instance decreased by 14.95%, the average length of the procedures at the second instance increased by 16.33% and the average length of the procedures at the highest instance also increased by 16.54%.

4 The judicial career in Spain

The legal framework related to the judicial career in Spain is provided by the General Council of the Judiciary. As it is explained by Moral et al (2021), all the relevant regulations are established (1) in the Statutory Law of the Judiciary 6/1985 and (2) the Regulation 2/2011 of the Judicial Career (Spanish General Council of the Judiciary, 1985, 2011). A publicly regulated selection process, in accordance with the constitutional principles of equality, merit and capacity, provides access to candidates for the judicial career in Spain. According to the law, the selection process will guarantee equal access to the judicial career for all citizens who have the necessary conditions and skills for the exercise of the jurisdictional function. To participate in any judge's selection processes, it is required to have: Spanish nationality, a degree in Law, the legal age for working and no criminal records. As shown in Table 2, the main differences between professional and non-professional judges are the way that

Table 1 Social Jurisdiction Key Indicators (2015–2019)

Indicator/Year	2015	2019	Variation
Number of filed cases	399,592	439,583	10.01%
Number of resolved cases	419,055	431,068	2.87%
Number of pending cases	312,460	318,628	1.97%
Number of filed cases per judge	745.50	788.50	5.77%
Number of sentences per judge	408.10	370.60	-9.19%
Litigation Rate (*)	8.60	9.20	6.98%
Resolution Rate	1.05	0.91	-13.33%
Pending Rate	0.75	0.81	8.00%
Congestion Rate	1.78	1.82	2.25%
Average length of the procedures (in months) at the first instance	10.70	9.10	-14.95%
Average length of the procedures (in months) at the second instance	4.90	5.70	16.33%
Average length of the procedures (in months) at the highest instance	12.70	14.80	16.54%

Source: Own elaboration from *Panorámica de la Justicia* 2015 and 2019. Spanish General Council of the Judiciary (<https://www.poderjudicial.es/cgpj/es/Temas/Estadistica-Judicial/Estudios-e-Informes/Panoramica-de-la-Justicia/>)

*Cases filed per thousand inhabitants

Table 2 Type of judges in Spain

Professional judges	Non-professional judges
Candidates are hired to start their judicial career within the Spanish Judicial System	Candidates are hired to act in the courts temporarily (maximum for 2 years) as a substitute or reinforcement and are not considered for the judicial career
Selection process: candidates must pass a public examination, and a course held at the Judicial Academy, convened by the General Council of the Judiciary. Another way to start a judicial career is directly as a justice, through a public competition among jurists with extensive experience and renowned prestige who have been working in the professional context for more than ten years and have passed a course held at the Judicial Academy. ^a	Selection process: if there are vacancies to be filled or needs for reinforcement in the courts, the General Council of the Judiciary may open a selection process based on a public competition to evaluate candidates' merits to hire non-professional judges. Candidates will obtain a higher classification if they hold a PhD in Law, have been substitute judges in the past, have worked as judicial staff previously, have been Law professors at the University and/or have an excellent academic record. The candidates selected in this public competition will be considered judges during the term of their contract
Promotion: to be promoted to the category of justice (<i>magistrado</i>), judges must have served three years in the category of judge and pass a selective exam in the case of the Civil and Criminal jurisdictions, or a specialization exam in the case of the Social, Administrative, Gender Violence and Commercial jurisdictions. These exams aim to evaluate the capacity and legal training of the candidates, as well as their knowledge of the different branches of the Law. Judges will also have to take courses and practical activities, designed by the General Council of the Judiciary as well as the exams described above. All activities and examinations will take place at the Judicial Academy	Promotion: there is no promotion for this type of judge. As we mentioned above, the candidates selected in this public competition will be considered judges during the term of their contract, but they are not considered for the judicial career. Nevertheless, once they finish their contract, they can participate in another public selection process to be hired again as a non-professional judge to act as a substitute or reinforcement

The Judicial Academy is a centre dedicated to the selection and training of judges and justices. It depends on the General Council of the Judiciary, and its main objective is to provide a “comprehensive, specialized and high-quality preparation to members of the judicial career, as well as the aspirants to enter it.”

they are selected and the possibility or not of doing a judicial career. It is important to note, however, that Spain is not the only country that allows non-professional judges to serve on the courts. The term *lay judges* is also commonly used in other European jurisdictions to refer to individuals who do not enter the judiciary through a traditional judicial career. As Maran (2024, p. 263) observes, “Non-professional

magistrates contributing to the administration of justice are a common feature across the European Member States. However, there is no universal approach to their selection and regulation, which heavily depends on the juridical traditions of the Member States and the choices made by their legislators”.

5 Database and descriptive analysis

As mentioned previously, the analysis focuses on the productivity of the Spanish first-instance courts of the Social Jurisdiction. In each of these courts, there is a single judge who is responsible for ruling on the cases assigned to him or her. However, there are also many courts where other judges are assigned to act as substitutes for the incumbent judges. Considering the results of previous literature (briefly reviewed in Sect. 2), it is plausible to assume that court productivity can be affected by this assignment of additional judges and also by the fact that they are professionals or not.

To carry out this analysis, it is necessary to start by defining an appropriate indicator of court productivity. The European Commission for the Efficiency of Justice (CEPEJ) uses the so-called clearance rate as its preferred measure of court productivity. It is defined as the number of resolved cases divided by the number of newly filed cases. This measure might be misleading sometimes, especially when the backlog significantly exceeds the number of newly filed cases. For this reason, it has been decided to use the resolution rate (Voigt & El-Bialy, 2016, El-Bialy, 2016) which considers the total number of cases, and is defined as follows:

$$Productivity = ResolutionRate = \frac{Resolvedcases(t)}{Pendingcases(t-1) + newfiledcases(t)} \times 100$$

Based on this definition, the analysis is conducted in two stages. Firstly, the paper analyses whether their productivity is affected by the fact that there are other judges, apart from the incumbent, acting in the court. In the second stage, it is analysed if this possible effect on productivity may be conditioned by whether these other judges are professionals or not. Martín-Román et al. (2013, 2015) and Malo et al. (2018) used a similar approach for the percentage of layoff cases resolved in favour of the worker and Moral et al. (2021) for the quality of judicial decisions.

All the data relating to filed cases, resolved cases, pending cases and the type of judges acting in the Spanish Social Courts has been obtained from the annual statistics provided by the General Council of the Judiciary¹³ for the period between 2005 and 2019.¹⁴ This is a database of courts whose number changes over time as new

¹³ <http://www6.poderjudicial.es/PXWeb/pxweb/es/>

¹⁴ Although information is available for the years 2020, 2021 and 2022, this data has been excluded from the analysis to avoid the effects that the COVID-19 pandemic may have caused on judiciary and socio-economic covariates.

Social Courts are opened.¹⁵ It goes from 299 courts in 2005 to 351 in 2019, although between 2012 and 2017 there was a period of stability with 339 courts.¹⁶

During the 15 years analysed, nearly 5 million cases were resolved in these courts, of which more than 2 million ended in conciliations, withdrawals, or other procedures. However, the focus of this paper is on the more than 2.5 million judgments that can be identified according to the type of judge who makes them. As can be seen in Fig. 1, more than two million were made by incumbent judges, while close to 300,000 were by substitute (non-professional) judges and the remaining 157,369 by other non-incumbent professional judges. The magnitude of these figures highlights the importance of these other judges in judicial activity and justifies the analysis presented here.

The next step in the analysis is to define different types of courts according to the type of judge who rules in them during a given year. Considering that the courts with reinforcement judges have been eliminated from the sample, a total of 4 types are defined:

- Courts where only the incumbent judge was acting.
- Courts where the incumbent and other (non-professional) judges were acting.

S E N T E N C E S	<i>Incumbent Judges:</i>	<i>Withdrawals</i> <i>1,138,588</i>	<i>Conciliation</i> <i>895,321</i>	<i>Others</i> <i>308,720</i>
	<i>2,048,945</i>			
	<i>Non-Professional:</i>			
	<i>292,285</i>			
	<i>Professional: 157,369</i>			

Source: Own elaboration with data published by the Spanish General Council of the Judiciary.

Fig. 1 Number of court cases by type of resolution and judge involved

¹⁵The creation of new courts could influence court productivity since it indeed affects the workload of the courts already established in the same city. However, we consider that this effect is not significant in our case because the creation of new courts is likely to be associated with places where the existing courts are overloaded and are operating with reinforcement judges. As these court-year observations are eliminated from the database because of the presence of reinforcement judges (2,396 court-year observations are removed), there should not be an effect on the estimated causal relationship we are interested in here. In any case, we conducted a robustness test to determine whether this a priori hypothesis is true or not. We conclude that our baseline model results are robust. See below.

¹⁶Some observations such as the courts placed in Ceuta and Melilla, or certain courts placed in Barcelona and Valencia have been dropped. On one hand, those corresponding to the autonomous cities of Ceuta and Melilla were eliminated due to problems when obtaining some control variables. On the other hand, some courts of Barcelona and Valencia were also suppressed for being dedicated only to one type of proceedings.

- Courts where the incumbent and other (professional) judges were acting.
- Courts where the incumbent and other (professional or non-professional) judges were acting.

Table 3 shows the annual mean values of the resolution rate according to the court composition. The first result is that, on average, productivity levels are higher when only incumbent judges participate in the court. Furthermore these productivity differences are greater when the courts are shared with non-professional judges, and smaller if these judges are professional. Finally, there is also a gradual reduction in court productivity over time.

Once these initial differences have been established, the next step is to analyse whether they are significant. To this end, Table 4 presents the results of an equality of means test to confirm that the average productivity of courts where only the incumbent judge rules is significantly different from that of the other types of courts.

The figures show a greater productivity in courts where only incumbent judges are present. The differences are significant at a 1% level if the court is shared with other non-professional judges and drop to 7% when the other judge is professional. This result seems to indicate a similar level of productivity when the incumbent judge shares the court with another professional judge.

Once the difference in means seems to be confirmed, it is also worth checking if the distribution of productivity changes according to the court composition. Table 5 presents a test for equality of distribution functions that indicates that, in general, courts where only the incumbent judges were acting are significantly more productive. The differences between the distribution functions range between -0.05 when the comparison is made with courts where, in addition to the incumbent, any other type of judge acts as substitution or replacement, and - 0.09 if the other judge is professional.

Figure 2 completes the analysis by showing the differences between the productivity distribution functions of the courts depending on the type of judge acting in them. The results are consistent with the Kolmogorov–Smirnov test shown previously. There is a certain similarity between the productivity distribution of the courts regardless of their composition. However, it can also be seen that the highest productivity (rightmost curve) is related to courts where there are only incumbent judges. In the same way, this productivity is progressively reduced when the court is shared, and even more when it is shared with non-professional judges.

6 Methodology

6.1 Overall approach

We are interested in estimating a causal effect of what we have defined as the treatment in this research. As explained above, our focus is on the effect on productivity because a different judge, in substitution of the incumbent one, is sitting in the court in a given year, yielding organizational issues potentially affecting such productivity. For this reason, it is key to appropriately address endogeneity concerns. In our view,

Table 3 Resolution rate per year and court composition

Year	Only incumbent			Incumbent & other nonprofessional			Incumbent & other professional			Incumbent & other ^a		
	Mean	Std. dev	Freq	Mean	Std. dev	Freq	Mean	Std. dev	Freq	Mean	Std. dev	Freq
2005	0.698	0.116	61	0.685	0.110	108	0.725	0.101	21	0.689	0.108	230
2006	0.703	0.114	77	0.683	0.103	110	0.727	0.101	27	0.673	0.109	230
2007	0.710	0.104	78	0.674	0.108	114	0.682	0.148	23	0.681	0.117	231
2008	0.626	0.106	85	0.624	0.103	128	0.575	0.104	21	0.611	0.107	222
2009	0.651	0.108	32	0.619	0.109	59	0.659	0.104	10	0.622	0.116	107
2010	0.633	0.118	30	0.612	0.115	69	0.630	0.133	11	0.609	0.118	104
2011	0.591	0.114	44	0.567	0.127	124	0.558	0.087	8	0.566	0.123	196
2012	0.560	0.123	50	0.551	0.111	187	0.633	0.158	10	0.552	0.115	270
2013	0.557	0.131	58	0.532	0.104	69	0.526	0.114	29	0.533	0.104	142
2014	0.588	0.120	51	0.574	0.102	34	0.579	0.094	33	0.574	0.096	96
2015	0.620	0.119	45	0.601	0.098	23	0.597	0.133	22	0.601	0.112	72
2016	0.641	0.114	49	0.633	0.122	21	0.653	0.113	17	0.623	0.115	69
2017	0.624	0.116	5–9	0.619	0.099	30	0.617	0.117	16	0.609	0.115	65
2018	0.607	0.128	62	0.605	0.092	35	0.585	0.080	24	0.590	0.103	85
2019	0.566	0.142	80	0.583	0.094	40	0.552	0.113	34	0.573	0.100	96
Total	0.628	0.129	861	0.612	0.120	1151	0.615	0.127	306	0.613	0.123	2215

Source: Own elaboration with data published by the Spanish General Council of the Judiciary

For each year, courts in which support judges have participated are eliminated from the sample

^a“Other” indicates that another judge participates in the court as a substitute (professional or non-professional). Includes the courts mentioned in the two preceding column blocks, as well as those with substitutions of both types of judges within the same year

there are two potential sources of endogeneity. One that we might define as more general, and the other as more specific to the research question that we are analysing here.

To begin with the second one, a major source of endogeneity has to do with the assignment of reinforcement or support judges to the most congested courts. Put differently, if those courts with more pending cases are provided with extra (reinforcement) judges, a spurious correlation would be generated, causing a reverse causality problem. To avoid this situation, we made the drastic decision to eliminate all of those court-year observations in which there were reinforcement judges involved. The rest of the non-incumbent judges intervening in a court are assigned there to cover substitutions because of vacation or illness, or to cover vacancies because of the movement of the incumbent judge from one court to another. These assignments occur regardless of the number of pending cases in each court, so they do not cause the sort of endogeneity previously described. Thus, with this ad hoc data cleansing and eliminating all those court-year observations causing the reverse causality issue, we prevent this type of endogeneity.

On the other hand, the common endogeneity issues affecting every empirical analysis might also be present in our study. To tackle this question, first, a sizeable number of control covariates are included to prevent the omitted variables bias. Second, and in the same vein, we employ a two-way fixed effects panel data structure to control for court and year unobserved heterogeneity. Third, we make use of a quasi-experimental design following the logic of the Difference-in-Differences (DiD) approach. We explicitly avoid the use of instrumental variables (IV) techniques since, according to Ebbes et al. (2016), when the IV are weak or endogenous, the IV estimator is potentially more biased than the OLS estimator.

Finally, we consider that the productivity effect investigated in this article may depend on the extent to which non-incumbent judges intervene in the court. For this reason, we also propose a dose–response analysis to study this question.

To sum up, the following hypotheses are tested:

Hypothesis 1: *Court productivity is reduced when judges other than the incumbent serve on the court as substitutes.*

Hypothesis 2: *The reduction in productivity is lower when the other judges participating in the court, in addition to the incumbent judge, are professional.*

Hypothesis 3: *The effect on productivity depends on the intensity with which labour courts are treated. That is, the resolution rate depends on the percentage of sentences handed down by substitute judges.*

6.2 Discrete treatment analysis

Following the empirical strategy, a court-year observation is treated if, during a given year, it includes rulings of the incumbent judge and also of any other substitute judge (professional or not professional) and it is considered untreated if it only has rulings of the incumbent (Martín-Román et al., 2013, Malo et al., 2018 and Moral et al.,

Table 4 Equality of means hypothesis test for the productivity indicator by court composition

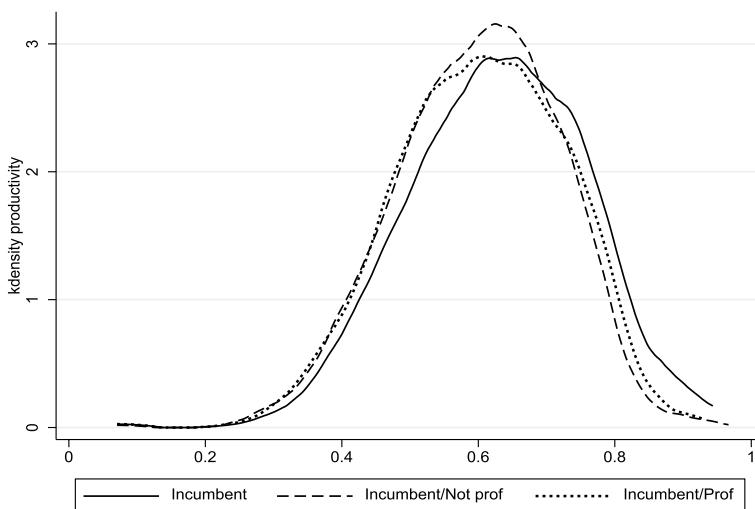
Other composition	Diff=mean(only incumbent judge)– mean(other composition)				
	Difference	t -statistic	Ha: diff<0	Ha: diff≠0	Ha: diff>0
Incumbent and other non-professional	0.016	2.832	0.998	0.005	0.002
Incumbent and other professional	0.013	1.474	0.930	0.141	0.070
Incumbent and other	0.015	2.939	0.998	0.003	0.002

Source: Own elaboration with data of the General Council of the Judiciary

Table 5 Two-sample Kolmogorov–Smirnov test for equality of distribution functions

Other composition	Smaller group	D	p-value
Incumbent and other non-professional	0	0.0035	0.988
	1	-0.0649	0.016
	Combined K-S	0.0649	0.032
Incumbent and other professional	0	0.0184	0.858
	1	-0.0946	0.018
	Combined K-S	0.0946	0.035
Incumbent and other	0	0.003	0.989
	1	-0.0549	0.024
	Combined K-S	0.0549	0.048

Source: Own elaboration with data published by the Spanish General Council of the Judiciary



Source: Own elaboration with data published by the Spanish General Council of the Judiciary.

Fig. 2 Productivity distribution by court composition

2021). Subsequently, the average effect of this treatment on the resolution rate of the courts is analysed as a DiD logic with the particularity that the moment of the treatment is different in each court. From a technical point of view, there are several ways to analyse the effect of a given treatment, but most of them assume independence between the treatment variable and the potential outcomes (unconfoundedness). The procedures applied in this work are as follows.

6.2.1 First step: OLS estimation

After eliminating the court-year observations that involve support judges, we first estimate a pool data structure in which the unconfoundedness or the Conditional Mean Independence (*CMi*) assumption is likely to be met. With this approach the aim of the paper is to analyse the effect of a given treatment (T) on an outcome variable (Y), and under *CMi*, this effect can be estimated through OLS according to the following expression:

$$Y_i = \beta_0 + X_i\alpha + T_i\beta + \mu_i \quad (1)$$

where T is a dummy equal to 1 for the court-year observations treated in a specific year and 0 for those not treated. X is a set of other observed characteristics of the court and μ is an error term reflecting unobserved characteristics that also affect Y . From a more conceptual point of view, the productivity takes a value of $Y_i(1)$ in the court-years where $T = 1$ and $Y_i(0)$ if $T = 0$. Therefore, the Average Treatment Effect (ATE) may be obtained as the mean difference in outcomes across these two groups:

$$D = E(Y_i(1) | T = 1) - E(Y_i(0) | T = 0) \quad (2)$$

However, treated and untreated court-year observations may not be equal before treatment and therefore, the difference between them may not be just a consequence of the program. To address this issue a counterfactual ($E(Y_i(0) | T = 1)$) is used, which is added to and subtracted from that difference as follows:

$$\begin{aligned} D &= E(Y_i(1) | T = 1) - E(Y_i(0) | T = 0) + E(Y_i(0) | T = 1) - E(Y_i(0) | T = 1) \\ D &= ATE + E(Y_i(0) | T = 1 - E(Y_i(0) | T = 0)) \\ D &= ATE + B \end{aligned} \quad (3)$$

where ATE is the effect to be calculated and B an estimation bias. The presence of such bias can also lead to inconsistent estimates. As already mentioned, the inconsistency may be a consequence of the presence of unobservable variables that affect both the court's productivity and the treatment variable.

6.2.2 Second step: fixed effect panel data estimation

These endogeneity problems may be solved if appropriate instruments are available, however, it is difficult to come up with credible instrumentation strategies. Alterna-

tively, another procedure to deal with endogeneity arises when the panel data are available (Verbeek, 2012; Wooldridge, 2010). The panel structure of the data can be leveraged to correct for endogeneity using “unobserved effects models” where omitted variables are controlled by using fixed effects (Germann et al., 2015; Wooldridge, 2010). Therefore, if the zero conditional mean assumption holds after controlling for court and time-fixed effects (unobservable heterogeneity), it is possible to obtain consistent estimations (Fortin et al., 2011).

Finally, to improve the quasi-experimental design, and as a robustness check, the data are filtered so that only courts that appear treated and untreated in any of the years are used. Therefore, the same court (or even the same judge in some cases) can be analysed as both treated and untreated, albeit at different times. In comparative terms, the most similar court to a treated one is the same court not being treated. The formal estimation in this case would respond to the following expression:

$$Y_{it} = X_{it}\alpha + T_{it}\beta + \delta_t\gamma + \eta_i + \mu_{it} \quad (4)$$

where η_i refers to the court fixed time-invariant effects and γ is the coefficient of the time fixed effects δ_t .

6.3 Dose–response analysis

In the last part of this methodological section, it will be considered that the effect of treatment on productivity may depend on the number of rulings made by substitute judges. In other words, we are interested in estimating the causal effect of the treatment variable (T) on an outcome (Y) within the observed sample, assuming that treated units may respond differently to the intensity of T . In this case, apart from the vector of confounding variables X , a continuous treatment indicator (s) is defined, taking values within the continuous range $[0, 100]$. The value 0 of the range indicates the absence of treatment, and the value 100 refers to the maximum number of sentences attributed to a non-incumbent judge during a year observed in our database. In this case, following the proposal of Cerulli (2015), the population-generating process for the two potential outcomes can be summarized by the following expression:

$$\begin{cases} T = 1 : Y_1 = \beta_1 + f_1(X) + h(s) + \mu_1 \\ T = 0 : Y_0 = \beta_0 + f_o(X) + \mu_o \end{cases} \quad (5)$$

where $f_1(X)$ and $f_o(X)$ are the unit i 's responses to the vector of confounding variables X_i for treated and untreated respectively, β_1 and β_0 are scalars, μ_1 and μ_o random variables, and $h(s)$ is a general derivable function of s with a polynomial parametric form of degree m as follows:

$$h(s) = \lambda_1 s + \lambda_2 s^2 + \dots + \lambda_m s^m \quad (6)$$

By assuming a parametric form for $f_1(X) = X\alpha_1$ and $f_0(X) = X\alpha_0$ the ATE conditional on X can be define as:

$$ATE = E(Y_1 - Y_o | X, s) = T(\beta + X\alpha + h(s)) + (1 - T)(\beta + X\alpha) \quad (7)$$

where $\beta = \beta_1 - \beta_0$ and $\alpha = \alpha_1 - \alpha_o$. Then, averaging in (X, s, T) we can also obtain the Average Treatment Effect on the Treated (ATET) and on the Non-Treated (ATENT):

$$\begin{cases} ATE = P(T = 1)(\beta + \bar{X}_{s>0}\alpha + \bar{h}_{s>0}) + P(T = 0)(\beta + \bar{X}_{s=0}\alpha) \\ ATET = (\beta + \bar{X}_{s>0}\alpha + \bar{h}_{s>0}) \\ ATENT = (\beta + \bar{X}_{s=0}\alpha) \end{cases} \quad (8)$$

And the Dose–Response Function (DRF) can be obtained by averaging ATE on X as follows:

$$ATE(s) = \begin{cases} ATET + \{h(s) - \bar{h}_{s>0}\} & \text{if } s > 0 \\ ATENT & \text{if } s = 0 \end{cases} \quad (9)$$

Given the unconfoundedness assumption and the observable variables included in X , both T and s_i are exogenous and the OLS estimation gives a consistent estimation of all the parameters. Following Rubin (1974) and Wooldridge (1997, 2003) the potential outcome equation is $Y_i = Y_{i0} + T(Y_{i1} - Y_{i0})$ and the regression line of the response Y can be written as follows:

$$E(Y|T, s_i, X_i) = \beta_0 + T_i \times \beta + X_{it}\alpha_0 + T_i \times (X_i - \bar{X})\alpha + T_i \times (h(s_i) - \bar{h}) \quad (10)$$

7 Results

7.1 Discrete treatment analysis

As explained above, the first step of the empirical analysis is the OLS estimation of the courts' productivity (Table 7). In this case, the data is assumed to be taken from a pool of courts regardless of whether they are observed year after year. Random treatment assignment and independence between the regressors and the error term must also be satisfied. The explanatory variables included in the estimation can be divided into two main groups (a summary of the descriptive statistics for these independent variables can be found in Table 6). The first refers to variables related to the court, such as the percentage of cases on collective bargaining agreements, dismissals, amounts or Social Security. According to the data of the General Council of Judiciary, the duration of Social Security or Amounts cases can be twice as long as dismissals, therefore, the percentage of these cases in each court can be important to justify differences in productivity. This group also includes a dummy variable that takes the value of 1 if there is only one court in the city, the weight of conciliations

Table 6 Descriptive statistics of the explanatory variables used in the estimation

Variable	Mean	Std. dev	Min	Max
Collective bargaining	0.008	0.006	0.000	0.104
Layoffs	0.281	0.082	0.066	0.583
Amounts	0.376	0.081	0.000	0.677
Social Security	0.247	0.102	0.000	0.665
Only one court	0.055	0.228	0.000	1.000
Conciliation	0.162	0.072	0.000	0.502
Court staff	7.999	4.049	0.000	12.000
Unemployment rate	16.040	8.004	3.033	42.308
Industry	0.151	0.060	0.038	0.330
Construction	0.092	0.035	0.038	0.220
Agriculture	0.049	0.045	0.001	0.292
Services	0.709	0.081	0.510	0.894

Source: Own elaboration with data published by the Spanish General Council of the Judiciary

among the total number of cases resolved and the number of people working as court staff. Although court human resources tend to be fairly standard, differences may appear in the number of people dedicated to procedural processing, which can also affect their productivity.

The second group is made up of different control variables. This includes economic indicators such as the unemployment rate of the region or the percentage of people working in industry, construction and agriculture. The group is completed with the inclusion of spatial and temporal controls (16 regional dummies with Andalusia as the reference and 14 yearly dummies with 2005 as the reference). Finally, the treatment variable is included, which takes the value of 1 if other judges rule in the court in addition to the incumbent during the same year.

Table 7 shows six columns, two for each of the three treatments analysed (all of them with adjusted R^2 values above 32%). The first two columns analyse the effect of having another judge, regardless of whether the judge is professional or not. The results seem to confirm the first hypothesis indicating that the ruling of other judges, besides the incumbent judge, reduces the court productivity. This reduction amounts to 1.7 percentual points with a p-value less than 0.01. The remaining columns allow us to test the hypothesis 2. The reduction in productivity is close to 2.5 percentual points if the other judge acting in the court is non-professional. However, if the substitute judge is professional, no statistically significant differences are found. The analysis of the rest of the regressors also yields interesting conclusions. The results show that productivity decreases when collective agreement, dismissal or social security cases have more weight. However, court productivity grows if there are more conciliations and if more staff are available. On the other hand, the weight of agriculture, construction and services also seems to reduce productivity, which will be higher in places where the service sector is more important. There is also a decline in productivity over time and Andalusia and the Balearic Islands are the regions with the lowest resolution rate.

Table 7 OLS estimation of court productivity by type of treatment (First Step)

Productivity	Incumbent and other		Incumbent and other non- professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Treatment	-0.017	0.000	-0.023	0.000	0.006	0.420
Collective bargaining	-1.372	0.000	-1.282	0.002	-0.543	0.314
Layoffs	-0.426	0.000	-0.383	0.000	-0.433	0.000
Amounts	0.039	0.356	0.017	0.747	-0.008	0.911
Social Security	-0.059	0.192	-0.061	0.272	-0.118	0.135
Only one court	0.056	0.000	0.052	0.000	0.054	0.000
Conciliation	0.254	0.000	0.283	0.000	0.243	0.001
Court staff	0.007	0.000	0.010	0.000	0.010	0.000
Unemployment rate	-0.001	0.238	-0.001	0.208	-0.003	0.010
Industry	-0.002	0.119	-0.002	0.083	-0.003	0.052
Construction	-0.008	0.117	-0.004	0.444	-0.007	0.313
Agriculture	-0.005	0.000	-0.004	0.020	-0.005	0.001
Aragón	0.025	0.104	0.022	0.237	-0.009	0.741
Asturias	0.049	0.000	0.057	0.000	0.025	0.269
Baleares	-0.053	0.002	-0.043	0.041	-0.094	0.001
Canarias	0.001	0.894	0.030	0.053	0.003	0.880
C la Mancha	0.022	0.061	0.040	0.005	0.050	0.059
C y León	0.087	0.000	0.107	0.000	0.084	0.000
Cataluña	0.077	0.000	0.087	0.000	0.050	0.006
C Valenciana	0.019	0.068	0.039	0.003	0.054	0.013
Extremadura	0.076	0.000	0.088	0.000	0.069	0.000
Galicia	0.058	0.000	0.070	0.000	0.104	0.000
La Rioja	0.071	0.001	0.074	0.005	0.059	0.073
Madrid	0.012	0.364	0.017	0.287	0.009	0.702
Murcia	0.047	0.000	0.061	0.000	0.051	0.007
Navarra	0.065	0.002	0.082	0.000	0.070	0.275
Pais Vasco	0.120	0.000	0.142	0.000	0.093	0.000
Santander	0.060	0.000	0.076	0.000	0.053	0.030
2006	-0.010	0.236	0.001	0.931	0.005	0.728
2007	-0.001	0.918	-0.004	0.744	0.000	0.993
2008	-0.056	0.000	-0.051	0.000	-0.051	0.001
2009	-0.046	0.000	-0.050	0.002	-0.005	0.819
2010	-0.080	0.000	-0.076	0.000	-0.038	0.125
2011	-0.098	0.000	-0.090	0.000	-0.055	0.031
2012	-0.114	0.000	-0.111	0.000	-0.063	0.028
2013	-0.126	0.000	-0.125	0.000	-0.093	0.002
2014	-0.100	0.000	-0.106	0.000	-0.078	0.005
2015	-0.090	0.000	-0.092	0.000	-0.073	0.004
2016	-0.073	0.000	-0.076	0.000	-0.050	0.034
2017	-0.090	0.000	-0.088	0.000	-0.076	0.001
2018	-0.008	0.854	-0.022	0.651	0.015	0.795
2019	-0.030	0.482	-0.051	0.306	-0.021	0.730
Constant	0.682	0.000	0.636	0.000	0.717	0.000

Table 7 (continued)

Productivity	Incumbent and other		Incumbent and other non- professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Observations	3075		2011		1167	
Adjusted R ²	0.329		0.336		0.361	

Treatment: Any other judge acts in the same court and year, along with the incumbent judge, as substitution or replacement

Once hypotheses 1 and 2 have been tested using OLS estimation, the next second step in the discrete treatment analysis uses panel data models to correct potential selection and endogeneity problems. Initially, the analysis is performed using only courts that appear as treated in some years and untreated in others. In this way, the same court is observed when only the incumbent judge rules and when other judges also act in the court, and the bias caused by differences between treatment and control units could be eliminated. The results of this estimation are shown in Table 8.

The figures shown in the first two columns of Table 8 again conclude that Hypothesis 1 is- satisfied. However, in this case, the effect of other judges acting in the same court only reduces productivity by 0.8 percentage points and with a lower level of significance (3%). As in the case of OLS estimation, Hypothesis 2 is also confirmed when the court is shared with non-professional judges (productivity is reduced by 0.9 percentage points) and no significant differences are observed if it is shared with professional judges. As regards the rest of the variables, most of the results discussed above are confirmed. Productivity decreases with dismissal and collective bargaining cases and increases when there are more workers in the court and when the number of conciliations increases. As for the economic variables, a lower resolution rate is also observed when unemployment rises and when the weight of industry and agriculture increases. Finally, a gradual reduction in productivity is also confirmed as time goes on.

The fact that only treated courts are ever considered implies that we are calculating a treatment effect on the treated units. To obtain the true treatment effect it would be necessary to consider also untreated courts that could be treated. For this reason, to test the robustness of the results, the analysis is repeated including all courts in which there are rulings made by professional judges, regardless of whether at some specific moment, another judge is also acting in the court. The results of this estimation are shown in Table A1 of the appendix and are very similar to those previously discussed in Table 8. This seems to indicate that treated and untreated courts behave similarly when controlling for possible unobservable heterogeneity with panel estimation.

As a second robustness check, the panel estimation is repeated including data for the years 2020, 2021 and 2022. These years were initially left out of the analysis to avoid possible effects of the pandemic. The results of this new estimation are included in Table A2 in the appendix. As in previous cases, Hypothesis 1 is not rejected, the reduction in productivity reaches 0.9% and increases the level of statistical signifi-

Table 8 Fixed effects estimation of court productivity by type of treatment (Second Step)

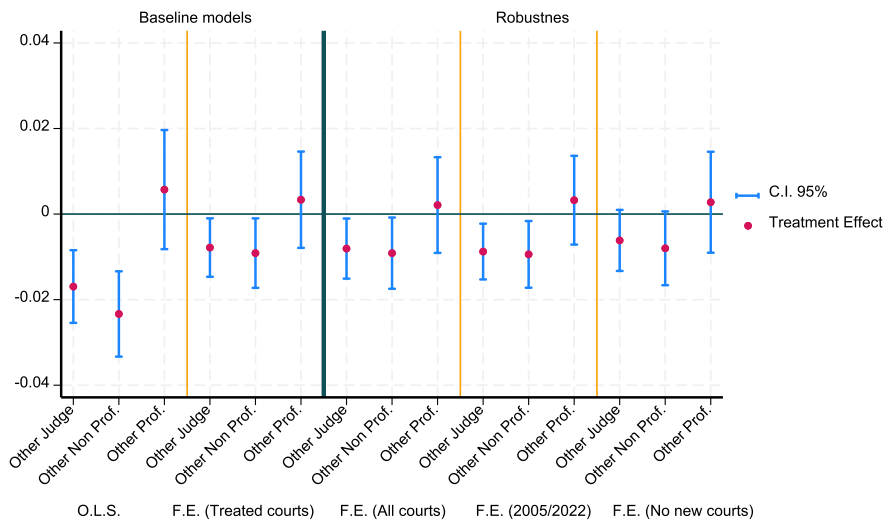
Productivity	Incumbent and other		Incumbent and other non- professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Treatment	-0.008	0.028	-0.009	0.031	0.003	0.551
Collective bargaining	-0.947	0.001	-1.237	0.000	-0.039	0.945
Layoffs	-0.377	0.000	-0.324	0.000	-0.347	0.000
Amounts	0.071	0.089	0.064	0.203	0.117	0.153
Social Security	0.029	0.539	-0.006	0.920	-0.010	0.918
Conciliation	0.251	0.000	0.161	0.006	0.364	0.000
Court staff	0.007	0.000	0.009	0.000	0.003	0.229
Unemployment rate	-0.004	0.000	-0.003	0.001	-0.001	0.620
Industry	-0.002	0.017	-0.002	0.031	-0.003	0.054
Construction	-0.005	0.201	-0.005	0.248	0.001	0.872
Agriculture	-0.005	0.000	-0.006	0.000	-0.004	0.004
2006	-0.012	0.064	0.005	0.571	0.003	0.826
2007	-0.004	0.527	0.001	0.929	0.018	0.178
2008	-0.051	0.000	-0.047	0.000	-0.042	0.004
2009	-0.028	0.011	-0.034	0.011	-0.061	0.006
2010	-0.059	0.000	-0.058	0.000	-0.090	0.000
2011	-0.069	0.000	-0.071	0.000	-0.106	0.000
2012	-0.071	0.000	-0.065	0.000	-0.124	0.000
2013	-0.093	0.000	-0.097	0.000	-0.166	0.000
2014	-0.081	0.000	-0.083	0.000	-0.156	0.000
2015	-0.080	0.000	-0.083	0.000	-0.141	0.000
2016	-0.074	0.000	-0.049	0.002	-0.126	0.000
2017	-0.093	0.000	-0.077	0.000	-0.142	0.000
2018	-0.014	0.673	0.009	0.816	-0.095	0.079
2019	-0.036	0.284	-0.013	0.739	-0.121	0.028
Constant	0.718	0.000	0.697	0.000	0.700	0.000
Observations	2625		1743		832	
F test that all $\eta_i = 0$:	F(267, 1446)=10.14		F(158, 645)=6.60		F(281, 2312)=8.26	

Treatment: Any other judge acts in the same court and year, along with the incumbent judge, as substitution or replacement. Regional dummy variables and only one court variable have been eliminated to avoid multicollinearity problems. Only courts with control and treatment data have been included in the estimations

cance. As regards Hypothesis 2, it is again corroborated that the reduction in productivity only occurs when the court is shared with non-professional substitution judges.

The final robustness analysis seeks to correct for possible endogeneity problems generated by the creation of new courts. For this purpose, observations are also removed for all courts located in cities where new courts are starting their activity, both in the year of its creation and in the previous year.¹⁷ The results of these new fixed effect estimates also confirm Hypotheses I and II although the significance level is now lower (Table A3 in the appendix). In this case, 90% confidence intervals are required to detect treatment effects.

¹⁷ In this case, this refinement involves the removal of 906 additional court-year observations.



Source: Own elaboration

Fig. 3 Estimation results of the discrete treatment analysis (First and second steps)

Figure 3 summarizes the results of the estimations made when the discrete treatment analysis is considered. In particular, the coefficient and the confidence interval of the variable measuring the treatment are plotted, both in the baseline models (OLS and panel) and in the robustness analysis where the court sample is modified. Figure 3 shows a negative and significant effect on productivity if the court is shared with other judges (Hypothesis 1). It is also observed that this effect is more important if the substitute judges during a given year are non-professionals, and that it disappears if they are professional judges (Hypothesis 2). Finally, a greater effect is found in the case of OLS estimation. This result may be hiding endogenous effects and unobserved heterogeneity that are corrected when using the panel structure (unobserved effects models).

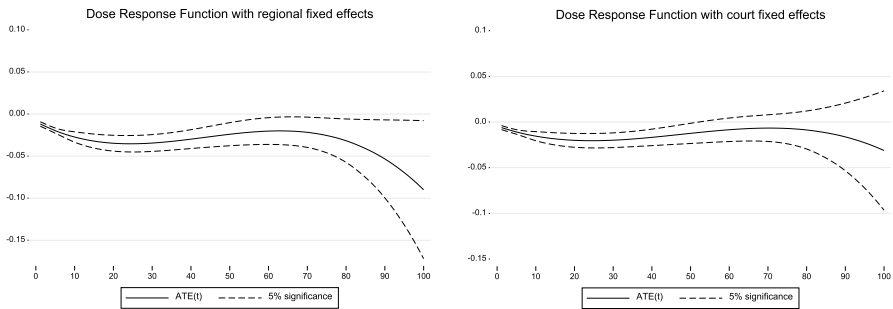
7.2 Dose–response analysis

In the last step of the empirical analysis, the participation of other judges is considered as a continuous treatment. To this end, a degree 3 polynomial function $h(t_i)$ is included in the estimation to capture non-linearities in the treatment effect, as explained in the methodological section. The analysis is carried out with two different specifications, one with the variables of the OLS estimation and regional dummies, and the other with the panel estimation variables and court-fixed effects. It should also be clarified that the sample used only includes those courts that have been both treated and untreated at some point in the period 2005–2019. Table 9 shows the value and significance of the variable measuring the treatment. Figures 4, 5 and 6 show

Table 9 Coefficient of the treatment variable with Dose–Response Model and exogenous treatment

		Coefficient	P>t	Adjusted R squared
Incumbent and other	Region Fixed effect	−0,016	0,000	0,367
	Court fixed effect	−0,009	0,011	0,649
Incumbent and other non-professional	Region Fixed effect	−0,019	0,000	0,358
	Court fixed effect	−0,008	0,049	0,665
Incumbent and other professional	Region Fixed effect	0,002	0,816	0,460
	Court fixed effect	0,006	0,388	0,717

Source: Own elaboration
Each specification includes court variables, economic variables, and time controls



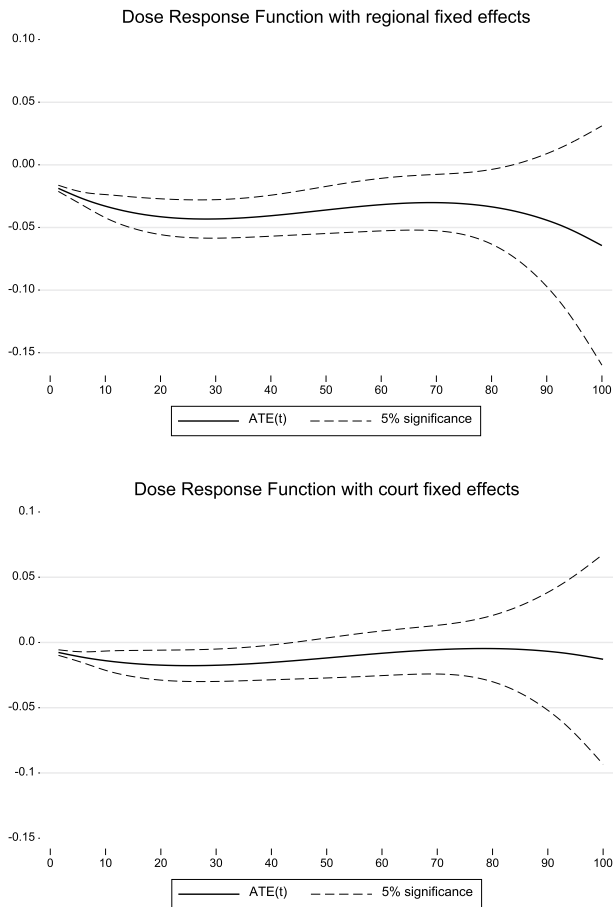
Source: Own elaboration

Fig. 4 Dose–response function with other judges acting in the same court as continuous treatment

the evolution of the treatment effect as the percentage of sentences handed down by substitution judges changes.

Regarding the coefficient value (Table 9) the results are very similar to those presented previously. The effect is significant if the treatment includes the participation of other non-professional judges, but if the court is only shared with other professional judges, productivity is not affected. In the specification that includes regional dummies (court fixed effects) the coefficient is −0.016 (−0.009) if the court is shared with any other judge and −0.019 (−0.008) if the substitution judge is non-professional. This result again confirms the fulfilment of Hypothesis 1 and Hypothesis 2.

Figure 4 presents the effects of continuous treatment when the incumbent judge shares the court with any other (non-support) judge. A negative effect on productivity is observed regardless of the percentage of sentences handed down by substitute judges (Hypothesis 1). It is also confirmed that the significance of the effect is lower as the treatment dose increases (Hypothesis 3) and that their magnitude is smaller if

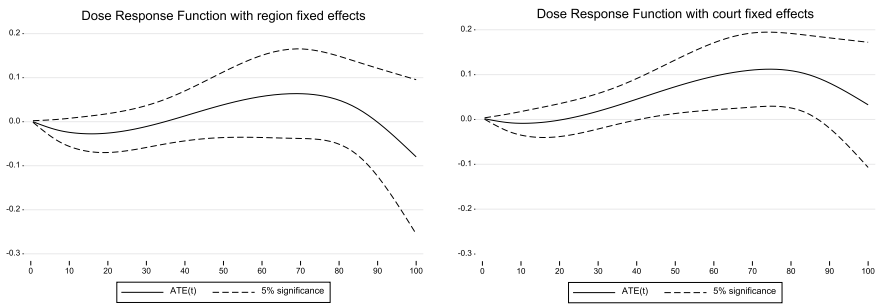


Source: Own elaboration

Fig. 5 Dose–response function with other nonprofessional judges acting in the same court as continuous treatment

court-fixed effects are included in the model. Figure 5 shows the effect of the participation of non-professional judges sharing a court with the incumbent. Both the evolution and significance are like those in Fig. 4, but a larger magnitude is observed in absolute terms (Hypothesis 2), especially in the specification that includes regional fixed effects.

Finally, Fig. 6 shows the continuous treatment effect when, in addition to the incumbent judge, other professional judges participate in the same court. In this case, the confidence intervals are very large, and this reduces the significance of the effect. This implies that the participation in the same court of other professional judges in addition to the incumbent does not affect court productivity and confirms the fulfilment of Hypothesis 2.



Source: Own elaboration

Fig. 6 Dose–response function with other professional judges acting in the same court as continuous treatment

8 Conclusions

The main purpose of this paper was to analyse the effect of other judges acting in the court as substitutes for the incumbent judge on courts' productivity. It was also looking to study if this effect depends on whether the substitute judges are professionals or not. Empirical results show that courts' productivity decreases when the incumbent judge shares the court with other judges. Nevertheless, this reduction is greater if the substitution judges are non-professionals.

The data on the average values of the resolution rate in the labour courts already showed statistically significant differences and reflected lower productivity in courts where both, incumbent and substitution judges, are present. However, it was necessary to apply econometric techniques to control the effect of all those variables that may be determining court productivity. Once these controls are included, it is possible to draw more realistic conclusions about whether the hypotheses tested in the paper are fulfilled.

The first decision consisted of the elimination of the most obvious source of endogeneity when estimating the treatment effect. For this reason, it was decided to eliminate the data corresponding to the support judges from the sample, and this allowed us to assume independence in the treatment assignment. With this assumption, the OLS estimation (first step of the discrete treatment analysis) is consistent, and hypotheses 1 and 2 could be tested. Specifically, a reduction in productivity of close to 2.5 percentage points can be observed when other non-professional judges were also working in the court. However, no significant differences are detected if these other judges were professional.

In the second stage of the analysis, it is assumed that some selection and endogeneity problems may remain. In this case, we try to solve this issue by using a panel estimation where each court is both control and treatment, thus also correcting for unobservable heterogeneity. The results obtained again corroborate the first two

hypotheses, although the magnitude of the effect is significantly smaller. Court sharing now only reduces productivity by slightly less than one percentage point and only when the substitute judge is non-professional. These results are also confirmed when the sample is extended to all courts where incumbent judges act and the years affected by the pandemic are included. This result may be a consequence of differences in access to the judicial career among judges. Professional judges, like the incumbent judges, have passed a course given at the Judicial Academy, and this training may help them to maintain a similar level of resolution in court. On the other hand, non-professional judges lack such training, which may make them less productive.

Finally, a dose–response function is implemented to consider the possibility of continuous treatment to test a third hypothesis. With this approach, the above two hypotheses are again confirmed with lower productivity in courts where the incumbent judge shares the court with other non-professional judges. However, productivity is not significantly affected if the substitute is another professional judge. The results of this analysis also confirm that the effect is less evident as the treatment dose increases (Hypothesis 3). Finally, the productivity reduction is smaller if the model includes controls for the unobservable heterogeneity of each court.

Relevant public policy implications can be deduced from our results: in Spain when there are judge's leaves, vacations or rotations in the court, other judges are hired to substitute the incumbent judge and maintain the court activity. If the objective is not to reduce the resolution rate per court, professional judges must be hired instead of non-professional judges. Nevertheless In the paper of Moral et al. (2021) it is found that the acting of other judges besides the incumbent one in the court decreases the quality of judicial resolutions, but this effect was lower in the case of non-professional judges. So, when hiring judges who will work as substitutes in a certain court, it is important to keep in mind that there is a trade-off between quality and productivity. A plausible explanation for these results lies in the fact that professional judges that substitute the incumbent in the court, usually are junior judges, while non-professional judges are law professors, doctors in law or senior lawyers. Then, the second ones having a higher experience, one can expect a lower reversal rate of their resolutions, compared to the professionals. However, the training received by these professional judges at the Judicial Academy gives them an advantage in terms of productivity.

Appendix

See Tables [A1](#), [A2](#) and [A3](#)

Table A1 Fixed effects estimation of the court productivity by type of treatment

Productivity	Incumbent and other		Incumbent and other non-professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Treatment	-0.008	0.024	-0.009	0.032	0.002	0.712
Collective bargaining	-1.116	0.000	-1.189	0.001	0.345	0.443
Lay-offs	-0.413	0.000	-0.334	0.000	-0.244	0.003
Amounts	0.079	0.048	0.048	0.328	0.170	0.014
Social Security	0.069	0.133	0.031	0.579	0.039	0.631
Conciliation	0.308	0.000	0.230	0.000	0.307	0.000
Court staff	0.006	0.000	0.007	0.000	0.004	0.087
Unemployment rate	-0.002	0.019	-0.002	0.013	0.000	0.779
Industry	-0.002	0.040	-0.002	0.068	-0.002	0.107
Construction	-0.005	0.155	-0.006	0.188	0.001	0.878
Agriculture	-0.005	0.000	-0.005	0.000	-0.004	0.001
2006	-0.010	0.091	0.002	0.761	0.008	0.493
2007	-0.004	0.542	-0.003	0.718	0.012	0.304
2008	-0.051	0.000	-0.046	0.000	-0.056	0.000
2009	-0.037	0.001	-0.044	0.001	-0.072	0.000
2010	-0.071	0.000	-0.066	0.000	-0.101	0.000
2011	-0.091	0.000	-0.083	0.000	-0.119	0.000
2012	-0.098	0.000	-0.084	0.000	-0.139	0.000
2013	-0.120	0.000	-0.115	0.000	-0.177	0.000
2014	-0.106	0.000	-0.098	0.000	-0.163	0.000
2015	-0.108	0.000	-0.100	0.000	-0.140	0.000
2016	-0.094	0.000	-0.076	0.000	-0.124	0.000
2017	-0.105	0.000	-0.096	0.000	-0.139	0.000
2018	-0.031	0.357	-0.017	0.671	-0.099	0.036
2019	-0.046	0.174	-0.032	0.419	-0.119	0.012
Constant	0.682	0.000	0.689	0.000	0.618	0.000

Table 10 (continued)

Productivity	Incumbent and other		Incumbent and other non-professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Observations	3075		2011		1167	
F test that all $u_i = 0$:	F(34782701) = 10.13		F(342, 1643) = 8.03		F(292, 849) = 7.00	

Treatment: Any other judge acts in the same court and year along with the incumbent judge as substitution or replacement. Regional dummy variables and only one court variable have been eliminated to avoid multicollinearity problems

Table A2 Fixed effects estimation of the court productivity by type of treatment

Productivity	Incumbent and other		Incumbent and other non-professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Treatment	-0.009	0.008	-0.009	0.018	0.003	0.540
Collective bargaining	-1.388	0.000	-1.502	0.000	-0.149	0.728
Lay-offs	-0.291	0.000	-0.219	0.000	-0.142	0.063
Amounts	0.123	0.001	0.093	0.047	0.186	0.005
Social Security	0.098	0.024	0.066	0.203	0.052	0.490
Conciliation	0.172	0.000	0.120	0.017	0.139	0.030
Court staff	0.008	0.000	0.009	0.000	0.004	0.065
Unemployment rate	-0.002	0.023	-0.002	0.017	-0.001	0.561
Industry	-0.003	0.000	-0.002	0.001	-0.003	0.008
Construction	-0.005	0.020	-0.005	0.067	-0.006	0.044
Agriculture	-0.006	0.000	-0.005	0.000	-0.004	0.000
2006	-0.010	0.110	0.002	0.771	0.008	0.490
2007	-0.002	0.785	-0.001	0.903	0.013	0.289
2008	-0.054	0.000	-0.049	0.000	-0.061	0.000
2009	-0.044	0.000	-0.051	0.000	-0.072	0.000
2010	-0.076	0.000	-0.071	0.000	-0.095	0.000
2011	-0.092	0.000	-0.084	0.000	-0.103	0.000
2012	-0.096	0.000	-0.083	0.000	-0.121	0.000
2013	-0.117	0.000	-0.115	0.000	-0.154	0.000
2014	-0.100	0.000	-0.096	0.000	-0.139	0.000
2015	-0.101	0.000	-0.094	0.000	-0.118	0.000
2016	-0.084	0.000	-0.065	0.000	-0.099	0.000
2017	-0.095	0.000	-0.089	0.000	-0.113	0.000
2018	0.005	0.820	-0.005	0.849	-0.021	0.539
2019	-0.014	0.571	-0.025	0.382	-0.041	0.229
2020	-0.088	0.000	-0.101	0.000	-0.117	0.001
2021	-0.035	0.136	-0.041	0.136	-0.040	0.245
2022	-0.039	0.088	-0.042	0.118	-0.053	0.115
Constant	0.636	0.000	0.633	0.000	0.615	0.000
Observations	3611		2393		1446	
F test that all $u_i=0$:	F(376, 3206)=9.67		F(365, 1999)=7.82		F(323, 1093)=6.95	

Treatment: Any other judge acts in the same court and year along with the incumbent judge as substitution or replacement. Regional dummy variables and only one court variable have been eliminated to avoid multicollinearity problems

Table A3 Fixed effects estimation of the court productivity by type of treatment

Productivity	Incumbent and other		Incumbent and other non-professional		Incumbent and other professional	
	Coefficient	P>t	Coefficient	P>t	Coefficient	P>t
Treatment	-0.006	0.091	-0.008	0.069	0.003	0.645
Collective bargaining	-0.921	0.002	-1.125	0.002	0.030	0.960
Lay-offs	-0.339	0.000	-0.285	0.000	-0.276	0.007
Amounts	0.107	0.018	0.078	0.153	0.201	0.018
Social Security	0.012	0.809	-0.047	0.431	0.056	0.568
Conciliation	0.289	0.000	0.208	0.001	0.404	0.000
Court staff	0.006	0.001	0.008	0.000	0.003	0.278
Unemployment rate	-0.003	0.002	-0.003	0.016	0.000	0.996
Industry	0.000	0.802	0.000	0.964	0.000	0.881
Construction	0.004	0.004	0.003	0.119	0.005	0.043
Agriculture	-0.005	0.000	-0.008	0.000	-0.005	0.030
2006	-0.025	0.001	-0.008	0.394	-0.017	0.238
2007	-0.021	0.005	-0.015	0.111	-0.008	0.584
2008	-0.064	0.000	-0.060	0.000	-0.068	0.000
2009	-0.047	0.000	-0.058	0.000	-0.072	0.003
2010	-0.069	0.000	-0.076	0.000	-0.098	0.000
2011	-0.082	0.000	-0.089	0.000	-0.105	0.000
2012	-0.083	0.000	-0.081	0.000	-0.130	0.000
2013	-0.106	0.000	-0.114	0.000	-0.171	0.000
2014	-0.091	0.000	-0.100	0.000	-0.155	0.000
2015	-0.091	0.000	-0.100	0.000	-0.145	0.000
2016	-0.081	0.000	-0.065	0.001	-0.124	0.000
2017	-0.098	0.000	-0.090	0.000	-0.135	0.000
2018	-0.112	0.000	-0.107	0.000	-0.153	0.000
2019	-0.128	0.000	-0.126	0.000	-0.165	0.000
Constant	0.701	0.000	0.723	0.000	0.613	0.000
Observations	2306		1532		766	
F test that all $u_i = 0$:	F(279, 2001)=8.67		F(264, 1242)=7.18		F(156, 584)=6.24	

Treatment: Any other judge acts in the same court and year along with the incumbent judge as substitution or replacement. Regional dummy variables and only one court variable have been eliminated to avoid multicollinearity problems. The observations are deleted for all courts in cities where new courts are created, both in the year they started their activity and in the previous year

Acknowledgements We greatly appreciate the valuable guidance provided by Ildefonso Villán Criado with the Judicial Statistics. The first author was partially supported by the Government of Spain Ministry of Science and Innovation under project PID2020-112509 GB-I00. The third author was partially supported by Grant PID2020-115660GB-I00/MICIN/AEI/<https://doi.org/10.13039/501100011033> financed by the Ministry of Science and Innovation and the State Research Agency of the Spanish Government and Grant PID2021-128606NB100 funded by the Spanish MCIN/AEI/<https://doi.org/10.13039/501100011033> and by “ERDF A way of making Europe”.

Author contributions All authors whose names appear on the submission 1. made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work; 2. drafted the work or revised it critically for important intellectual content; 3. approved the version to be published; and 4. agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding Open access funding provided by FEDER European Funds and the Junta de Castilla y León under the Research and Innovation Strategy for Smart Specialization (RIS3) of Castilla y León 2021-2027. Open access funding provided by FEDER European Funds and the Junta de Castilla y León under the Research and Innovation Strategy for Smart Specialization (RIS3) of Castilla y León 2021-2027. Ministerio de Ciencia e Innovación, PID2020-112509 GB-I00, PID2020-115660 GB-I00/MICIN/AEI/<https://doi.org/10.13039/501100011033>

Data availability No datasets were generated or analysed during the current study.

Declarations

Competing Interests The authors declare no competing interests.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Autor, D., Kostøl, A., Mogstad, M., & Setzler, B. (2019). Disability benefits, consumption insurance, and household labor supply. *American Economic Review*, 109(7), 2613–2654.
- Beenstock, M., & Haitovsky, Y. (2004). Does the appointment of judges increase the output of the judiciary? *International Review of Law and Economics*, 24(3), 351–369.
- Bhuller, M., Dahl, G. B., Løken, K. V., & Mogstad, M. (2020). Incarceration, recidivism, and employment. *Journal of Political Economy*, 128(4), 1269–1324.
- Bielen, S., Marneffe, W., & Vereeck, L. (2015). An empirical analysis of case disposition time in Belgium. *Review of Law & Economics*, 11(2), 293–316.
- Bielen, S., Peeters, L., Marneffe, W., & Vereeck, L. (2018). Backlogs and litigation rates: Testing congestion equilibrium across European judiciaries. *International Review of Law and Economics*, 53, 9–22.
- Buscaglia, E., & Dakolias, M. (1999). *Comparative international study of court performance indicators: A descriptive and analytical account*. World Bank.
- Buscaglia, E., & Ulen, T. (1997). A quantitative assessment of the efficiency of the judicial sector in Latin America. *International Review of Law and Economics*, 17(2), 275–291.
- Cabo, F., & Martín-Román, A. (2019). Dynamic collective bargaining and labor adjustment costs. *Journal of Economics*, 126(2), 103–133.
- Cerulli, G. (2015). ctreareg: Command for fitting dose-response models under exogenous and endogenous treatment. *The Stata Journal*, 15(4), 1019–1045.
- Dakolias, M. (1995). A strategy for judicial reform: The experience in Latin America. *Va. J. Int'l L.*, 36, 167.
- Deyneli, F. (2012). Analysis of relationship between efficiency of justice services and salaries of judges with two-stage DEA method. *European Journal of Law and Economics*, 34, 477–493.
- Di Vita, G. (2010). Production of laws and delays in court decisions. *International Review of Law and Economics*, 30, 276–281.
- Dimitrova-Grajzl, V., Grajzl, P., Slavov, A., & Zajc, K. (2016). Courts in a transition economy: Case disposition and the quantity-quality tradeoff in Bulgaria. *Economic Systems*, 40, 18–38.

- Dimitrova-Grajzl, V., Grajzl, P., Sustersic, J., & Zajc, K. (2012a). Court output, judicial staffing, and the demand for court services: Evidence from Slovenian courts of first instance. *International Review of Law and Economics*, 32, 19–29.
- Dimitrova-Grajzl, V., Grajzl, P., Zajc, K., & Sustersic, J. (2012b). Judicial incentives and performance at lower courts: Evidence from Slovenian judge-level data. *Review of Law and Economics*, 8, 215–251.
- Dimitrova-Grajzl, V., Grajzl, P., & Zajc, K. (2014). Understanding modes of civil case disposition: Evidence from Slovenian courts. *Journal of Comparative Economics*, 42(4), 924–939.
- Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2003). Courts. *The Quarterly Journal of Economics*, 118(2), 453–517.
- Ebbes, P., Papies, D., & van Heerde, H. J. (2016). Dealing with endogeneity: A nontechnical guide for marketing researchers. In C. Homburg, M. Klarmann, & A. Vomberg (Eds.), *Handbook of market research*. Springer. https://doi.org/10.1007/978-3-319-05542-8_8-1
- El Bialy, N. (2016). The 2007 judicial reform and court performance in Egypt. *Review of Law & Economics*, 12(1), 95–117.
- Elbialy, N. and García-Rubio, M. A. (2011). Assessing Judicial Efficiency of Egyptian First Instance Courts. A DEA Analysis. Joint Discussion Paper Series in Economics by the Universities of Aachen-Giessen-Göttingen-Kassel-Marburg-Siegen N° 19.
- Espasa, M., & Esteller-More, A. (2015). Analyzing judicial courts' performance: Inefficiency vs. Congestion. *Revista De Economía Aplicada*, 23(69), 61–82.
- Falavigna, G., Ippoliti, R., & Ramello, G. B. (2018). DEA-based Malmquist productivity indexes for understanding courts reform. *Socio-Economic Planning Sciences*, 62, 31–43.
- Ferrandino, J. (2014). Testing the packer theorem: The efficiency of Florida's criminal circuit courts. *American Journal of Criminal Justice*, 39(2), 375–393.
- Ferro, G., Oubiña, V., & Romero, C. (2020). Benchmarking labor courts: An efficiency frontier analysis. *International Journal for Court Administration*, 11(2), 2–22.
- Ferro, G., Romero, C., & Romero-Gómez, E. (2018). Efficient courts? A frontier performance assessment. *Benchmarking: an International Journal*, 25(9), 3443–3458.
- Finocchiaro Castro, M., & Guccio, C. (2014). Searching for the source of technical inefficiency in Italian judicial districts: An empirical investigation. *European Journal of Law and Economics*, 38, 369–391.
- Fortin, N., Lemieux, T., & Firpo, S. (2011). Decomposition methods in economics. In *Handbook of labor economics* (Vol. 4, pp. 1–102). Elsevier.
- García-Rubio, M., & Rosales-López, V. (2010). Justicia y economía: Evaluando la eficiencia judicial en Andalucía. *Revista Para El Análisis Del Derecho*, 4, 1–26.
- Gennaioli, N., & Shleifer, A. (2008). Judicial fact discretion. *The Journal of Legal Studies*, 37(1), 1–35.
- Germann, F., Ebbes, P., & Grewal, R. (2015). The chief marketing officer matters! *Journal of Marketing*, 79(3), 1–22.
- Gomes, A. O., Alves, S. T., & Silva, J. T. (2018). Effects of investment in information and communication technologies on productivity of courts in Brazil. *Government Information Quarterly*, 35(3), 480–490.
- Grajzl, P., & Silwal, S. (2020). Multi-court judging and judicial productivity in a career judiciary: Evidence from Nepal. *International Review of Law and Economics*, 61, Article 105888.
- Hamermesh, D. S. (2017). *Demand for labor: The neglected side of the market*. Oxford University Press.
- Hammergren, L. (1999). Quince Años de Reforma Judicial en América Latina: dónde estamos y por qué no hemos progresado más. Reforma judicial en América Latina. Una tarea inconclusa. In: <http://www.oas.org/juridico/spanish/adjusti5.htm>
- Ichino, A., Polo, M., & Rettore, E. (2003). Are judges biased by labor market conditions? *European Economic Review*, 47(5), 913–944.
- Jimeno, J. F., Martínez-Matute, M., & Mora-Sanguinetti, J. S. (2020). Employment protection legislation, labor courts, and effective firing costs. *IZA Journal of Labor Economics*, 9(2), 1–26.
- Kesan, J. P., & Ball, G. G. (2011). Judicial experience and the efficiency and accuracy of patent adjudication: An empirical analysis of the case for specialized patent trial court. *Harvard Journal of Law Technology*, 24(2), 393–468.
- Kittelsen, S. A. C., & Forsund, F. R. (1992). Efficiency analysis of Norwegian district courts. *The Journal of Productivity Analysis*, 3, 277–306.
- Malo, M. Á., Martín-Román, Á. L., & Moral, A. (2018). “Peer effects” or “quasi-peer effects” in Spanish labour court rulings. *European Journal of Law and Economics*, 45, 497–525.

- Maran, E. (2024). The working conditions of non-professional magistrates and the European concept of 'worker.' *European Labour Law Journal*, 15(2), 263–276.
- Marciano, A., & Khalil, E. L. (2012). Optimization, path dependence and the law: Can judges promote efficiency? *International Review of Law and Economics*, 32(1), 72–82.
- Marinescu, I. (2011). Are judges sensitive to economic conditions? Evidence from UK employment tribunals. *ILR Review*, 64(4), 673–698.
- Martín-Román, Á. L., Moral, A., & Martínez, M. (2013). Tipo de juez y estimación de los casos de despido: Un análisis de los Juzgados de lo Social en España. *Cuadernos De Economía*, 36, 142–154.
- Martín-Román, Á. L., Moral, A., & Martínez-Matute, M. (2015). Peer effects in judicial decisions: Evidence from Spanish labour courts. *International Review of Law and Economics*, 42, 20–37.
- Melcarne, A., & Ramello, G. B. (2015). Judicial Independence, Judges' Incentives and Efficiency. *Review of Law and Economics*, 11, 149–169.
- Mitsopoulos, M., & Pelagidis, T. (2010). Greek appeals courts' quality analysis and performance. *European Journal of Law and Economics*, 30, 17–39.
- Moral, A., Rosales, V., & Martín-Román, Á. (2021). Professional vs. non-professional labour judges: their impact on the quality of judicial decisions. *International Review of Law and Economics*, 65, 105948.
- Mora-Sanguinetti, J. S. (2010). A Characterization of the Judicial System in Spain: Analysis with Formalism Indices. *Economic Analysis of Law Review*, 1(2), 210–240.
- Palumbo, G., Giupponi, G., Nunziata, L., & Sanguinetti, J. S. M. 2013. The economics of civil justice: new cross-country data and empirics.
- Pastor, S. 2003b. "Los Nuevos Sistemas de Organización y Gestión de la Justicia: ¿Mito o Realidad?", Conferencia sobre Justicia y Desarrollo en América Latina y el Caribe, Banco Interamericano de Desarrollo.
- Pastor, S. 2003a. "Eficiencia y Eficacia de la Justicia", Papeles de Economía Española, núm. 95.
- Pastor, S., Manspons L. 2004. Cifrar y descifrar: indicadores judiciales de las Américas. Volumen II, Centro de Justicia de las Américas, Chile.
- Pastor, S. (1993). *Ah de la Justicia*. Política Judicial y Economía.
- Pedraja-Chaparro, F., & Salinas-Jimenez, J. (1996). An assessment of the efficiency of Spanish Courts using DEA. *Applied Economics*, 28(11), 1391–1403.
- Posner, R. A. (1993). What Do Judges and Justices Maximize? (The Same Thing Everybody Else Does). *Supreme Court Economic Review*, 3, 1–41.
- Posner, R. A. (2000). Is the ninth circuit too large? A statistical study of judicial quality. *Journal of Legal Studies*, 29(2), 711–719.
- Posner, R. (2005). Judicial behavior and performance: An economic approach. *Florida State University Law Review*, 32(1), 1259–1279.
- Rosales, V. (2017). Demanda y Oferta de Justicia Civil en España. *Papeles De Economía Española*, 151, 102.
- Priest, G. L. (1989). Private litigants and the court congestion problem. *Boston University Law Review*, 69(3), 527–559.
- Rosales-López, V. (2008). Economics of court performance: An empirical analysis. *European Journal of Law and Economics*, 25(3), 231–251.
- Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of Educational Psychology*, 66, 688–701.
- Schneider, M. R. (2005). Judicial career incentives and court performance: An empirical study of the German Labour Courts of Appeal. *European Journal of Law and Economics*, 20, 127–144.
- Semet, A. (2016). Political Decision-Making at the National Labor Relations Board: An Empirical Examination of the Board's Unfair Labor Practice Disputes through the Clinton and Bush II Years. *Berkeley Journal of Employment and Labor Law*, 37(2), 223–292.
- Spanish General Council of the Judiciary, 1985. Statutory Law of the Judiciary 6/1985. <https://www.boe.es/buscar/act.php?id=BOE-A-1985-12666>
- Spanish General Council of the Judiciary, 2011. Regulation 2/2011 of the Judicial Career. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2011-8049.
- Verbeek, M. (2012). *A guide to modern econometrics* (4th ed.). Wiley.
- Voigt, S., & El-Bialy, N. (2016). Identifying the determinants of aggregate judicial performance: Taxpayers' money well spent? *European Journal of Law and Economics*, 41, 283–319.

- Wooldridge, J. M. (1997). On two stage least squares estimation of the average treatment effect in a random coefficient model. *Economics Letters*, 56, 129–133.
- Wooldridge, J. M. (2003). Further results on instrumental variables estimation of average treatment effects in the correlated random coefficient model. *Economics Letters*, 79, 185–191.
- Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press.
- World Bank 2004. Initiatives in Legal and Judicial Reform. In: <https://documents1.worldbank.org/curated/en/139831468778813637/pdf/250820040Edition.pdf>
- Zuckerman, A. A. (2000). Reforming civil justice systems: trends in industrial countries.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.